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First Session—Twenty-eighth Parliament

1968-69

THE SENATE OF CANADA

PROCEEDINGS

OF THE

SPECIAL COMMITTEE

ON

SCIENCE POLICY

The Honourable MAURICE LAMONTAGNE, Chairman

The Honourable DONALD CAMERON, Vice-Chairman

No. 62

THURSDAY, JUNE 12th, 1969

WITNESSES:

The Arctic Institute of North America: Professor Trevor Lloyd, Chairman of the Board of Governors; Dr. P. D. McTaggart-Cowan, Governor; Dr. M. J. Dunbar, Professor, McGill University; Brigadier H. W. Love, Executive Director. The Mining Association of Canada: Mr. J. [illegible] Bates, Managing Director; Dr. [illegible] Smith, Research Co-ordinator; Dr. W. H. Gauvin, Research Manager, Noranda Mines Ltd.; Mr. A. R. Pasieka, Chief Mines Research Engineer, Falconbridge Nickel Mines Limited. The Canadian Council on Urban and Regional Research: Mr. Jean-Marie Martin, Chairman; Mr. Alan Armstrong, Executive Director; Mr. Eric Beecroft, Past Chairman; Mr. William Teron, Member of the Board.

APPENDICES:

136—Brief submitted by the Arctic Institute of North America.

137—Brief submitted by the Mining Association of Canada.

138—Brief submitted by The Canadian Council on Urban and Regional Research.

29956—1

First Session—Twenty-eighth Parliament

1968-69

THE SENATE OF CANADA

PROCEEDINGS OF THE SPECIAL COMMITTEE ON

SCIENCE POLICY

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137—Brief submitted by the Mining Association of Canada
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20648—1

MEMBERS OF THE SPECIAL COMMITTEE

ON

SCIENCE POLICY

The Honourable Maurice Lamontagne, *Chairman*

The Honourable Donald Cameron, *Vice-Chairman*

The Honourable Senators:

Aird
Belisle
Blois
Bourget
Cameron
Carter
Desruisseaux
Giguère
Grosart
Haig
Hays
Kinnear
Lamontagne
Lang
Leonard
McGrand
Nichol
O'Leary (*Carleton*)
Phillips (*Prince*)
Robichaud
Sullivan
Thompson
Yuzyk

Patrick J. Savoie,
Clerk of the Committee.

ORDERS OF REFERENCE

Extract from the Minutes of the Proceedings of the Senate, Tuesday, September 17th, 1968:

"The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That a Special Committee of the Senate be appointed to consider and report on the science policy of the Federal Government with the object of appraising its priorities, its budget and its efficiency in the light of the experience of other industrialized countries and of the requirements of the new scientific age and, without restricting the generality of the foregoing, to inquire into and report upon the following:

(*a*) recent trends in research and development expenditures in Canada as compared with those in other industrialized countries;

(*b*) research and development activities carried out by the Federal Government in the fields of physical, life and human sciences;

(*c*) federal assistance to research and development activities carried out by individuals, universities, industry and other groups in the three scientific fields mentioned above; and

(*d*) the broad principles, the long-term financial requirements and the structural organization of a dynamic and efficient science policy for Canada.

That the Committee have power to engage the services of such counsel, staff and technical advisers as may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to examine witnesses, to report from time to time, to print such papers and evidence from day to day as may be ordered by the Committee, to sit during sittings and adjournments of the Senate, and to adjourn from place to place;

That the papers and evidence received and taken on the subject in the preceding session be referred to the Committee; and

That the Committee be composed of the Honourable Senators Aird, Argue, Bélisle, Bourget, Cameron, Desruisseaux, Grosart, Hays, Kinnear, Lamontagne, Lang, Leonard, MacKenzie, O'Leary (*Carleton*), Phillips (*Prince*), Sullivan, Thompson and Yuzyk.

After debate, and—
The question being put on the motion, it was—
Resolved in the affirmative."

Extract from the Minutes of the Proceedings of the Senate, Thursday, September 19th, 1968:

"With leave of the Senate,

The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That the name of the Honourable Senator Robichaud be substituted for that of the Honourable Senator Argue on the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—

Resolved in the affirmative."

Extract from the Minutes of the Proceedings of the Senate, Wednesday, February 5th, 1969:

With leave of the Senate,

The Honourable Senator McDonald moved, seconded by the Honourable Senator Macdonald (*Cape Breton*):

That the names of the Honourable Senators Blois, Carter, Giguère, Haig, McGrand and Nichol be added to the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—

Resolved in the affirmative.

ROBERT FORTIER,
Clerk of the Senate.

MINUTES OF PROCEEDINGS

THURSDAY, June 12, 1969.

Pursuant to adjournment and notice the Special Committee on Science Policy met this day at 8.00 p.m.

Present: The Honourable Senators Lamontagne (*Chairman*), Cameron, Carter, Grosart, Haig, Phillips (*Prince*), Robichaud and Yuzyk—8.

In attendance: Philip Pocock, Director of Research, (*Physical Science*).

The following witnesses were heard:

THE ARCTIC INSTITUTE OF NORTH AMERICA

Professor Trevor Lloyd,
Chairman of the Board of Governors.
Dr. P. D. McTaggart-Cowan, Governor.
Dr. M. J. Dunbar, Professor, McGill University.
Brigadier H. W. Love, Executive Director.
Miss Moira Dunbar, Governor.

MINING ASSOCIATION OF CANADA

Mr. J. L. Bonus, Managing Director.
Dr. W. R. Horn, Research Co-ordinator.
Dr. W. H. Gauvin, Research Manager,
Noranda Mines Ltd.
Mr. A. R. Pasieka, Chief Mine Research Engineer,
Falconbridge Nickel Mines Limited.

THE CANADIAN COUNCIL ON URBAN AND REGIONAL RESEARCH

Mr. Jean-Marie Martin, Chairman.
Mr. Alan Armstrong, Executive Officer.
Mr. Eric Beecroft, Past Chairman.
Mr. William Teron, Member of the Board.

(*A curriculum vitae of each witness follows these Minutes*)

The Canadian Council on Urban and Regional Research submitted five documents which the Committee retained as Exhibits:

A) 1968 Annual Report

B) A Survey of Spending on Urban-Regional Research by Selected Public Bodies in Canada in 1965-1966

C) Canadian University Units with Special Interest in Urban Affairs

D) Report of Special Research Programming Committee as adopted by Directors, quoted from 1967 Annual Report

E) The Uses of Urban Research

The following are printed as Appendices:

No. 136—Brief submitted by the Arctic Institute of North America

No. 137—Brief submitted by the Mining Association of Canada

No. 138—Brief submitted by The Canadian Council on Urban and Regional Research

At 10.55 p.m. the Committee adjourned to the call of the Chairman.

ATTEST:

Patrick J. Savoie,
Clerk of the Committee.

CURRICULUM VITAE

Armstrong, Alan: Born Toronto 1916. Studied at Toronto and New York Universities. Member, Town Planning Institute of Canada. Was Executive Director of the Community Planning Association of Canada (1946-52) and served in the Public Housing Division and as Adviser on Community Planning to Central Mortgage and Housing Corporation (1953-60). He was Secretary of the Committee of Inquiry into the Residential Environment, set up by the Royal Architectural Institute of Canada, 1959-60. He was first Director of the Institute for Community Planning, University of Science and Technology, Kumasi, Ghana (1961-62); and since 1963 has been Executive Officer, Canadian Council on Urban and Regional Research. Adviser to Canadian delegations Washington, Paris and Stockholm on environmental research (1965-68).

Beecroft, Eric: Born in Toronto on September 7, 1903. Graduate of the University of Toronto in political economy with B.A. and M.A. degrees; received his Ph.D. degree in economics from Yale University. At Yale he spent two years as Cowles Fellow in Government and was professor of Government at the University of California for several years before the war. For 14 years, 1941-54, Mr. Beecroft was engaged in international service. Throughout the war he was with the United States Government, serving from 1943 to 1945 in charge of U.S. war supply activities in India. From 1945 to 1947 he was Special Assistant to the Secretary of the Interior of the United States, Hon. Harold Ickes. He was a loan officer of the World Bank (the International Bank for Reconstruction and Development) for the seven-year period, 1947-54, serving the bank mainly in its relations with India, Ceylon, Pakistan, the Philippines and other countries in Asia and the Middle East. Mr. Beecroft was National Director of the Community Planning Association of Canada for six years in the period 1954-60 and was editor of the Community Planning Review and other CPAC publications. In the period 1960-65 Mr. Beecroft was the Ottawa representative for the Canadian Federation of Mayors and Municipalities. In 1965 Mr. Beecroft was appointed professor of political science at the University of Western Ontario and is Director of Urban and Regional Development Studies, Faculty of Graduate Studies at U.W.O. Mr. Beecroft was a founding Member of the Canadian Council on Urban and Regional Research; served as Vice-Chairman 1962-65 and as Chairman 1966-69; member of the Council's Board of Directors 1969-.

Bonus, John Leopold: Born: Mons (Belgium). Education: Royal Athenaeum, Belgium (Humanities-Classics). King's College, London University. Business: 1932-1940. Partner in family business in Brussels, Belgium (footwear manufacturing). Also started own import-export business (leather and hides), covering Benelux countries. War Service: 1941-1945: Joined British Army (Royal Artillery) in the ranks. Commissioned in RA in 1942. After series of regimental duties, transferred in 1943 (as Staff Captain) to GHQ Home Forces. In early 1944 transferred (as Staff Major) to Headquarters of Marshal B. L. Montgomery (21 Army Group). Participated in Normandy landings and campaign through France, Belgium, Holland and Germany. Post-war Career: Demobilized in 1945 at request of British Board of Trade and Federation of British Industries to take over duties of Secretary-General of the British Chamber of Commerce in Belgium and representative in that country of the FBI. In 1951 came to

Canada at request of FBI to represent them and manage the Canadian Association of British Manufacturers and Agencies (CABMA), later re-named The British Canadian Trade Association (BCTA). As General Manager of the BCTA, with offices in Toronto, Montreal and Vancouver, was concerned with the initiation and development of all aspects of British trade promotion in Canada, working in close co-operation with the offices of the British High Commission in Canada. Assumed present duties as Managing Director of The Mining Association of Canada in February 1968.

Dunbar, Moira: Defence Research Board, Defence Research Telecommunications Establishment; Governor, AINA. Geography/glaciology.

Dunbar, Dr. M. J.: B.A. M.A. Ph.D. McGill University. Guggenheim Fellowship, 1952-53; Bruce Medal for Polar Exploration, Royal Society of Edinburgh, 1950; Canadian Acting Consul to Greenland, 1941-44, 1945-46; Governor, AINA; Chairman, Marine Sciences Centre, McGill University. Oceanography and marine biology.

Gauvin, William Henry: Born: Paris, France, March 30, 1913. Education: Early schooling in Paris, Brussels, London. B.Eng. (Chem. Eng.), McGill University (1941); M.Eng. (Chem. Eng.), McGill University (1942); Ph.D. (Physical Chemistry), McGill University (1945); P.Eng. (Quebec); D.Eng. (H.C.), Waterloo University (1967). Career: Lecturer, Department of Chemical Engineering, McGill University (1942-44); Plant Superintendent, F. W. Horner Ltd., Montreal (1944-46); Associate Professor, Department of Chemical Engineering, McGill University (1947-62); Consultant to Pulp and Paper Research Institute of Canada, Montreal (1951-57); Head, Chemical Engineering Division, Pulp and Paper Research Institute of Canada (1957-62); Research Manager, Noranda Research Centre (Sept. 1961 to date); Research Associate, Department of Chemical Engineering, McGill University in charge of doctoral research theses (1961 to date). Professional Societies: Member of: Chemical Institute of Canada; Canadian Society of Chemical Engineering; Engineering Institute of Canada; American Institute of Chemical Engineers (U.S.A.); Technical Section, Canadian Pulp & Paper Association; American Society for Engineering Education (U.S.A.); Corporation of Engineers of Quebec; Canadian Institute of Mining and Metallurgy; American Institute of Mining & Metallurgical Engineers (U.S.A.); Canadian Research Management Association; Industrial Research Institute (U.S.A.); Institution of Chemical Engineers (England); British Non-Ferrous Metals Research Association; Technical Association of the Pulp and Paper Industry (U.S.A.); Dechma (Germany); Sigma Xi, La Société de Chimie Industrielle (France); Society of Chemical Industry (England). Activities: Member of Council of National Research Council (1964 to date); Member of Science Council of Canada (1961- to date); President, Canadian Society for Chemical Engineering (1966-67); Conference Chairman, Tripartite Conference of Chemical Engineers 1968 (I.Chem.E., A.I.Ch.E., C.S.Ch.E.); Member of Board of Directors of Weizmann Institute of Science (1966 to date); Member of Board of Directors of Canadian Organization for Joint Research (1966 to date); Member of Research & Development Planning Council of the American

Management Association (1968 to date). Awards: Fellow of Chemical Institute of Canada; Fellow of Royal Society of Canada; Recipient of I. H. Weldon Medal for 1958, awarded by Canadian Pulp and Paper Association; Recipient of Chemical Institute of Canada Awards for 1960 and 1961 for best papers published in Can. J. of Chemical Engineering; Recipient of R. S. Jane Memorial Lecture Award for 1963, awarded by Chemical Institute of Canada for contributions to chemical engineering; Recipient in 1964 of Senior Moulton Medal awarded by the Institution of Chemical Engineers of Great Britain; Recipient of Medal of Chemical Institute of Canada for 1966; Recipient of Médaille Archambault, ACFAS (1966); Doctor of Engineering (honoris causa), University of Waterloo (1967); Membre d'Honneur de la Société de Chimie Industrielle de France (1968); Recipient of Canadian Society for Chemical Engineering Award in 1968. Publications: Over 100 paper in the field of electrochemistry, high-temperature heat and mass transfer, fluid mechanics and particle dynamics. Sixteen patents in high-temperature chemical processing. Clubs: Royal St. Lawrence Yacht Club, Faculty Club of McGill University; University Club of Montreal. Montreal Board of Trade. Recreation: Tennis, fencing, sailing, chess, music.

Love, H. W.: O.B.E., C.D., B.Sc. Commander, Northwest Highway System, 1951-55; Deputy QM General for Equipment Engineering, 1957-61; Director, General Plans and Operations, Army HQ, Ottawa, 1961-64; Director, Montreal Office, AINA, 1965-67; Executive Director, AINA, 1968-.

Horn, Wallace Randolph, B.A., M.A., Ph.D., F.C.I.C.: Dr. Horn was born in Toronto, Ont. He attended Queen's University, Kingston, Ont., where he received a B.A. degree in Chemistry, Mineralogy and Geology in 1933, and an M.A. in Chemistry in 1934. His Ph.D. in Physical Chemistry was obtained from McGill University in 1936. The following year he joined Eldorado Gold Mines Ltd., (later Eldorado Mining & Refining Ltd.) at its radium and uranium extraction plant at Port Hope. Here he held various posts in both research and production. As Chief Chemist and Manager of Research he was to a large extent responsible for the technical innovations which produced, early in 1942, the first contract shipments of Canadian uranium oxide to United States nuclear processing. In 1943 he transferred to International Rare Metals Refinery, Inc., New York, N.Y. (Canadian Radium & Uranium Corp.). Dr. Horn successfully developed the first large scale method for the separation of polonium. He returned to Canada in 1948 to become Director of Research, Dominion Tar and Chemical Co. Ltd., (later Domtar Ltd.), a post he held until 1961. This was followed by a period during which Dr. Horn acted as Special Consultant on coal tar and coal tar chemicals to the Mines Branch, Department of Mines and Technical Surveys, Ottawa. In 1964 he accepted the newly created post of Research Co-ordinator, The Mining Association of Canada, Toronto, Ont. Dr. Horn was made a Fellow of the Chemical Institute of Canada in 1950. He has been Member and Chairman for Chemistry, Engineering Advisory Council of Queen's University. In 1968 he was appointed to the National Advisory Committee on Mining and Metallurgical Research. During the past several years he has been especially interested in industrial wastes abatement and control and has been active within numerous bodies. He is a Member of the Canadian Institute of Mining and Metallurgy. The American Institute of Mining, Metallurgical & Petroleum Engineers, The Chemical Institute of Canada, The American Chemical Society, The Air Pollution Control Association. Within the Mining Association of Canada, Dr. Horn's interests are notably oriented towards increasing the awareness of the mining industry to mining research and new technological developments; improving communication between the industry and public research agencies; the establishment of organized, collective liaison between the industry and the suppliers of equipment and materials; the promotion of industrial wastes management. Numerous other activities are generally directed towards the increased involvement of the mining industry with the scientific community, and with technological progress in mining and in other relevant fields.

Lloyd, Trevor: Ph.D., 1940; D.Sc., 1949. Dartmouth College, Hanover, 1942-59; Consul for Canada in Greenland, 1944-45; Chief, Geography Bureau, Government of Canada, 1947-48; Governor, Institute of Current World Affairs; Governor, AINA; Chairman, Geography Department, McGill University, 1962-1966. Human geography. Specialist in northern lands, including Scandinavia and Siberia.

Martin, Jean-Marie: Born in La Malbaie, Charlevoix County, July 18, 1912. Degrees from Laval University (B.A.), University of Montreal (L.S.A.) and Cornell University (M.A., economics). Mr. Martin served on the Wartime Prices and Trade Board as Assistant General Director (1944), then as General Director (1945-47). He was Director of the Economics Department and professor in the Faculty of Social Sciences of Laval (1947-51) and at the same time Director of the Research Centre of the Faculty. From 1951 to 1955 he was Director of the Public Relations Branch of Laval University, then from 1955-61, Dean of the Faculty of Social Sciences. General Director of higher education in Quebec with the Department of Youth (1961-64), he became Chairman of the Superior Council of Education in 1964 until the end of his term of office in August 1968. Since then, he has been full professor in the Economics Department, Faculty of Social Sciences of Laval University, as well as member of the board of the Laval School of Social Service.

Mr. Martin is Chairman of the Commission on Housing in Quebec and Special Advisor for the National Capital Commission in its study on the urban renewal of Hull; he is a member of a Central Mortgage and Housing Corporation commission dealing with low-cost housing programmes and rental rates and advisor to a committee established by the Ontario Housing Association for the study of the problem of housing in Canada (publication: *Good Housing for Canadians*). He has a seat in the Board of Governors of the Canadian Welfare Council and in the task force on social security policy in Canada; in 1964 he was Canadian delegate to the Commonwealth Education Conference held in Ottawa.

Chairman of the Canadian Council on Urban and Regional Research since April 1969, Mr. Martin is a founding member of the Council; he has been a Director since 1962, Vice-Chairman for two years and Chairman of the research advisory committee of this Council; he is a member of the Board of Directors and Executive of the Institute of Public Administration of Canada and Chairman of the Research Committee of this organization. He is also a member of the committee for the national conference on housing, of the task force on national welfare policy and sits on the special committees of the Association of Universities and Colleges of Canada. He is a member of the Association of French-Language Economists and the Association des professeurs de carrière of Laval University. He participated in the writing of *Changing Patterns of Higher Education in Canada* (University of Toronto Press, Robin S. Harris, editor); he is the author of several works including *L'Assistance publique et les municipalités du Québec* and *Les problèmes économiques et sociaux du Bas St-Laurent.*

McTaggart-Cowan, P.D.: M.B.E. B.A., University of British Columbia; Rhodes Scholar, Oxford University, 1936. D.Sc. Chief Meteorological Officer, R.A.F. Ferry Command, 1942-45; Director, Meteorological Service of Canada, 1959-64; President, Simon Fraser University, 1963-68; 1969. Executive Director, Science Council of Canada; Governor, AINA. Polar meteorology and navigation.

Pasieka, A.R.: received his elementary school education in Flin Flon. After serving with the R.C.N.V.R. he returned to Flin Flon late in 1945 and completed his secondary school education and started a university education at the University of Manitoba. After several years mining with Midwest Diamond Drilling Company Limited and Hudson Bay Mining & Smelting Company, he returned to the University of Ottawa, graduating in 1952 with a B.Sc. degree in mathematics and physics. He then continued his mining career in Eastern Canada at International Nickel Company, Sudbury, Ontario. A. R. Pasieka joined Falconbridge Nickel Mines Limited, at Falconbridge, in June 1955 where he has served in various production and technical capacities. Mining research has been one of his chief interests for the past ten years. In 1965 he was transferred to Toronto and appointed Chief Mine Research Engineer for the Company. He is presently Chief Mining Engineer for the Falconbridge group of companies. This assignment also includes the mining research activities of the Company. Other activities include: Member—C.I.M.M. Executive Member—Canadian Advisory Committee on Rock Mechanics Research. Ground Control Committee—Ontario Mining Association. Member of Mining Sub Committee of N.A. Committee on Mining & Metallurgical Research.

Teron, William: Born in Gardenton, Manitoba 1932. President of William Teron Limited, a design oriented, construction and development organization; prime current activity: the total design and development of "Kanata", a new town for 60,000 people to the west of Ottawa which is a 20 year, 300 million dollar venture. Mr. Teron is Vice-President and Director of Canadian Interurban Properties and Vice-President of Talisman Hotels Ltd. He is a member of the Board of Governors of Carleton University and Chairman of the Building Committee. Mr. Teron is a Director of the Canadian Council on Urban and Regional Research. He is a member of the Canadian Housing Design Council and of the Committee on Urban Development of the Science Council of Canada. Mr. Teron is a Director of the Queensway-Carleton Hospital Board, the Ottawa Football Club and is President of the Edelweiss Ski Club. Mr. Teron is a Trustee of the National Arts Centre and is a member of the Executive Committee; he is President of the National Capital Arts Alliance and is Associate Chairman of the Canadian Festival of the Arts.

THE SENATE

SPECIAL COMMITTEE ON SCIENCE POLICY

EVIDENCE

Ottawa, Thursday, June 12, 1969.

The Special Committee on Science Policy met this day at 8 p.m.

Senator Maurice Lamontagne (*Chairman*) in the Chair.

The Chairman: Honourable senators, we have with us this evening representatives of The Arctic Institute of North America, The Mining Association of Canada, and the Canadian Council on Urban and Regional Research.

We have at the head table Professor Trevor Lloyd, Chairman of the Board of Governors, and Dr. P. D. McTaggart-Cowan, Governor of the Institute, who will represent the Arctic Institute. Then we have Dr. W. H. Gauvin, Research Associate, Department of Chemical Engineering, McGill University, and Dr. W. R. Horn, Research Co-ordinator, both representing the Mining Association of Canada. Dr. Gauvin is very well known among the members of this committee, because he has been before us several times. Then we have Mr. Jean-Marie Martin, Chairman, and Mr. Alan Armstrong, Executive Officer, of the Canadian Council on Urban and Regional Research.

Honourable senators, I will first ask Professor Lloyd to make his opening statement on behalf of the Arctic Institute of North America. Of course, I do not have to welcome them all before the committee. They know they are welcome, and we are very pleased to have them with us this evening.

Professor Trevor Lloyd, Chairman of the Board of Governors, The Arctic Institute of North America: Honourable senators, because I am by profession a university professor and am therefore programmed to speak for 50 minutes, I have written out what I have to say and, with your permission, I will read it.

(I) The Arctic Institute of North America had its origins a quarter of a century ago here in Ottawa. It was founded to meet certain immediate needs and in anticipation of the eventual opening up of the north.

The founders were scientists, administrators, professional and businessmen, most of them associated with universities and government. While their major concern was with advancing the scientific study and the rational development of northern Canada, they recognized that research cannot be confined within national boundaries. So they invited Americans, Newfoundlanders and those responsible for Greenland affairs to join with them.

The organization they devised—the Arctic Institute of North America—has proved to be a singularly appropriate one, and possibly unique in its provision for joint Canadian-American operations and policy-making arrangements. The Institute was incorporated by act of this Parliament in December, 1945, and, in almost identical terms, was also incorporated in the United States. It has been able to carry on activities applicable to both countries or, as the need has arisen, to limit programs to one or the other. Through a Danish member of the Board of Governors it maintains close contacts with Greenland affairs, and in fact with all of Scandinavia. In one way or another it is in continuous touch with corresponding bodies in many countries including the Soviet Union. Through its United States connections it is able to keep in touch with scientific activities in Antarctica.

(II) The Artic Institute's primary interests and activities may be summarized as follows:

(a) It brings together, as Associates and Fellows, as Governors and as members of various working committees and in research undertakings, virtually everyone in North America who is actively concerned with research concerning the Arctic and the Middle North.

(b) The Institute publishes a quarterly journal *Arctic*, a *Newsletter* and the *Arctic Bibliography*, which has so far appeared in 14 stout volumes, and also many special publications. Some of these are books of general interest, such as *The Arctic Frontier*, which is a study of northern Canada in relation to other northern countries. A rather different type of book is *The Arctic Basin*, which is an up-to-date account of the physical environment of the Arctic Ocean and the lands around it. It is based on the most recent information from all the countries concerned.

(c) The only comprehensive polar library in North America is in the Arctic Institute headquarters in Montreal. This is recognized as an invaluable information source—scientific, technological, administrative, historical and literary. Its present high quality is due in part to support from the National Research Council and the Canada Council.

(d) From its founding the Institute insisted on the need to encourage and expand research in northern Canada. This it is has accomplished in three ways:

(1) By providing grants-in-aid, particularly to young scientists. Many who are today government scientists and members of university staffs were assisted early in their careers. Through the expertise of its reseach committee the Institute is able to assess the merits of proposals for research submitted to it and, when its own funds are exhausted, to recommend the best of them to government or other agencies for support.

(2) By carrying on its own field research in selected areas. For example it pioneered glacier research in northern Canada by expeditions to Baffin Island in 1950 and 1953, and now maintains fixed field stations in the Yukon and in Devon Island about two thousand miles north of Ottawa.

(3) By means of contracts with government agencies or industry to carry out work required by others.

(e) The Institute organizes working conferences, several of which have been arranged in recent years—all of them more or less international. These have brought together experts from government, universities and industry for the discussions of specific aspects of the north. Thus in 1963 the Institute held in Montreal, in collaboration with McGill University, a large and representative conference for consideration of the inter-relationships of resources, transportation and northern settlement. In 1967 a specialized meeting on circumpolar public health was held in Fairbanks, Alaska. In March of the present year a highly successful resources and transportation conference was held in Montreal—attended incidentally by a very strong representation of the international oil industry. Also this year, at Dartmouth College, New Hampshire, was held an international working conference on all aspects of northern community development. Two months from now there will be in Montreal an international conference on education in northern countries, with special reference to education of the native peoples. This will be attended by strong delegations from Greenland, all of the Scandinavian countries and the U.S.S.R., as well as from this country and the United States. The objective of these and other conferences still in the planning stage is to bring together experts from the northern countries so that they may pool their knowledge and experience to the advantage of all.

(f) Finally the Arctic Institute is a recognized source for providing general and specialized advice, technical information and assistance concerning the Far North—not only through the direct participation of its staff, but also by calling on its 250 Fellows in North America and abroad. They and the members of its various specialized committees comprise a remarkable pool of skills and experience.

The Institute desires to draw to the attention of the committee several matters which have a degree of urgency at the present time, and to make recommendations.

(1) The Government of Canada, and also the private sector needs to devote on a continuing basis an appreciable and indeed increasing share of its scientific and technological resources to the very large underdeveloped part of this country lying north of the settled area. It is recommended that Canadian Science Policy include as a major objective realization of the full social and economic potential of the north.

(2) It is in the national interest for Canada to ensure the continuation of capable non-governmental, non-profit organizations engaged in research and related activities concerning the north.

(3) The rational employment of available human and other resources requires that a proportion of the national research effort concerning the north should be carried on through universities, institutes and other similar agencies outside the established government departments.

(4) There is need for a National Advisory Committee on Northern Research to which

the Government can turn for disinterested counsel, and which could serve to review all major research being carried on in and concerning the north; recommend research policies to government and others; and recommend the extent and direction of major research fund allocation. The present Advisory Committee on Northern Development—which is an interdepartmental body within the Government—might be adapted for the purpose by the addition of representatives from non-official bodies and of individuals.

(5) There is a continuing need for closer international collaboration in northern research and development. Government policies should aid in this by encouraging visits of scientists from other countries to northern Canada and of Canadians to northern areas abroad.

In conclusion, among the founders of the Arctic Iustitute were several who held responsible positions in the Canadian Government service. They believed that a responsible private organization could be a major factor in furthering the exploration, the scientific study and the development of northern Canada. The Institute has throughout its 25 years been successful in maintaining a close working relationhip between those in government, industry and the universities. Today there is an urgent demand for accurate information on the far north and this seems certain to continue. There is a growing need for the services of specialists in a wide range of sciences, technology and administration.

The Arctic Institute sees itself as a meeting point and clearing house, a source of specialized information and services, a device for encouraging young people to gain northern experience, and a unique link in all such matters between Canada and the rest of the polar world.

The Chairman: Thank you very much. We will now hear from the spokesman for The Mining Association of Canada.

Mr. J. L. Bonus, Managing Director, Mining Association of Canada: Mr. Chairman and honourable senators, my name is John L. Bonus, and I am the managing director of the Mining Association of Canada. Accompanying me are Dr. W. R. Horn, Research Co-ordinator of our association, and Dr. W. H. Gauvin, Research Manager, Noranda Mines Limited. Both are members of our study group which prepared the submission now before you.

In the audience we also have Mr. A. R. Pasieka, Chief Mine Research Engineer, Falconbridge Nickel Mines Limited. Whilst he is not a member of our original study group, we are happy that he is present, and with your permission we may later on refer to him any questions which might relate to specific matters concerning mining operations.

[*Translation*]

I would inform you that two of our delegates are fully bilingual: Dr. Gauvin—as you know—and myself. Those of you who would like to put questions to us in French may therefore rest assured that we shall be able to understand them, and shall endeavour to interpret them.

[*Text*]

We would like first of all to express our appreciation for this opportunity of appearing before you on behalf of and representing The Mining Association of Canada. We are particularly conscious of the massive and thorough efforts of this committee towards the extremely important goals of its order of reference, and would wish to convey to you our very genuine appreciation.

You will have noted from our brief that the membership of our association is composed of companies which account for over 95 per cent of Canada's output of metals and major industrial minerals. We, therefore, speak on behalf of an industry whose total production value in 1968 was well in excess of $3 billion, by far the most important section of the Canadian mineral industry.

It is a section which has the highest export yield of any resource based industries, which contributes in an exceptional manner to Canada's regional development, and in which productivity is very high. Its multiplier effect is quite remarkable and, more particularly, it contributes greatly to the development of Canada's secondary manufacturing industries, its transportation systems and communications.

[*Translation*]

Our Association represents the largest sector of the Canadian mineral-producing industry—that concerned with metals and the basic industrial minerals; total 1968 production in this sector was worth over 3 billion dollars.

Our sector also makes an outstanding contribution to regional development throughout Canada; our export performance is of paramount importance for the economy of the country, and our productivity is at a very high level.

It should also be noted that the mining industry exercises a very profound influence on many other sectors of industry—transport and communications, for example.

It has been estimated that every man working in the mines provides work for five men working on the surface in secondary producing and related service industries.

[*Text*]

Our industry is at the present time somewhat apprehensive in regard to some of the tax reform proposals which are due to be presented to Parliament this summer. A number of tax provisions which have long been in effect in Canada have done much to encourage exploration and the subsequent development of new mines. Indeed, it could be argued that these tax provisions constitute one of the most successful economic policies ever devised in this country. We sincerely hope that their impact on the past, present and future growth of the mining industry will be taken fully into consideration.

Mr. Chairman, honourable senators, with your permission I shall now call on Dr. W. R. Horn, Research Co-ordinator of the Mining Association of Canada, who will present to you a brief statement of policy. He and Dr. Gauvin will, of course, be dealing with some of the technical questions with reference to the basic and specific recommendations contained in our brief.

Dr. W. R. Horn Research Co-ordinator, Mining Association of Canada: Mr. Chairman and honourable senators, in the following short comments our purpose is to restate and in some instances to amplify certain of the points of our written submission.

I would first mention that in the development of our basic recommendations it has certainly not been our intention to consciously orient these towards the minerals industry, although you may have noticed this has been twice mentioned as an example within what we believe to be a broader philosophy. In a separate short section we have briefly listed some of the more important specific objectives of mining and metallurgy.

Our six basic recommendations have stated, in effect:

1. That social objectives can only be attained by economic prosperity which, in turn, can only be maintained and advanced by a judiciously balanced growth in our scientific and technological efforts and achievements. Generally within this context we might add the opinion that, if it be otherwise, there will ultimately be little money for any kind of research, including that involved with basic science;

2. That we adapt existing, available information and know-how from other countries, wherever this is possible and appropriate;

3. That in future we give greatly increased attention to those areas in which, because of special, natural circumstances, we can excel. (We refer especially to Canada's natural resources and to the distances and climatic conditions which are peculiarly associated with this nation's life and development);

4. That a much enlarged proportion of the nation's total research effort be carried out by industry, with government support;

5. That for the purpose of establishing common interests and improving the effectiveness of research in all sectors, processes of communication between these sectors receive intensive condideration. (It is our opinion, Mr. Chairman, that this area is of the greatest importance towards making research effective. The advent of major, national programs would even more sharply demand mutual understanding between research agencies and research sectors, and, indeed, between the fields of basic and applied research, and development);

6. That funds be provided for the installation of programs oriented towards the needs of whole, separate industries. We have referred to these as "medium size" programs, as distinct from the major national concepts advanced by the Science Council.

I would like to say a few words more about our concept of a medium size program. The kind of program we have in mind is that which is either too big, too long term, or requires the application of too many disciplines or too much specialized equipment for likely adoption or effective prosecution by any one organization. These programs are, however, of potential application and benefit to whole industries.

It is, of course, true that numerous programs, or at least projects, as conceived and carried on by federal research agencies are potentially of benefit to whole industries. However, it is sometimes the case—often I would say—that when such continuing research comes to a point requiring an engineering approach, prototype hardware and field testing, the project may die in its promising youth. We believe such cases could be clearly avoided if they were parts of national, industrial programs.

I do not, of course, refer in this exemplary way to programs of defence and so on, or even of an organization as large as the National Research Council. I am referring more specifically to the research projects of certain federal branch research agencies.

The Chairman: Such as the Department of Energy, Mines and Resources?

Dr. Horn: Yes, I could give that example.

We have suggested in our brief, Mr. Chairman, that such medium-size programs could be implemented more quickly than major national ones, and that they could be administered within existing facilities. We believe that there is quite an urgent need—and here again we must bring our own industry into it as an example—for this kind of program. We believe, Mr. Chairman, that a central, policy-directing agency, responsible for the statement and control of national, priority objectives will be strongly required.

It is, however, our view that central, administrative control of government funded research agencies or programs in industry or universities would not result in the most efficient overall process of research and innovation. With respect to industry, we believe that within the framework of a directive national policy or objective, industry itself will generally be in the best position to choose the nature and course of its research projects.

On the other hand, the co-ordination of research objectives must surely be held as one of the most important features of any future science policy and practice in this country. Again, whether this is a job for an advisory body or for a ministry with authority for the distribution of research funds, we are not prepared to competently suggest, though we would comment that we are not aware of any method for the effective and continuing co-ordination of research, other than one involving control over the distribution of the funds for its prosecution.

We would emphasize our opinion, Mr. Chairman, that for the achievement of more innovation there should be greater support, in both breadth and depth, of all phases of the innovation process in industry. The pilot plant and design and engineering phases, the developmental production problems, the modifications to manufacturing methods, the market research and marketing trials, together with the initial research activity which, in practice, frequently must be made to continue, even into the manufacturing phase, add up to a weight of risk and expenditure which is often too great for a responsible company to accept, and their investment may be diverted elsewhere. We suggest that whatever plan, therefore, may evolve it will take into consideration these other risks and costly phases of the total innovation process. Thank you, Mr. Chairman.

The Chairman: Thank you, Mr. Bonus and Dr. Horn.

[*Translation*]

I now invite Mr. Jean-Marie Martin to make his opening statement. As you know, Mr. Martin is President of the Canadian Council on Urban and Regional Research. Mr. Martin.

Mr. Jean-Marie Martin, Chairman, Canadian Council on Urban and Regional Research: Monsieur le président and other members of the committee, my name is Jean Martin and I am the Chairman of the Canadian Council on Urban and Regional Research. I am accompanied by the following people who are members of the council, Mr. Beecroft, Mr. Dobush, former Chairmen of the council, Mr. Teron, a member of the Board and Mr. Armstrong, who is the Executive Officer.

The Canadian Council on Urban and Regional Research welcomes the opportunity to submit its views to the Special Committee on Science Policy of the Senate. We should also like the opportunity to appear before the Committee: to sketch research resources that should be called into play in facing unprecedented urbanization, as called for in your reference (a); to outline the structure we believe appropriate to support productive urban research, as called for in your reference (d); and to emphasize the steps needed to improve the linkage between available knowledge and common practice in our field.

[*Translation*]

Practically the entire research budget of the Council—over 100,000 dollars per year—comes from the Ford Foundation; however, neither they nor we regard this dependence as a permanent state of affairs. The cost of administering our subsidy programs, and of providing bibliographical and other services, has been met with the assistance of grants under the National Housing Act, which have averaged approximately 100,000 dollars annually. These receipts, together with the corresponding expenditures, for 1966-67, are detailed in Appendix A.

Expert consultants were retained by the Council to look into the possibility of obtaining funds from Canadian corporations; they found that corporation officials saw no reason to support our work, and no tangible profit to be derived from direct contributions to basic research on urban problems; they feel that work of this kind should rightfully be financed out of taxation, to which they already contribute. Opinions gathered in 1967 on this subject will be found in Appendix B.

Also in 1967, the Council made a study of public expenditure on what we term "urban and regional research"; in this work, we had the enthusiastic assistance of the Dominion Bureau of Statistics. Detailed findings are attached in Appendix C, and relate to the 1966-67 financial year, the last for which figures were available when the study was made. It was found that the bulk of the work was concerned with isolated local problems, limited in scope. The breakdown of the total expenditure is as follows: federal expenditure, 18.3 per cent; provincial expenditure, 45.5 per cent; municipalities and other local groups, 36.2 per cent.

It is for the Committee to judge whether this rate of expenditure on urban and regional research is adequate, basing their assessment on one or other of the many criteria that follow:

The first criterion: the total research effort, considered as a fraction of total urban investment. Urban capital formation is running at approximately 10 billion dollars annually in Canada; of this amount, 3 billion dollars are devoted to housing, with one billion coming out of federal housing allocations; in other words, we are spending less than one cent on the analysis of urban problems for every ten dollars spent on urban construction and infrastructure development; to put it yet another way, for every ten dollars of federal money invested in housing, barely one cent goes towards urban and regional research.

The second criterion: urban research in relation to research in other fields. Research and development expenditure in Canada in 1965-66 was almost 525 million dollars, according to the Fourth Annual Report of the Science Council, published in 1968; the portion of this amount devoted to the social sciences was approximately 25 million dollars; this means that this country, which is highly urbanized and still rapidly moving towards even greater urbanization, spends about $4.75, at most, on the social sciences for every 100 dollars spent on research as a whole, and of the $4.75, barely $1.90 goes towards research on urban problems.

The third criterion: urban know-how originating abroad. No-one can claim that the problems involved in creating and administering Canadian communities—any more than problems in other branches of knowledge—can be solved by importing ready-made wisdom from abroad; on the contrary, it is obvious that it is precisely those problems faced by different societies in their individual physical environments that are most critically dependent on on-the-spot research for solution.

The fourth criterion: the number of Canadians with qualifications in the field in question. Until very recently, this factor imposed a severe limitation on the amount of work that could be accomplished, but the staffs of our universities are expanding rapidly, and graduate enrolment in the social sciences is also increasing. Within this field, the study of urban and regional problems is arousing growing interest, as shown in Appendix D.

The fifth criterion: the amount of research investment required to produce significant results. The complexity and close interdependence of urban problems require that a broad range of talents be brought to bear, if a successful outcome is to be achieved. For this reason, the minimum research investment necessary to produce more useful results is all the greater. Our subsidies, which average only 8,000 dollars each, because of our limited funds, have helped to finance an ever-increasing number of research projects; we have also helped some researchers by referring them to other agencies when we were unable to subsidize them ourselves, and by orienting individual research activities around major themes. In this respect, we are in agreement with the Science Council's statement—in its Fourth Annual Report—to the effect that only a wide-ranging research program will be capable of producing any detectable change in the Canadian urban environment.

[*English*]

Each of these five yardsticks leads us to the conviction that the scale of Canadian urban and regional research effort should be magnified in the next few years by at least two or three times, that is to say from under $10 million a year from all sources to something like $25 million a year. Only an increase of this order will make headway against the urbanisation issues being encountered, by exploiting the able and willing talents becoming available in Canada. It is also clear from our experience and surveys that most of the new money required for fundamental urban research will have to be federal money.

Those who established the Canadian Council on Urban and Regional Research had an important information function in mind: one of our charter objects is "to facilitate efforts to gather, analyze, co-ordinate and distribute available knowledge". Those who need urban information should be served as well as anyone else with important decisions to make. We are engaged in raising about $150,000 to prepare an outline specification for a modern Canadian urban information service; this service would belong not to the council, but to its users.

Canada has plenty of cause to want its own urban information service. We have our own customs, constitution, languages and cultures as reasons for believing we shall not be well served by depending wholly on someone else's network. We know that we are spending millions of dollars a year looking for urban information, sometimes not getting it in time, sometimes never getting it but having to take decisions without it. We believe that the technology and facilities developing in the statistical field, and taken for granted in the physical and life sciences could be parallelled for the use of people facing urban issues of every sort. We learn of new channels of communication to be built across Canada in the next few years.

By "urban information" is meant those facts, documents and experience useful for the management of the affairs of urban centres and urban regions. The council believes it is possible to devise methods by which those who need this urban information (no matter how isolated) will spend less time and money seeking it and will be able to locate and obtain what they want precisely and quickly. The first aim of the project is to clearly establish the needs of urban information users. Then to determine how best to meet these needs by improving the gathering, storing and dissemination of urban information throughout Canada: how costs can be cut, how quality of information can be improved and how to obtain co-operation among those who use or produce urban information.

This project has been designed with the help of agencies familiar with the problems of information delivery in both languages, including experts who assisted in the preparation of the Science Council's Special Study No. 8 on scientific and technical information in Canada. Recommendations made in other areas of information have illustrated that not only are savings in time and money possible but, by providing more useful information more quickly, decisions become increasingly more effective.

In sum, it is the object of this council's project to complete four steps preparatory to the establishment of a co-operative urban information service for Canadians:

1. To identify the rough profile of user needs;
2. To catalog the sources and channels now serving;
3. To discover what is now spent on search and delivery;
4. To draw an outline specification for a service that will link sources to needs more efficiently, without radical change from present money outlays. The specification should provide for links to related information networks in Canada and beyond. It should call for a built-in response by the service to the changing scope and character both of urban information sources and of user demands.

Funds for this project have been asked of all three levels of government. There has been amazing consensus as we shaped this effort, even though the funds are not yet assured. We are hopeful that they will come. No-one asked to take part has declined. The result is that a very able group is ready to proceed, after many hours discussing exactly how best to use the limited weeks and dollars that can be spared. We hope to have the outlines of a possible Canadian urban information service drawn by early 1970.

In urban and regional affairs, a particularly strong case can be made for the founding of an information service tailored to the needs of those with operational responsibilities. Surveys sponsored by this Council indicate a serious lag between what is known from urban research and what is put to use by way of innovations possible in daily decision-making. These decisions, both as to public works and as to private and corporate choices, are likely to last through the next generation and hence affect the well-being of millions of Canadians. The more speedily and efficiently the relevant facts and experience can be brought to the time and place of choice, the better the urban environment can be modified to respond to our changing human expectations of it.

We have urged that more coherent and ambitious programs of fundamental research should be undertaken in Canadian urbanisation and urban affairs, and that the greater funds needed for these studies can and should come mostly from the Government of Canada. The case has been made well by others (e.g. the Glassco Royal Commission Report in 1963, Vol. 4, pp. 225-230; or the U.S. National Academy of Sciences Report to the House of Representatives' Committee on Science: Basic research and national goals, 1965) that the best use of most of these federal funds will be obtained by placing them in non-government institutions. This case is especially clear for the human sciences and, in Canadian constitutional and cultural circomstances, perhaps clearest of all in the investigation of urban development and urban management issues.

The desire for responsible control of public funds for urban research has led some to recommend a central government agency to 'organize', 'co-ordinate' and 'undertake' the needed work; these ideas are prominent in the Report of the Task Force on Housing and Urban Development 1969 (pp. 70-75). But the arguments to centralize the control of research programming and funding on grounds of efficiency lose much of their force, once there is the possibility of full, free and prompt exchange of information among all the Canadian institutions concerned with the conduct and use of urban research. This information service will be especially valuable for its reports of work in progress or newly undertaken, reports essential to research programming and funding decisions.

The rest of the brief bears on this question of establishing various sources of assessment and funding and there is an argument there which you can look at when you have time.

In concluding, Mr. Chairman, I would like to say that your committee is charged to report on trends in research and development expenditure in Canada; and we have shown that in urban and regional research the outlays have been tiny; that the urgency of the specifically Canadian issues and the talents able to tackle them warrant spending at least two or three times as much money per year right away; and that most of that increased funding will have to be from federal sources. Ways should also be found to encourage federal incorporation of private foundations.

Your committee is also charged to report on the principles, long-term requirements and structural organization for research; and, in that respect, we contend that the nature of Canada and the imminence of speedy and selective communication of urban knowledge throughout this land make for the devolution of responsibilities for formulating major urban research programs and for allocating funds to carry them out; and that major responsibilities be devolved to extra-governmental bodies, for the sake of free yet informed coupling of abilities and resources, powers and concerns.

The Chairman: Merci, M. Martin.

Senator Haig: Mr. Chairman, if I may start off the questioning, Mr. Martin says that urban research and development should be done by the federal Government. Where do the provinces or cities fit into this program

Mr. Martin: I shall ask Mr. Armstrong to answer that question.

Mr. Alan Armstrong, Executive Officer Canadian Council on Urban and Regional Research: This question that Senator Haig asked inevitably arises.

Senator Haig: That is why I asked it.

Mr. Armstrong: We have conducted a survey of what public bodies at all three levels in Canada were spending on urban and regional research. We got the figures for 1965-66, which, by the way, is why we compared them with the Science Council's figures for that year and not for a later year; and it turns out that in 1965-66, to the best our ability to discover, with the help of the Dominion Bureau of Statistics, total public spending on urban research was in the order of $6.7 million, of which the federal share was 18.3 per cent, the provincial share 45.8 per cent and the municipal share 36.2 per cent. And that represents only the 20 largest cities and largest municipal associations.

Senator Haig: Why ask the federal Government to increase their share?

Mr. Armstrong: Basically, sir, because what is most needed is work of a kind that all Canadian cities can use, and this survey indicates that the largest part of what has been done by the provinces and especially by the municipalities, because of their resources and statutory responsibilities, is immediate, short-terms, specific kinds of firefighting research jobs. What is missing, as I think the Science Council and others have pointed out, is the sort of fundamental, large-scale work which in most modern countries is being funded, whatever the subject field, by the central government because it is to the general advantage of the citizens of the whole country.

Senator Haig: In other words, research in one city could apply to research in another.

Mr. Armstrong: Research of the fundamental kinds that I have been describing, yes.

Senator Haig: Thank you.

Senator Carter: Mr. Martin, on what do you base the $25 million that you say you need? How do you arrive at that figure?

Mr. Martin: I think Mr. Armstrong is once again in a better position to answer that question.

The Chairman: Do you mean the $25 million they are asking for now?

Senator Carter: Yes. You say you have approximately $10 million a year now, but you want $25 million. I would like to know how you arrive at $25 million.

Mr. Armstrong: Mr. Chairman, this is the kind of figure which, I suppose, can never be substantiated in any close kind of argument. We can, I believe, say that the Canadian Council on Urban and Regional Research has a pretty fair idea of the talents available in universities and other institutions usefully to spend this money. We have received many hundreds of proposals for research and we have reviewed them very carefully. Therefore, when we say we need an immediate increase in the order of two or three times what we now have, we are really saying that there are people in Canada to do very necessary work and that their capabilities are at least two or three times what they are now being asked to do.

Senator Carter: I don't doubt that you could spend $50 million, if you had it; but you say $10 million is not enough and that you want $25 million. Can you not give us a little more specific breakdown?

Mr. Armstrong: I think we said in the order of two or three times, which probably now would come to something in the order of $25 million. If I may say, sir, I don't agree that you could spend usefully just any amount.

Senator Carter: But you do say you could spend usefully $25 million.

Mr. Armstrong: Yes.

Senator Carter: Yes. Well, I would like to know what you are going to spend it usefully on in terms of broad categories. I am not asking for 100 different projects, but merely for broad categories. Where are you going to spend it?

Senator Haig: Where is the research going to be done?

Mr. Martin: In that respect, I will just outline the general areas of research. After six years of operation we have been able to trace and define various areas of research. One of these we call trends to metropolitanism. There have not been any major studies of the various aspects of government of metropolitan centres here in Canada. Just that area alone could easily take many millions of dollars per year on the study of the problem of growth and the consequences of the growth of metropolitan centres upon the rest of Canada.

Another area we are now outlining as a field for research is regional development and urbanization and the function of urbanization in regional development. This is again a very broad area in which we can invest a great deal of money.

Still another area for research is the training of public servants at a level of local government. This would be developed from studies that we have financed and would take the form of seminars in order to induce people to become interested in that area.

Still another area that we are greatly concerned with is the socio-economic impact of transportation projects. Many millions of dollars are invested every year in this field but just on technical aspects alone. I might say that we did not go as far in studying that third field as we did with respect to the trends in metropolitanism and urban and regional development.

So there you have three broad areas in which a great deal of research could be done.

Senator Carter: Have you any breakdown of how much you would spend in each area?

Mr. Martin: The proportion in each area? I would ask Mr. Armstrong to answer that, because he is the most familiar with the division of the funds that we might be prepared to allocate to each of those areas.

Senator Haig: Where would this research be done? Would it be done locally or in a central body or would it be done in centres of excellence? Just where would it be done?

Mr. Martin: In most cases research will be done by experts. Most of them we find in universities, but the Council, in order to make sure that the proper type of research in which we are mostly concerned for the time being is made, will have to identify the experts. It may well happen that we will give contracts for certain major pieces of research and in other cases we may receive applications from competent institutions within a university.

Senator Carter: This project you have outlined here, how much is that going to cost?

Mr. Armstrong: If I may interrupt, Mr. Chairman, may I say first of all for the record that Mr. Martin described these medium-sized projects very quickly. They are slightly more fully described in paragraph 9 of appendix B of our brief for those who would like to look at them.

Now to answer your question about proportions, the council is at this moment inviting proposals up to our means which you will appreciate are very modest. We have ourselves decided that within those means a problem like the alternatives to the present concentration in metropolitan cities in Canada is clearly six or seven times as expensive and probably three or four times as long to tackle as a problem such as one or two of the others which Mr. Martin mentioned. The apportioning or allocation of funds among these is to some extent conditioned by what we have in our own hands or what we can persuade other people to part with. But even in those terms we can say that the themes that he has mentioned, that have to do with metropolitan cities and that have to do with the role of the cities of regional economic disparities, would probably take 75 per cent of the total.

Senator Carter: But you still did not tell me how much this is going to cost. Have you made no assessment?

Mr. Armstrong: Maybe I should say more about the process, because we are not conducting the research; we are inviting people to conduct research within this framework, and therefore what it will cost will depend on the people coming forward and on what is available through other channels.

Senator Carter: Have you any way of assessing what it would add up to?

Mr. Armstrong: I would say we are well along with the one described in paragraph 3 on page 5 of the appendix and I can say we shall not be spending more than $25,000 or $30,000, so it is obviously much less expensive than the other two I mentioned. That is the one that is furthest advanced.

Senator Carter: We have three briefs before us this evening and all have stressed the lack of communication. Where is the breakdown in communications in the urban field? And how are Canadian urban problems so much different from those of other countries? It seems you want to gather Canadian information, and I can understand about specific regional differences, but surely the broad urban problems are not much different from what they are elsewhere. For example, is there much difference between Montreal and a city of the same size in the United States or, for that matter, Toronto, apart from the race distribution? Thinking about urban problems such as pollution, transportation, land values, are they much different from city to city? There have been numerous studies in the States.

Mr. Martin: If you like, I will ask the former President of the Council, Mr. Beecroft to answer that.

Mr. Eric Beecroft, Past Chairman, The Canadian Council on Urban and Regional Research: I would suggest as a short answer to that question that we work in a very different political framework and we must solve Canadian problems through, for the most part ultimately, political decision-making. We have to make these decisions in a unique way through a very elaborate tri-level kind of government. It is very important that Canadians therefore should exchange information among themselves and not be at the mercy of networks which are north or south of which are primarily international in character. We are constantly feeding information and data from Canadian cities and municipalities into very elaborate electronic data gathering equipment in New York and Chicago, then buying it back again with an enormous amount of information which we sometimes do not need, and which we have to interpret in very, very different ways in order to be able to fomulate programs that require in this country co-operation between federal, provincial and local authorities. It is very hard to find solutions to very big problems like pollution control, urban transportation, urban renewal programs, housing, new town development—which is perhaps ahead of us—except by innovation in inter-governmental machinery. In fact the problem of bringing about innovations in inter-governmental workings and relationships seems in itself to be one of the problems which requires an enormous amount of research.

Senator Carter: You say we have to work out solutions within a different framework. But we are not talking about that. We are talking about getting information. You say in your brief that you invest a lot of money to get information, and yet you cannot get that information when you want it.

Mr. Armstrong: What we said is that Canadians are spending the money, and by that we mean mayors, aldermen, city clerks and city solicitors who are spending many millions of dollars a year to get information and are not getting the information which they know exists. That is the multi-million dollar question we raise which is very similar to the questions raised in the report. The aggregate Canadian expenditure is very high. In this connection I would refer to the Tyas Report of the Science Council.

The Chairman: Do you accept their main recommendations?

Mr. Armstrong: I do not think the Council has had an opportunity to debate the main recommendations, but I think we accept the estimates of expenditures. It means that with the use of data collected from other countries the network can draw upon whatever is imported. But, as I think Mr. Beecroft was pointing out, there is a great deal that cannot be imported. For example, taking the winter weather conditions, this city and Montreal have some of the highest ratio of cars combined with one of the heaviest snowfalls in the world. In that regard there is nobody who can tell us how to deal with that situation so far as our streets are concerned.

Senator Haig: Have you ever been to Winnipeg?

Mr. Martin: We are speaking of cities the size of Montreal.

Senator Cameron: If I were representing a foundation which had $100 million of money to give away, I would want an awful lot more precise information than you have submitted so far as the terms of what exactly what you would do are concerned.

The Chairman: But we have not come here with the detailed projects, expecting to get money tonight.

Senator Cameron: No, but they are asking the federal Government for it, and it amounts to the same thing. In other words, the federal Government is Santa Claus.

Mr. Martin: Mr. Chairman, I would like to make a slight correction here. The Council is not asking for money from the federal Government, as a Council, in the brief.

Senator Cameron: We know that.

Mr. Martin: We just say we feel that in that area which is so important here, in a country where the urbanization process is even faster than in the United States and is a national problem from coast to coast, the only agency of government which is really in a position to pour in the amount of money that is necessary to know what are our urban problems, is the federal Government, if I am permitted to correct that.

Senator Haig: Mr. Chairman, I would like to ask Dr. Trevor Lloyd a question on No. 3:

> It is recommend that Canadian Science Policy include the realization of the full social and economic potential of the North as a National Goal.

What do you mean by "the full social and economic potential," and where would the science policy fit into that?

Professor Lloyd: Mr. Chairman and honourable senators, before answering the question, I wonder if I might mention the names of others who are present with me, so that I may be rescued by them if I get into trouble.

Senator Haig: You made the presentation, so you are responsible.

Professor Lloyd: Yes, and I take it. On my right is Dr. McTaggart-Cowan.

The Chairman: He is well known here.

Professor Lloyd: Yes, I know. Dr. McTaggart-Cowan is Governor of the Institute. Then we have with us Brigadier H. W. Love, Executive Director of the Institute; Miss Moira Dunbar, Governor, who is employed in the Defence Research Board; Dr. M. J. Dunbar, professor from McGill; and Dr. Olaf Löken, a fellow.

Senator Haig: Now would you answer the question.

Professor Lloyd: Yes. Would you please repeat it?

Senator Haig: You mentioned on page 1 of your brief, recommendation No. 3:

> It is recommended that Canadian Science Policy include the realization of the full social and economic potential of the North as a National Goal.

That is all underlined. Would you explain to us where the science policy of Canada could fit into "the realization of the full social and economic potential of the North"?

Professor Lloyd: As I mentioned in my brief supplementary submission, the problem of the research background for development is fundamental. The north is an area where the margin of error is very small indeed, and it is possible to spend large sums of money, to use large human resources, and so on, and to waste them. This has been done in the past, and doubtless the same will be done in the future—indeed, this summer—in the far north.

In order, then, to realize the full social and economic potential of the north one must before that time undertake research. One reason I went to the trouble to emphasize what the Arctic Institute is trying to do is that for 25 years it has been trying to get this kind of research started in advance of the need.

Senator Haig: In what areas, sir?

Professor Lloyd: Do you mean subject or territorial?

Senator Haig: In what areas?

Professor Lloyd: Initially, the research undertaken through the Arctic Institute, and by others interested in it, was physical research. They were interested in photographing and mapping the north, charting the seas, finding out where islands and glaciers were, the fundamental physical and geophysical work, and so on.

Senator Carter: I think what Senator Haig means is, what do you do at these two summer stations, one in Devon Island and the other in the Yukon?

Professor Lloyd: Both are parts of this physical and scientific research. I suppose their basic justification is for training. They do very good scientific work, but they also train a number of young men in the process.

The north is opening up and the Eskimoes and Indians are taking a far more active part in the life of the north, and we are running into sociological and economic problems, and others. Th Artic Institute and others are shifting their research interests into this new field, and this is where the point you mentioned comes up.

Dr. P. D. McTaggart-Cowan, Governor, Arctic Institute of North America: Perhaps I could give a specific example of this. Let us go back before the war. The professional staff in Whitehorse were transitory. We ran a large meteorological station there; they were posted there for two years, and by the time the two years were up they wanted out. Shortly after the end of World War II the population became stable. Instead of looking for hand-outs for evertying, they took the bit in their teeth and formed good school boards, built a curling rink and organized themselves, which transformed Whitehorse; but we do not know why.

The same was the case at Yellowknife. For a time it was an in-and-out proposition for most of the professional staff. In the new communities built around mining developments and for other purposes, some are stable and others are highly unstable, and we do not know the reasons why.

This is a specific answer to your question, that we must find out why, because everybody who goes into the North to develop something would like a stable population so that the turnover is minimal, because the cost of turnover is high.

This is a specific example of the gaps in our knowledge of the sociological and political aspects of the problem as to what makes a stable community in the north. We have seen them transformed, but we do not know the ingredients.

Senator Phillips (Prince): In the brief of the Canadian Council on Urban and Regional Research, in the introductory summary, paragraph 2, subparagraph (3), you state that:

> the immediate allocation of funds...can be better done by several granting bodies than by a single monolithic agency.

Could you tell us what agencies you have in mind there?

Mr. Martin: I will ask our Executive Director to give you an answer.

Mr. Armstrong: I think the whole argument, which is the last two pages of our brief, arises out of these observations. Of course, there are many administrative objections to the Government of Canada, or anybody else, entrusting money to a number of non-governmental agencies to make the judgments about research to be funded, but there are also some things to be said in favour of that. One of them is that research in this field is effective if it moves in the direction of development and application, if those with the direct operational responsibilities are involved as the research goes on and, therefore, are convinced about its validity. This happens in urban affairs where there are 6,000 jurisdictions involved in the application, and each has its own contribution to make in terms of operational records and data. We are saying, therefore, that there will be at least that number of places in which research should be done, and they are not all under federal jurisdiction.

Perhaps I might make a point that comes back to Senator Haig's question, which I do not think was answered. Senator Haig asked where the research would be done, and I have given part of the answer. It will be done where the records and the operational people are.

In our own experience, Senator Haig, about two-thirds of the work is done in universities, and this is partly because of the reason Professor Lloyd alluded to. That is the place where young people are taught, and, therefore, a few thousands of dollars invested in research conducted in universities produced not only answers but also additional able people. Of the $600,000 approximately that we have placed in urban research in Canada, over $400,000 has been distributed in the form of grants to Canadian universities.

Senator Haig: For student training?

Mr. Armstrong: It is for the conduct of research under faculty direction, and this inevitably involves graduate students as assistants.

The Chairman: If the research can be done in the universities then it will certainly have to be done there, if we are to believe what Central Mortgage and Housing Corporation told us. They lost 45 per cent of their research personnel last year.

Senator Phillips (Prince): Now that he has answered Senator Haig's question I wonder if he would mind answering mine.

Senator Haig: Ask a pertinent question and you get a pertinent answer.

Senator Phillips (Prince): I asked what granting bodies you had in mind.

Mr. Armstrong: I believe, sir, that they might include some departments of the federal Government which have a particularly operational interest in it. There is already urban research being conducted by seven or eight agencies of the Government of Canada. The Canada Council is another instance, and they have a different attitude to the research to be done. They would certainly include bodies like our council which has federal Government members, provincial government members, and local government members, so that we are able to fund things without regard for the constitutional barriers that would apply to any one of those governments. In other words, we do not mind saying that we think we can place a federal government grant in urban research better than a government agency. This is one of the reasons why we have been so generously supported under the National Housing Act.

Senator Robichaud: When you refer to granting bodies do you not refer to agencies of the federal Government which can provide the funds. Here you say "several granting bodies".

The Chairman: Within the federal Government.

Senator Carter: Yes, that is what the brief says.

Mr. Armstrong: We are saying that they are within the federal Government, and also that the federal Government should be prepared to pass on to granting bodies outside the Government. There are several arguments for this, but I think the case has perhaps been made most cogently by Joseph Ben-David in the O.E.C.D. report "Fundamental Research and the Universities". This argument is the subject of the whole report. I do not know whether that satisfies the question.

Senator Haig: I would like to ask a question of The Mining Association of Canada. At page 5 of their brief they say:

> The industry is very conscious of the fact that its continued growth and the further development of its international stature must depend to a major extent on an increase in flow of young professional and technical men from many disciplines being attracted to mining and making their careers in it.

My question is how can this be helped by any science policy of Canada.

Dr. W. H. Gauvin, Research Manager, Noranda Mines Limited: Mr. Chairman, this question touches on a very important problem, and one that has received a great deal of attention from our industry, namely, the decreasing number of departments at universities specializing in mining. You can go to any number of universities—I do not want to be parochial—and you will find that the mining departments have virtually disappeared. They seem to re-appear in some universities as departments of mineral science and under various other titles, with slightly different aims and, possibly, a more multi-disciplinary outlook. But, the fact remains that the mining industry as distinct from its metallurgical arm is gravely concerned about the decreasing availability of well-trained mining engineers on the one hand, and of people who are trained in mining research on the other hand. It is believed that support of research in this particular area at universities would help the situation.

I do not know whether I have answered your question.

Senator Haig: Yes, you have, sir. Thank you very much.

Senator Yuzyk: Continuing on with the topic of universities and research, in recommendation number 2 at the bottom of page 10 it is stated:

> ...we would add our belief that Canadian universities graduate engineers able to perform efficiently in industry and elsewhere.

This would lead me to believe that the universities are not producing the type of engineers that would be the most useful from the point of view of the mining industry. I would like you to comment on industry-university relations. What do you expect of the universities in this matter.

Mr. Bonus: I would ask Dr. Horn to deal with that question.

Dr. Horn: First, I think our statement was general and did not apply specifically to the mining industry. I think the terminology "to perform efficiently in industry and elsewhere" was the precise wording of Senator Lamontagne's specific question, or a typical question in his invitation to submit a brief. I am trying to answer your question as a continuation of Dr. Gauvin. At the present time the kind of engineer the mining industry is now turning out, or at least beginning to turn out from the universities is able to perform well in industry and elsewhere. "Elsewhere" would frequently mean in the civil engineering industry on the one hand, or it would mean in foreign countries and competing with foreign engineers on the other hand. That was the import we meant. In other words, Canadian engineers are as good as any in any part of the world. I do not know whether that answers your question entirely.

Senator Yuzyk: Partially. I would still like to have some idea specifically what relationship the mining industry has with the universities in research.

Dr. Horn: The one main program that industry has going with the universities in respect of mining is, I would say, at McGill. This program is funded by industry to the extent that it brings promising post-graduate men, who are recently post-graduate, or men who may have been out for anything up to 15 years and want to come back and polish up their mining engineering, into the McGill educational program. It fully funds these students on an annual basis with something of the order of $6,000 to $7,000 per student. This is educational in terminology, so to speak. It also during a two-year period funds the student in order to do research together with what is basic to the program, which is an educational function. This, as I say, is now operating at McGill. It is not a large number; it may be 15 very carefully chosen people each year. It has the added significance that it was initially set up as a crash program because there were just not enough engineers available to mining.

Senator Yuzyk: Does this apply to other industries and not only mining?

Dr. Horn: It applies only to mining, but not only to mining engineering.

Senator Yuzyk: Is this helping to meet the demands of the mining industry?

Dr. Horn: It is helping to meet the demand and is greatly upgrading those who attend such courses.

Mr. Bonus: I should add that there are quite a number of universities that also offer awards given through the mining industry, awards for scholarships, if you like, to students for certain courses having to do with mining. I do not think McGill is the only one, although it may be in the context of that very large program.

Senator Yuzyk: Mining also does its own research, does it not?

Dr. Horn: Yes.

Senator Yuzyk: How is this connected with university research?

Dr. Horn: Here is where the problem of communication is possibly no greater but just as great as in other disciplines and other engineering. The problem of communication between universities and industry is only partially solved, and on a strictly ad hoc basis. It is one of the things we are worrying about within the context of our more general statements about communication. Again, attempts are being made to solve it through extensive two and three-week courses with a significant number of mining engineers coming into universities, getting together, interchanging opinions and also listening to lectures partly by industry and partly by the university, which are oriented towards them and at their stage of scientific development.

Senator Yuzyk: But there is no national program as such.

Dr. Horn: There is no national program whatever.

Senator Yuzyk: Would you like to see a national program?

Dr. Horn: I think it is an absolute must, not just in our own particular area but in others as well. In this brief we have not tried to suggest any of the methodology. I must say that in speaking to university deans myself I become somewhat more confused, if not almost discouraged, when I hear their statements that they feel it is almost impossible to have a total and effective communication process going on within their university for as frequently as it would have to be with all areas of engineering, including the social sciences. Yet I do not see any way but the most direct kind of seminar and personal communication, far more than ordinary routine things. This is our concern.

Senator Yuzyk: I have at least one other question, but I will give way in case there are supplementary questions.

Senator Robichaud: I have a related question, which has to do with recommendation No. 4 of the Mining Association of Canada brief, on page 11, where you suggest that through the use of tax and other incentives, the proportion of the national research and development effort carried out by the industrial sector be substantially increased. By this I understand that the industry is already taking advantage of tax concessions and other incentives offered by the federal Government. Could we have an idea of the extent to which the mining industry has taken advantage of this policy in order to increase their work in research? Is it substantial? Are they really taking advantage of the existing concessions?

Dr. Horn: Holding it strictly to mining rather than including metallurgy, the figure I have for 1967, which is a very recent figure of DBS would show that the Government of Canada was the source of $500,000 only for mining research funds, out of a total of $1.3 million for mining and metallurgy.

Senator Robichaud: When you say research funds, were they grants or were they tax incentives?

Dr. Horn: One hundred thousand of those funds would be incentives.

The Chairman: There are no tax incentives for research.

Dr. Horn: Dr. Gauvin might speak specifically on this.

Dr. Gauvin: No, the very latest figures on the portion of gross national product allocated to research in Canada for 1968 is still not strictly and precisely set. We suspect it is around 1.3. We must take into account both mining and metallurgy, which has spent slightly over $45 million, and which represents, compared to the total metal sale, roughly 1.3 per cent of its gross sale. Our industry is running at the Canadian average, which is quite good because you have to consider that other industries which depend very largely on research—I only have to mention electronics and aircraft—run very much higher. Pulp and paper, which is also a primary resource industry runs at a fraction of 0.5.

To answer your question, it is true that on the one hand industry has received incentives, the ones mentioned before. It is using at least some of those funds in order to support what I consider to be a good program of research and development.

Senator Yuzyk: I actually have three questions here in connection with Section 4 on pages 17 to 19, regarding the specific scientific and technological objectives. They are outlined here and this is worthy of pursuance in every possible way. The questions that I have to ask regarding these objectives and tasks are these: I should like one of the witnesses or any of the three witnesses to reply. Should the research task not be pursued also by the Mines Branch of the Department of Energy, Mines and Resources? What co-operation has this department given to industry? The other question is has industry considered establishing its own research institute?

Dr. Horn: Could I have the first one again, Senator Yuzyk?

Senator Yuzyk: The research task as outlined here. How much of these tasks can be performed by the Mines Branch?

Dr. Horn: Yes, definitely. I do consider, in all of those, that the Mines Branch would be a part of practically every one of them, if not all of them. As a matter of fact, in writing these down I am sure that we all felt that they were practically, with the exception of possibly one, candidates for what we have called these medium size programs. In other words, I do not think that any single agency, public or private, would ever be completely effective in prosecuting the whole of any one project. The answer is definitely yes, that the Mines Branch would come into all of them.

Senator Yuzyk: How much co-operation has this branch been giving to the mining industry?

Dr. Horn: I would say over a long period of time, certainly a great deal in certain areas, but notably in the mineral processing area which is the concentration of ore since ores are different all over Canada. Whoever begins a mine has to establish a method within his mill and his flotation circuit. To this extent, contribution of the Mines Branch has for many, many years been tremendous. In the area of mining research, which has to do with the mining process or with the excavation process the Mines Branch has been very severely limited by research funds. Let me put it the other way. Until about two years ago with the introduction of the Elliot Lake Research Laboratory I do not believe there was a year when they had a budget of more than $300,000 to $350,000 to do research for a $3 billion industry and I am excluding, by the way, mineral fuels, which is not a part of the mining association in Canada's interest.

The way I am trying to answer the question is that they certainly have given co-operation, needless to say, we cannot always see eye to eye with what should be done for industry and what we believe industry needs to have done for it.

Senator Yuzyk: Does the industry make representations?

Dr. Horn: We do and we have in the past, but we were trying to exert an advisory function on the basis of being a single sector of society. This, we learned, was not really a formal possibility with Government.

Senator Yuzyk: There is a lack of communication there as well.

Dr. Horn: I hope a great deal of it will be solved by the recent formation of the National Advisory Committee on Research of Mining and Metallurgy. We submitted a brief to the Honourable Jean Luc Pepin in February 1967, urging the formation of this committee.

Senator Yuzyk: The third question is about the establishment of the research institute that would be operated by the mining industry itself.

Dr. Horn: Yes, a great deal of consideration has been given to that. I think that possibly one reason why it was turned down after a period of very intensive thought four years ago was that industry still felt that the Government, that is the Mines Branch, should be doing so much more work of that kind, that industry did not feel it was necessary to spend its own money on setting up a national industrial research institute.

Senator Yuzyk: It should pay off, because there is research done, I understand, at the various mines at the local level. If there was more co-ordination I should think you would get better results.

Dr. Horn: That will always be a reason, but I would not say it will always prohibit the establishment of an institute, because the geology of Canada is so variegated. It is so different between British Columbia and Ungava and in view of this fact, when you set up a mining research institute you have to set it up at or in a mine somewhere in one specific geology. So many of the results of research that you get are applicable only to a portion of the actual production part of the mining industry. Particularly it goes for such things even as methods for the support of underground openings, et cetera. Almost everything is governed one way or another by a particular geological surrounding.

Senator Carter: You have a $4 billion industry. How much of that $4 billion goes into research?

Dr. Gauvin: Forty-five million dollars.

Senator Robichaud: I have a question on the brief of the Arctic Institute. On pages 4 and 5 you mention the need for improved relations with the Government. On page 5, in the second paragraph you say that this collaboration has, in fact, grown steadily with the increase of Government activity.

Then you carry on by saying:

> The Institute has endeavoured to stay abreast of thinking in those departments and agencies concerned with the north—Indian Affairs and Northern Development, Energy, Mines and Resources, Transport, Defence, Agriculture, External Affairs and, of course, the National Research Council, to mention some.

I am a little surprised, due to the fact that I understand the chairman is from Montreal and the Department of Fisheries has an Arctic laboratory in Montreal connected with McGill and operating connections with McGill University and also due to the fact that you have mentioned in your preliminary remarks your contact with Greeland. My question—and I have reason to ask it—would be, do you have any direct contact with the Arctic laboratory in Montreal of the Department of Fisheries; and also, in view of your connection with Greenland, have you any interest in one of the major research problems of the fishing industry in connection with Greenland, that is, the taking of our Atlantic salmon, which are being depleted, our Atlantic salmon population is being depleted, due to the fact that they are being taken by the Greenland fishermen.

Professor Lloyd: This is a particularly sensitive question, the first one, because about six feet from where the senator is sitting is Dr. Dunbar, who is or was one of the leading lights of the Arctic section of the Fisheries Research Board and the captain and designer of its research ship the M/V *Calanus* in the Arctic. Therefore, I would have to apologize not only to the Senate but also to Dr. Dunbar.

What we are speaking about is Arctic research in general and the Fisheries Research Board, the Arctic section, has done admirable work which is very important and has helped a lot of students get training.

On the question of the Arctic, Dr. Dunbar was not only the Arctic research skipper but was also Canadian counsel in Greenland and did marine biology there. I put in a little time in Greenland, too.

The problem that arises—I do not know whether we should pursue it now—for eastern Canadians, Scots and Norwegians, is that they have for years been fishing salmon, who have obediently returned to the rivers where they were born. For the last few years, a lot of salmon fishermen in the areas of the rivers in Norway, Scotland and eastern Canada have been upset by salmon not returning. It turned out that the Eskimos and the Danes found that the salmon had been spending the intervening years in Greenland waters.

So the local salmon fishery in Davis Strait interfered with the other one.

Dr. Dunbar may want to add details on that.

Dr. M. J. Dunbar, Professor, McGill University: May I add a few words. This problem concerns that part of the Arctic Institute which is Danish, but the problem does not really touch on the Canadian Arctic areas at all. The salmon is scarce even in Ungava Bay and does not come in farther north at all. We are keeping an eye on it, and it came up at the last board meeting. In point of fact, this same problem is being handled at the level of the ICNAF, the International Committee on North Atlantic Fisheries.

Senator Grosart: My first question relates to the figures of research and development support in the brief of the Council on Urban and Regional Research. Has any estimate been made of the support given by the private sector?

Mr. Armstrong: We do not have any hard figures. We engaged a very well known consultant, to explore this area. On the whole, it turned out that, of course, utilities and some of the finance institutions were spending money to find out things for their own purposes but on the whole were not making the results available to anyone else and not inclined to say what their spending was. I cannot answer in any detail.

Senator Grosart: Could you make a guess at the magnitude, because it is a rather important figure? I would go so far as to say that the figures you have on page 3 are almost meaningless unless you can relate them to what the private sector is spending.

Mr. Armstrong: These were based on a survey we conducted on public spending. This was the suggestion, in the first instance, of people in private corporations, who said that they thought this was primarily a governmental responsibility and asked what Governments were doing about it. That is why we went to find these figures and why they are confined to public sources.

Senator Grosart: One of the questions we have to answer is whether that is true or not. I would suggest it is very important that we have these figures, because it is meaningless to suggest to the federal Government that they should increase substantially their funding in any one area if the people concerned are not able to relate this to private sector funding. This is, after all, one of the essential decisions that any government must make.

The Chairman: Are you speaking now about funding or research being done in the private sector, in urban affairs?

Senator Grosart: Both in the performing sector and as funding. In other words, the response of the Government is to fund where the private sector, where any industry or discipline, is unable to do it or is not doing it—particularly where it is unable.

The Chairman: Private funding would be a very small proportion in research.

Senator Grosart: It depends on how you define "research", Mr. Chairman. Obviously a developer in a city is doing a great deal of research. I would doubt if the suggestion made is really valid, that if they are not prepared to give it to somebody, and if they do it for their own purposes, that it ceases to be research.

The vital question is the total funding of research. Funding is the same thing as performance, in this sense, because if you are funding, someone is spending money, therefore you are performing.

Mr. Martin: I do not know if we can answer your question but I would like to ask Mr. Teron, who is one of the important developers in Canada and a member of our board, to give some idea of what the private sector may do in that area.

Mr. William Teron, Member of the Board, Canadian Council of Urban and Regional Research: I think it would have to be said that the amount of urban and regional research work done in the private sector is very small. The research done by private industry is done by the product people like Domtar, on the product itself. So, while this is in the realm of building, it is not in the realm of urban or regional research.

Senator Grosart: I don't understand that position at all. We hear about perma-frost research. Well, research is research. If Domtar are doing research on producing better building products, surely that is research in any definition that I know of the word.

Mr. Teron: Mr. Chairman, we are recommending that Canadians spend more on urban research because our cities are in a fairly bad state. We are trying to encourage a whole new attitude of finding out more about our urban centres. The Council itself spends about $200,000 a year, but that is a relatively modest amount of money. It takes $100,000 just to have a staff to try to find out what the problems are.

The Chairman: And half of that is American money.

Mr. Teron: So it is really a pittance when you think of the amounts of money being spent on our cities at the present time.

If you stop to consider what has been said by our executive officer, you will realize that what is being spent on work being done municipally and provincially is more than what is being spent federally. Moreover, that work is done in a more short-term, immediate way about particular local problems.

To that you can add a larger amount of money invested by private enterprise, but again it has even more short-term immediate application.

But the real problem in urbanization lies in the infrastructure itself. It is in the overcrowding which no private enterprise gets involved in, in respect of research. It is in the relationship between environment and poverty; in urban transportation and what it can do; in the problem of 20 million people spread over 3,000 miles, and in the fact that opportunity usually lies far away from those Canadians.

Senator Grosart: If I may interrupt you, I was not asking you what particular kinds of research were being done or by whom they were being funded. I am not asking for an analysis of the problem or whether it should be related to poverty or whether it is valid at all. I am not asking for a philosophical dissertation at all at the moment. All I am asking for is the total figure being spent on research and development. That is all. An estimate or even a guess will do.

Mr. Armstrong: May I say, sir, that Canadian universities do report annually what they are given for research and from what sources. The amounts in this field are so small that they don't even make a separate item.

It just happens to be one of our functions to run a list of research in progress. So we know that Bell Telephone, for instance, has made fairly substantial grants to the University of Toronto in the last couple of years, directly in the area of urban research. These are very small, relatively; so small, in fact, that they don't appear either in published company accounts or university accounts as separate items.

Perhaps, if there were the kinds of Government grants for research in this field that there are in some of the other sciences, there would be more adequate returns and, incidentally, more adequate subscriptions.

Senator Grosart: I won't pursue the question. I am merely asking for the total figure. If anybody wishes to attempt it, I can suggest to you some places where you will find some of the components. You will find them in reports of the Bell Telephone, in reports of RCA Victor, in reports of CNR and CPR, all of whom do research and development in various aspects of urbanization.

I suggest to you that is not an adequate answer to skate round the question and say that you cannot find the answer. It can be found. This is a science committee and you are scientists and I suggest that the answer can be found.

The Chairman: I suppose, Senator Grosart, that that would be much more the responsibility of the committee than of our guests tonight. I don't think they would be able to get the kind of answers we would get.

Senator Grosart: Not tonight, but I merely suggest that anybody coming to the Government asking for money should be able to give some comparative figures to help the Government make its judgment. However, I will leave that subject.

The second point that occurs to me is perhaps deliberate but explainable. The whole brief seems to concentrate on the urban aspect with very little emphasis on the regional aspect. Nevertheless, the figures in paragraph 6 on page 3 of your brief purport to take in regional research and development as well as urban. Are there other regional research and development expenditures that would not be included here?

Mr. Martin: Before you came in, Senator Grosart, I explained that one of the major areas in which we decided to invest a small amount of money at our disposal was regional development and urbanization. We are concerned with that, therefore.

The Chairman: But you are primarily interested in the urban affairs.

Mr. Martin: Urban affairs and the impact of urbanization in regional development.

Senator Grosart: I can understand that in view of the funds at your disposal and it was not a criticism. I presumed it could be explained.

Mr. Armstrong: I should say that "Regional" in our title refers to the urban-centred region. That is the region of greater Montreal, for example, as distinct from the Atlantic region. Therefore, when we set out to find out what governments were spending we set out some different figures, with the advice of

DBS, to identify this kind of "urban-regional" rather than "urban and regional", if you like. Therefore, items coming from federal agencies did not include research expenditures of what is now Urban and Regional Expansion or its components in the Atlantic Provinces. It does include the usual local studies.

Senator Grosart: I am interested in definitions because, when we make our report, we are going to have to use words.

With respect to the mining and metallurgical industry, I read two figures, one of $80 million on exploration and the other of $45 million, which are apparently expenditures on research and development. How do you define research and development in your industry? To me as a layman I would call exploration research and development.

Dr. Horn: Senator Grosart, Dr. Gauvin may define metallurgical research, but mining research has always been difficult to define, I must admit. Mining research is the investigation of problems within the total mining operation, which investigation is based upon and procured through systematic, scientific principles. What that would rule out in our industry is a great deal of testing which companies do carry on and have carried on for many years. I am referring to such things as for example, testing 1,000 drill bits in the same rock in order to find out what is best about one of those drills. In other words, the investigation would not be based upon scientific principles. Mining research nowadays has a very heavy element of what is termed rock mechanics, and rock mechanics really is the study of the response of rock and the behaviour of rock under the force field of its physical environment.

Now, this means the stability of all underground openings so that it is becoming quite a field of research. But in the most general sense I would insist that it be based on investigations conducted according to scientific principles and not on purely empirical test work so to speak.

Mr. Bonus: I wonder if Mr. Gauvin or Mr. Pasieka would care to speak on this aspect of it?

Dr. Gauvin: I would simply add to that, that mining research definitely does not include any exploration work of any kind. The two accounts are completely separate but when it comes to distinguishing between where mining research ends and the separation, refining and purification of the metals begins, the dividing line is indeed very thin and in some of the problems we handle, for example, the floatation operation and the fragmentation or breaking up of rocks, it applies to both the mining and metallurgical operations. I believe Mr. Pasieka, who is a mining engineer, may wish to say a few words on this.

Mr. Bonus: Mr. Pasieka may like to give his opinion as to the extent to which exploration overlaps development.

Mr. A. R. Pasieka, Chief Mine Research Engineer, Falconbridge Nickel Mines Limited: Mining, as Dr. Horn mentioned, is unique in many ways. It is very hard to set up test plants and pilot operations as you do in metallurgy. Consequently when you get into the definition of research, you get into some very thin areas in relation to lab research and scientific investigation. The reason is, I think, that it is the classic definition of research which is a little hazy in relation to the miner who cannot simulate or scale down in the lab or what have you the environment he has to deal with in a mine. But generally speaking the definition that IRDIA has is a good one and that is the definition we generally try to follow. They define pure, fundamental research for no specific end, and they also define applied research and development. I think generally the mining industry follows the government definition. We do not agree entirely in the mining end that it is the same as the metallurgical people say.

Senator Grosart: But the IRDIA definition is comparatively recent. I do not think it would be the traditional definition of research. The reason the question is important is that we are faced with international comparisons, and when I asked our friends from OECD if they were reasonably certain that our comparisons were based on constant definitions, their answer was no.

The Chairman: Well, we are just at the beginning of a new experience in that field among nations and it is not easy to have common definitions, but to come back to your original question on data collection and exploration, the Dominion Bureau of Statistics included it in what they call scientific activities, but it is not included in R & D which is part of scientific activities.

Senator Grosart: Again in the definition on page 11 of the Urban and Regional Council report I read that "forced labour on imposed intellectual assignments has repeatedly proven a wasteful way to try to expand knowledge." Do we have forced labour in Canada?

Mr. Martin: It is a question of style.

The Chairman: We have it in the Senate.

Senator Haig: Especially in your committee.

Senator Grosart: Finally on centralization versus diversification at the funding level, as you know I am always surprised at the resistance of the science community to centralization, which I am unable to understand, because it is there anyway. It is not a question of whether we should have centralization of funding but really what kind would the scientific community like. We are getting plenty of answers, but we are having difficulty getting a consensus. At the moment there is one central agency known as Treasury Board and anyone who understands the process leading up to Treasury Board's decision knows that they look at every item of expenditure and say "yes, no, maybe, more or less." I would like to throw out the thought that since it is there, there is no use arguing against it. It is there and it will always be there.

The Chairman: I am sorry senator, to intervene again but I think our guests were speaking not so much about the amounts; they were speaking specifically of a diversity of agencies allocating funds once the Treasury Board has done its job.

Senator Grosart: I do not see anything to indicate that is so in the brief, and I have read it very thoroughly. The brief does discuss it and I wont quote it, but it does suggest there should be many agencies. I agree with this, but I say no matter how many agencies you have you still have centralization of decision unless the science community can come up with something which will persuade the political decision-maker that there should not be this particular kind of centralization. We have now, to answer your point, Mr. Chairman, the situation where the Treasury Board does come up with broad allocations, and it also comes up with specific questions. It decides whether Energy, Mines and Resources will be permitted within the terms of the budget to spend X dollars on X project at Y university.

The Chairman: But it does not say whether or not I should receive a grant. They would probably turn me down anyway.

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Senator Yuzyk: Not this government.

The Chairman: I think this brings us to the question that was raised in particular by the brief presented to us by the mining industry about their centralized agency. I think there has been no question about this up to now. I would hope that Dr. Horn would perhaps explain this a little more fully, how he visualizes this agency; and perhaps also we could have some comments from the two other groups represented here tonight on this kind of concept.

Dr. Horn: Mr. Chairman, I must honestly admit that I think, as I said earlier in the brief, we have given a minimal amount of thought to the methodology of the things that we have generally recommended.

I think that what we are trying to say in regard to the centralized agency would be that it would have somewhat more direct knowledge and, possibly, scientific capability to very toughly direct policy and national objectives, even including the general course of major national programs, without having the authority or the trouble of administering the course of these programs once they had set sail, so to speak. I certainly would not myself presume to suggest Government organizational changes for that. I do not know whether my colleagues have something to add on that.

The Chairman: In any case, if you visualize a central agency at that level, it cannot be at the official level; it has to be at the ministerial level.

Dr. Horn: Yes, and I have implied that, or tried to, in the brief.

Dr. Gauvin: I would like to add something on this, Mr. Chairman. You will appreciate what the association recommends, it supports Science Council Report No. 4 and says that is good, sound and well established. Some people say it is motherhood, but our friends down south have recently hailed. . .

The Chairman: Do not speak about that today. We had a long discussion in the Senate today against motherhood!

Dr. Gauvin: We do not feel it is proper for us, and you have been hearing a great deal about this major problem; but what we need in Canada are medium-sized projects directed towards industrial needs that industry cannot meet.

Our recommendation No. 1 is a good example. It is important to have remote sensing methods to detect new ore bodies. We are running short of copper and zinc in this country, though we are possibly bringing into production bodies which 10 years ago we would have laughed at. We need more precise methods. We have made a particular study of these problems, and we figure it would cost about $5 million, over a period of three years, on a joint program of action involving university talents, and we know we can get people in the Government, in Energy, Mines and Resources, and skilled industrial people; but no company, even as large as my own company, can contemplate the expenditure and magnitude of that task over such a short period of time. The problem, as Senator Grosart has pointed out, is this. Suppose that Treasury Board does assign a certain amount, "X" dollars, for "Y" projects.

Is it up to the Treasury Board to recommend that the laser method of remote detection be adopted? Instead of thinking of new organizations that are going to be funded or established in the future why do we not look at what we have. We find that we have a parallel existing right now. The IRAP system of helping industry is one of the most satisfactory methods of Government incentive or industrial research in operation today. We know that it is administered by capable people drawing not only on the 839 professionals that you can find in the National Research Council, but far more than that through their numerous advisory committees and their associate committees. I am a very proud member of the National Research Council, among other things. I know that it can draw on another task force of about 600 top scientists in the country who have great experience in establishing priorities and in carefully selecting and planning these medium sized projects. All of this expertise could be brought to bear tomorrow, if necessary, without any necessity of establishing a super body such as that which has been under discussion for a long time.

I would suggest to you, gentlemen, that it would have the added merit of providing us in Canada with the experience of handling a project of some magnitude prior to the vastly more intricate problem of handling very much larger projects of the nature of transportation, urban development, and all the major national projects recommended by the Science Council.

The Chairman: But is your proposal to the effect that the National Research Council should become the centralized agency to coordinate research within the federal Government?

Dr. Gauvin: That is a very insidious question, Mr. Chairman.

The Chairman: I thought that this was your proposal. I was not trying to be insidious at all.

Dr. Gauvin: I would recommend that this body at least consider the possibility for the administration of those medium sized programs. I am not referring to those far more complex and complicated programs which require resources infinitely larger. I am referring to those medium sized programs which are still beyond the capability of a single firm, and sometimes a single industry. This is where I believe the real need is—at least in our industry.

Senator Grosart: Did you cost that suggestion?

Dr. Gauvin: Yes, sir.

Senator Grosart: I think you were going to give us a figure?

Dr. Gauvin: The figure is around $5 million. I have a break-down, but like all research projects it is based on intangibles. It is the best we can do in the light of experience.

Senator Grosart: I am speaking from memory, but I think the total expenditures by IRDIA in 1968 were $23 million. So, to IRDIA this is not going to be medium sized. It is going to cost almost a quarter of its budget. Now, IRDIA has to go to the Treasury Board to get that money. How do we get around that? I am not in favour of Treasury Board's making the decisions, but I am looking for a way to get the political decision made with the maximum of in-put of advice of the science community.

Dr. Gauvin: But, Mr. Chairman, may I remind Senator Grosart that IRAP was awarded $7 million this year by Treasury Board. This, of course, is a relatively small amount of money compared to what we have been discussing, but I submit it is very effective support to the industry.

The Chairman: But you do not consider the programs administered by the Department of

Industry, Trade and Commerce to be as good as the one administered by NRC?

Dr. Gauvin: No, sir.

The Chairman: I think Mr. Armstrong wanted to make a comment on this.

Mr. Armstrong: I think Dr. Gauvin has made the main point, that while the members of the Treasury Board make the global allocation, they do not presume to make the scientific judgment on the substance of the research.

Senator Grosart: As a matter of fact they do. You simply cannot get away from the fact that they do. The secretariat of the Treasury Board goes down every item according to the evidence we have had here.

Mr. Armstrong: I can only say, sir, that in my several years of administering federal research grants I must have been extraordinarily lucky, because they were prepared to say "Yes" or "No", but not to second guess the judgment that the Government has got, as Dr. Gauvin has said, from its own experts.

Senator Grosart: I agree with you. All I am saying is that the vital decision is "Yes" or "No". This is as scientific a decision as it can be. The decision not to give money to ING was a science decision, and it is part of the problem of national science policy.

Mr. Armstrong: I quite agree. What we suggest in our brief, to which you were kind enough to refer, is that this judgment in our field of urban affairs necessarily has to be delegated somewhat outside the federal Government, the kind of judgment on which the ultimate "Yes" or "No" depends; it must be delegated outside so that it will involve other governments, and if you like private industry as co-subscribers to the major program, so that it will enlist the judgment of enormous numbers of volunteers who are willing to give judgment but get nowhere near the Treasury Board.

Senator Grosart: I am not arguing against this. All I say is that this is exactly what you have now. You may not, as one institution outside of government, be getting what you want, but there are many similar institutions that are getting money, so you are describing a situation that exists, and we are told over and over again it is not satisfactory. The OECD says it is not right, so everybody keeps coming back and saying, "We should have this", and I sit here and say, "That is exactly what we have." What is wrong with it? We know it is wrong, but what is wrong? What do we substitute for it?

Mr. Armstrong: I think that if there were a much more complete sharing of information among these delegated judgment-bodies the system would work very much better. That is one of the reasons why there is a considerable emphasis in our brief on information services. Nobody wants to duplicate other people's work; nobody wants to commit oversights. This happens in both directions for the lack of this kind of information service in most of the sciences, and certainly in our field.

Senator Grosart: Information is only one part of the problem. When you have the exchange of information you still must have the assessment of the comparative values of different pieces of information, which brings us back to where we were. I see Dr. McTaggart-Cowan smiling. He and I have been through this before, and I think will be again soon.

Professor Lloyd: If I might speak as an academic rather than as Chairman of the Board of Governors of the Arctic Institute, I am a geographer, and as such find myself involved as a social scientist and a natural scientist in this problem of fund raising for research. It has generally been true that the natural scientists are reasonably well financed—as I am sure you have heard before—but that the social scientists are less so, and perhaps inadequately so.

Senator Grosart: Except that we do not hear that from the natural scientists.

Professor Lloyd: No. You hear too many natural scientists perhaps. The other point is that when you come to an area like the Arctic, which has no senators, sir, and has very little influence on the world, it is at the end of the list in picking up research money.

About 15 years ago the Carnegie Corporation of New York with American money, through its Commonwealth funds, gave a grant jointly to the Arctic Institute and McGill, which was, as far as we could judge at the time, almost an ideal way of guaranteeing the production of good young scientists who might work in Government, industry and universities in the future. They simply turned out a certain number, perhaps 15, fellowships here, maintaining the young men and women in the winter and giving them a grant for the summer. They did this for 10 years and having demonstrated the process, assumed that some Canadians would pick it up. It worked admirably and there must be three or four dozen in Canada who have gone through that system. We have never succeeded, either through the Arctic Institute or anywhere else, in getting that kind of a very simple setup. We do it for students from Borneo, Africa and Latin America. They are well financed and do a good job, but they go home. We have never done it in Canada for corresponding young Canadians who wish to go north and do research.

There was an attempt made in connection with the Centennial. As many of us remember, there was a profit after the 1851 British Exhibition and in those days some of the surplus was put aside and many generations of British institutions received fellowships from them. Some of us approached the federal Government and suggested that as the Northwest Territories have not had anything yet to celebrate in the way of culture for the last 100 years we might guarantee they would have something to celebrate 100 years hence if some money was spent on research. We, therefore, asked the Government to set aside $2 million or $3 million as a capital fund, the interest of which each year would be available for this kind of fellowship, based on the Carnegie and the 1851 pattern.

We worked very hard for a year and sought everyone we could, but finally it ended up upon a desk and never, in fact, got to the Cabinet. The whole thing died.

The Chairman: Your mistake was that you did not come to see me.

Senator Grosart: This is exactly it, Mr. Chairman. This is illustrating my point, because if I understand what happened, you went around knocking on political doors.

Professor Lloyd: No, sir, we received a good deal of advice on this. I am a political neophyte. We realized that there were two levels to approach, the professional and administrative level.

I am sorry Senator Lamontagne did not, in fact, get it on his desk. It was very near to your desk several times. The problem is that there is not financing for good university students who need to be trained in many of the research fields for which there is a need in northern Canada.

Senator Grosart: This seems to support the suggestion that there should be, somewhere in the mechanism, some group representative of the science community so that if you were turned down by such a body at least you would know it was your fellow scientists who said that you should not have the $2 million or $3 million instead of having to tell us that you did not have any success at the Public Service level or the political level.

The Chairman: Perhaps it was Mr. John Fisher who said no.

Professor Lloyd: No, it went further than that. It was on one of your colleague's desks.

Senator Haig: You had better quit while you are ahead, senator.

The Chairman: I should like to ask perhaps a final question. It is getting late. I think it is a question that is related to all three groups here. Do you feel at the moment that we are doing enough research in the field of transportation in Canada? This is, of course, more of direct interest to you.

Professor Lloyd: Brigadier Love might want to follow me on this. About five years ago the Arctic Institute, along with its friends in the Government, concluded that a very large proportion of the money spent on research in northern Canada was spent on transportation. The second problem was that any development in northern Canada ultimately depends on research. When a particular Government agency has been asked to report on it, it either says, "Fly everywhere, go everywhere by icebreaker or use snowmobiles", depending on the agency of the Government you speak to.

We were urged to attempt to set up, outside government, with government encouragement, a research project. Brigadier Love took charge of this. He contacted Canadian industry, hoping to work without public funding on this, so as to be entirely free of prejudices. He succeeded in raising, I think, $80,000 for an independent study on research on transportation.

We needed several hundred thousand dollars. We used up the private industry money. We stopped. We failed to get the balance of the money from the Government, although I think we went through the right channels.

Brigadier H. W. Love, Executive Director, Arctic Institute of North America: I think that covers the facts as well as they need to be covered now.

The Chairman: What about your reaction? You are interested in transportation, even in the north?

Mr. Horn: Yes. As a matter of fact, in our recommendation No. 3 we successfully tore ourselves away from our temptation to say that the mineral industry should have top priority, and we said that, from the point of view of our industry, we believed that the major problem facing it—this was supporting the Science Council—that the emphasis should be put on transportation.

From our point of view, transportation means a great deal more than long haul transportation into the north, but it means that very strongly indeed.

We have very important and critical problems of transportation, even within a mine property. In the future, as ore grades are likely to become lower and as depths become greater we will have tremendous problems within the mine itself. But the answer is yes, that that is our first choice of major problems.

The Chairman: You know, of course, that very little money has been devoted to this field of research up to now, and again we have quite a diversity of agencies concerned with research in transportation, each doing a little bit here and there. Would you tend to favour a proposal which is being made in certain quarters now, that we should have a kind of national research institute on transportation?

Mr. Horn: As a quick first thought, it sounds very good to me, from the one viewpoint, that is, the viewpoint of long distance transportation. As I say, to us and more and more in the future, the development of a mine may well depend on the kind of transportation measures, which I question would fit into your own possible concept of this.

The Chairman: That is not my concept, but this is a concept which has been put forward, in the north and west particularly, by other people.

Mr. Bonus: Very often, the determination as to whether an ore body will become a mine will depend entirely on transport, how to bring the product to the market.

Mr. McTaggart-Cowan: The Science Council has commenced its study on transportation as a major program. To reinforce what Senator Grosart has brought out (a) it lacks a focus and (b) the troubles of the Arctic Institute are just an example that what is in existence is highly segmented and therefore there are no true centres of excellence.

Senator Grosart: Is the opposite of segmentation, centralization?

Mr. McTaggart-Cowan: Not necessarily. That is one way of preventing segmentation, but the other thing is what is called mountain building, which means building more than one mountain, each one being a centre of excellence. Maybe we need a range of mountains rather than Mount Everest itself.

The other thing is that it is, as Dr. Horn has brought out, a very diverse field in that you run the full gamut from the actual mode of transportation within the mining property itself, the interconnection between that property and your national systems and then, when you get into your urban environment, you get into a completely new ball park that is as much a part of urban development as anything else.

This major program study is just getting underway. Also, the investigation of urban development as a possible major program is going forward. The urban transportation problems are part of our urban development committee and all other forms of transportation are in the transportation study, because, according to the best advice we could get, the interfacing of those was best done where the urban transportation system meets the long haul and specialized systems.

We have lots of examples of transportation systems that have been built without studying the problem of transportation. The railway line up to Churchill is a good example. If it had been intentionally designed to miss the major ore bodies, a better job could hardly have been done.

Mr. Armstrong: Mr. Chairman, I cannot answer the question whether enough is being spent on transport research. I can give facts to the committee to judge whether it is the right proportion. In the case of our own program, 20 per cent of our outlay is, broadly speaking, on urban transportation. In terms of public research funds as a whole, it would seem to be 27 or 28 per cent.

From our point of view, this is an area where at least a good deal of the vehicle technology, except in cold climates, can be imported. The area we think particularly neglected in urban transportation is what we might call the side effects, community impact of transportation development. Highway engineers do find that there tends to be an oversight in respect of the people along side and the noise and other associated problems which are not directly the concern of the highway authorities, and that is where we would like to put our emphasis.

Senator Grosart, it seems to me that, in research programming, the opposite of segmentation may be collusion.

Senator Grosart: Collusion sounds a little like back door politics.

Mr. McTaggart-Cowan: Mr. Chairman, another specialized arm of research in transportation is in the region of perma-frost up in the Arctic. Other witnesses may have mentioned the example of the tractor trains which for years have been the standard way of moving goods in the winter in the middle north without really hurting the environment. However, they misguidedly ran a tractor train up over the perma-frost in Alaska and that did disturb the environment. They now have a gulley that is presently 16 feet deep, and it won't stop there. It is an irreversible damage to the environment.

Another example is when they were putting in seismic lines in the perma-frost, they got a bulldozer blade and stripped the cover off the perma-frost, to put down their seismic instruments and the result is that now they have formed a chain of lakes up there. This again is irreversable and it is a problem which has to be tackled as a matter of urgency as one which is changing the whole environment. The problem is transferring the technology from the lower part of the middle north up to the arctic coast and it does real damage.

Professor Lloyd: This is not a matter of lack of scientific knowledge. Canada is probably the leader in basic research on perma-frost in the world, if not the Soviet Union. We have been trying to get this information to the bulldozer operator or at least to his boss.

Senator Grosart: It has been suggested to us that there is a feeling that we are a long way behind Russia in our research and development of the north and it has been rather vehemently denied.

Senator Yuzyk: I have a quotation here from Mr. R. A. J. Phillips, of the Privy Council Office, who stated that the Russians already know more about our side of the arctic than we do, and that we are behind the Russians in work on arctic sea lanes. How much do we know about what the Russians know? I am referring now to the Ottawa *Journal* of November 28, 1968. He also stated that if Canadians are not willing to pay taxes they may see the arctic taken over by the Russians and the Americans.

Professor Lloyd: I think we have two separate questions here. Mr. Phillips has been in the Soviet Union and he was in External Affairs a long time ago. I have tried to go to the Russian arctic. I was in Russia six times and each time I thought I was going to the arctic and the last time I got as far as Murmansk which is just the beginning.

I think it is true that 20 years ago the Soviet Union led us both in the science and the application of science to the far north. But we have to remember that all Russians live much farther north than we do. Leningrad is up where Churchill is, or somewhere in that region. Secondly we must remember that they have been at it for a very long time.

The Chairman: And I am prepared to leave it to them in each case.

Professor Lloyd: The first crossing of Canada took place in 1789 and they did the equivalent crossing of Siberia in 1648.

Senator Grosart: The American made their crossing after us, and they have done all right.

Professor Lloyd: Another point to remember is that the Soviet Union had a determination to explore all parts of the north including the Arctic and they did it very systematically. However, from my point of view, the Russians in the Arctic do not do any better than they do in the south. They do not build any better towns and they do not use any better equipment up there. I have seen it in the south, and I am not terribly impressed with it. I do not think we have anything to learn on the applied side. They of course spend enormous sums of money and the Government has scientists working in the north over 20, 30 or 40 years. It has spread over several generations, while Dr. Löken is the third generation of Canadian glaceologists. We have something to learn from them about national policy and we have a good deal to learn about individual scientific effort but that does not indicate that we have anything to learn about the technology involved. Miss Dunbar, who is here, and who speaks Russian, may like to add a word on this.

Miss Moira Dunbar, Governor, Arctic Institute of North America: If they have done more for the Russian north, as Dr. McTaggart-Cowan points out, the reason is that they have made a systematic policy of doing this for a variety of reasons, not all of which would apply here, and you must also remember that their north is very different from our north. People talk gaily about the Arctic, but as a matter of fact the Russian north except for some islands off the coast where there is no development and a very small strip along the coast, is bush and so they have acceptable forests up to the north coast. This makes a tremendous amount of difference in many aspects of the country and serves to make it inhabitable. But, in fact, when they talk about Russian cities in the arctic I think there is only one that is north of the treeline and that is Norilsk which is only just north. A quotation was mentioned about the northern sea route being developed, and this is true that it has been developed far more than our north. But they wanted to do this. They had reasons to use it. They wanted to export their timber down the Siberian rivers. They also had other reasons for wanting to develop it, and so they did. Apart from that, they have a slightly easier problem than ours because in our case it is all cluttered up with islands and the narrows are worse and the ice is worse.

Senator Yuzyk: And there is no problem where they are concerned because they can use forced labour.

Professor Lloyd: I think what Mr. Phillips had in mind when he spoke about the Russians knowing more about our arctic than we do is something about 15 years old. During the exploration of the polar continental shelf the Soviet Union working from its own side of the arctic on the ice was taking soundings well beyond the north pole and in fact in 1957 the Soviet Union had made landings on the ice in the arctic basin and they got within 100 kilometres of Canada. They knew where the continental shelf was and we did not. The following year the continental shelf study was set up and has worked very hard ever since. I would say the extent to which it is financed determines the extent to which we stay ahead of the Russians in the polar basin.

Senator Grosart: Would that be described as research?

Professor Lloyd: 100 per cent. Dr. Fred Rootes who was to have been on our delegation this evening has gone north again.

Senator Yuzyk: I have one more question which stems from a quotation an I think it is appropriate since Dr. Ian McTaggart-Cowan is quoted here at the 19th Alaskan Science Conference. I am taking it from the Ottawa *Citizen* of August 31, 1968. The quote is as follows:

> The Canadian Arctic could be a major source of food for a hungry world.

This is a part of my vision of the Canadian north. Would you care to comment?

The Chairman: Is that a new one?

Senator Yuzyk: I think it is a part of our vision. Would you care to comment on the wealth of the untapped resources of the north?

Dr. McTaggart-Cowan: Yes. I think I can add to that that, apart from the clearly identified resources that Dr. Horn and his colleagues could speak on, and the petroleum that we know is being explored, there are several other avenues. The protein, the food value is there. The regenerative period is longer than farther south, but it is exploitable if the need is there. The cost per pound right now would not make it competitive.

Another area my brother has touched on—and I am not sure whether it was in that article or another one—is that we should be very much aware of the potential of the whole Arctic area, the middle north and the high north, for recreation. We know that the megalopili are going to continue to develop and that people, to retain their sanity, are seeking wilderness vacations in the north. The mobility of the tourist is increasing, and I think we have a tremendous resource there in recreation, but it has to be husbanded very carefully because fishing now in the rivers by tourists is fairly far north. You can fish out a northern river quicker than a southern one, because it takes longer for the fish to mature, and so the fishing has to be very carefully controlled. However, I do not think any of us have any idea how great the recreational potential is.

The Chairman: Would you want to revive the Dawson Festival?

Dr. McTaggart-Cowan: I think we can do all kinds of imaginative things. I think we have to have a closer look, but I am sure the potential is there. However, we have to time it so that we spend our money progressively, at the right time, but the controls and limitations on the bags, when going in for hunting and fishing, have to be carefully understood and a lot of basic knowledge established. It is a matter of transferring that in terms of conditions one would spell out, and we can do a complete circle and come back to transportation. If we want to develop it, we have to develop the kinds of transportation that makes tourism attractive.

The Chairman: I think we will adjourn now. We have been sitting since 10 o'clock this morning, and we will be back tomorrow morning at 10 o'clock. I am sure we still have all kinds of questions to ask, but I hope that when this committee becomes a permanent or standing committee we will have the pleasure of inviting you to come before us again for a longer discussion.

Thank you very much indeed for being with us tonight.

The committee adjourned.

APPENDIX 136

BRIEF SUBMITTED TO

THE SENATE SPECIAL COMMITTEE ON

SCIENCE POLICY

BY

THE ARCTIC INSTITUTE OF NORTH AMERICA

ARCTIC INSTITUTE OF NORTH AMERICA

Brief to the Senate Special Committee
on Science Policy

SUMMARY

Conclusions

1. The Arctic Institute considers that, despite the pressing nature of many of the problems of the cities of regional disparity in the populated parts of Canada and other economic and social demands upon scientific and technological resources, it is most important that Canada devote a sufficient share of these resources to the North on a continuing basis. Only through thorough knowledge will the full potential of the North be realized for the benefit of this country.

2. It is further concluded that the private, non profit independent research organization fills an essential role in northern research, complementing government, industry and university research activity.

Recommendations

3. It is recommended that Canadian Science Policy include the realization of the full social and economic potential of the North as a National Goal. In this context, the North includes the Arctic and the "Middle North" and this encompasses large segments of each of seven provinces as well as the Yukon and the Northwest Territories.

4. To implement this recommendation requires first the statement itself in national science policy, followed by the provision of enhanced support for Research and Development in all of the physical, biological and social sciences relating to the North, including enhanced support for the training of northern specialists, particularly in social sciences and economics.

5. It is recommended that the Government of Canada recognize the important role of private, non profit research institutions and provide operating grants to sustain their growth at a rate commensurate with their role in the total spectrum of research.

6. To implement this recommendation, and the support of northern research proposed in the first recommendation (para 3 above) requires that the

merit of northern research be assessed against other demands upon scientific resources. This cannot be done on the basis of the numbers of people involved nor, in many cases, can it be done on the basis of prospective economic return in the near or mid-term. It must then be assessed as an investment in Canada's longer term future.

7. Until or unless the Federal Government sets up other more appropriate machinery, it would seem that the Advisory Committee on Northern Development is the best existing body to study the level of funding of Research and Development for the North and the funding of private organizations involved in northern studies. An overview taken by that Committee could then be made known to granting agencies in the form of recommendations. When discussing this subject the ACND might ask experts from other sources to sit with them. Since north⁻n development does involve many provinces as well as the Territories, and since objective widely based scientific advice will be increasingly important, consideration might be given to representation from the provinces concerned and from industry, universities and other private agencies.

ARCTIC INSTITUTE OF NORTH AMERICA

Brief to the Senate Special Committee
on Science Policy

Introduction

8. This paper sets forth the views of the Arctic Institute of North America which bear upon the study of science policy for Canada as set forth in the Order of Reference of the Special Committee of the Senate of Canada on Science Policy.

9. The Arctic Institute is a private, non-profit research organization incorporated in Canada by Act of Parliament in 1945 with the following purposes:

a) To initiate, encourage, support and advance by financial grants or otherwise the objective study of arctic conditions and problems, including such as pertain to the natural sciences, sciences generally and communication;

b) To collect, arrange and preserve records and material relating to the arctic regions, and especially to such areas thereof as form part of or are contiguous to the Continent of North America;

c) To make such records and material available for pure and applied scientific use by properly qualified individuals and organizations, including governmental agencies;

d) To arrange for or to assist in the publication of reports, maps, charts and other documentary material relating to the arctic regions;

e) To establish and maintain close contact with other Arctic Institutes and organizations engaged in similar or related fields of study.

10. In the interpretation of its purposes the Institute has established that the term "arctic" includes alpine and antarctic and other areas with similar cold weather conditions, and that the terms "natural sciences, sciences generally and communication" include scientific, social, economic, administrative and educational matters.

11. The Institute was also incorporated in 1945 in the United States, now in Washington, D.C., the incorporation there being precisely similar to the Canadian Act of Parliament except for the necessary legal changes. The Institute Head Office is in Montreal and it has a branch office in

Washington, D.C. It is controlled by a single Board of Governors, roughly one-half Canadian and one-half American, and a group of committees of the Board, also roughly equally divided between the two countries. It has a small permanent staff which is largely administrative, editorial and library personnel, while the Institute's scientific capacity lies in its Fellows, who number about 250, and its Associates, who number about 1,700. The great majority of Fellows are of doctorate academic status, and all are elected by the Board for distinguished contributions to northern science and development. The Associates include a wide range of academic backgrounds. The Fellows and Associates are found chiefly in universities, government agencies and industry throughout North America, but also include about 40 Overseas Fellows and 100 Overseas Associates. This group provided the Institute with the best possible expertise on northern scientific and technical matters, to scrutinize its research, publications and library programs, and to work on the Institute's projects.

12. Appendix A is a detailed coverage of the history, organization and activities of the Institute.

The Relevance of Northern Research in Canada

13. The immediate compelling problems of today in industrialized countries are largely those of poverty, regional disparity, urban congestion - with the consequent housing, transportation, pollution and related matters - and the social aspects of the adaptation of society to rapid technological change. In Canada also there is concern to achieve the right balance of research and development in industry in order to maintain and enhance Canada's competitive position in domestic and in world markets. Such matters affect directly most of the population of Canada. The risks of failure to deal adequately with them is becoming clear and they rightly will be accorded a major share of Canada's scientific and technological resources.

14. Yet there are vast land areas to the north which so far are almost untouched by such problems and which will be important in Canada's future. One of the aims of this brief is to show that there is a great potential opportunity for Canadians, for economic and social development of

the North which merits an appropriate share of research and development effort.

The Potential of the North

15. North of the area of population concentration and relatively intense development are large segments of each of seven provinces (excluding only the Maritimes) and the whole of the two territories into which industrial activity, mainly non-renewable resource development, is penetrating at an increasing pace and to the benefit of Canada as a whole. Much of this area is habitable permanent, happy communities exist the mining regions of Val d'Or, Rouyn, Kirkland Lake, and Timmins are examples, as are Yellowknife, N.W.T. and Whitehorse, Yukon further north and west. Other regions are less hospitable there are large areas of muskeg bog and, north of the treeline, the tundra of the true Arctic. Yet all these regions, both the habitable parts and the inhospitable, are known to contain large mineral resources. They are capable of significant animal husbandry which might be exploited if a world food crisis necessitated use of all possible food sources; their inland waters and the adjacent seas have a substantial food potential and their forests are vast but, as with marine production, very slow growing. Agricultural potential is limited by lack of good soil and probably is useful only as a supplement to imported vegetable products in restricted local areas.

16. In all, the North accounts for nearly three quarters of the land area of Canada but now contains only a negligible population. Will it ever contain a large population or will it remain an empty region with its chief importance the exploitation of non-renewable resources carried out at isolated sites where for a time a community appears and disappears again when the resource has been exhausted? This is an imponderable question at present. There are second generation northerners who remain in the North because they find it a good place to live and they believe in its future. There are others who live there because of an employment opportunity and leave for the South when a better opportunity arises. There are those who say that living in Whitehorse or Yellowknife is no more rigorous than in Quebec City, Winnipeg or Edmonton, and who look forward to a day when their community will be large enough to support the sophisticated amenities

of the big city even though, so far, their economic base depends directly or indirectly on resource industries, and is therefore very vulnerable.

17. The problems most directly related to the development of northern Canada are those of human geography. Studies in many other fields of knowledge contribute to these, but it should be the geographer who distils the findings of the physical scientist, the biologist, the engineer, the economist and the sociologist and asks the questions: Can northern Canada support more people? Where, how, and what kind of people? Should we expect them to be permanent, semi-permanent, or transient? Can they expect to bring their old values and amenities with them, or is this concept doomed to frustration and failure and must we learn and accept new standards for the North? The federal and provincial governments are engaged on much needed land use surveys, resources analyses, and settlement evaluations, but it is the rightful place of the university scientist to use the results of such surveys to investigate the delicate question of whether persons from over-populated parts of the world could live in the Canadian North in significant numbers, or to compare the success or failure of Canada's attempts to develop her North with those of other countries, such as Scandinavia or Siberia, who have similar problems. The likely degree of self-sufficiency of particular northern settlements, and the transportation and economic arrangements that will have to evolve to eliminate the inadequacies, need to be investigated. The analysis of the pattern of frontier settlement, which as applied to northern Canada is no longer advancing along a "front" ahead of more or less continuous occupation but is springing up, sometimes ephemerally, from widely scattered oases, should bring out important differences between the present facts of northern development and our traditional ideas of pioneer life and the opening of a new land. These differences should be made known to and be heeded by the planners, the administrators, the school boards and the policy makers, who in turn can apply the results of independent northern research to the benefit of all Canadians.

The Main Responsibility for Northern Research

18. In the face of forecasts of a very large population increase

in Canada within the next century, at the very least Canada should keep open the option to absorb large numbers of people in the habitable parts of the North. This involves continuous study of the environment, the means of creating fully acceptable northern communities, the potential of new more efficient and economical transportation, the usefulness of animal plant and marine productivity in the world wide food situation, the human and physiological aspects of northern living, and many other subjects.

19. This must be largely the responsibility of government. Industry can be counted upon and has demonstrated its willingness to provide decent living conditions for its employees in the communities it creates at its mining sites. But to create self-perpetuating centres of populations, to urbanize and industrialize the North, goes far beyond the reasonable role of industry. If the North is to be populated in future it must be demonstrated that many parts of the North are indeed desirable places to establish secondary industry so that employment opportunities exist, to find unique recreational opportunities, to live and to raise and educate a family. The starting point is research - basic research so that the natural, biological and social background is understood and mission oriented research, so that all available knowledge is applied to the specific problems of northern development. The final answer will not be found until much more study has been accomplished.

20. There are two other major aspects both of which primarily require government support of research. Some authorities regard the North as a region which should be retained as a wilderness preserve from which significant population and industrial activity should be excluded. The need for the conservation of wildlife species, of natural beauty spots and of botanical regions unmarred by pollution and by physical disfigurement is unquestioned. On the other hand the need to utilize the resources of the North is already apparent and it has been suggested that the potential of the North for the absorption of major population should be protected for the future.

21. The Arctic Institute believes that the retention of wilderness preserves, of recreational and tourist quality and of suitable areas for

the study of nature are not incompatible with planned use of resources and the introduction of substantial population. The mistakes of the past, typified by destructive and wasteful exploitation of resources, lack of pollution controls, and overcrowding of urban areas in the South can be avoided in new developments in the North. The biologist and the industrialist can be brought together to achieve both preservation and wise use of resources. Again, thorough knowledge of the region, through research, will provide the means and this too is the responsibility of government.

22. Finally there is the national responsibility for the native Indians and Eskimos. These people are few in number, but they pose Canada with the challenge of providing them with opportunities to enjoy the full life available to all Canadians, without taking from them many useful traits in their original culture which they desire to retain, just as other ethnic groups retain the more valuable features of their earlier societies. The Indians and Eskimos have much to offer their fellow-Canadians in terms of adaptation to northern conditions. Given the education and training available to those other Canadians, they can become, as the Eskimos of Greenland have become, the North's skilled labourers, its efficient technicians, and its capable administrators. Along with the few whites already accustomed to northern living, they can provide the nucleus of a stable population.

The Role of a Private Research Institution

23. There are four principal sources of research effort in Canada. Government, industry, the universities and finally the private institution not directly associated with an industry or a university. The Arctic Institute is in the latter category. It has operated with success for some twenty-four years and has been responsible in large measure for creating Canadian competence in cold climate research. (Appendix A).

24. Private, non-profit research organizations provide uniquely a means of thinking out and organizing research on interdisciplinary matters which normally is difficult in universities because of departmental organization along disciplinary lines. They provide a truly national background for research projects which also is difficult as universities

in Canada, regrettably but inevitably, become more regionally oriented because of the predominance of provincial financing. Private organizations also provide to government a means of conducting research on a truly objective basis, unfettered by the existing policies and practices of government and, in some types of work, at considerably lower cost than the government could achieve if it did the job itself.

25. As examples, the Institute operates annually two summer research stations which provide logistic support, scientific equipment and general scientific guidance and coordination to a wide variety of research projects. At the larger station in the Yukon Territory some Institute-inspired programs are conducted under direct control of the Project Scientists, while others are initiated in the universities and are conducted under detailed supervision of senior university scientists with only general coordination by the Institute. At the smaller station on Devon Island in the Arctic Archipelago, all project work is now initiated and supervised by the universities. The Institute provides the logistic support. Each station involves a minimum of capital investment as accommodation and feeding are on an outdoor, field camp basis. The major costs are in transportation to and from the station and for local transportation to research sites in the vicinity of each base camp. Scientific quality is ensured for the Institute by careful screening of applications prior to acceptance by the Institute's Research Committee and general surveillance of the work by the special Project Committees concerned. Both these stations attract considerable scientific interest and their continuance for several years appears justified by the research opportunities present in their vicinities. However, because of their temporary nature, they can be closed down and moved at small cost when their useful life comes to an end.

26. On the other hand private organizations are not in a position to organize very large operations such as the permanent Meteorological Stations in the Archipelago. This needs massive resources which only government can command. The value of the Arctic Institute in this regard is its local environmental knowledge and logistical capability which make it possible to conduct relatively small operations at minimum cost, and to remain flexible so that when the main thrust of research interest is exhausted, it can

withdraw without abandoning any large capital investment. A university is not organized to provide this sort of support and could do so only at the expense of actual research work which would otherwise be carried on by its trained personnel.

27. Through its wide contacts (Appendix A) the Arctic Institute has a truly unique ability to bring universities research workers together into multi-disciplinary teams, which at best one university could do only very slowly, and governments could do only at great cost. It is able to call upon the top specialists available for any specific problem not only within Canada, but where appropriate from United States, Scandinavia and other countries including the Soviet Union at times, to confer without political or national restrair

28. The international character of the Arctic Institute is a great advantage to Canada. When appropriate it can operate as a purely Canadian entity. When it is useful, as is normally the case in scientific matters, it can operate on an international scale and bring to bear on Canadian problems world-wide experience. Canada has no monopoly on scientific talent and money and has already benefited from AINA contacts outside her boundaries (Appendix A). This also enables AINA to organize international conferences on northern problems with attendance from many disciplines and many nations and to run them at minimum expense and minimum involvement with political hurdles.

The Financial Position of Private Institutions

29. The principal sources of private financing for non-profit organizations are industry and foundations. In the present milieu, educational and charitable institutions receive the majority of such private donations. These causes have the main appeal, together with such problems as urban crowding, pollution and youth programs as they have a direct visible impact on large numbers of people. Institutions such as AINA have always been significantly dependent upon government, and as more and more demands are made upon corporations and foundations for funds for the immediate and directly apparent causes, their dependence increases.

30. If the need for northern research is accepted, governments must then accept a major role in its financing. If the role of the private institution is accepted as a valuable and indeed an essential complement to government, industrial and university research, then the government must recognize its importance and provide operating grants to keep them going.

31. As the principal private non-profit research organization interested in the North, the Arctic Institute has already achieved much in the furtherance of northern knowledge and in the development of mature scientific specialists. As actual development moves rapidly northward, however, it is not sufficient to carry on at the present level of activity. Every agency with any degree of experience in arctic operations is flooded with demands for advice and assistance today as a result of only the very spectacular petroleum finds in Alaska.

32. Also coincident with the spread of development is the threat of irreparable damage to portions of the environment through pollution and through unthinking and ill-advised movement through and construction on muskeg and permafrost areas. And, as Canadians move northward for short or long term residence in the North, the need to improve living conditions becomes more pressing and the contrast between the standards demanded by southerners and those at present possible for the native people of the North becomes more clear.

33. As noted in Appendix A, the Arctic Institute now has very little permanent scientific talent on its staff. Its method of operation, relying on voluntary control and advisory groups for policy and for scientific guidance has been satisfactory until recently. For actual project work it has been able to attract good scientists for short term employment, chiefly during the summer field season. This system is already proving deficient as longer term, more complex programs are planned, such as a proposed major transportation study and the programs of continuing study of northern communities and of native education upon which AINA is now embarked.

34. One course that is being considered to permit this Institute to measure up to the demands of the future is the acquisition of a staff

scientific group. It is not desirable to bring scientists permanently on to the staff, however, except perhaps in a few special cases. Scientists would be able to avoid loss of career opportunities and contact with their disciplines and would remain up to date, if they were seconded from universities or other agencies to AINA for periods not exceeding two years during which they would work on the conception, planning and scientific coordination of Institute major programs. These will be of an inter- or multi-disciplinary nature and the ideal appears to be a group of five or six, representing a mix of the key disciplines in the physical, biological and social sciences.

35. Such a team would be able to plan and implement programs covering the very wide range of disciplines and subjects with which this Institute is required to deal. It would maintain the Institute's high standards, and individuals in the group would be chosen for their abilities, their desire for a period away from personal research and yet be able to return to their parent institutions after such an interval, to resume active research, and teaching if appropriate.

36. It is by some such expansion that this Institute plans to enlarge its programs to meet the needs of northern research and development in the future. Obviously this would require enhanced financial support.

37. This brief has dealt largely with the Arctic Institute of North America rather than more generally with the problems of private, non-profit organizations because it is the only institution in Canada devoted entirely to northern research and development, which is not supported either by a university or by industry. Its problems therefore are unique and its value to Canada is unique.

Examples of Northern Research Requirements

38. Appendix B sets forth briefly some of the main problems now foreseen and requiring study in the interests of northern development.

The Arctic Institute Brief

39. This Institute desires to present its brief at a public hearing, to the Senate Special Committee. Institute personnel who will appear are:

Dr. Trevor Lloyd - Chairman, Board of Governors, AINA

Dr. P.D. McTaggart-Cowan - Governor, AINA

Brig. H. W. Love - Executive Director, AINA

40. Depending on availability at the time of the hearing, the following will also appear in order to assist in discussion of the Institute Brief:

Dr. M. J. Dunbar - Governor, AINA

Miss Moira Dunbar - Governor, AINA

Dr. Diamond Jenness - Fellow, AINA

Dr. Olav Løken - Fellow, AINA

Dr. Svenn Orvig - Governor, AINA

Dr. E. F. Roots - Governor, AINA

Curriculum vitae for these are contained in Appendix C.

Appendix A

ARCTIC INSTITUTE OF NORTH AMERICA

Brief to the Senate Special Committee on Science Policy

The History, Organization and Activities of The Arctic Institute of North America

Origins

1. The Institute was founded in 1944 and incorporated in 1945 by Act of Parliament in Canada. It is a Canadian corporation in the full sense of this phrase; it is private and non-profit, and hence classed as "Charitable" for taxation purposes in Canada. The founders numbered thirty-eight in all, of whom eighteen were Canadian, eighteen American, one British and one Danish. Among the Canadians were such notable names as J. Robert Beattie, then Deputy Governor of the Bank of Canada, Dr. Charles Camsell, then Deputy Minister, Department of Mines and Resources and Commissioner N.W.T., Philip A. Chester, then General Manager Hudson's Bay Company, Dr. Raymond Gushue, then Chairman, Fishery Products Committee, International Emergency Food Council, Arnold D.P. Heeney, then Clerk of the Privy Council, Dr. Hugh L. Keenleyside, then Assistant Under- Secretary of State for External Affairs, and Dr. C. J. Mackenzie, then President, National Research Council. It is interesting that with such a weighting of senior government officials, the founders always contemplated a private institution which would have the closest possible relations with other similar organizations both within North America or abroad and whether private or governmental, and yet would be independent.

Control and Management

2. The Institute was also incoporated in the State of New York in 1945; the official document enacting this was precisely similar to the Canadian Act in all but the legal details. The U.S. Corporation was moved to Washington, D.C. in 1967. There is one Board, one group of Officers comprising an Executive of the Board, one set of policy and control committees. The Board meets twice annually as the Canadian corporation, then dissolves and in one simple motion decrees that the deliberations of the Canadian corporation are applicable to the American. In the exercise

of their responsibilities Governors and Committee members act without national identity. However, should a matter of purely Canadian concern arise the Canadian Governors prevail. It is legally possible and is within the policy of the Institute to form a wholly Canadian subsidiary or other unit if a need should arise.

3. The Institute's scientific capability lies in its Governors, Committee members, 250 Fellows, who are elected by the Board, and approximately 1700 Associates. The Board and Standing Committees establish policies and general and specific direction as necessary and Project Committees are appointed to oversee specific important projects of research, publishing, conferences and so on. Members of all of these bodies serve voluntarily without remuneration.

4. The operations of the Institute are carried out by a permanent staff headed by an Executive Director at the Montreal Headquarters Office, with an Office in Washington. The staff is primarily administrative and is about equally divided between Montreal and Washington. The Library, with a full time staff of three, is in Montreal, and most Institute publication work is centered there including the journal Arctic, which has a full time Editor. In Washington there is a particularly heavy accounting load to meet the requirements of U.S. Government contract administration. Both offices use part-time employees in junior positions to meet administrative needs and both have some senior part-time employees. Dr. John C. Reed, formerly Executive Director, is the Institute Senior Scientist working out of the Washington Office. A few other scientific and technical employees who normally are engaged on Institute projects sometimes are carried on office strength. The specialized staff employed to compile the Arctic Bibliography in the Library of Congress, Washington, numbers five full time experts who are considered as Project staff, although they are virtually permanent.

5. The Institute owns its own building in Washington but rents space from McGill University in Montreal. Salaries, office space and office expenditures, travel, legal and audit fees, insurance and other administrative costs amount to approximately $300,000 in the 1968/69

budget. It should be stressed that administrative costs include a substantial amount of staff effort for such activities as committee meetings, conferences, preparing briefs and surveys and handling enquiries, which are an important means of performing the Institute's function as the leading communicator in northern science. This has been held constant or slightly lower than previous years by economies in travel and by accepting staff shortages, despite generally rising costs. Obviously it must rise in future to keep salaries competitive and to meet minimum needs.

Achievements

6. In twenty-four years of active contribution to northern knowledge, the Institute has achieved a great deal:

(a) It has been a significant factor in creating the increasing interest and awareness of Canadians of the potential of the North.

(b) It has awarded some seven hundred grants-in-aid through which several hundreds of researchers have been attracted to and have become knowledgeable about the North. An appreciable portion of Canadian Government and university scientists in disciplines such as physical geography, glaciology and oceanography have at one time held Arctic Institute grants.

(c) It has established a number of substantial research projects that have concentrated research in special regions and provided scientific training to hundreds of participants as well as adding to knowledge. The Institute pioneered arctic glaciology with its Barnes Icecap Expeditions of 1950 and 1953.

(d) It has published the results of many research projects - those of the Institute's grantees and of the Institute's projects as well as those of others - and now publishes annually some 2,500 printed pages.

(e) It has created an outstanding library with an unexcelled collection of regional literature.

(f) It has contributed to education within many universities and through its own courses and programs.

(g) It has acquired an expert staff, experienced in organizing research projects and with the ability and goodwill to enlist the participation of top-ranking scientists and specialists to assist with any polar or northern problem.

The Scope of Institute Work

7. The "Proposal" drawn up by the founders of the Institute in 1944 emphasized that its studies should be coordinated with work already under way to ensure that these studies would be systematically designed to obtain answers to major questions called for by any intelligent and orderly development of the North. These, the Proposal said, would involve three main things: "(a) general research into the natural conditions of the North; (b) studies applied to specific problems of the development of the Arctic and arctic living; and finally, (c) a broad study of the relationships of the arctic regions to the physical, social and economic problems of the world as a whole". The Proposal then went on to outline in considerable detail the general scope of activities within the two distinct aspects involved - pure research and applied studies in both the natural and social sciences, with some special emphasis on the latter.

Government Relations

8. This same original proposal also emphasized the great importance of having the goodwill and cooperation of government, if its work in such fields was to be effective, and the consequent need of close, frank and mutually helpful relations with every type of government agency. Many things have changed since the Proposal was written, but this continuing requirement certainly has not. Canadians are much more aware of the North; the Government of Canada is much more active in the North, in its large geological and topographical surveys, its other scientific

programs and its measures of assistance to industry engaged in resource development. On the social side, for many years it has recognized and actively pursued its major responsibilities for administration and for the well-being of people of the North. This was not the case in 1944. Also much of the necessary preliminary research and gathering of data has now been accomplished, not only by government but with the help of universities and agencies such as this Institute, so that the Arctic is better known. Because of this and because of the development in transportation technology, no part of the Arctic is inaccessible.

9. Despite these and other changes, however, the objectives and scope of the Institute remain valid today, although priorities and emphasis have altered from program to program as knowledge and experience has developed. Certainly there has been no change at all in the need for close collaboration by the Institute with the Government of Canada. This has, in fact, grown steadily with the increase of Government activity. The Institute has endeavoured to stay abreast of thinking in those Departments and agencies concerned with the North - Indian Affairs and Northern Development, Energy, Mines and Resources, Transport, Defence, Agriculture, External Affairs and, of course, the National Research Council, to mention some. This has been done by having amongst its Governors and Committee members, both scientific and administrative officials of the Government, as well as others who are in touch with Government work. The Institute also attempts to keep in personal contact with key individuals, from Ministers of the Crown down, in order to assess against government needs, the type of work it should be doing and to make known to the Government the Institute's potential value. This has been done with considerable success - the existence of goodwill and very substantial understanding and support by Government is apparent. Nevertheless as the activities of government agencies and the numbers of people involved in northern affairs increase, there is increasing difficulty in ensuring that the Institute is considered for all those services which it could perform in furtherance of national objectives in the North.

Relations with Universities

10. As with governments, it is important that the Institute keeps abreast of what is going on in the universities - who is active in northern studies; who is in need of assistance; what research is under way at the moment; what plans are being developed for the future. Further, the Institute must know who has competence in each of the many disciplines concerned with northern studies as the universities are the prime source of experts for work on Institute projects and of reviewers for its publications, its proposals and its research reports. The location of the Institute in Montreal makes liaison with the Governments more difficult but greatly facilitates its university relations because Montreal is a major centre of academic northern work, and is an international city with frequent, broadly based scientific and technical meetings. This location has led to mutually advantageous arrangements - for instance McGill does not duplicate the Institute's library holdings which serve McGill students freely as well as other students in the Montreal area and all Institute Associates and friends. The Institute has growing relations with all the universities in Montreal, as it has for many years with Laval.

11. Again, as with governments, the Institute attempts to develop and maintain its university relations throughout the country by personal contacts and by attracting onto its Board and Committee leaders in northern research in the universities. Also, the Board elects Fellows, who now number about 250, on the recommendation of other Fellows for distinguished contribution to northern science and development. Such an honour carries with it an implied obligation, which is always willingly accepted to serve the Institute. Many Arctic Institute Fellows are in universities, thereby enlarging the Institute's contacts and goodwill.

Industrial Relations

1 . The Institute also maintains contact with those industries which are active in the North. Generally these are the mining, petroleum, transportation and related engineering companies, plus some merchandising and some financial companies. Significant but not major

financial support is derived from such contacts. The Institute is able to offer advice, contract research, library and bibliographic services and general information.

13. Contacts with industry from the Montreal Office are generally to Canadian industry and from the Washington Office largely to industry in the United States. However so many of the major companies with which the Institute is concerned operate in both countries that there is really little distinction possible, and frequently a national distinction is undesirable. Industrial contacts by the two offices is therefore closely coordinated by one staff member under the supervision of the Executive Director.

Relations with United States

14. The Institute maintains in so far as it is possible, similar relationships with U.S. Government agencies including those dealing with the Antarctic, with universities which have northern programs in the U.S. and, of course, with its Fellows and Associates in that country.

15. There is not the same obvious national interest in the North in the United States as that which exists in Canada. Northern and polar research activities are concentrated in a relatively small portion of U.S. universities and in government agencies are pretty well confined to the Defense Departments, the Department of the Interior, for Indian and Eskimo affairs, the Geological Survey and similar activities, the Department of Transportation, the Department of Health, Education and Welfare, largely for Indian and Eslkimo interests, the Department of Commerce to some extent because of economic development problems, and the National Science Foundation. All of these Departments have major interests elsewhere and northern matters are frequently not of large concern. The State of Alaska of course with its many agencies and with the special Federal Government organizations operating there, lies entirely within the region with which the Arctic Institute is concerned. The University of Alaska is of particular interest in this regard.

16. Despite the lack of a major national northern interest, the agencies listed do spend a very large amount of money on northern research

and development studies. The Institute, and through the Institute Canada itself has received a great deal of assistance. The Institute in fact has been able to attract U.S. money to research work carried out in Canada which has had a very beneficial effect. Some notable examples of this are: the wide ranging seismology programs subcontracted through the Institute to a half dozen Canadian universities during the period 1961 to 1968 with over $350,000 in funds provided by the U. S. Air Force; The Middle North Tour in 1967 financed by U.S. foundations, of which many of the participants were from Canadian universities; the annual grants-in-aid program funded by the Office of Naval Research and the U.S. Army, and the Institute's major in-house projects which receive a variety of support from U.S. agencies. A recent illustration of how this works involved five Canadian and U.S. university and government oceanographic groups who wished to rent a submersible vessel to undertake research in Baffin Bay. Because of conflicting government regulations and the shortness of time it was impossible for all the groups to join forces. The Institute was asked to help and successfully negotiated the contract on behalf of all parties. The report of the PISCES operation will appear in the March '69 issue of Arctic.

17. Over the past five years between $200-$300,000 annually of U.S. agency research funds have been spent on Institute projects in Canada - this represents about 20% of an average year's overall expenditures on AINA project activity.

18. Many of these projects, although carried out for logical U.S. purposes have had equal if not greater application to Canadian problems and have served to develop scientific competence in Canadian universities and individuals. There have been occasions when the Institute has acted as a bridge between the two countries over which it has been possible to transmit scientific and technical information, funds for work in Canada which might not otherwise have been carried out and a flow of scientific and technical personnel. It should be pointed out that this has not been in only one direction. Much Canadian scientific talent has, through the Institute, been brought to bear on programs of particular interest to

the United States.

International Relationships

19. The Institute always has one Danish Governor because Greenland is geographically a part of North America and because the Scandinavian countries have had long experience in many of the same problems which face Canada in northern development. Similarly, the Greenlander and the Lapp have much in common with the Eskimo and Indian of North America. There is, therefore, much value in close collaboration. The Institute also is gradually developing working relationships with the Soviet Union. So far this has been particularly successful in library exchange arrangements and in contacts between individual scientists in Canada and the Soviet Union. Perhaps the best expressions of the relationship which is developing were the visit in 1963 of Academician P.A. Shumskiy of the U.S.S.R. Acad my of Science, who did an extended tour of Canada at the Institute's initiation, and more recently the month-long tour of Dr. N. V. Grosswald, of the same Academy, during which he visited, lectured and conducted seminars at thirteen Canadian universities last autumn.

20. The Institute library actually has exchange arrangements with some twenty-seven foreign countries involving a very large number of overseas libraries, including many in the Soviet Union. There has been a suggestion that a branch might be established in Denmark to provide a focus for Scandinavian Associates and Fellows of the Institute. There are about 40 overseas Fellows. The Institute participates whenever cost and circumstances permit in scientific meetings on northern and polar subjects wherever they are held throughout the world, and the Institute whenever possible includes in its conferences, seminars and so on, foreign specialists from the many institutions with which it has contact. The Institute in 1969 has in its program five international conferences - one, at the end of February was on Community Development, and may lead to subsequent meetings. This was supported financially by Indian Affairs and Northern Development, together with Central Mortgage and Housing Corporation. A second on Transportation was held in early March,

financed by the Canadian Transport Commission, the U.S. Coast Guard, and industry. It attracted some 400 participants. A third is on Cross Cultural Education to be held in August sponsored jointly by AINA and the University of Alaska and financed by the Ford Foundation, with supplementary grants from Indian Affairs and Northern Development and the U.S. Bureau of Indian Affairs, and very significant assistance in the form of a full time expert for sixteen months by the Government of Quebec. A fourth arises from a Scandinavian initiative to consider international collaboration in all northern social science research, and the last now contemplated is on Icebreaking, in which the Department of Transport has shown interest.

The Value of the Institute to the Government of Canada

21. The Arctic Institute is in fact capable of bringing to bear on any northern problem, specialists competent and experienced in all of the scientific disciplines and technologies. Spanning both the natural and social sciences as it does, and having such contacts throughout North America and indeed world-wide, there is no area of study in which the Institute could not make a very substantial contribution to the Canadian Government. Obviously the Government has at its disposal, and should make appropriate use of researchers grouped in one university or another; the professional consulting companies, and the large contracting-consulting firms which exist. This Institute, through its Board, Committees and Fellows, is particularly well suited to deal with interdisciplinary and multidisciplinary problems beyond the range of skills likely to be found in any single university or consultant's office. Moreover, it has long experience in organizing complex programs both from the point of view of scientific management and logistics planning in support of field activities.

22. The Institute's library itself, the Institute's range of publications, and particularly the Arctic Bibliography, provide a major source of scientific and technical information as well as historical background and some works on the Arts. The Institute is cooperating with the Science Secretariat in its study of the holdings of scientific and technical information in Canada, and the means to make these universally

available. Coincident with this the Institute is re-examining its own overall information services with a view to modernizing them. When the Science Secretariat report is released it is expected that the Institute will be asked to play a larger role as the source of northern regional information.

23. Another significant aspect is the supplement which the Institute provides to the education of northern specialists. The Institute's Research Committee has a very high reputation, and its ratings of research proposals are valued. Although the total sum available for grants to well-rated applications is small, they provide a useful supplement to other funding sources and the Institute's contacts, together with the reputation of its Research Committee, frequently make it possible to find support for good projects which otherwise might not be funded. The Institute considers that its screening and rating process could be used to advantage by other organizations, including Government, and that the calibre of its Research Committee is not likely to be exceeded by any other group. Further, in the field of education the Institute does provide modest support to some university programs such as the McGill University Geography Summer School, and the many symposia and seminars and similar meetings which it sponsors or in which the Institute participates also make a significant contribution to knowledge. In such activity stress is placed upon the young scholar and the need for developing more northern specialists.

24. There is also the aspect of bringing into Canada projects financed in the United States, together with a large input of knowledge from the U.S. through contacts south of the border. This is not "one-way", as has been pointed out, but in terms of research dollars the advantage is definitely with Canada. A large flow of information is also gained from the Institute's contacts outside North America.

25. Consequently in any northern problem which needs consideration and study beyond the capacity of the Government agencies by themselves, the Institute can make a contribution; before the Department of Indian

Affairs and Northern Development at the present time are suggestions for the exchange of personnel, or the absorption within the Institute of government personnel for a limited period. Other proposals relate to the Institute's ability to act as a consultant on such things as the Frobisher Development project, the Institute's readiness to do specified Transportation studies for the Canadian Transport Commission and Indian Affairs and Northern Development on a consulting basis, and the possibility of the Institute preparing a primary and high school publication series on the North in cooperation with the Department of Indian Affairs and Northern Development. For some northern problems the Institute is unquestionably the best agency to supplement Government.

Appendix B

ARCTIC INSTITUTE OF NORTH AMERICA
Brief to the Senate Special Committee
on Science Policy

Examples of Northern Research Requirements

Transportation

1. Some studies are of immediate urgency to support both governmental and industrial decisions on the transportation systems to carry arctic petroleum to markets.

(a) Research on sea ice - the future of arctic sea transportation may well depend upon increased knowledge here.

(b) Testing to determine the most suitable navigation aids. It may prove feasible to utilize satellite positioning supported by land radar targets.

(c) Oceanographic studies, in particular hydrography in the navigable channels in the western arctic.

(d) Improved ice reconnaissance year-round and production of a much better seasonal ice atlas. This will likely require better sensing equipment for aircraft and satellites - possibly combined radar, infrared and photography.

(e) More detailed topographical mapping particularly to provide more accurate geodetic positioning of shore lines in relation to the safe use of satellites for positioning of ships.

(f) Continued research and assessment of overland vehicles and air cushion vehicles particularly for special roles over muskeg and delta terrain.

(g) A comprehensive assessment of the total northern resource potential and an analysis of the alternative transportation systems to most economically develop and market such resources.

Conservation

2. There is evidence that pollution is becoming a world-wide human hazard. Traces of insecticides have been found in arctic marine species. The effect of the wrecking of a large tanker, or leakage from a sub-surface oil well in the Arctic would be even more destructive to marine life than in southern waters because of the slow regeneration rate. Human and industrial waste disposal also poses special problems in permafrost regions. In the light of sad experience in other regions and the value of the North for wildlife sanctuaries for biological preserves and for recreation, it is imperative that these interests be protected in the development of northern resources. It is equally important that such resources be wisely used.

Community Development

3. Social research is required into the problems of the relatively small northern communities. The means must be found to incorporate into architectural and engineering designs special features to adapt them to the environment and to the needs of northern dwellers, both the native people and the whites from the South. The Arctic Institute has taken an initial step to develop a program with this objective and has found widespread concern about these problems and widespread interest in seeking solutions.

Native Education

4. In the past there has been no international approach to the problems of educating northern native peoples (Indians and Eskimos) despite the many similarities found in all the circumpolar countries. Also analogies exist between the educational problems in the emerging underdeveloped regions of Africa, South America, the Pacific Islands and so on. The Arctic Institute jointly with the University of Alaska has taken an initial step to study these problems, commencing with a major international conference in Montreal in August 1969. An eminent anthropologist who has devoted his life to the needs of the Eskimo suggests that a crash program is necessary to train these citizens for employment, more swiftly than is now possible.

Poverty and Employment in the Arctic

5. Thirty years ago the Social Science Council of Canada financed a survey of health and education in Mackenzie District which was instrumental in sparking the administrative revolution of the Canadian Arctic after the Second World War. A similar investigation into poverty in the Arctic and the present and future labour needs is now needed and might have equally salutary results.

Manipulation of Climate

6. There has been talk of large scale alteration of the climate of the Arctic by major works such as damming Bering Strait as suggested by the Russians. There is a possibility which is accepted by some experts, doubted by others, that the Arctic Ocean ice cover is decreasing and may eventually disappear. There is also the possibility that more limited and hence more practicable measures which would conserve a relatively small amount of heat would do much for arctic navigation. For example the damming of Fury and Hecla Strait would prevent the flow of arctic water into Foxe Basin and might materially improve ice conditions in that Basin and in Hudson Bay.

Experimental Soil Formation

7. Experimental farms exist in the North and have been successful in growing good crops of a wide variety. The particular limiting factor to more agriculture in the North is the absence of good soil except in a few restricted regions, chiefly because of glacial scarification. The short season and climate are also limiting factors but seem to have been overcome in some parts of Siberia where good soil exists. What are the possibilities of artificial soil formulation? If there is an economic possibility for the creation of soils, would the season and climatic limitations permit agricultural development?

APPENDIX 137

SUBMISSION

by

THE MINING ASSOCIATION OF CANADA

to the

SPECIAL SENATE COMMITTEE

ON

CANADIAN SCIENCE POLICY

MAY 1969

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CANADIAN SCIENCE POLICY

MAY 1969

CONTENTS

I. S U M M A R Y

National prosperity is the key to the attainment of Canada's major social goals.

That prosperity depends heavily on the rapid and judiciously balanced growth in all aspects of its scientific and technological resources.

Minerals are one of the most important natural resources in terms of the national economy, the present and potential contribution to exports, the continued high rate of regional development and the growth of transportation and communications.

Consequently, towards determining the framework of a Canadian science policy, the following basic recommendations are offered:

1. That preference be given to national objectives of a predominantly economic nature.
2. That major consideration be given to the adaptation of existing know-how from other nations, notably in socio-economic fields such as pollution and space science.
3. That highest priorities be assigned to those subject areas which, by reason of natural circumstances, are of unique importance and potential to Canada.
4. That, through the use of tax and other incentives, the proportion of the national research and development effort carried out by the industrial sector be substantially increased.
5. That processes of communication between government, industry and universities be greatly improved.
6. That early attention be given to the urgent need for programmes oriented towards the requirements of specific industries, as distinct from the major national programmes advocated by the Science Council.

From the viewpoint of the mining industry, in order to maintain a secure position in international trade, the most important specific objectives are seen to be the following:

1. Improved sensing devices for the location of mineral values.
2. New methods for the primary excavation of rock and ore.
3. The measurement and prediction of rock stability.
4. Methods for the improvement and control of mining environment.

5. Improved methods for the maximum beneficiation of ore.

6. More efficient and economical metals recovery processes.

7. Development of upgraded products for manufacturing industries.

8. Development of automation.

9. Improved methods of transportation.

II. INTRODUCTION

1. THE MINING ASSOCIATION OF CANADA

The M.A.C. was originally incorporated as "Canadian Metal Mining Association" under the Companies Act of Canada, with Letters Patent granted on January 16th, 1935. The name of the corporation was changed to "The Mining Association of Canada" under Supplementary Letters Patent granted on March 10th, 1965.

It is the recognized national organization of the metallic and non-metallic sections of the mining industry and is composed of companies engaged in mineral exploration, mining, smelting and refining, who account for more than 95 per cent of Canada's output of metals and major industrial minerals (see Appendix 3).

The Association's main role is to project the views of the industry on a national scale and co-ordinate its efforts with those of government departments in regard to policies affecting exploration, mining and processing, and the development of exports. Through its Research Division, the Association also seeks to strengthen the technical awareness within the mining industry through liaison with public research agencies and universities and the monitoring and communication of the results of mining research in this country and abroad. Major attention is also devoted to the area of industrial wastes.

M.A.C. works in close co-operation with The Canadian Institute of Mining and Metallurgy, the industry's professional and technical body, and the Provincial Mining Associations across Canada.

2. DIMENSIONS AND SPECIAL CHARACTERISTICS OF THE CANADIAN MINING INDUSTRY

(a) Output and Exports

Minerals constitute one of Canada's leading industrial groups. The value of its current annual total output at $4.7 billion represents over 7 per cent of Canada's GNP. Canada is the world's leading producer of nickel, zinc, asbestos and silver, the second largest producer of molybdenum, selenium, sulphur, titanium, uranium and gypsum, and it ranks high on the list in the production of many other minerals, including copper, gold, iron ore, lead, cobalt, magnesium, nepheline syenite, platinum group metals and potash.

In 1968, the value of net exports of crude minerals (excluding oil ans gas) amounted to $1,581 million. Shipments abroad of semi-fabricated domestic mineral products were valued at an additional $1,795 million. The grand total value of $3,376 million represented 25.5 per cent of Canada's total domestic exports in that year. This was the highest export yield of any resource-based industries and was exceeded only by the manufacturing industries group. This leadership performance of the mining industry has been maintained over many years.

It is of the greatest national importance that little short of 60 per cent of Canada's total mineral exports finds a market in the United States, thus effectively controlling our balance of payments with that country.

(b) Regional Development

The mining industry's contribution to regional development is exceptional. Nothing in the postwar period has in any comparable measure improved the balance as between provinces and as between regions within provinces.

Iron ore in Newfoundland, lead and zinc in New Brunswick, nickel in Manitoba, potash in Saskatchewan, sulphur in Alberta, lead, zinc and gold in the Northwest Territories have been the mainstays of economic progress and of diversification in these areas.

A variety of other mineral developments in the outlying regions of Quebec, Northern Ontario and the interior of British Columbia have strengthened the unsheltered areas of the three largest provinces.

(c) Transportation

The industry's encouragement of transportation growth is also remarkable. Since the end of World War II, more than 2,500 miles of new railways have been laid to serve new mines. Many airports in the Canadian northland were originally built to aid exploration work, and today they handle a varied flow of cargo and an increasing number of passengers.

Road networks are constantly being extended to bring our mineral resources within easier reach of their markets. New port facilities, constructed especially to handle mineral and metal cargoes, have been established on both coasts, and the St. Lawrence Seaway system is, of course, one of the principal routes for Canadian mineral products.

Each year, crude minerals account for more than 40 per cent of all the tonnage shipped on Canadian railways and inland waterways, and this will no doubt increase as production rises, particularly of iron ore in the east and potash and sulphur in the west.

Within a few years it is possible that pipelines may also be used to transport ores and concentrates from mine to market or to a coastal port. Research into pipelining of solids has been underway for many years.

(d) Manpower

The industry is very conscious of the fact that its continued growth and the further development of its international stature must depend to a major extent on an increasing flow of young professional and technical men from many disciplines being attracted to mining and making their careers in it. Hence, through liaison with the universities, the technical schools, and The Canadian Institute of Mining and Metallurgy, it encourages strongly the development of policies aimed at promoting the scope and effectiveness of courses of study concerned with the subjects in which mining is essentially interested. The industry can indeed play an important role in helping to solve what the Economic Council of Canada calls one of the nation's greatest challenges: finding jobs for the wave of young people now entering the labour market.

From the point of view of overall employment, recent statistics show that over 130,000 Canadians are directly employed in exploration, extractive operations, smelting and refining. Furthermore, the multiplier effect of the industry is very substantial. Economists estimate that one worker in a primary industry such as mining supports some five workers in associated service industries and secondary manufacturing.

It might be noted that in 1968 average wages and salaries in the mining industry were highest of any industry group in Canada. Since 1939 they have risen 387 per cent, compared with a rise in the consumer price index of 145 per cent (source: DBS data).

(e) Tax Incentives

As opposed to other resource-based industries (except oil and gas) and manufacturing industries, mining is concerned with the discovery and development of a raw product (ore in the ground) which is exhaustible and non-renewable (wasting assets). This means that, whilst a particular ore body is being extracted, processed and consumed, a mining operation must also undertake a constant search for new materials, and furthermore it cannot be assured of finding them. This naturally involves a very high risk. Before a worthwhile discovery is made, much expenditure can and does extend over years of often fruitless though inevitable exploration. And it should be noted also that, once a discovery of value has been made, vast amounts of capital are immediately required to bring it into production.

It is in recognition of these very special characteristics that Canadian tax legislation has developed over many years of experience a number of incentives to encourage increased development of mining and to offset the inherent and unavoidable disadvantages.

It is to be noted that every major mineral producing country makes provisions of a similar nature.

The basic tax incentives presently applicable in Canada are:

1. Percentage depletion allowances on the aggregate of the profits and losses reasonably attributable to the mine production, and

2. a three-year exemption from income tax for new mines.

Depletion of an ore body is considered as a proper cost to be allowed before determining the profit from the winning of the ore. This recognizes the difficulty of determining the cost of any specific ore body and contains elements of equity since it is an attempt to allow the taxpayer to recover a portion of the income as a return of capital laid out to discover a mine.

As for the tax exemption, this practice was originally introduced as a temporary measure in times of national crisis - economic in the thirties and defence in the forties. It proved so successful in generating exploration activity at minimal cost to the Treasury that, following the termination of World War II, the provisions of the Income Tax Act under which the three-year exemption is provided were revised and extended on a permanent basis.

These provisions have had a material effect on the value of new mineral discoveries.

It is quite evident that without these incentives the Canadian iron ore industry, whose output value in 1968 was $556 million, would not have been developed because many of its ore deposits, though large, are low-grade and would have proved uneconomic. It is also probable that Murdochville and its Gaspé Copper would not have seen the light of day and that we would not have a thriving Thompson in Manitoba. Neither could we have expected further large-scale nickel producing operations in the Sudbury Basin of Ontario, the major potash mining developments in Saskatchewan, and the many promising lead, zinc, copper, asbestos and molybdenum developments in British Columbia. In fact, it can be said that the incentives have turned worthless rock into valuable ore, and that the legislation providing them constitutes one of the most successful national policies in the history of Canada.

(f) Exploration

As indicated above, exploration is the lifeblood of the industry and has been greatly encouraged by the existing tax incentives.

At the present time, exploration expenditures in the industry are running at the rate of about $80 million per annum (source: DBS data). It is expected that by 1975 this figure will approach the $100 million mark.

In the future, the industry will have to rely mainly on large low-grade deposits as opposed to small to medium-sized relatively high-grade ones. To find them, increasing emphasis will be placed on the interdependence between geology, geophysics and geochemistry. There will also be a steady increase in costs, because searching will take place in more remote areas or at greater depths, using advanced and expensive techniques.

(g) Research and Development

The Canadian mining industry is very much aware of the value of research at every stage of exploration, development, production and processing. It is indeed a striking example of an industry where scientific as well as other technological advances are encouraged and play a most important role.

In 1967, more than $45 million was expended by the Canadian mining and smelting industries on research and development, of which approximately 85 per cent was spent in Canada (source: DBS data).

Industrial waste is also a matter to which the mining and associated industries are giving major and increasing attention. Particularly throughout the past three decades, much progress has been achieved through improved methods of the roasting of ore, the conversion of off-gases into useful by-products, the collection of dusts, the increased removal of acid-forming constituents from solid waste products, and the return of waste solids to underground openings.

As the result of these past efforts and developments, the mining industry is in a better position than some others to contribute effectively to the current national pursuit of an improved environment. Material progress is being made in controlling all aspects of environmental pollution.

A good deal of progress has already been made in the stabilization and reclamation of solid waste products and the wastes from milling operations; it has been shown possible to cultivate grass and grain on these structures.

Where the design of new operations is involved, particular attention is being given to plans for immediate as well as long-term protection against all aspects of pollution.

III. BASIC RECOMMENDATIONS FOR A CANADIAN SCIENCE POLICY

RECOMMENDATION NO. 1

That preference be given to national objectives of a predominantly economic nature.

It is our conviction that major social goals such as health, high life expectancy, education and personal development, personal freedom and national security can only be attained through national prosperity. In turn, the prosperity of this nation will depend upon a rapid and judiciously balanced growth in all aspects of its scientific and technological resources.

RECOMMENDATION NO. 2

That, in the establishment of priorities, major consideration be given to the possibilities of adaptation of scientific data and technological know-how from other countries. This applies notably to those socio-economic objectives related to pollution abatement and environmental control, water resources management, municipal development and renewal, and space science.

We submit that it is of the greatest importance to recognize that Canada is in unique geographic and economic proximity with the United States - a country with social objectives generally similar to our own, but more pressing. Furthermore, in that country a research and development effort upon a scale many times greater than our most hopeful future level is already being brought to bear on such major social goals.

At the same time, these goals are involved with what are estimated to be among the most costly of potential national research programmes.

Because we believe that many of the results of the research and development carried out in the United States in these fields can be successfully adapted to Canadian situations, we submit that a national science policy for Canada should not place such social objectives above predominantly economic ones from the standpoint of research expenditures, but that we might better utilize our national funds in doing those things we need to do for ourselves.

Indeed, under the existence of an unfavourable gap between Canada and the U.S. of about $1,400 in per capita national productivity (as for 1968), our funds for national research are more limited.

An important consideration associated with this general concept is the capability to adapt. In line with those circumstances associated with the Canadian gap between applied research and the actual production phase (further described under Recommendation No. 4), we may not always possess the ready capability for the most efficient adaptation of existing technology. This is sometimes exemplified by a tendency to scale down in size without modifying and diversifying the process and equipment to satisfy the pattern of a Canadian market.

In any case, the strengthening of our capability to correctly adapt will be a less costly and, at the same time, more productive principle than starting research from scratch.

Thus, in the field of space science it is justifiable to carry on sufficient research to develop a Canadian capability to adapt and operate. We need to have space corridors and satellite communication systems. We suggest, however, that it would be injudicious to launch and maintain a massive, national research programme aimed at the development of the needed hardware.

Whether the objectives be social or economic, Canada certainly cannot at this time afford to do research which is unnecessary or the results of which will be either obsolete or repetitious.

Within the context of Recommendation No. 2 we would add our belief that Canadian universities graduate engineers able to perform efficiently in industry and elsewhere.

RECOMMENDATION NO. 3

That highest priorities be assigned to those subject areas which, by reason of natural circumstances, are of unique importance and potential to Canada.

We fully recognize the significance within a national science policy of the major national programmes recommended by the Science Council.

From the point of view of our industry, we believe that, of the major programmes presented, first emphasis should be placed on transportation.

The extent to which much of northern and regional development and the elimination of economic disparities within the nation will depend upon transportation, together with the exploration and development of mineral values, is a matter worthy of the most serious consideration.

We are of the opinion that government science expenditures have not been sufficiently directed towards those areas in which this nation can develop its greatest positions of strength in the world market place.

Therefore, the implications of Recommendation No. 3 are notably oriented towards minerals development, for the following reasons:

(a) The importance to the national economy.

(b) The present and potential contribution to exports.

(c) The high growth potential involved.

(d) The high potential for up-grading and diversification.

(e) The inadvisability of being overtaken by superior foreign technology, in the absence of a stronger Canadian policy and effort.

(f) The high scientific potential of competing countries in this sector of natural resources.

(g) The possibility of making technical advances in this sector beyond those which have been made in other countries.

(h) The high rate of expansion of markets for metals and other mineral products.

(i) The increasing degree to which technological progress in the resource industries is based on science, and the high potential of the minerals industries for the utilization of technical manpower.

We would add the important comment that the portion of our foreign aid to developing countries which is allocated to mineral resources development could be rendered much more effective under the existence of greater national programmes in Canada, in this sector.

Summarily, we believe that in the face of possible future common market developments and global, economic trends, Canada should place first emphasis upon those fields in which she can, for special reasons, excel.

RECOMMENDATION NO. 4

That, through the use of tax and other incentives, the proportion of the national research and development effort carried out by the industrial sector be substantially increased.

The achievement of a nation's economic and cultural objectives depends to a very large extent upon its ability to take advantage of technological achievements. It should be noted, however, that much importance must be given to the phrase "take advantage of".

The fact is well documented that the level of total spending in Canada on research and development is not and has not been as high as in some other developed nations. Nevertheless, we have not been without a major scientific effort during the past three decades and, as is also well known, the larger part of the total effort has been carried out in federal departmental agencies and in the National Research Council Laboratories.

While we would not depreciate the practical contributions which have been made by these agencies throughout the years, nevertheless we are of the opinion that they have been substantially fewer in number and more restricted in fields than should be consistent with the total national expenditure involved.

We suggest that a gap has for too long existed between the prosecution of relatively "basic", as well as so-called "applied" research - as carried out in government agencies and often in universities - and, at the other end, technology in plant.

Within this gap there has been an untended area which, in a general way, encompasses the phases of applications research and engineering design and adaptation - necessary steps towards a workable technology.

While we would not presume herein to suggest and develop all of the reasons for the existence of this gap, we are of the opinion that a lack of sufficient common interest and effective communication between government research agencies and the industrial sector has resulted in a less than desirable efficiency in the utilization of the results of research.

We submit that the principle of government funding in industrial laboratories of more applied research, and especially of the development phases of national programmes and other investigational work, would (a) improve the efficiency of research through close orientation to the objectives, (b) allow prompter and continuing economic appraisal of processes and products, and, through similar means, earlier perception of the cut-off point of unproductive or inadvisable projects, (c) benefit the scientific texture of industrial laboratories and their overall potential for private research, (d) promote the introduction of research into valid, though small organizations, (e) improve communication between industry and other research agencies.

In this context we would also submit that, within the major objectives and guidelines of a national science policy, industry is itself in the best position to choose the projects for research.

We would recall and emphasize that it is usual for industry to look at research in a context characterized by a number of distinguishing features, of which the two most important are:

(a) R and D is an investment.

(b) R and D's objectives are always analyzed according to criteria dictated by the concepts of reward, risk and consequences.

Within Recommendation No. 4, the first characteristic (a) is particularly important since it explains industry's reluctance to support long-range R and D projects in the face of competing opportunities for investment in other areas, such as increased production, promotional campaigns, exploration or solely financial investments. Returns from these are generally more predictable than those from long-term R and D projects where the pay-offs, though sometimes potentially larger, are less tangible and involve long waiting periods.

Corporate management's willingness to support a reasonable amount of short-term research is, by the same token, explained.

We would comment as below upon the main, current government programmes of financial assistance to research and development in industry.

Industrial Research Assistance Programme - IRAP:

Though it is one of the more successful schemes, we suggest that it suffers from a number of defects, chief among which are:

(a) A five-year limitation on duration of support, which should be eliminated.

(b) It supports only additions to the basic staff contingent.

(c) The level of government funding is too low (currently about $7,000,000 per year).

Defence Industrial Research - DIR:

Though also partly successful, we believe the limitation on duration of support should be removed.

<u>The Industrial Research and Development Incentives Act - IRDIA</u>:

While the grant of 25 per cent of the capital cost of research (building, equipment, etc.) is helpful to industry, the grant of 25 per cent of the operating cost is much less attractive because:

(a) It applies only to the increase in research over the preceding five years and therefore requires sizable annual increases in R and D to be of assistance. It is recommended that the moving base be eliminated.

(b) The administrative costs are excessive.

(c) The requirement that the results of research should be first exploited in Canada is too restrictive.

(d) The definition of the type of R and D activity which qualifies is too restrictive.

However, much more important to the economy than the research and development coming within the financial assistance discussed above, is the practical implementation of the results. More than 90 per cent of the cost of the total process of innovation lies in the engineering and design, tooling, production start-up and marketing start-up phases.

<u>Programme for the Advancement of Industrial Technology - PAIT</u>:

This plan is, we realize, in partial recognition of the importance of the fact just stated above.

However, in the face of the numerous conditions and restrictions of this plan, viz. the repayable feature under an effectively high interest rate, the restriction in respect of "special purpose equipment", the restriction to initial exploitation in this country and the excessive administrative costs - this plan is of limited assistance indeed, except in the unlikely case of failure.

While it is probable that an improved form of PAIT, less restrictive and with no interest rate, would be useful in some cases, it would still fall far short of the level of assistance required by much of Canadian industry in the face of mounting competition from abroad.

It is clear that government support for innovation must be an across-the-board effort, not merely the support of research and development.

Finally, within the scope of Recommendation No. 4, we submit that the amount of basic research carried out by government agencies should be substantially reduced, and that such fundamental work should be moved into the universities.

RECOMMENDATION NO. 5

That processes of communication between industry, government and universities be developed so as to be effective for the most judicious adoption, efficient prosecution and maximum exploitation of research and development efforts.

We have already suggested that a major reason for the low frequency of exploitation in the past of the results of research carried out by, e.g., the National Research Council of Canada, is the lack of effective communication between this research agency and the industrial sector.

In a broader sense, however, we recognize that there is no real barrier between industry, government and universities, but rather a lack of communication arising from a lack of common interest.

We suggest that contract work of clearly identified programmes, awarded by a government agency to the three sectors according to their respective capabilities and research interests, could accomplish much towards establishing common interests and effective communication. Working together on different aspects of the same problem would draw the sectors into the closer contact required for the improved efficiency of each.

While we do not propose herein to pursue in detail the methodology of effective communication processes, we would note that the National Advisory Committee concept can be effective in the adoption phase and, to some extent, in the active prosecution of research projects and programmes. Such Committees should contain strong industry representation. There has not yet been time to assess the effectiveness of the recently inaugurated National Advisory Committee on Mining and Metallurgical Research.

However, in initial concept at least, such an advisory body is not designed to perform the total communication function between the research agency and the potential developer and manufacturer.

While improvements in information facilities may help in the effective closure of this gap, we suggest that further methods must be found for the maintenance of close liaison between industry, the universities and other research agencies for the maximum utilization of the results of investigational work.

In addition to contracting of organized programmes as discussed above, such methods might involve other co-operative projects, exchange of personnel and, in all cases, greatly increased dialogue.

In any case, there must be involved the conscious orientation of university and government research staff to industrial objectives.

Without the co-operation, co-ordination and full briefing of all sectors, none of the purposes of our basic recommendations can be satisfactorily achieved.

With regard to foreign technology, it is felt that much more is actually available than is generally known. There would appear to be great need for better information systems, including considerably improved translating facilities.

RECOMMENDATION NO. 6

That early attention be given to the urgent need for programmes oriented towards the requirements of specific industries, as distinct from the major national programmes advocated by the Science Council.

While we consider that it applies to numerous industrial segments, we submit that the minerals industry has a pressing need for the solution of problems which are shared by its components, but are too complex and costly for effective research by any one organization.

Such programmes are of medium size in comparison with major national programmes, though are still of such magnitude as to require full government funding of contracts awarded to industry and universities, as well as to government agencies.

It is suggested that such medium size programmes could be implemented more quickly than national programmes and administered within existing facilities.

IV. SPECIFIC SCIENTIFIC AND TECHNOLOGICAL OBJECTIVES OF THE MINING INDUSTRY

1. To develop improved sensing devices for the location of mineral values, including the progressive exploration of existing underground ore bodies.

From the viewpoint of surface exploration, much of the future of Canada's minerals development will be associated with more and more difficulty in finding ore.

The development of improved sensing devices for this costly phase of minerals development represents a field of research with a very high potential of reward.

It is furthermore clear that the efficiency of primary ore extraction can be significantly influenced by improved means for the prediction and selection of ore encountered during the progressive working of an established deposit.

2. New and improved methods for the primary excavation of rock and ore.

We have first of all in mind improved methods for the primary breakage of ore. A desirable method would, for example, likely depart from the conventional use of chemical explosives.

Not only in itself but from the point of view of its potential effect upon handling and transportation, dust, fumes, noise, service facilities, control of rock stability, selective mining, etc., the development of improved methods of breaking rock and ore is of the greatest importance to the efficiency of the excavation process. It may, of course, equally apply to the excavation processes involved with other resource development, ground and underground transportation and other public works projects.

3. Practical methods for the measurement of rock behaviour and for the forecasting of the stability of mine openings.

Such problems fall largely within the field of study of applied rock mechanics. Once again, they are to be found in numerous construction fields, as well as in the mining industry.

4. <u>Methods for the improvement and control of mining environment.</u>

Towards higher environmental standards in mining and in the other areas noted above, many disciplines will have to be brought to bear.

5. <u>Improved methods for the maximum beneficiation of ore.</u>

This area has, as is known, been an active one for many years with respect to research and development work. However, the full and efficient utilization of Canada's mineral resources will, to an important extent, depend upon both the physical and economic capacities of mining and milling lower grade ores, found at greater depths. A substantial and sustained research effort will be required to achieve maximum success.

6. <u>Development of more efficient and economical metals recovery processes.</u>

We refer to the smelting and refining phases with special mention of hydro-metallurgical processes.

7. <u>Development of new or up-graded products for utilization by manufacturing industries.</u>

This is an area of research and development of great potential importance in increasing the national product value of the minerals segment of our economy.

8. <u>To achieve a degree of automation in both underground and surface operations which will represent increased efficiency in mining systems, including maintenance and in the deployment of labour.</u>

While the general nature of our "Basic Recommendations" did not allow specific mention of the importance of developing the field of computer technology, we are, nevertheless, alert to its potential contributions to the minerals industry. In a similar way, the achievement of a considerable degree of automation is an important element in the efficient system and this is especially true in the case of a system so dependent upon queueing as is the total mining operation.

Considerable development work is needed on equipment to provide much further automation within the industry.

9. To improve methods for both the primary (underground and open pit) and secondary (surface) transportation of ore and final products.

In the primary extraction process, i.e. the breakage of ore and its transportation to the point of subsequent concentrating processes, the transport phase may represent 50 per cent of the costs of ore extraction. It is therefore clear that problems of materials handling demand much future attention.

In the case of very large and possibly low grade, open pit workings and in future requirements to mine at great depth, such problems take on even greater proportions.

The physical and economic problems involved in surface transportation in remote regions are obvious and well known. The resolution of such problems will be decisive in many instances of the future development of Canada's mineral resources.

V. APPENDICES

1. MINERAL PRODUCTION OF CANADA BY KINDS, 1967-1968
(Preliminary Estimate)

		1967		1968	
		QUANTITY	VALUE dollars	QUANTITY	VALUE dollars
Metallics					
Antimony	lb.	1,267,686	671,874	1,124,000	595,720
Bismuth	"	668,476	1,918,951	639,866	2,435,399
Cadmium	"	4,836,317	13,541,688	5,437,917	15,287,811
Calcium	"	543,692	535,509	445,612	421,756
Cobalt	"	3,603,773	7,352,433	3,488,656	7,490,060
Columbium (Cb_2O_5)	"	2,159,557	2,404,475	2,118,000	2,393,340
Copper	"	1,226,627,725	582,585,272	1,233,152,827	593,083,576
Gold	troy oz.	2,993,366	112,999,568	2,748,333	103,639,636
Indium	" "	..	..	..	..
Iron ore	ton	42,317,800	470,121,685	49,373,329	555,912,519
Iron, remelt	"	..	18,584,745	..	22,523,000
Lead	lb.	635,926,511	89,029,711	693,760,476	93,796,415
Magnesium	"	17,774,684	5,654,243	19,756,598	6,153,270
Mercury	"	-	-	..	..
Molybdenum	"	21,376,766	37,900,039	20,006,958	36,026,623
Nickel	"	497,294,289	463,139,703	527,697,695	527,005,070
Platinum group ...	troy oz.	401,263	34,668,915	464,400	44,025,124
Selenium	lb.	724,573	3,514,179	709,200	3,280,345
Silver	troy oz.	36,315,189	62,897,907	45,621,355	105,750,300
Tellurium	lb.	73,219	475,925	65,193	419,990
Thorium (ThO_2)	"	117,383	214,597	139,191	269,128
Tin	"	437,804	621,682	335,147	552,993
Titanium ore	ton	-	-	-	-
Tungsten (WO_3)	lb.	..	..	..	..
Uranium (U_3O_8)	"	7,476,228	53,021,936	7,400,000	38,482,000
Yttrium (Y_2O_3)	"	172,551	1,594,298	111,326	934,986
Zinc	"	2,222,906,092	322,099,092	2,337,660,977	329,610,197
Total metallics		...	2,285,547,427	...	2,490,089,258
Non-metallics					
Arsenious oxide	lb.	755,050	48,193	692,564	51,942
Asbestos	ton	1,452,104	165,118,786	1,596,011	190,068,054
Barite	"	172,270	1,573,370	137,699	1,581,129
Diatomite	"	..	..	..	..
Feldspar	"	10,394	241,715	10,708	258,723
Fluorspar	"	..	2,099,855	..	2,474,362
Gem stones	lb.	24,160	28,341	7,110	10,125
Grindstone	ton	10	3,000	-	-
Gypsum	"	5,175,384	11,348,351	6,145,193	13,158,742
Helium	mcf.	..	..	..	..
Iron oxides	ton	664	37,023	600	33,000
Lithia	lb.	436,894	266,226	-	-
Magnesitic dolomite, brucite	ton	..	3,515,917	..	2,719,377
Mica	lb.	..	..	..	..
Nepheline syenite	ton	401,601	4,752,875	325,463	3,929,446
Nitrogen	mcf.	..	..	..	..
Peat Moss	ton	280,731	8,006,091	288,219	8,617,661
Potash (K_2O)	"	2,383,253	67,395,461	2,890,733	73,950,000
Pyrite, pyrrhotite	"	377,941	1,702,516	320,090	2,215,161
Quartz	"	2,610,740	5,530,044	2,621,326	6,459,343
Salt	"	5,361,463	27,808,129	4,887,634	31,907,986
Soapstone and talc (1)	"	60,665	900,985	77,300	1,194,000
Sodium sulphate	"	428,316	6,359,039	469,076	7,403,494
Sulphur, in smelter gas	"	592,035	7,182,139	565,696	6,951,687
Sulphur, elemental	"	2,499,205	68,613,866	2,585,513	81,276,703
Titanium dioxide, etc.	"	..	23,737,330	..	24,574,000
Total non-metallics		...	406,269,252	...	458,834,935

See footnotes at end of table.

Mineral Production of Canada by Kinds, 1967-1968 (concluded)

		1967		1968	
		QUANTITY	VALUE	QUANTITY	VALUE
			dollars		dollars
Mineral fuels					
Coal	ton	11,148,716	82,759,916	10,973,753	61,266,762
Natural gas	mcf.	1,471,724,535	198,430,946	1,642,636,000	225,682,325
Nat. gas By-products	bbl.	..	112,780,125	..	121,722,600
Petroleum, crude	"	351,292,332	864,953,755	377,694,500	933,420,250
Total fuels		...	1,258,924,742	...	1,342,091,937
Structural materials					
Clay products (brick, tile, etc.)		...	44,356,825		46,264,483
Cement	ton	7,994,954	143,150,284	8,279,152	156,541,049
Lime	"	1,422,899	16,567,197	1,365,988	17,086,528
Sand and gravel	"	209,665,578	143,706,843	198,528,587	128,100,791
Stone	"	80,636,102	100,416,233	74,683,885	96,413,751
Total structural materials		...	448,197,382	...	444,406,602
GRAND TOTAL		...	4,398,938,803	...	4,735,422,732

(1) Includes pyrophyllite.
.. Figures not available.
... Figures not appropriate or not applicable.
Nil or zero.

2. MINERAL PRODUCTION OF CANADA BY PROVINCES, 1966-1968
(Preliminary Estimate)

Provinces	1966		1967		1968	
	Dollars	Per Cent	Dollars	Per Cent	Dollars	Per Cent
Newfoundland	244,020,086	6.1	266,633,099	6.1	323,663,829	6.8
Prince Edward Island	2,756,780	0.1	2,605,806	0.1	1,432,187	0.1
Nova Scotia	85,416,974	2.2	77,226,142	1.8	58,399,179	1.2
New Brunswick	90,221,237	2.3	90,418,690	2.1	86,799,414	1.8
Quebec	762,944,986	19.2	734,141,939	16.7	731,373,022	15.4
Ontario	957,857,765	24.1	1,194,545,248	27.1	1,340,369,094	28.3
Manitoba	179,241,152	4.5	184,679,374	4.2	204,934,815	4.3
Saskatchewan	349,303,729	8.8	362,193,519	8.2	376,453,226	7.9
Alberta	846,678,642	21.3	973,326,938	22.1	1,080,420,896	22.8
British Columbia	331,143,633	8.3	379,986,091	8.6	391,366,130	8.3
Yukon	11,975,757	0.3	14,990,529	0.3	23,496,328	0.5
N.W. Territories	111,220,178	2.8	118,191,428	2.7	122,214,612	2.6
TOTALS	3,972,780,919	100.0	4,398,938,803	100.0	4,740,922,732	100.0

3. MEMBER COMPANIES OF
THE MINING ASSOCIATION OF CANADA

Algoma Steel Corporation, Limited, The - Algoma Ore Division
Allan Potash Mines
Alwinsal Potash of Canada Limited
American Smelting and Refining Company - Buchans Unit
Anaconda Britannia Mines Ltd.
Asbestos Corporation Limited
Aunor Gold Mines Limited
Bell Asbestos Mines Ltd.
Bethlehem Copper Corporation Ltd.
Bralorne Pioneer Mines Limited
British Newfoundland Exploration Limited
Brunswick Mining and Smelting Corporation Limited
Caland Ore Company, Limited
Camflo Mines Limited
Campbell Chibougamau Mines Ltd.
Campbell Red Lake Mines Limited
Canada Tungsten Mining Corporation Limited
Canadian Dyno Mines Limited
Canadian Exploration Limited
Canadian Johns-Manville Co., Limited
Cassiar Asbestos Corporation Limited
Coast Copper Company, Limited
Cominco Ltd.
Consolidated Canadian Faraday Limited
Conwest Exploration Company Limited
Copperfields Mining Corporation Limited
Craigmont Mines Limited
Denison Mines Limited
Dickenson Mines Limited
Discovery Mines Limited
Dome Mines Limited
Dominion Magnesium Limited
Dresser Minerals
Duval Corporation of Canada
East Malartic Mines Limited
East Sullivan Mines Limited
Eldorado Nuclear Limited
Endako Mines Ltd.
Falconbridge Nickel Mines Limited
Gaspé Copper Mines, Limited
Giant Yellowknife Mines Limited
Granby Mining Company Limited, The
Granduc Operating Company
Granisle Copper Limited
Gunnar Mining Limited
Hallnor Mines, Limited
Heath Steele Mines Limited
Hilton Mines, Ltd.
Hollinger Mines Limited
Hudson Bay Mining and Smelting Co., Limited
Indusmin Limited
International Nickel Company of Canada, Limited, The
Iron Ore Company of Canada
Kam-Kotia Mines Limited
Kennco Explorations, (Canada) Limited
Kerr Addison Mines Limited
Labrador Mining and Exploration Company Limited
Lake Asbestos of Quebec, Limited
Lake Dufault Mines Limited
Lake Shore Mines, Limited
Lamaque Mining Company Limited
Leitch Gold Mines Limited
Little Long Lac Gold Mines Limited, The
Macassa Gold Mines Limited
Madsen Red Lake Gold Mines, Limited
Manitou-Barvue Mines Limited
Marbridge Mines Limited
Mastodon-Highland Bell Mines Limited
Mattagami Lake Mines Limited
McIntyre Porcupine Mines Limited

New Calumet Mines Limited
New Hosco Mines Limited
New Imperial Mines Ltd.
Newmont Mining Corporation of Canada Limited
Noranda Mines Limited
North Coldstream Mines Limited
Opemiska Copper Mines (Quebec) Limited
Orchan Mines Limited
Pamour Porcupine Mines Limited
Patino Mining Corporation, The
Pine Point Mines Limited
Placer Development Limited
Preston Mines Limited
Quebec Cartier Mining Company
Quebec Iron and Titanium Corporation
Rayrock Mines Limited
Renabie Mines Limited
Rio Algom Mines Limited
Rycon Mines Limited
Sherman Mine
Sherritt Gordon Mines Limited
Sigma Mines (Quebec) Limited
Silverfields Mining Corporation Limited
Siscoe Mines Limited
Steep Rock Iron Mines Limited
Sullivan Mines Limited
Sunro Mines Limited
Texas Gulf Sulphur Company
United Keno Hill Mines Limited
Upper Canada Mines Limited
Western Mines Limited
Willroy Mines Limited

APPENDIX 138

BRIEF

TO THE

SENATE SPECIAL COMMITTEE

ON

SCIENCE POLICY

SUBMITTED BY

THE CANADIAN COUNCIL ON URBAN AND REGIONAL RESEARCH

15 May 1969

To Hon. Senators Maurice Lamontagne (Chairman) and Members,
Special Committee on Science Policy
Senate of Canada

INTRODUCTORY SUMMARY

1. The Canadian Council on Urban and Regional Research welcomes the opportunity to submit its views to the Special Committee on Science Policy of the Senate. We should like the opportunity also to appear before the Committee: to sketch research resources that should be called into play in facing unprecedented urbanisation, as called for in your reference (a); to outline the structure we believe appropriate to support productive urban research, as called for in your reference (d); and to emphasize the steps needed to improve the linkage between available knowledge and common practice in our field.

2. Our Conclusions, supported by what follows, are these:

(1) Canadian spending on fundamental urban studies should in the next few years rise to two or three times the present annual rate, in order to exploit the research talents available and to inform the massive urban investments that are taking place; and further that in the nature of the case most of this increase will be Federally funded;

(2) A bilingual Canadian urban information network should be developed in the next few years so that the growing stream of urban knowledge will be accessible to those who will be making vital decisions on urban affairs in the diverse situations across this country; and

(3) Given any likely division of responsibilities and abilities among our institutions and regions, and given that all concerned can be served by the co-operative network, the assessment of urban research programs and proposals and the immediate allocation of funds to pursue them can be better done by several granting bodies than by a single monolithic agency.

3. We attach the following Appendices:

   A. Officers who make this submission for the Council and who would like to appear as witnesses before the Committee;

   B. A brief account of the composition, objects and activities of the Canadian Council on Urban and Regional Research; and

   C. A list of Exhibits to accompany this brief.

FUNDING CANADIAN URBAN RESEARCH

4. Virtually all the research funds so far made available to this Council (over $100,000 a year) have been entrusted to us by the Ford Foundation; but neither they nor we look upon that dependence as permanent. The costs of administering grant programs and rendering bibliographic and other services have been met with funds received by the Council under the National Housing Act (also averaging about $100,000 a year). These receipts and corresponding disbursements are shown in Exhibit A for 1966-67.

5. The Council retained expert consultants as to our prospects of raising funds from Canadian corporations; we were told that corporation officers can see no incentives or tangible returns to warrant their direct subscriptions to basic urban studies, and regard such work as properly supported from the taxes they pay. Advice received in 1967 on the Council's 'fund-raising potential' is in Exhibit B.

6. In 1967 we commissioned a survey of public spending in Canada on urban and regional research as we understand the terms; in this we had the ready co-operation of the Dominion Bureau of Statistics. The results, applying to fiscal 1965-66 (then the latest year of record) are detailed in Exhibit C. Most of the effort was on local, short-term, isolated problems. The aggregate expenditures were as follows:

	$	%
Federal Expenditure:	1,261,730	18.3
Provincial Expenditure:	3,139,290	45.5
Main Municipalities & Groups:	2,500,945	36.2
Total from these Sources:	$ 6,901,965.	100.

7. The Committee is invited to judge the adequacy of this spending rate on urban and regional research by any of several yardsticks:

(1) Total research as a fraction of total urban investment: urban

capital formation is running at about $10 billion a year in Canada, of which about $3 billion is for housing and $1 billion is federal housing money; so for every $10 we spend on urban buildings and equipment we are spending less than $0.01 on analysis of urbanisation; or for every 10 federal dollars invested in housing hardly more than a cent is spent on urban and regional research.

(2) Urban research relative to other kinds of research: Canada's current spending on R & D amounted to nearly $525 million in 1965-66 (Science Council Report No.4, 1968) and of this about $25 million was spent in the human sciences (Dominion Statistician before this Committee, 5 February 1969); so this highly urban and rapidly urbanising nation spends out of each 100 research dollars at most about $4.75 in the human sciences and of that hardly $1.90 on urban problems.

(3) Access to adequate urban knowledge from outside Canada: no-one will contend that the problems of building and governing Canadian communities can more often be solved with knowledge imported 'ready-made' than can problems in other fields of knowledge; on the contrary, it is almost axiomatic that the issues faced by distinctive human groups in unique physical settings are of the kind most deserving of on-the-spot research.

(4) Numbers of Canadians competent to work in this field: this was until recently a real limitation on the amount of work that could be done, but growth of university staffs and graduate enrollment in the social sciences is rapid (see Canada Council Annual Report 1967-68, pp. 52-55) and within that group urban and regional studies have grown as fast as any, as indicated in Exhibit D.

(5) Research investment needed to obtain significant results: the complexity and interrelatedness of urban problems, hence the range of skills required to tackle them usefully, set high

thresholds of minimum effective research investment in this field; with limited funds we have met multiplying research proposals with grants averaging only about $8,000 each, by referring what we cannot fund to those who might do so, and by seeking to link individual researches around major themes (see Appendix E); in this we agree with the case argued by the Science Council (Report No.4, 1968, pp.29-42) that the Canadian urban environment can be markedly affected only by a major program of urban research.

Recommendation on Funding

8. Each of these five yardsticks leads us to the conviction that the scale of Canadian urban and regional research effort should be magnified in the next few years by at least two or three times, that is to say from under $10 million a year from all sources to something like $25 million a year. Only an increase of this order will make headway against the urbanisation issues being encountered, by exploiting the able and willing talents becoming available in Canada. It is also clear from our experience and surveys that most of the new money required for fundamental urban research will have to be federal money.

THE COUNCIL'S URBAN INFORMATION SERVICE PROPOSAL

9. Those who established the Canadian Council on Urban and Regional Research had an important information function in mind: one of our Charter objects is "to facilitate efforts to gather, analyze, co-ordinate and distribute available knowledge". Those who need urban information should be served as well as anyone else with important decisions to make. We are engaged in raising about $150,000 to prepare an outline specification for a modern Canadian urban information service; this service would belong not to the Council, but to its users.

10. Canada has plenty of cause to want its own urban information service. We have our own customs, constitution, languages and cultures as reasons for believing we shall not be well served by depending wholly on someone else's network. We know that we are spending millions of dollars a year looking for urban information, sometimes not getting it in time, sometimes never getting it but having to take decisions without it. We believe that the technology and facilities developing in the statistical field, and taken for granted in the physical and life sciences could be parallelled for the use of people facing urban issues of every sort. We learn of new channels of communication to be built across Canada in the next few years.

11. By 'urban information' is meant those facts, documents and experience useful for the management of the affairs of urban centres and urban regions. The Council believes it is possible to devise methods by which those who need this urban information (no matter how isolated) will spend less time and money seeking it and will be able to locate and obtain what they want precisely and quickly. The first aim of the project is to clearly establish the needs of urban information users. Then to determine how best to meet these needs by improving the gathering, storing and dissemination of urban information throughout Canada: how costs can be cut, how quality of information can be improved and how to obtain co-operation among those who use or produce urban information.

12. This project has been designed with the help of agencies familiar with the problems of information delivery in both languages, including experts who assisted in the preparation of the Science Council's Special Study No.8 on scientific and technical information in Canada. Recommendations made in other areas of information have illustrated that not only are savings in time and money possible but, by providing more useful information more quickly, decisions become increasingly more effective.

13. In sum, it is the object of this Council's project to complete four steps preparatory to the establishment of a co-operative urban information service for Canadians:

1. To identify the rough profile of user needs;
2. To catalog the sources and channels now serving;
3. To discover what is now spent on search and delivery;
4. To draw an outline specification for a service that will link sources to needs more efficiently, without radical change from present money outlays. The specification should provide for links to related information networks in Canada and beyond. It should call for a built-in response by the service to the changing scope and character both of urban information sources and of user demands.

14. Funds for this project have been asked of all three levels of government. There has been amazing consensus as we shaped this effort, even though the funds are not yet assured. No-one asked to take part has declined. The result is that a very able group is ready to proceed, after many hours discussing exactly how best to use the limited weeks and dollars that can be spared. We hope to have the outlines of a possible Canadian urban information service drawn by early 1970.

15. In urban and regional affairs, a particularly strong case can be made

for the founding of an information service tailored to the needs of those with operational responsibilities. Surveys sponsored by this Council indicate a serious lag between what is known from urban research and what is put to use by way of innovations possible in daily decision-making. These decisions, both as to public works and as to private and corporate choices, are likely to last through the next generation and hence affect the well-being of millions of Canadians. The more speedily and efficiently the relevant facts and experience can be brought to the time and place of choice, the better the urban environment can be modified to respond to our changing human expectations of it.

STRUCTURE FOR DETERMINATION AND SUPPORT OF MAJOR RESEARCH PROGRAMS

16. We have urged that more coherent and ambitious programs of fundamental research should be undertaken in Canadian urbanisation and urban affairs, and that the greater funds needed for these studies can and should come mostly from the Government of Canada. The case has been made well by others (e.g. the Glassco Royal Commission Report in 1963, Vol.4, pp.225-230; or the U.S. National Academy of Sciences Report to the House of Representatives' Committee on Science: Basic research and national goals, 1965) that the best use of most of these federal funds will be obtained by placing them in non-government institutions. This case is especially clear for the human sciences and, in Canadian constitutional and cultural circumstances, perhaps clearest of all in the investigation of urban development and urban management issues.

17. The desire for responsible control of public funds for urban research has led some to recommend a central government agency to 'organize', 'co-ordinate' and 'undertake' the needed work; these ideas are prominent in the Report of the Task Force on Housing and Urban Development, 1969 (pp.70-75). But the arguments to centralize the control of research programming and funding on grounds of efficiency lose much of their force, once there is the possibility of full, free and prompt exchange of information among all the Canadian institutions concerned with the conduct and use of urban research. This information service will be especially valuable for its reports of work in progress or newly undertaken, reports essential to research programming and funding decisions.

18. With that kind of information service in being, arguments for wide participation in the shaping of major urban research programs grow stronger. We see the main arguments as follows:

(1) Each operating department of federal, provincial or local government involved in urban affairs has unanalyzed data and experience to offer to researchers, in amounts and kinds

not available elsewhere. The advantages of direct sponsorship and contact by the agency with the researchers lie not only in access to these resources, but also in the greater likelihood that the study will be oriented towards the realities faced by the agency and that agency leaders will believe in the research findings that they have seen develop. This point of view is set out in our seminar proceedings 'The Uses of Urban Research' (Exhibit F). For these reasons there will always be many public bodies harbouring and sponsoring urban studies in Canada. So long as there is a network of contacts among agencies and researchers, so that intentions, awards, progress reports and findings are fully communicated, this freedom of sponsors and researchers to pair off in their mutual pursuits can make for discoveries and applications not possible under single, central direction.

(2) This Council enjoys frequent informal contacts with those in charge of many other research-supporting programs, in governments, the Canada Council, foundations and elsewhere. There are observable differences in grantor attitudes. Government agencies are loath to make grants for studies that might seriously call in question their reason for being, or that are likely to raise issues far beyond their departmental or constitutional jurisdiction. They are likely to have to pay for assessors' advice, which we have never done. They may at times be unwilling to see findings published. So while a department or a government may be the appropriate supporter of many kinds of urban study, there are other important kinds it cannot or will not support. The American (and some Canadian) foundations, and such extra-governmental bodies as this Council, have helped in this area. The federal government should seek removal (e.g. by tax agreements) of the present deterrents to federal incorporation of private Canadian foundations for support of scientific and scholarly pursuits. In any case,

there will continue to be a vital place for non-governmental judgment in the placing of urban research funds in Canada.

(3) The rapid increase of knowledge will require that judgment about new and substantial investments in urban research should be made in consultation with the people most au courant of recent work; in every expanding field of knowledge, these tend to be the younger members of university faculties, because the obsolescence of concepts is faster than the education or replacement of senior professors or officials can be. In any case, productive research will be planned best with the free participation of those who are to carry it out; forced labour on imposed intellectual assignments has repeatedly proven a wasteful way to try to expand knowledge. The general case for joint consultation by government and university people in formulation of major research programs (among which Canadian urbanisation will be included) is well made by Joseph Ben-David in Fundamental Research and the Universities, OECD, 1968 and by Alan Waterman in Science, AAAS, January 1965.

(4) Investment in research inevitably involves a willingness to take chances. We believe that, by reason of our special objectives and good fortune over half a dozen years, we are as well able to judge the merits of Canadian urban research proposals as any other institution; there would be cause for surprise if we did not think so. Yet we are not so sure of our judgment as to believe that any research proposal that had been unsuccessful with us should find no other application route open. That, we think, is the kind of outcome that centralisation of research support would lead to. We heartily support the conclusion on this matter reached in Science Council Special Study No.7, (p.156).

19. In the light of all these considerations, we recommend that the federal

government should begin to multiply its spending on urban and regional research; it should immediately support the establishment of a bilingual urban information network of the kind we are outlining; and it should then encourage the shaping of urban research programs and the allocation of government funds to those programs according to the fully-informed wisdom of a variety of regional and extra-governmental groups in Canada.

CONCLUSIONS

20. Your Committee is charged to report on:

(a) Trends in R & D Expenditure in Canada:

We have shown that in urban and regional research the outlays have been tiny; that the urgency of the specifically Canadian issues and the talents able to tackle them warrant spending at least two or three times as much money per year right away; and that most of that increased funding will have to be from federal sources. Ways should also be found to encourage federal incorporation of private foundations.

(d) Principles, Long-term Requirements and Structural Organization:

We contend that the nature of Canada and the imminence of speedy and selective communication of urban knowledge throughout this land make for the devolution of responsibilities for formulating major urban research programs and for allocating funds to carry them out; and that major responsibilities be devolved to extra-governmental bodies, for the sake of free yet informed coupling of abilities and resources, powers and concerns.

All of which is respectfully submitted,

Jean-Marie Martin	Président
C. McC. Henderson	Vice-Chairman
Robert Adamson Eric Beecroft William Teron	Directors
Humphrey Carver Peter Dobush	Members
Alan Armstrong	Executive Officer

for Canadian Council on Urban and Regional Research

Appendices Attached

APPENDIX A/APPENDICE A

CANADIAN COUNCIL ON URBAN AND REGIONAL RESEARCH
CONSEIL CANADIEN DE RECHERCHES URBAINES ET REGIONALES

The following officers of the Council have taken part in preparing this submission and would like to be present when it is heard by the Special Committee of the Senate on Science Policy:

Les officiers du Conseil ayant participé à la préparation de ce mémoire et désirant assister à sa présentation devant le Comité Spécial du Sénat sur la Politique Scientifique, sont les suivants:

Jean-Marie MARTIN

Président du Conseil; professeur d'économique à l'Université Laval; conseiller en rénovation urbaine; membre de l'Institut Canadien d'Administration Publique; anciennement président du Conseil supérieur de l'éducation du Québec; conseiller à l'Union des municipalités du Québec, au Conseil canadien du bien-être et à la Fédération des co-opératives d'habitation du Québec.

Cyril HENDERSON

Municipal manager of the District of North Vancouver; previously manager of the new city of Kitimat. Named to the Urban Research Council by the Canadian Federation of Mayors and Municipalities; served on the Council's research committee and Board of Directors.

Robert ADAMSON

Executive Director and Chief Economist at Central Mortgage and Housing Corporation; formerly research assistant with the University of Toronto's Metropolitan Housing Research Project; (for further details see Proceedings of this Committee, No.33, 27 February 1969).

Eric BEECROFT

Past Chairman, founding member and Director of Council; Director, Urban and Regional Development Studies, University of Western Ontario; former director of the Canadian Federation of Mayors and of the Community Planning Association of Canada.

Humphrey CARVER

Former Director, Member of Council; Fellow and former President, Town Planning Institute of Canada; Author, "Cities in the Suburbs" etc.; first Chairman, Advisory Group, C.M.H.C.

Peter DOBUSH

First Chairman of Council; senior partner, Dobush, Stewart, Bourke, Longpré, Marchand, Goudreau, Architects, Montreal; Fellow of the Royal Architectural Institute of Canada.

William TERON

Director of Council; President, William Teron Limited; Vice-President, Canadian Interurban Properties Limited; Member, Board of Governors, Carleton University, and of National Arts Centre; developer of the new town of Kanata, near Ottawa.

Alan ARMSTRONG

Executive Officer of the Council; was Secretary of the Committee of Inquiry into the Residential Environment of the Royal Architectural Institute of Canada; first Director of the Institute for Community Planning, University of Science and Technology, Kumasi, Ghana; former member, Advisory Group, C.M.H.C.

CANADIAN COUNCIL ON URBAN AND REGIONAL RESEARCH

APPENDIX B

Origin and Composition:

B.1 Responsible officials and building professionals impelled this Council into being in 1962, because they felt the need for a richer common stock of intellectual capital on which to base the performance of their various tasks. They recognized many of the human questions raised by rapid Canadian urbanisation as distinctively our own to solve, even if we share with the rest of the world the technical achievements and changing economy that give rise to that urbanisation. Human questions in Canadian urbanisation call for the concerted and sustained attack that the Science Council identifies with major research programs.

B.2 The Urban Research Council consists of 60 persons concerned with the promotion, conduct and use of urban and regional research. Local, provincial and federal officials, university teachers and leaders of the building industry and professions are found on the Council and in its Board and committees. This feature of its constitution enables the Council to examine urban research needs and policies in the round, some of us as scholars seeing free inquiry as a good in itself, and others among us as practitioners attentive to the conduct of research missions that meet special needs. In the Council we have found an instrument for agreeing upon programs and allocating very limited resources towards both demands, an instrument perhaps not possible within a single public agency, government or learned society. Academic work gains through the Council by access to operational experience, and official studies are enriched through the Council by the resources and perspective of the universities.

Council Activities:

B.3 Now in its seventh year of activity, the Council has concentrated its early efforts as necessary to open up a relatively unfamiliar field of research: discovering able and willing urban researchers; assembling them with other specialists to identify urgent and practicable sequences of inquiry; finding funds to support the investigations (either by gift to the Council or by referring sound proposals to sources from which they could be supported directly); administering modest grants-in-aid and helping the researchers to complete and publish their work; producing our own classified indexes of urban research in progress or recently published; conducting surveys about urban research; and in other ways.

B.4 The inputs to the Council have been roughly equal amounts of money from The Ford Foundation and the Government of Canada (about $750,000 each in 7 years) and the time and energy of the Council's members and advisers (which have been freely contributed and in alternative employments would be worth at least as much as either kind of cash revenue). The Council's own research funds represent something like one-twentieth of a typical year's Canadian spending on urban research. To discover the sources and purposes of governmental spending we commissioned (with D.B.S. co-operation) the Survey reported in Exhibit C; in doing so we found that most urban research money was being spent in narrow and local investigations and that most of the sponsors said they lacked a view of Canadian urban research effort as a whole. This and other evidence has led to the formation of the Intergovernmental Committee on Urban and Regional Research, on which the ten provincial governments and the federal government have seats; we welcome this ally in our field, as we welcome the bodies set up to some degree in imitation of this Council in Britain and Australia. Our clearinghouse function has assumed increasing importance.

Maintaining Contacts between Worlds of Research and Action:

B.5 Our Council performs several services to the Canadian urban research community in addition to the award of research grants. The Council was formed to constitute a bridge between those engaged in urban teaching and research and those in need of sounder systematic knowledge and better access to that knowledge for the resolution of pressing problems of urban policy and management. Our most tangible service to the communities of urban affairs and urban research has been the classified and indexed list of Canadian urban documents we publish as Urban & Regional REFERENCES; these help the administrator to find what has been written on the problem he faces, and aid student and teacher to identify materials on which learning or further research must feed. Our practice is to encourage scholars to make full use of the operational data available in their own milieu as they tackle research, and to direct administrators to the university resources relevant to their operational problems.

B.6 Consistent with our aim to disseminate as well as develop new urban knowledge, we make payment of the full amount of a research grant conditional upon publication of research findings, even if only in the form of a research note on an unrewarding attempt. Over 120 documents have resulted from Council-aided undertakings to date. We have seen to the deposit of all these and many other urban documents (including those submitted to us for listing in REFERENCES) in the National Library of Canada, thus making sure that each is entered in their general bibliography <u>Canadiana</u> and is available to any Canadian who may need it, through inter-library loan. This is of some importance, as many urban documents are produced in limited quantities for local administrative use, but contain data and analysis of use to a rapidly-growing body of Canadians. So far as this Council is concerned, research results should always come into the public domain; we are glad to see the recommendation on this in Science Council <u>Special Study</u> No.7 (p.161).

B.7 All the operations of the Council have been carried on with the combined advice of administrators and teachers, men and women of urban affairs in the widest sense. (Indeed a considerable number of the Council's officers and members move during their terms between governmental and university appointments, or divide their time between teaching and operational activities.) We have followed the careers of over 100 young people who gained their initial experience of urban research procedures as graduate student assistants on Council-aided research projects, and find that nearly all are now launched as practitioners or teachers in urban affairs; in the long run this may be the most vital contribution the Council has made, in awarding some 70 grants totalling about $600,000 during six years of activity.

Objectives and Priorities:

B.8 Thoughtful scientists of many kinds, from Waddington the biologist to Seaborg the physicist, have pointed out that modern science and technology are almost able to bend energy and materials to any conceivable purpose; but man remains alarmed at what may happen when millions of people choose to indulge in these marvels of technique, without regard for wider environmental and social effects. The urgent and difficult questions now are these questions of human choice and consequence. The scientists who have arranged miracles of astronavigation say these earthbound human problems are beyond them. Indeed their main efforts have gone (as pointed out by Boguslaw in The New Utopians) towards the virtual elimination from their work of the factors of human variability, judgment and frailty. Yet as men and women crowd into greater and greater cities, it seems to be precisely in order to express their individual abilities and assert the widest range of individual choices. Mechanistic or authoritarian solutions in housing accommodation, traffic control, administration of education and police power in the great city run counter to these personal expectations, and the collisions lead to protest, dislocation and violence.

B.9 These considerations lie behind the Council's emphasis on the consequences for Canadians and Canadian communities, both in its general selection of fields of urban research for support, and in its designation of those broad urban issues on which the Council will itself initiate major programs. In the briefest of terms, four of these themes being pursued by the Council are described as follows:

The Metropolis

(1) Given that Canada is to have more and more city folk, why are they so largely congregating in a few big metropolitan centres? Would it be worthwhile to opt for more cities, none of them inhabited by so many millions of people as greater Montreal or Toronto may expect to have by the year 2000 on present trends? What would be the advantages and disadvantages for the Canadian people as a whole in other possible distributions of our next 10 millions of urban population? Are our governments able to work together to achieve a more advantageous distribution? Or are the present results of individual human choices immune to collective intervention? Are governments in pursuit of other ends reinforcing the present trend to urban concentration unknowingly, and without counting the ultimate costs?

The Region

(2) Canadians are exercised to find how unequal are the opportunities from one part of the country to another. In response, our senior governments are fashioning bold programs of regional development. What is to be the future of the urban centres in these special development regions? What exactly is the part to be played by urban communities and facilities in the success of these great regional programs?

Large Projects

(3) We sense that the pattern and quality of cities is changing under the impact of new transport and communication devices and we see that the new landmarks in our cities are typically development superblocks of enormous size and influence. Each great new work is urged for its own purpose, to speed movement or enhance commerce, and on its own terms it may serve well. But these huge new works cast shadows on the surrounding city; they often displace beloved places and have other unintended effects now shown in the records of their sponsors. What do

these side-effects cost? Who pay those costs? Would a wider urban accounting make for different solutions to Canadian urban development and transport needs?

New Urban Managers

(4) Three-quarters of Canadians live in cities and this ratio is still rising. Municipal governments have no choice but to appropriate a growing share in the national economy and to engage thousands of new employees every year. Are we getting the able urban managers we need? What is being done to prepare young Canadians for these administrative careers that will be so vital to the future health and well-being of the nation?

APPENDIX C/APPENDICE C

CANADIAN COUNCIL ON URBAN AND REGIONAL RESEARCH
CONSEIL CANADIEN DE RECHERCHES URBAINES ET REGIONALES

EXHIBITS / PIECES

A. Council 1968 Annual Report /
Rapport annuel du Conseil, 1968

B. Report on Fund-raising Potential 1967

C. Survey of Spending on Urban-Regional Research, 1968 /
Aperçu des dépenses publiques pour la recherche urbaine-régionale, 1968

D. Canadian University Units with Special Interest in Urban Affairs, 1969

E. Research Themes to be Explored, 1967 /
Les problèmes à explorer, 1967

F. The Uses of Urban Research, 1964

First Session—Twenty-eighth Parliament
1968-69

THE SENATE OF CANADA

PROCEEDINGS
OF THE
SPECIAL COMMITTEE
ON
SCIENCE POLICY

The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*
The Honourable DONALD CAMERON, *Vice-Chairman*

No. 63

FRIDAY, JUNE 13th, 1969

WITNESSES:

The Canadian Chemical Producers' Association: Dr. Bertrand B. Hillary, Chairman, Research and Development Committee, Dr. Herman F. Hoerig, Vice-President, Research and Development, Du Pont of Canada Ltd., Mr. John Stuart Dewer, President, Union Carbide of Canada; Canadian Pulp and Paper Association: Mr. R. M. Fowler, President; Pulp and Paper Research Institute of Canada: Dr. Pierre Gendron, President; Machinery and Equipment Manufacturers' Association of Canada: Brigadier-General C. A. Peck, General Manager; Pharmaceutical Manufacturers' Association of Canada: Dr. William Ward Wigle, President; Dr. Bernard Belleau, Senior Consultant, Bristol Laboratories; Canadian Electrical Manufacturers' Association: Mr. K. H. Rapsey, President, Mr. J. C. R. Punchard, Assistant Vice President, Northern Electric Co. Ltd., Mr. E. G. Samis, General Manager, Mr. A. R. T. Hailey, Manager, Engineering Laboratory, Canadian General Electric Co. Ltd.; Electronic Industries Association: Mr. Léon Balcer, President, Mr. J. Sutherland, Vice-President, Mr. Maurice Kenyon Taylor, Director, Research and Development, Ferranti-Packard Ltd., Dr. J. J. Green, Litton Systems (Canada) Ltd.

APPENDICES:

139—Brief submitted by The Canadian Chemical Producers' Association
140—Brief submitted by Machinery & Equipment Manufacturers' Association of Canada
141—Brief submitted by the Canadian Pulp and Paper Association, and the Pulp and Paper Research Institute of Canada
142—Brief submitted by the Pharmaceutical Manufacturers Association of Canada
143—Brief submitted by the Canadian Electrical Manufacturers' Association
144—Brief submitted by the Electronic Industries Association

20650—1

MEMBERS OF THE SPECIAL COMMITTEE

ON

SCIENCE POLICY

The Honourable Maurice Lamontagne, *Chairman*

The Honourable Donald Cameron, *Vice-Chairman*

The Honourable Senators:

Aird
Belisle
Blois
Bourget
Cameron
Carter
Desruisseaux
Giguère
Grosart
Haig
Hays
Kinnear
Lamontagne
Lang
Leonard
McGrand
Nichol
O'Leary (*Carleton*)
Philips (*Prince*)
Robichaud
Sullivan
Thompson
Yuzyk

Patrick J. Savoie,
Clerk of the Committee.

ORDERS OF REFERENCE

Extract from the Minutes of the Proceedings of the Senate, Tuesday, September 17th, 1968:

"The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That a Special Committee of the Senate be appointed to consider and report on the science policy of the Federal Government with the object of appraising its priorities, its budget and its efficiency in the light of the experience of other industrialized countries and of the requirements of the new scientific age and, without restricting the generality of the foregoing, to inquire into and report upon the following:

(*a*) recent trends in research and development expenditures in Canada as compared with those in other industrialized countries;

(*b*) research and development activities carried out by the Federal Government in the fields of physical, life and human sciences;

(*c*) federal assistance to research and development activities carried out by individuals, universities, industry and other groups in the three scientific fields mentioned above; and

(*d*) the broad principles, the long-term financial requirements and the structural organization of a dynamic and efficient science policy for Canada.

That the Committee have power to engage the services of such counsel, staff and technical advisers as may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to examine witnesses, to report from time to time, to print such papers and evidence from day to day as may be ordered by the Committee, to sit during sittings and adjournments of the Senate, and to adjourn from place to place;

That the papers and evidence received and taken on the subject in the preceding session be referred to the Committee; and

That the Committee be composed of the Honourable Senators Aird, Argue, Bélisle, Bourget, Cameron, Desruisseaux, Grosart, Hays, Kinnear, Lamontagne, Lang, Leonard, MacKenzie, O'Leary (*Carleton*), Phillips (*Prince*), Sullivan, Thompson and Yuzyk.

After debate, and—
The question being put on the motion, it was—
Resolved in the affirmative."

Extract from the Minutes of the Proceedings of the Senate, Thursday, September 19th, 1968:

20650—1½

"With leave of the Senate,

The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That the name of the Honourable Senator Robichaud be substituted for that of the Honourable Senator Argue on the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—

Resolved in the affirmative."

Extract from the Minutes of the Proceedings of the Senate, Wednesday, February 5th, 1969:

With leave of the Senate,

The Honourable Senator McDonald moved, seconded by the Honourable Senator Macdonald (*Cape Breton*):

That the names of the Honourable Senators Blois, Carter, Giguère, Haig, McGrand and Nichol be added to the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—

Resolved in the affirmative.

ROBERT FORTIER,

Clerk of the Senate.

MINUTES OF PROCEEDINGS

FRIDAY, June 13, 1969.

Pursuant to adjournment and notice the Special Committee on Science Policy met this day at 10.00 a.m.

Present: The Honourable Senators Lamontagne (*Chairman*), Carter, Grosart, Haig, McGrand, Robichaud and Yuzyk—7.

In attendance: Philip Pocock, Director of Research (*Physical Science*).

The following witnesses were heard:

THE CANADIAN CHEMICAL PRODUCERS' ASSOCIATION

Dr. Bertrand B. Hillary, Chairman,
Research and Development Committee.
Dr. Herman F. Hoerig, Vice-President,
Research and Development, Du Pont of Canada Ltd.
Mr. John Stuart Dewer, President, Union Carbide of Canada.

CANADIAN PULP AND PAPER ASSOCIATION

Mr. R. M. Fowler, President.

PULP AND PAPER RESEARCH INSTITUTE OF CANADA

Dr. Pierre Gendron, President.

MACHINERY AND EQUIPMENT MANUFACTURERS' ASSOCIATION OF CANADA

Brigadier-General C. A. Peck,
General Manager.

PHARMACEUTICAL MANUFACTURERS' ASSOCIATION OF CANADA

Dr. William Ward Wigle, President.
Dr. Bernard Belleau, Senior Consultant, Bristol Laboratories.

CANADIAN ELECTRICAL MANUFACTURERS' ASSOCIATION

Mr. K. H. Rapsey, President.
Mr. J. C. R. Punchard, Assistant Vice-President,
Northern Electric Co. Ltd.
Mr. E. G. Samis, General Manager.
Mr. A. R. T. Hailey,
Manager, Engineering Laboratory
Canadian General Electric Co. Ltd.

ELECTRONICS INDUSTRIES ASSOCIATION

Mr. Léon Balcer, President.
Mr. J. Sutherland, Vice-President.
Mr. Maurice Kenyon Taylor, Director, Research & Development
Ferranti-Packard Ltd.
Dr. J. J. Green, Litton Systems (Canada) Ltd.

(*A curriculum vitae of each witness follows these Minutes*)

The following are printed as Appendices:

No. 139—Brief submitted by The Canadian Chemical Producers' Association.

No. 140—Brief submitted by Machinery & Equipment Manufacturers' Association of Canada.

No. 141—Brief submitted by the Canadian Pulp and Paper Association, and the Pulp and Paper Research Institute of Canada.

No. 142—Brief submitted by the Pharmaceutical Manufacturers Association of Canada.

No. 143—Brief submitted by the Canadian Electrical Manufacturers Association.

No. 144—Brief submitted by the Electronic Industries Association.

At 12.40 p.m. the Committee adjourned to the call of the Chairman.

ATTEST:

Patrick J. Savoie,
Clerk of the Committee.

CURRICULUM VITAE

Balcer, Hon. Leon, P.C., Q.C.: Born in Trois-Rivières, P.Q., on October 13, 1917, son of Leon Balcer and Berthe Harnois. Schools: Kindergarten, Daughters of Jesus, Trois-Rivières; Trois-Rivières Seminary; Laval University, Quebec. Degrees: B.A., LL.L., (Law, Laval). Admitted to the Quebec Bar in July 1941. Married on September 8, 1943, to Geneviève, daughter of Hon. Élisée Thériault of Quebec. Two children: Pierre and Nicole. 1941-1945: On active service with the Royal Canadian Navy. January 1946: Started Law practice in Trois-Rivières. 1946-1949: Secretary-Treasurer of the Town of Trois-Rivières, and of the School Board of the Banlieue of Trois-Rivières. 1947: Secretary of the Provincial Committee of the rights of married women. 1948: Secretary of the Provincial Committee on juvenile delinquency. Elected for the first time on June 27, 1949, member of Parliament for the constituency of Trois-Rivières. Re-elected in 1953, 1957, 1958, 1962 and 1963. 1950-1953: President of Young Conservatives of Canada. 1952: Named Queen's Counsel. 1952: Canadian delegate to the Sixth Session of the United Nations in Paris. 1955: Delegate to the "Association des Parlementaires" of NATO in Paris. January 1956: Elected President of the Conservative Association of Canada. December 1956: President of the Conservative Convention for the election of a leader. June 21, 1957: Sworn to the Privy Council and appointed Solicitor General of Canada and Acting Minister of Mines and Technical Surveys. July 1957 to April 1963: Permanent member of the Treasury Board of Canada. November 1958: Delegate of the Canadian Government at the funeral of His Holiness Pope Pius XII, in Rome. October 1959: Chief of the Delegation of Canada to the 15th Session of GATT Conference in Tokyo, Japan. November 1959: Chief of the Delegation of Canada to the 9th Conference of the Colombo Plan, in Djakarta, Indonesia. October 11, 1960 to April 1963: Minister of Transport of Canada. June 1966: Liberal Candidate in the Provincial General Election. October 1966: Appointed Vice-President of Marsh & McLennan, Montreal. June 1969: Appointed President of the Electronic Industries Association of Canada.

Belleau, Dr. Bernard: 1947, B.Sc. University of Montreal; 1948, M.Sc. University of Montreal; 1950, Ph.D. McGill University; 1955-1958, Assistant Professor, Laval University; 1958-1961, Associate Professor, Ottawa University; 1961 to present, Professor, Ottawa University. Chairman, Advisory Board, Defence Research Establishments; Recipient of the Merck, Sharpe and Dohme Award; Centennial Medallist; Fellow of the Royal Society of Canada; **Regional Editor:** *Life Sciences;* Associate Editor: *Canadian Journal of Biochemistry;* Associate Editor, Molecular Pharmacology; Senior consultant, Bristol Laboratories; Total papers published: 56.

Dewar, John Stuart: President and Director of Union Carbide Canada Limited, Born June 24, 1918, Guelph, Ontario. Queen's University (B.Sc., Chemical Engineering) 1941. After graduation joined Defense Industries where he remained until 1943 when he joined National Carbon Company, Toronto, as a Chemical Sales Engineer. Subsequently served in many capacities and became President of the company in 1955. In 1956 became Vice-President of Union Carbide Canada Limited; Director in 1959; Executive Vice-President in 1963 and President in 1965. Director of the Toronto-Dominion Bank. Memberships: National Research Council; Advisory Council to Minister of Industry, Trade and Commerce; Canadian Council of National Industrial Conference Board—Vice-Chairman, 1968-1969; The Canadian Chemical Producers' Association, Past Chairman; Queen's University, Board of Trustees; York University, Advisor Council of School of Business.

Fowler, Robert MacLaren, LL.D., B.A.: President, Canadian Pulp and Paper Association and President, Newsprint Association of Canada. Personal: Born December 7, 1906 at Peterborough, Ontario, the son of the late Mr. and Mrs. E. Bruce Fowler. Married in 1934 to Sheila Gordon Ramsay, of Toronto, daughter of Mr. and Mrs. A. Gordon Ramsay. Five children. (Diana, Robert, Bruce, Philip, Robin). Educated: Peterborough Public Schools and Collegiate Institute. Edward Blake Scholarship in Mathematics to the University of Toronto. Honour graduate in Mathematics, University of Toronto, 1928; Honour graduate in Law, Osgoode Hall, 1931. LL.D., University of Montreal, June 1961. 1931-37, Practiced law in Toronto with McMaster, Montgomery, Fleury & Company, engaged in litigation and commercial legal practice. 1937-39, Royal Commission on Dominion-Provincial Relations (Rowell-Sirois Commission)—first as legal Secretary to the Chairman, Chief Justice N. W. Rowell, and later as one of the secretaries of the Commission participating in the preparation of the Commission's report. 1939-45, Practiced law in Toronto with McCarthy & McCarthy, engaged in litigation and insurance and commercial practice. 1942-45, Secretary and General Counsel of Wartime Prices and Trade Board, Ottawa. 1945, Appointed president, Canadian Pulp and Paper Association and Newsprint Association of Canada. He is also associated with the legal firm of Gowling, MacTavish, Osborne, and Henderson, Ottawa. Activities: Member, Economic Council of Canada; Director, Chemcell Ltd.; Director, Canadian Enterprise Development Corp. Ltd.; Director, Automobiles Renault (Canada) Ltée.; Director, Westmount Life Insurance Company; Director, Regent Fund Ltd.; Director, Templeton Growth Fund Ltd.; Director, B. P. Canada Limited; Governor, Royal Victoria Hospital, Montreal; Co-Chairman, Canadian-American Committee; Chairman, (1953-54) Executive Council, Canadian Chamber of Commerce; President (1945-50), Canadian Institute of International Affairs; Chairman (1956-57), Royal Commission on Broadcasting; Chairman (1964-65), Federal Government's Committee on Broadcasting Clubs: St. James's and Mount Royal (Montreal), University (Toronto).

Gendron, Pierre R., B.Sc., Ph.D., (LL.D., D.Sc.hon.): President, Pulp and Paper Research Institute of Canada. Born St. Hyacinthe, Que., May 1, 1916, son of the Honourable Lucien H. and Marguerite (de Lorimier) Gendron. Educated: Catholic High School of Montreal; University of Montreal (B.Sc., 1941); University of Montreal (Ph.D., Chemistry, 1949); LL.D. (hon.) Doctory (honoris causa) University of Montreal, 1959; D.Sc., (hon.) Doctor (honoris causa) University of Ottawa, 1963. Lever Bros. Ltd., Technical Representative, 1941. Lieutenant, R.C.N., Overseas Service, 1941-45; Lieut-Commander, R.C.N.-(R); Commanding Officer, U.N.T.V., University of Montreal, 1945-53. Assistant Professor of Chemistry, University of Montreal, 1946; Lecturer, Chemistry, Columbia University, New York, 1949-50; Associate Professor, Chemistry, University of Montreal, 1952; Dean, Faculty of Pure and Applied Science, University of Ottawa, 1953-62; Vice-President, Dow Brewery Limited, 1962; President, Dow Brewery Limited, May 1964; Vice-President and General Manager, Canadian Breweries Limited, Eastern Division. Affiliations: Chairman, Montreal Section Chemical Institute of Canada, 1951; Member, Board of Directors, Chemical Institute of Canada, 1951-53; Fellow, 1956; Member, National Research Council, 1957-64; Chairman, Selection Board, National Research Council, 1960-64; Member, Defense Research Board of Canada, 1958-61; Member, Selection Committee Defense Research Board of Canada, 1958-64; Canadian Scientific Delegate to XIth General Conference, Unesco, Paris, 1958; Canadian Scientific Delegate to XIth General Conference, Unesco, Paris, 1960; Delegate Pan American Conference, Unesco, Buenos Aires.

Green, Dr. John Joseph, M.B.E., Ph.D., B.Sc., A.R.C.S., D.I.C., F.R.Ae.S., F.A.I.A.A., F.C.A.S.I., M.E.I.C.: Born Nov. 9, 1905, Portsmouth, England. 1926-30 attended London University—The Imperial College of Science and Technology—Royal College of Science. Graduated in 1928 in honours Physics, awarded Imperial College Governors' Prize in Physics. 1928-29 Busk Studentship in Aeronautics for graduate study and research. 1929-30 Beit Fellowship for scientific research. Diploma of Membership of the Imperial College (DIC) in 1929, Ph.D. Aeronautics, London University 1930. 1930-43 National Research Council of Canada, Head of Aerodynamics Laboratory, M B.E. (Civil) 1943. 1943-45 commissioned in RCAF and served as Chief Research Engineer, RCAF Test and Development Establishment. 1945 received King's Commendation for valuable service in the air, 1945-49 Chief Research Aeronautical Engineer, Air Transport Board. 1949-55 Chief Division 'B', Defence Research Board and Scientific Adviser to the Chief of the Air Staff, RCAF. 1955-59 Defence Research Member, Canadian Joint Staff and Defence Research Attache, Canadian Embassy, Washington, D.C. 1959-63 Chief Superintendent Canadian Armament Research and Development Establishment. 1963-69 Director of Research, Litton Systems (Canada) Limited. 1969- Director of Government Relations, Litton Systems (Canada) Limited. 1954 first President, Canadian Aeronautical Institute (now the Aeronautics and Space Institute). 1962 President, Canadian Aeronautics and Space Institute. Member, International Council of the Aeronautical Sciences and Chairman of its Executive Board. Honorary Life Member, American Association of Airport Executives; Member, Institute of Navigation; Member, Society of Automotive Engineers; Senior Member, American Astronautical Society; Editor-in-Chief, C.A.S.I. Journal; Member, Boards of Award, Laura Taber Barbour Flight Safety and Daniel Guggenheim Medal; Member, Industrial Advisory Committee, Flight Safety Foundation; 1967 Vice-Chairman, Canadian Research Management Association; Chairman, Associate Committee on National Museums of Science and Engineering, NRC; Member, Associate Committee on Avionics, NRC; 1954 Eleventh Commonwealth and Empire Lecturer before the Royal Aeronautical Society.

Hailey, Arthur Roberts Trail, B.A.Sc., P. Eng.: Manager, Engineering Laboratory, Canadian General Electric Co. Ltd. Born: Vancouver, November 15, 1914. Educated: Elementary and Secondary Schools, Vancouver; University of British Columbia (Electrical Engineering) 1941. Joined Canadian General Electric in 1941, serving in various machine design, supervisory and engineering management positions. Appointed to present position in 1962. Membership: National Research Council Advisory Committee on Applied and Engineering Research, University of Western Ontario Materials Advisory Committee; Association of Professional Engineers of Ontario; American Society for Testing and Materials, Canadian Research Management Association.

Hillary, Dr. Bertrand B.: Born in Vancouver, British Columbia. University of British Columbia (Bachelor and Master degrees in Biology and Chemistry), Toronto (Ph.D.) 1939). His industrial career began with Polymer Corporation in 1942-43 during construction of the synthetic rubber plant. From 1943 to 1946 he was with Dow Chemical of Canada, Limited on the Styrene Monomer operations at the Polymer plant at Sarnia. In 1946 he transferred to the new Dow Chemical of Canada, Limited plant as Plastics Superintendent. In 1953 he was appointed Research Co-ordinator, Dow Chemical of Canada, Limited, and in 1956, Research Manager, the position he now holds. Memberships: Engineering Institute of Canada; Chemical Institute of Canada (Fellow); Canadian Research Management Association (Chairman, 1962-64); Member, Advisory Board of the Industrial Research Institute of the University of Waterloo; Chairman, Research and Development Committee of the Canadian Chemical Producers' Association.

Hoerig, Dr. Herman F.: Vice-President, Research and Development, Du Pont of Canada Limited. University of Wisconsin (Ph.D.) 1942. After research work with Goodyear Tire and Rubber Company in the United States, he became an instructor in chemical engineering at the University of Wisconsin. He joined E. I. du Pont de Nemours and Company in 1942 as a research engineer at the Yerkes Research Laboratory at Buffalo, N.Y. In 1950 he was named director of the laboratory. Dr. Hoerig later moved to the technical division of Du Pont's Foreign Relations Department and then, in 1954, to Du Pont of Canada where he became manager of the Research and Development Department in Montreal. He was named a vice-president in September 1960 and designated Vice-President, Research and Development, in April, 1969. Memberships: Chemical Institute of Canada; Society of Chemical Industry; Corporation of Professional Chemists of Quebec; Past Chairman of the Executive Council of the Canadian Chamber of Commerce.

Peck, Brigadier-General, C. A., OBE, CD: Born 1912 in New Brunswick. Bachelor of Science (Electrical Engineering), University of New Brunswick. Joined Canadian Army as second lieutenant in the Royal Canadian Corps of Signals, 1936. Overseas, 1940-45—U.K., Italy and North West Europe. Ended war service as lieutenant-colonel commanding Second Canadian Division Signals. Post-war employment included Staff College in England; command of Royal Canadian School of Signals, Kingston, Ontario; Director of Signals, Ottawa; liaison staff London, England; military commander Canadian delegation Viet Nam; deputy adjutant-General, Ottawa and Director-General Canadian Armed Forces Centennial Program, Ottawa. Retired as brigadier-general January 1968, and became General Manager MEMAC in August 1968. Married with two daughters, 22 and 20. Member of the Association of Professional Engineers of Ontario.

Punchard, J. C. R.: Assistant Vice President, Northern Electric Company Limited. Born: Toronto, Ontario 1911; Educated: Central Technical School, Toronto; University of Toronto B.A.Sc. (Electrical Engineering) 1933; Business: Radio Engineer, Northern Electric Co. Ltd., 1935; Loaned to Research Enterprises Ltd., Leaside, Ontario as project engineer on development and manufacture of AAA Mark VI Radar Equipment 1944-1945; Northern Electric study of radio Aids to Navigation 1945; Equipment Engineer 1947-49; Development Engineer 1949-50; Manager, Northern Electric, Belleville Plant 1954-60; Director of Research and Apparatus Development, Northern Electric 1960; Director of Research, Northern Electric 1962; Director of Transmission Development, Northern Electric 1965; Appointed Assistant Vice President 1968; Memberships: I.E.E.E. Fellow, Director, Region 7, 1964-65; Association of Professional Engineers of Ontario; A.I.E.E.; 1951; Engineering Institute of Canada; Interpretations Committee, Canadian Standards Association, 1955; Kiwanis Club of Belleville, President, 1957; Belleville Chamber of Commerce President, 1957; Board of Governors, Albert College, Belleville 1955-60; Ottawa Hunt & Golf Club, 1962; Canadian Delegation to C.C.I.R. Conference, Geneva, 1962; Electronics Division, Electronic Industries Association, Chairman and Vice President, 1959; Board of Directors, E.I.A., 1957-63; E.I.A. representative to Canadian Radio Technical Planning Board 1958-60; CEMA representative to Canadian Radio Technical Planning Board 1961; First Vice President, Canadian Radio Technical Planning Board 1964-67; President of C.R.T.P.B. 1967; Treasurer, Canadian Organization for Joint Research, 1968.

Rapsey, Keith H.: President, Allen-Bradley Canada Limited; Born: Port Arthur, Ontario. Educated: Schools in Port Arthur and Toronto; University of Toronto B.A.Sc. (Electrical Engineering) 1930. Scholarship in each undergraduate year and medal from the British Association for the Advancement of Science in graduating year. Business experience has been concerned with the design and production of industrial electrical motor-control equipment. Joined Allen-Bradley Canada Limited in 1954, and is also a director of that company, as well as the Allen-Bradley Company of Milwaukee, Wisconsin. Memberships: Canadian Electrical Manufacturers Association—President; Chairman of the Tariff Committee and Industrial Control Section of the Canadian Electrical Manufacturers Association; Executive Council of the Canadian Manufacturers' Association; Galt Board of Trade as President; Galt and Suburban Planning Board as Chairman; Both at Galt and at Weston, has been a member of the Board of Education.

Samis, Frederick, George: General Manager, Canadian Electrical Manufacturers Association. Born: Sarnia, Ontario, April 25, 1911. Educated: Public and high schools, Sarnia; McMaster University, B.A. 1935 (Honour Mathematics and Physics); Business: Massey-Harris Co. Ltd. 1935; Northern Electric Co. 1936; Controller of Purchasing 1948-53; Commercial Manager, 1953-59; Marketing Manager, 1959-63. Appointed General Manager, Canadian Electrical Manufacturers Association 1963. Memberships: The Board of Trade of Metropolitan Toronto; Past President, Canadian Association of Purchasing Agents; Rotary Club of Toronto; Canadian Club; Institute of Association Executives; The Granite Club; Mount Stephen Club, Montreal; Institute of Administration.

Sutherland, John Graham, B.Sc.: Born in Winnipeg, Manitoba in 1923, Mr. Sutherland graduated from the University of Manitoba in 1945 with the degree of Bachelor of Science in Electrical Engineering. He is Vice-President and General Manager, Commercial and Defence Systems Division, and a Director of RCA Limited. Mr. Sutherland joined RCA Limited in 1946 and spent 10 years in development engineering, microwave and VHF radio relay equipment, and from 1950-54 was Manager of Radio Relay Engineering Design and Development, responsible for development of wideband systems operating in the VHF microwave regions. In 1954 Mr. Sutherland was appointed Manager, Technical Products Engineering, responsible for engineering design and manufacture of electronic equipment for government and industry; in 1957 Manager, Commercial Marketing and in 1958 General Manager, Technical Products Division. He was appointed to his present position in 1960. In addition to being a member of the Corporation of Engineers of Quebec, Mr. Sutherland is a member of the Institute of Electrical and Electronics Engineers. He is Vice-President of the Electronic Industries Association of Canada and Chairman of the Electronics Division of EIA. Mr. Sutherland, his wife and three children, live at 4 Lancaster Drive, Pointe Claire, Quebec.

Taylor, Maurice Kenyon:—was born in June 1908 in Scotland. He is married with two sons, Dr. M. Martin Taylor and Vincent Taylor. He attended Oundle School in North Hampshire, England and spent two years in Kings College, Cambridge. He has been granted more than ninety patents in the electronic and electromechanical field. During the war he was responsible for the development and engineering of variations of identification equipment I.F.F. used by the Allied Air Forces of shipborne beacons. Subsequently, he inaugurated the Ferranti-Packard Laboratories in Edinborough, Scotland. In 1946, he was awarded the Page Prize by the Institution of Electrical Engineers for a thesis on pulse position modulation. In 1949, Mr. Taylor immigrated to Canada (Toronto) to open the Research Division at Ferranti-Packard Limited, returning to Scotland in 1950. In 1951, he returned to Ferranti-Packard Limited in Toronto as Chief Engineer. In 1957, he became Head of Research & Development at Ferranti-Packard, a post he had held until being appointed as Director of Research and Development in 1968. He has since been personally engaged in the design and development of electromechanical information display devices, an activity which won for him and his staff "an award of excellence" by the Canadian Design Committee in 1967. He is a member of the Association of Professional Engineers and is an Overseas Representative of the Council of the Institution of Electrical Engineers of which he is a Fellow. He is also a member of the Canadian Research Management Association.

Wigle, Dr. William Ward: Primary education: Dryden, Ontario. 1937, Success Business College, Winnipeg, Manitoba; 1938-1943, Queen's University—graduated July 1943 M D., C.M.; 1943-1944, Toronto General Hospital; 1944-1945, R.C.N.V.R.—Surgeon Lieutenant; 1945-1946, Lancaster Hospital, Saint John, New Brunswick; 1946-1949, Medical Practice in Red Rock, Ontario; 1949-1961, Dryden, Ontario—surgery and general practice in group practice with Dingwall Medical Group; 1961-1962, Medical Director, Associated Medical Services, Toronto; 1963-1965, Director of Hospital Medical Records Institute—a data processing service to assist physician and hospital; 1960-1961, President, Ontario

Medical Association; 1963-1964, President, Canadian Medical Association; 1964-1965, Director, Canadian Mental Health Association; 1965, President, Pharmaceutical Manufacturers Association of Canada; 1969, Vice-Chairman of the Board, Hospital Medical Records Institute. While in Dryden, served on Public School Board and Town Council. Past President of Dryden Rotary Club; active in United Church in Dryden. Presently an Honorary Member of the Academy of Medicine, Ottawa. Member of the Royal Society of Health, Canadian delegate to the council of the International Federation of Pharmaceutical Manufacturers.

Medical Association, 1963-1964, President, Canadian Medical Association; 1964-1965, Director, Canadian Mental Health Association; 1965, President, Pharmaceutical Manufacturers Association of Canada; 1969, Vice-Chairman of the Board, Hospital Medical Records Institute. While in Dryden, served on Public School Board and Town Council. Past President of Dryden Rotary Club; active in United Church in Dryden. Presently an Honorary Member of the Academy of Medicine, Ottawa. Member of the Royal Society of Health. Canadian delegate to the council of the International Federation of Pharmaceutical Manufacturers.

THE SENATE

SPECIAL COMMITTEE ON SCIENCE POLICY

EVIDENCE

Ottawa, Friday, June 13, 1969

The Special Committee on Science Policy met this day at 10 a.m.

Senator Maurice Lamontagne (Chairman) in the Chair.

The Chairman: Honourable senators, we have a very impressive delegation here this morning from private industry. We have representatives of the Machinery & Equipment Manufacturers' Association of Canada, the Canadian Pulp and Paper Association, the Canadian Chemical Producers' Association, the Pharmaceutical Manufacturers Association of Canada, the Electronic Industries Association of Canada, and the Canadian Electrical Manufacturers Association.

Perhaps this is the first important occasion for us to discuss what is being done in various sectors of industry in terms of research and also to discuss the government incentive program.

Without any further introduction, I will ask Dr. Hillary of the Canadian Chemical Producers' Association to make his opening statement.

Dr. Bertrand B. Hillary, Chairman, Research & Development Committee, the Canadian Chemical Producers' Association: Mr. Chairman and senators, I am very pleased to have this opportunity to make this presentation on behalf of the Canadian Chemical Producers' Association. We believe that the way you are conducting these hearings will be very fortunate for the future of science in Canada.

Before I go any further I would like to introduce the members of my delegation here. First there is Dr. Herman F. Hoerig, Vice-President, Research & Development, Du Pont of Canada Ltd.; Dr. Cameron H. Caesar, Deputy Manager, Research Department, Imperial Oil Enterprises Ltd.; Dr. John Harvard Shipley, Vice-President and Director, Canadian Industries Ltd.; and Mr. John Stuart Dewar, Past Chairman, President of Union Carbide of Canada, and Dr. E. J. Buckler, Polymer Corporation of Canada Ltd.

I would like to say a few words about the Canadian Chemical Producers' Association. It is an association of 44 chemical manufacturers in Canada. These companies must be manufacturers and have a plant in Canada and sell a major portion of their output on the open market in Canada. Let me give you a few statistics about the Chemical industry; the annual cost of R & D amounts to \$37.4 million or 1.7 per cent of the industry's sales of \$2.2 billion. To put it another way it amounts to 12 per cent of all private R & D undertaken in Canada, and many of the individual members of the association spend more than 1.7 per cent of their sales on research. These figures indicate that the chemical industry makes a major contribution to the country's economy, and this is, no doubt, the result of the extensive program of research that it carries on.

We also feel that more can be done. Before we go into how this can be accomplished I would like to help you look at and try to understand the character of the Canadian Chemical Industry, and Canada's industry in general, actually, in the problems and challenges it presents to research.

I think this is best summed up in a quotation from the Science Council's Annual Report of June, 1967, and I will quote:

> The pattern of industrial research in Canada will not be exactly the same as in other highly industrialized countries. In most of our industries, we have a unique combination of widespread geographical dispersion, extensive foreign ownership, and unusually easy access to new technology for import. Secondary industry has the additional problems of limited domestic markets and of many small companies.

This committee addressed itself not to the total innovation process, which is really the use of knowledge, but to the innovative part, the research and development aspect of innovation, and I think from this you can realize that R & D is just one facet of management's total effort to bring about change, growth, profitability, efficiency and productivity.

R & D itself can be affected by many factors. Mr. Chairman, I must apologize for this monster of a projector, but I thought it might be easier if we saw a few slides so that you could follow the visual word. All we could find was this thing, which will add to the heat, but if we turn the lights off we will get rid of some heat, to balance it off.

One of the first things affecting research is the economic environment. In the Canadian chemical industry increases in R & D commitment are most probable whenever the anticipated return on such investment is greater than for any alternative application of existing financial resources. This, in turn, is most likely to occur with improvements in the stability and the hospitability of the economic environment. This can be affected by availability of markets, size of competitive manufacturing units, combines legislation, tariffs, non-tariff trade barriers, dumping, taxation, and the costs of capital, raw materials, construction and R & D itself.

I am going to confine myself to a few remarks on the cost of R & D itself. We can, in Canada, develop entirely new chemical products, but the commercial exploitation of them is often difficult because of the high cost of market development, the limited Canadian market, and the difficulty of developing foreign markets.

Since R & D costs are high, the manufacturer must be able to anticipate a market sufficiently large that the economic returns will cover expensive R & D commitments. For this reason, the minimum R & D program required to support a newly developed product in Canada is frequently prohibitive in cost, is beyond the reach of many.

Normally, in the international chemical industry about 3 to 5 per cent of sales is regarded as an appropriate R & D expense for a new product. Certain ones, such as new resin, can go even higher.

Another point on costs is that research, to be successful, must be continuous, and this requires a large investment in buildings, equipment and staff. We look at things this way, that for every dollar spent at the bench on laboratory research, at least ten more are needed to bring the project through the pilot plant stage, and perhaps a hundred more are needed to bring it into commercial production. Then if we go on to the innovative stage, using the cost of production and marketing, and things like that, you have about as much more.

Then the next slide. One factor affecting chemical research in Canada is the import of technology, and any company in Canada that is going to be internationally competitive must import because it can only generate a small fraction of the total research that it needs—or technology, to use a broader term—and we feel we must import. Such a policy obviously requires a strong technical staff capable of detecting and recognizing relevant new developments, and then adapting and applying them to the needs of Canada.

Likewise, we must be able to export technology. This means the sale of our research and getting a return for it. It gives us the opportunity to exchange research for other research we need; it is a "swop" sort of deal. It also helps open up other export markets.

Now we come to R & D incentive programs, and I am not going to dwell at any great length on this. Our views are covered in the brief, and I am sure all of you have heard many comments, and you are going to hear more this morning. However, let us say a word or two about each one. Let us first take the IRDIA program, No. 2, the Industrial Research and Development Incentives Act. That has had the effect of stimulating research, but at a point we begin to level off and stimulation drops, and this is worrying many people. Likewise, in IRDIA the cost of administration, the cost of preparing the reports take up a large amount of technical people's time, accounting people's time, and then the subsequent hassle you get with the various departments after that, this has soured many people on its use.

One the chemical industry could use is PAIT. The restrictions on PAIT on the export of technology have meant that the chemical industry has not been able to use it to any degree, and also the fact that the results of unsuccessful research must be turned over to the Government, because you cannot segregate your technology from someone else's, and you may drop something and then go back to it at a later time. These are factors which make that program very difficult for the chemical industry to use.

I think the point there is because of the international nature of the industry, we have to be able to freely exchange information.

The Program for the Advancement of Industrial Technology has certainly been accepted and widely used, and seems to be the easiest one to live with.

We spent in this committee a great deal of time last summer arguing between ourselves and with the financial arms of our companiee, we found, because of the differences of views of the different companies and their different approaches, and when you enlarge this over all types of industry—and I am sure you will hear different views expressed today—and also the fact that we are not familiar with the problems that face the Government in setting up these programs, we felt we would refrain from making definite recommendations.

What we propose instead is that a joint industry-government study be initiated to determine the most appropriate type of support which Canadian industry needs, and then a suitable formula to administer such support. This program is already under way. There have been a number of meetings between the industry representatives and the Department of Industry, and I think we will see some modifications.

Another factor that could affect research in Canada is Government research contracts. As we are all aware, much of the research done in Canada and supported by Government is in-house, as opposed to the situation in the United States, where a great deal of government-funded research is contracted out to industry.

We feel that if we are to attain some of the national objectives now being defined by the Science Council of Canada, the Government should consider contracting out a larger part of its R & D to industrial organizations. This is because they have the competence to do an effective R & D job. Also these organizations have the major advantage of being in the most strategic position possible from which to recognize and exploit any commercial "fall-out".

R and D personnel comes in for a great deal of discussion. The chemical industry hires all types of personnel from technicians to postdoctorates. We see a possible surplus of engineers with higher degrees such as doctorates and postdoctorates, and a shortage of bachelors. In fact, the shortage of bachelors is already here, and we might also say that the surplus of Ph.D's is upon us. We feel that some means of controlling this, and some guideposts for the universities as to what kind of people to turn out, could be achieved if there was comprehensive and continuous survey which would forecast the number of graduates at all academic levels and disciplines, and relate these to the manpower requirements.

Patents and trademarks are very important to the chemical industry. Canada's existing patent laws afford deserved protection to the originators of products and processes, and thus constitute an incentive of vital importance not only to R and D itself, but also to the industrial investment which may be the result of commercially successful research. We recommend strongly that the patent laws be left as they are.

I have a few other points but I think I have run out of time, and I will turn the meeting over to someone else.

The Chairman: Thank you very much, Dr. Hillary. We shall now hear from Mr. R. M. Fowler, the President of the Canadian Pulp and Paper Association.

Mr. R. M. Fowler, President, Canadian Pulp and Paper Association: Mr. Chairman and honourable senators, I want to start by saying how pleased we are at having this opportunity of coming before your committee. We from the private sector applaud the initiative of the Senate in undertaking this inquiry. It is a crucially important one. This seems to us to be a most appropriate and useful way of making a study such as this, and we are honoured to be a part of it.

I am the President of the Canadian Pulp and Paper Association, and with me is Dr. Pierre Gendron, who is the President of the Pulp and Paper Research Institute of Canada.

The Chairman: He is also well known around here.

Mr. Fowler: I am afraid he is notorious. There is, as far as I know, no difference between the views of the two industry organizations on science policy, and we have, therefore, submitted a joint brief, which you have.

There are some differences in the memberships of the two organizations. All maintaining members of the P.P.R.I. are members of the C.P.P.A., but not all members of the C.P.P.A. are supporting members of the P.P.R.I. However, there is a substantial degree of identity between the members of the two organizations, and there is no difference at all on the subject we are discussing today.

There is one other difference between the two witnesses that are now appearing before you, and that is that in respect of any detailed, technical or scientific question Dr. Gendron is the expert, and I am not. I have only one possible advantage over him, and that is that I have been around for rather longer, and if some question comes up about history or what we have been doing in the past then I may be able to answer it.

You have our brief. I do not propose to read it in any detail, unless you want sections read for you. I want only to indicate something of what is in it, and some of its salient points.

The Chairman: I should add at this stage that all the briefs are printed as part of our proceedings.

Mr. Fowler: Starting somewhat at the wrong end, I would like to refer to some of the appendices in the brief. Appendix C gives a brief description of the prospects ahead for the pulp and paper industry of Canada. It may not give a sufficient indication of where we stand at the moment, and if I may, I will give you that now.

The gross value of last year's pulp and paper production was almost exactly $2.5 billion. Of this $1.7 billion was exported, and this was about 50 per cent of the total production. That export trade is about 13 per cent of the total Canadian export trade, and it is very close to 15 per cent of the exports to the United States.

The capital expenditures in the industry for the last five years have exceeded a quarter of a billion dollars a year, and in some years they have been considerably higher than that. The capital employed per person employed is about $30,000, so this is a highly capital intensive industry. The total employment, apart from woods employment, is about 75,000 people with an annual salary or wage bill of the order of $500 million a year.

So, by any test this industry is a major Canadian industry, and it is a large contributor to Canadian employment, trade and development.

However, the future is more important. The growth rate over 40 or more years of this industry measured in terms of wood consumption has been slightly over 4½ per cent per year, despite wars, depressions, booms, recessions, and the like. Projected at this rate of growth of wood usage the expansion of pulp and paper production, trade and employment is very considerable.

Just a couple of years ago at another meeting called by the federal Government we made some estimates on a rather conservative basis that fibre demands for Canadian pulp and paper production will rise from 17 million cunits of wood in 1965, to 27 million in 1975, and to 92 million in 2000. So, on that basis, you would have a demand at the end of the century 5½ times what it has been in recent years. It could well be at an even faster rate than this because of what appears to be a fundamental shift in the sources of supply of wood fibre which could favour Canada, but which will not necessarily do so.

We note in Appendix C that the FAO predicts that the world pulp, paper, and paper board demand will rise from 110 million metric tons in 1965 to 225 metric tons in 1980. So, there is more than a doubling in 15 years, as there has been a doubling in the preceding 15 years.

In other areas, notably Western Europe including Scandinavia, demand is rising more rapidly than there are available wood supplies. They are nearing the end of their wood reserves, and the future growth of pulp and paper production there is going to be limited by their fibre availabilities.

It is now a question of where this new demand for fibre will go. In whatever form it is—wood logs, pulp, or newsprint, or sophisticated product—it is still fibre in one way or another. Conceivably this increased demand could go to the USSR where they have enormous wood reserves, but production development there has ben lagging, and the domestic needs are growing very rapidly. Possibly this demand might go to some of the underdeveloped countries. If it did it would, incidentally, have considerable value in the context of the problems of the poorer world, but so far it has been impeded by political and economic instabilities. But, it could go in large measure to North America, and particularly to Canada.

Attention seems to be concentrated—and this is natural, I guess—on the newer and more exotic opportunities for growth in secondary manufacturing industries, and I would be the last person in the world to suggest that these are not important and exciting, but I think we should not lose sight of the opportunities in the resource industries which have been a source of Canadian economic strength in the past, and where we have proven specialized international competence. However, it must be emphasized that the potential growth for the Canadian pulp and paper industry is neither automatic nor certain. We have no world monopoly in these commodities; there are other possible sources of supply. Generally these products sell in world markets with very few tariff barriers, so trade is determined in international markets by rather fierce international competition. That fact, I suggest, Mr. Chairman, underlies the importance of research, an importance that is far greater than it has been in the past.

It should be mobilized in two main directions. The first is in forestry research and forestry practices. For years in this country we have gone along with the comfortable assumption that we had huge reserves of wood that other countries did not have, and that has been true. We still have unutilized wood resources, but the potential for increased consumption of wood in Canada is not unlimited. Some time in the last quarter of this century we will reach the limit of present available wood supplies. The important point is that wood supplies can be increased, and increased quite rapidly by improved silviculture, protection and harvesting methods. It is not just the planting of trees. You can take an existing stand and do more in the way of getting increased growth by silviculture methods, but there still has to be some planting. To do this for effect in 1980 or 1990 we have to begin now. The tree crop cycle is a long one in Canada—40, 50 or 60 years, or more—and I remind you that the time ahead to 2000 A.D. is the time back to 1948. Perhaps a few honourable senators may recall 1938!

Secondly, we need additional effort in pulp and paper technological research simply because this is an industry involved in strong competition in international markets, and that competition is increasing from our major world competitors, especially in their greater research efforts. Dr. Gendron can explain later, if you wish, on the basis of a recent European trip, what is going on in some of our competitor countries. However, we start with the technology in a reasonably good state, but we must continue to be unceasingly concerned with competence in the pulp and paper industry in the improvement of existing products and the development of new products.

Industrial research in Canada generally in the past has probably come up to the levels of research by industry in many other countries, especially the United States. While it clearly has not been as much as it should be, I think it can be said that the research effort in the Canadian pulp and paper industry has been somewhat, and perhaps considerably, better than the general average of industrial research in Canada. Some idea of this is given for your committee in Appendix B to the brief. I think one factor that has generally been lacking in Canada in comparison with, for example, United States performance, has been a failure to merge and co-ordinate research efforts between governments, industry and the universities. This has been a remarkably successful process in the United States, notably in the Boston area, where I know you have been, and in the California area. They have set up a strong interplay of ideas and manpower between government, industry and university research efforts, which is clearly beneficial.

We in the pulp and paper industry have been attempting to do this for something over 40 years, increasingly so in the last 24 to 25 years, since the war, in the Pulp and Paper Research Institute. This, as you will see from Appendix A, is a three-cornered partnership between the pulp and paper industry, the federal Government and McGill University. We can tell you more about it later on if you wish, to expand what is in the appendix. I will only say now that I think it has proved to be an increasingly useful joint effort, which conceivably could possibly be some kind of model for an approach to this problem by other industries or by the federal Government.

However, I think there are two points I should make about it. First, co-operative research is not easy to direct, stimulate and administer, especially in a highly competitive industry. Secondly, a co-operative research effort that can save duplication, and can save going over the same ground by a great many people who have had to do it, does not and cannot supply the total research needs of a major industry. You cannot just set up a joint research division and think you have dealt with your research responsibilities. Indeed, we have found that the success of the co-operative venture in practical terms in almost directly related to the existence of large research efforts in the individual companies. You must have a mechanism in each company that can understand, pick up and apply the results of co-operative research in individual company application and development. Co-operative research is extensive in both the central institution and the individual company efforts to make use of it.

The budget of the PPRIC—which today is roughly about 10 per cent of the total industry research effort—has grown steadily from something of the order of $200,000 back at the end of the war to an annual expenditure of $2½ million today, which is provided virtually entirely by the industry. I should say, however, so that it is clear to everyone, we have excellent laboratories and buildings at Pointe Claire that were provided by the federal Government.

I should say a few words about the brief itself and the appendices. The chief points are set out on page 2, and there are four short paragraphs to which I would refer you now.

1. We consider that there is an urgent need for greater consultation and coordination between government and private industry concerning the research requirements of industry, the priorities to be given specific research projects, and the appropriate agencies to be used in carrying out those projects.

2. We suggest, further, that federal Government research activities, and indeed research philosophy, receive the most careful study with a view to determining whether they reflect an adequate concern with the potential economic benefits of research to the Canadian economy. In other words, not sufficiently oriented.

The Chairman: Or perhaps innovation oriented.

Mr. Fowler: Perhaps that, yes. Innovation, and even to some extent developmental. I think you could read through the piece here. It is a little too theoretical and ivory tower, if you like.

3. We suggest that the federal Government seriously consider having a greater portion of its research carried out in the laboratories of industry. This pertains especially to applied research and development work which, as a general rule, is best performed nearest the point of application. This is much the same point as the previous speaker made.

4. Finally, we suggest that existing federal Government programs for the encouragement of industrial research in Canada be strengthened, in part, to broaden their scope and increase their usefulness, and in part, to alter their direction so as to reward successful research.

These four points are more fully developed in the succeeding pages and can be discussed if you wish in the question period. The brief concludes with the expectation that government research programs will be extensively revised and reshaped when a national science policy has been developed and articulated. Meanwhile, we make these suggestions about strengthening existing Government programs to increase their usefulness, really only as an interim or stop-gap measure for existing programs which should be particularly reviewed against the background of accepted national science policy. Unless that is done and while the programs remain on the books there is value in strengthening them and removing some of their deficiencies. That is all I need to say at the moment.

The Chairman: Thank you Mr. Fowler.

Who is going to speak on behalf of the Machinery & Equipment Manufacturers' Association of Canada?

Brigadier-General C. A. Peck, General Manager, Machinery & Equipment Manufacturers' Association of Canada: I should like to associate myself with the previous speakers in expressing my appreciation for the opportunity to be here today. I am General Manager of the Machinery & Equipment Manufacturers' Association of Canada, and I am here with Mr. Lewis, who is the President of MEMAC and Vice President of the Dominion Engineering Works in Montreal. I hope that when question time comes we will lean on him rather than to me.

Our brief on science policy outlines a few specific points which are, I am sure, not new to members of this committee, but which are ones which have been raised specifically by our own members. Our members include most of the companies in Canada whose principal business is the manufacture of industrial machinery, but exclusive of agricultural, automative, electrical, aircraft and office machinery. Our annual sales are in excess of $300 million, and our 16,000 employees include a high proportion of technically trained people—engineers, designers, draftsmen, pattern makers, machinists and other skilled trades.

Our companies are fully aware of the need for constantly improving technology as one of the essentials to competitive survival. They recognize, as well, the extent of the research which this demands if it is to be effective, and the wide range of specialists required, and the fact that few individual companies or organizations can cope with these needs on their own.

Industrial machinery normally has a long life span—10 to 40 years. It is important therefore that each new machine incorporate the latest performance and capacity improvements and innovations. This is particularly true when we are trying to get a piece of the export market, that we should introduce a product into this market which is the best of its kind before our improvements and innovations are available to the rest of the world on a full-scale basis. Such a product will normally result only from a heavy R and D program and one which obviously, as I indicated earlier, is too much for the average company to carry out on its own. The importance of some form of Government assistance obviously rates very highly in our minds.

Most companies have and R and D program as part of their product development and improvement plans, but these are necessarily limited in scope by budget considerations. The Canadian Government assistance and incentives programs are used by our members when they offer advantages, and perhaps I may comment on some of the specific points which have been raised in this area.

Some of these points are, of course, all right, such as the Industrial Research and Development Incentives Act, IRDIA. The most frequently raised point which I have heard is from industries other than our own. A firm may fail to qualify for aid at the very time its need is greatest, during a down-turn in business and when there is no increase over the previous period of R and D. The paper-work involved in applying for the aid is considered to be overly heavy, and the subsequent delay too long. Some of the information required appears to be in the trade secret category, and our members have found that on occasion they are not prepared to answer some of the questions on which they are required to give information.

Under the regulations, "development" does not include aids to the production process to increase output, but in many industries R and D to increase output of an existing process may be of greater economic importance than work on a new or novel process.

The point has been stated often that Canadian industry undertakes too little R and D on its own. Without arguing the validity of that observation, it is I think fair to say that the machinery manufacturing industry is, by its nature, more logically concerned with devoting its limited resources in this field to the application of research than to basic research itself. It seems that the existing aid programs lean toward basic or laboratory research, but tend to exclude applied work on manufacturing techniques and improvements in production.

Central Policy Co-ordinating Agency: If a national science policy is to be implemented effectively, obviously a strong central co-ordinating agency will be needed to co-ordinate the efforts of the various Government departments, agencies, universities, and other organizations now contributing to the total work in this field. From the manufacturer's point of view it is apparent that although a wealth of scientific information is being generated each year, the proportion which reaches him in a form which he can understand and use is probably small. A worthwhile central agency can render great value in collecting, collating, interpreting and distributing such information; the same agency could also serve as the medium through whom industry would acquaint the scientist with its needs and priorities.

It follows, of course, that the central agency would be in a position to identify duplication and overlapping of effort, and it should be able to co-ordinate these efforts on a national basis to ensure that available resources are being effectively used.

Senator Grosart: Can I ask if this particular comment on the strong co-ordinating agency is covered in your brief in these words?

Brigadier-General Peck: It was not in these words.

Senator Grosart: The phrase you used was "a strong central co-ordinating agency".

Brigadier-General Peck: That is right and we did not use that in the brief; I am sorry.

It should be able to assign priorities to projects, bearing in mind the economic growth which might be expected to flow from them. An international exchange of technology is essential, and it should concern itself in this field of R and D and again to avoid duplication of effort.

This is very brief, but I know that most of these points have been dealt with many times in the numerous other hearings. I said at the opening that they are points which our members have raised in particular, as applying to them. As an overall comment, we appreciate again the interest which the Government is taking in this field. We feel the potential value is great and finally we are happy to have the chance to participate in your discussion.

The Chairman: Thank you very much.

Now we have Dr. Wigle of the Pharmaceutical Manufacturers Association of Canada.

Dr. William Ward Wigle, President, Pharmaceutical Manufacturers Association of Canada: Mr. Chairman and senators, may we say how pleased we are to have the pleasure and honour to be able to come and assist in the deliberations of your committee on science policy.

Without being facetious, I might make some light reference to the fact that we welcome the opportunity of being constructive, instead of having to be defensive. We have had a fair experience of the latter.

There is a little item of popularity, which is less than one per cent of the consumer policy, but it makes a lot of difference.

Senator Grosart: This is your chance to be offensive.

The Chairman: I would prefer that it should be positive.

Senator Gorsart: I mean it in that way.

Dr. Wigle: The delegation we have today consists, first, of Mr. Edward Roger Rowe, C.A., President and Director, Bristol Laboratories of Canada Limited, chairman of the committee which prepared this brief for your Senate committee.

With him is Mr. R. G. McClenahan, Barrister and Solicitor, who is a patent and trade mark attorney in Ottawa and has considerable experience in these problems in relation to this industry. We also have Dr. Yvon G. Perron, Director of Laboratories, Bristol Laboratories of Canada, who has a Ph.D. in chemistry. We also have Dr. Bernard Belleau, Professor, Ottawa University—Senior Consultant, Bristol Laboratories. Dr. Belleau is well acquainted with the combined efforts of industry and university in the research of this particular field.

Mr. Chairman, for those who have not studied the brief—and I do not mean the committee, but the many visitors here today who have not had it—I would remind you that this association represents 58 of the research oriented pharmaceutical manufacturers who are established in Canada. We have about 12,000 employees who are directly within our industry, and the support of a total of some 25,000 who participate through other industries which are made use of in our operations.

The research expenditure by this industry in Canada has doubled in the last five years. In the last survey we did, it amounted to $12 million a year—which we think is a considerable expenditure when we remember it is equal to $1 million a month in Canada.

We have a high percentage of highly qualified people in our research, because the proportion of Ph.D's to other people is much higher than it is in research generally.

With those brief comments, I would like to read our recommendations and then wait for the questions that might be properly answered by the people we have here today.

Our association has recommended in its brief:

a) that research in the pharmaceutical industry be encouraged in Canada;

b) that interaction and co-operation between industry, university and government researchers be fostered;

I might at this point remind the committee that one of the appendices is a report of which we are very proud, where the Medical Research Council of Canada did an objective survey of the research in this industry in Canada and has given us a very glowing report.

Our recommendations continue:

c) that scientific activities of the federal government be co-ordinated as much as possible;

d) that every opportunity be sought to explain and communicate to the "public" the role, activities and benefits of science, scientists and scientific endeavours;

e) that Canada, as a technologically evolved nation, uphold her international relationships by recognizing the importance and value of the Patent Act in creating the proper incentive and environment for research in Canada;

f) that pharmaceutical manufacturers with substantial Canadian investment, employment, taxes, purchases, research and development not be discriminated against by encouragement of importers;

g) that recognition be given to the fact that only to the extent that patent protection permits, will publication of research findings by scientists continue to be a tool in retaining scientists in Canada;

h) that government assistance for industrial research take the form of tax allowances with carry forward to future years for loss years;

i) that tariffs for scientific equipment and chemicals used in research, but not made in Canada, be done away with.

With that, Mr. Chairman, I will wait for the question period.

The Chairman: Thank you very much, Dr. Wigle. Now we will have Mr. Samis, representing the Canadian Electrical Manufacturers Association.

Mr. E. G. Samis (General Manager, Canadian Electrical Manufacturers Association): Mr. Chairman and honourable senators, I wish to join my colleagues from industry in congratulating you and the committee on the monumental effort that you have put and are putting forth in an endeavour to raise the level of research and development being done in this country.

I would like to commence by introducing the members of the delegation from the Canadian Electrical Manufacturers Association. We have Mr. Rapsey, who is President of the Association and also President of Allen-Bradley Canada Limited. We have Mr. Keith Alexander, Chief Product Engineer, Canada Wire and Cable Company Limited; Mr. J. K. Carman, General Manager, Electronic and Defence Products Group, Canadian Westinghouse Co. Ltd., Mr. A. R. T. Hailey, Manager, Engineering Laboratory, Canadian General Electric Co. Ltd.; Mr. A. F. Johnston, Manager, Corporate Relations, Canadian General Electric Co. Ltd.; Mr. J. P. Jones, Corporate Director, Engineering and Facilities Planning, General Steel Wares Ltd.; Mr. A. A. McArthur, Assistant to the President, Canadian Westinghouse Co. Ltd.; Mr. C. E. McRoberts, Chief Engineer, Low Voltage Distribution Equipment, Federal Pacific Electric of Canada; Mr. R. Noonan, President and General Manager, Pioneer Electric; and Mr. J. C. R. Punchard, Assistant Vice President, Northern Electric Company Limited.

We have a fairly sizeable delegation which would be able to discuss the brief in detail as the committee would wish. We do not have a prepared statement, but perhaps I would draw attention to a few important items in the brief, and make one or two minor corrections.

The brief begins by describing the industry and its 163 companies, and a list of the products of the association. It says that the annual output of the industry is $2.3 billion, that it employs 139,000 Canadians and represents more than 90 per cent of the output of the electrical manufacturing industry in Canada.

It goes on to say that the level of the research and development expenditure is in excess of $80 million annually, which puts the electrical manufacturing industry on a pretty high level, exceeding 3 per cent of the sales dollar. I believe it is the largest single industry in dollar expenditure, exceeding 80 million annually.

The brief goes on to develop a number of points which have been already stated by others, so I will not repeat them. We put much emphasis on the need to encourage a shift of development work from government laboratories and university laboratories to industrial laboratories. That is not a new statement, but we think it is rather important.

We comment on the various research and development incentive programs now in operation, and I would like to read what we say about one of these, which happens to be an important one to this industry. I am referring to IRDIA, the Industrial Research and Development Incentive Act.

This program, administered by the Department of Industry, is, without doubt, potentially the most significant of the several government sponsored incentive programs for research and development. It is the successor program which, commencing in 1967, replaced the previous incentive provided under Section 72 (A) of the Income Tax Act.

It is the Association's opinion that IRDIA is not entirely realistic, and we suspect not fully effective, in advancing research and development in Canada. Its effectiveness may become fully evident when the final figures for 1967 become available and we learn what proportion of the applicants for assistance under this program by this industry totalling $83.8 million are approved.

The requirement for individual project application and approval is fundamentally wrong. A decision to engage in an industrial research and development program is an entrepreneurial decision of the highest order. It involves consideration of available human resources, physical resources, capital, potential markets, prices, an estimate of the competitive situation several years in advance. Decisions of this kind can best be made and can only successfully be made by thousands of individual business executives with the knowledge and experience available to them through their daily activity in a competitive environment. To expect such decisions to be made intelligently in a single location in Ottawa is a fundamental mistake in concept.

The Canadian Government, in its recent White Paper on Policies for Price Stability, recognized the impracticability of attempting to centralize such decision making in Ottawa when it said:

> Moreover, to undertake a comprehensive surveillance and review of the thousands of price and income decisions occurring regularly in all parts of our economy would require the services of a vast bureaucracy. Such a bureaucracy could operate only on the basis of highly simplified rules and standards which would conflict with the needs of a dynamic growing economy. For all these reasons, detailed review of specific price and income decisions would be highly inadvisable, and the Government rejects this approach.

Now, that is our comment on IRDIA. We think that is one of the more significant statements we have in our grief.

Mr. Chairman, there are one or two corrections I should like to make before concluding. On page 15 of the brief, paragraph 25, we used the expression IRDIA. It should have been PAIT. The equivalent change should be made in the French translation on the opposite page.

On page 21, paragraph 35, (1) the word "prior" should be removed. It is an inaccuracy to include that word, and it should be removed. Again, the French translation should also be corrected by the removal of the word "première".

The Chairman: I would now ask Mr. Leon Balcer to present the brief of the Electronic Industries Association of Canada.

Mr. Leon Balcer, President, Electronic Industries Association of Canada: Thank you very much, Mr. Chairman, but the Vice-President of our association, Mr. Jack Sutherland, will make the presentation for us.

The Chairman: Thank you.

Mr. Jack Sutherland, Vice-President, Electronic Industries Association of Canada: Before saying a few words about our brief, Mr. Chairman, I would like to introduce our delegation: Mr. Leon Balcer, P.C., Q.C., President, Electronic Industries Association of Canada; Mr. D. Carrol, President, T.M.C. Canada; Dr. P. Lapp, Spur Aerospace Limited; Dr. J.J. Green, Litton Systems (Canada) Limited; Mr. J.C.R. Punchard, Northern Electric; Mr. M.K. Taylor, Ferranti Packard Limited.

Canada and the world are just now entering the electronic era. The Electronic Industries Association is pleased to have this opportunity to meet with the Special Senate Committee on Science Policy to expand upon and answer any questions in connection with our brief, and to recommend policies to be considered, in order to provide an environment which will allow the electronic industry to optimize its contribution to the economic and social progress of Canada.

Our association was formed 40 years ago as the Radio Manufacturers Association of Canada, subsequently became the Radio Television Manufacturers Association and then the Electronic Industries Association of Canada, reflecting the widening interests of its members.

The products produced and, in many cases, designed in Canada include: consumer electronics, television, radio receivers and hi-fi stereo; industrial electronics systems and products for data processing, communications, space and terrestrial, navigation and education; components required for the above, including TV picture tubes, black and white and colour, semiconductors, receiving and industrial tubes and other conventional components.

To illustrate our membership, I would mention five companies: Electrohome in Kitchener, manufacturers of TV, radio and hi-fi; CAE in Montreal, manufacturers of navigational and training aids; IBM in Toronto, manufacturers of data processing and educational aids; Lenkurt in Vancouver, specialists in communications; Renfrew Electric in Toronto, manufacturers of a wide range of components for electrical and electronic companies.

These are five of our 109 member-companies which I have named to illustrate the diversity, product scope and geographic distribution of our membership.

To illustrate our size, the Canadian Electronics Industry is a billion dollar industry with factory shipments of $886 million. It employs 55,000 Canadians not counting an estimated equivalent number in supplying industries. It exported $272 million in 1968, a five-fold increase in eight years.

But in addition, there are other factors which identify the uniqueness of the electronics industry to Canada's progress. You have given high priority to the need for improving the productivity of Canadian industry and institutions including government. Electronics is the key to improved productivity, particularly in Canada with long distribution and communication distances, with a requirement for a full variety of product at relatively low volume, and with important process industries. Electronics opens up entirely new possibilities in information processing with computers and high speed data transmission and in automation and process control. These new possibilities are the real keys to increasing the productivity of Canada's industries and institutions.

You have given high priority to education, in regional development, in equal opportunities to all. In bilingualism, electronic aids such as television, computer-assisted instruction, language laboratories, provide the opportunity for achieving better instruction at lower cost.

Much attention has been directed to development of Canada's north. This is dependent on communications. Canada is, and has been for many years, a leader in communications capability which filled a need created by the great distances in our country. By maintaining a strong and virile electronics industry, Canada can realize the benefits of space communications, as well as other modern communications means, which are needed for the ever-increasing demand for more and superior transmission media.

Our industry is a technologically-based industry with a higher level of technical and engineering and scientific employment than other Canadian industries, and as a consequence, we are playing an increasing role in providing challenging opportunities for the scientific and engineering professions in Canada to offset the movement of this talent to other countries.

From the above it is easy to see how electronics pervades in all sectors of our economy and why its future vitality is essential.

The need for a healthy electronics industry can best be illustrated by one or two quotes from the business classic *The American Challenge*—by Servan Schreiber.

> The most important sector of the economy, however, and the one most crucial for the future, is electronics—for electronics is not an ordinary industry: it is the base upon which the next stage of industrial development depends.
>
> We are now living in the second industrial revolution—a country which has to buy most of its electronic equipment abroad will be in a condition of inferiority similar to that of nations in the last century which were incapable of industrializing. Despite their brilliant past, these nations remained outside the mainstream of civilization. If Europe...

And this applies equally to Canada.

> continues to lag behind in electronics, she could cease to be included among the advanced areas of civilization within a single generation.

This is why we are appearing before you today, and why, earlier this year, we submitted a brief to the Government on the need to increase the technological capability of Canadian industry—because we believe the electronics industry is unique in its importance to Canada. So much of the progress we all seek for our country is dependent on electronics and on the technical capabilities to develop and supply know-how to meet Canada's needs.

We have followed closely and with interest the hearings of your committee. Much of that which is in our brief has been written or said before, however, there are a few concluding observations we would like to make:

The Canadian electronics industry expends more dollars on R and D, and is accelerating its growth of expenditure in this area more rapidly than any other segment of the manufacturing industries.

Direct federal funds in aid of R and D in industry supported fewer scientists and engineers in 1968 than in 1958, and, furthermore the most recent figures released by DBS in May of this year indicate that industry's share of increased current support of R and D has decreased in relative and absolute terms since 1965.

The level of support of R and D provided Canadian industry by the Federal Government is much less, in relative and absolute terms, than the level of support to R and D in industry in other advanced nations of the world, with whom we are endeavouring to compete.

Federal support of R and D in the universities and in government is increasing rapidly and conditions are such as to require a re-evaluation by the Government of the amounts so spent, lest these institutions consume all of the available funds in the years ahead.

We believe there should be identification and pursuit of fully-supported national programs to be undertaken by industry and involving as appropriate government agencies and universities. As a means of stimulating growth in science-based industries and to help to solve some of our national problems.

The Chairman: Thank you very much.

At this stage it would be rather appropriate to adjourn for 15 minutes, but unfortunately we do not have time to do so. I hope you will all bear with me if we proceed immediately to the question period.

Senator Robichaud.

Senator Robichaud: Thank you, Mr. Chairman. We have noticed that in the recommendations placed before us this morning there seems to be a general consensus of opinion that there is a greater need for increased co-operation, better relations, greater consultation and co-ordination between industry, universities and government regarding research and development programs. This seems to be well in line with the briefs which have been presented to us so far.

In coming to my questions, I think I should start with the first brief from the Canadian Chemical Producers' Association and follow it up with a question directed to the witnesses representing the Canadian Pulp and Paper Association. We have been told, and this is to be found on page 12 of the brief submitted by the Canadian Chemical Producers' Association, that the high cost of R & D is a major problem facing every Canadian chemical producer. It is also stated that the limited Canadian market is another major problem closely related to the first and we must conclude therefore that what we need for our chemical producers is a larger export market. We have been told by witnesses who have appeared before us so far that Japan's economic growth has relied to a great extent on an expanding chemical industry and also that 20 per cent of the exports of Switzerland, a country with a population which is 25 or 30 per cent that of Canada, are accounted for by exports of the chemical industry.

I would like to know what percentage of Canada's exports come from the Chemical industry, and also what percentage of the chemical industry is marketed in Canada and what percentage is exported. At the same time we might also be told what is the potential for increasing our exports, particularly if we could base our production on innovation—innovation which would be the result of more effective use of science and technology.

Dr. Hillary: Your first question, senator, about the percentage of exports is one that I am going to have to call for some help on. I do not have the figures in my head, but perhaps one of the more economics-oriented members of the delegation may be able to help us on that.

Dr. Herman F. Hoerig, Vice-president, Research & Development, Du Pont of Canada Ltd.: I do not have with me the economic data required by Senator Robichaud, but I would like to answer his question in this way; the chemical industry because of its international character in Canada is technologically as modern and up-to-date as any of the chemical industries in the rest of the world.

You raised the question of whether technology could perhaps improve our position. The problem is not one of a lack of competent scientific personnel, nor is it a lack of communication and exchange of technology world-wide. The level of intelligence in this area is equal to that which exists elsewhere.

Actually, as far as import and export statistics are concerned, the Canadian chemical industry is a very definite net importer of chemical products, and this is largely due to the fact that the scale of manufacture in Canada which is possible does not make it economically sound to try to meet all of the needs of the country in an open tariff situation. The scale of operation in the United States and in some European countries is of such a size that the manufacturing costs are necessarily lower.

Now, the question is: Can the Canadian chemical industry become a net exporter of goods? I think the answer to that, to be pragmatical and realistic, is that it is not on the cards. As a matter of fact, the industry forecast over a period of the next five years is that it may become a net deficit in imports of almost $1 billion a year.

The Chairman: Why this pessimism?

Dr. Hoerig: I would like to answer that question. This pessimism is due to the fact that the tariff barriers on chemicals in the rest of the world are such that the manufacture of these goods in Canada does not make it possible for the industry to gain access to these other large markets in competition with other large-scale producers. It is just about that simple. If any of my colleagues would like to amplify on that remark, I would certainly like to hear them.

Mr. John Stuart Dewar (President of Union Carbide of Canada): Certainly, the deficit in trade in chemicals is a fact. It is reaching a point where it is not unlike the situation reached when the automotive agreement was undertaken; it is somewhere around $300 million deficit.

As Dr. Hoerig has stated, the way the ground rules are now, it is bound to increase. I think if there is to be a salvation it comes within the scope of what Dr. Hillary referred to in page 1 or 2 of our brief, wherein we state that the rationalization of tariff barriers and numerous other things have to be party to the overall picture, and there may be, in some phases of the chemical and resins industry, possibly some who have some arbitrary trade arrangements which involve countries other than Canada. I believe that is all.

Senator Robichaud: Could the witness mention at least some successful Canadian innovations which have resulted in increased exports for our chemical products? Could we have a concrete example of any case where we have gone into the export of our chemical products?

Dr. Hoerig: I take it you are looking for specific examples.

Senator Robichaud: Yes, just one or two.

Dr. Hoerig: I will talk, then, as a member of the Du Pont Company. Our export activity has been in the nature of about 20 per cent. We have at Sarnia, for example, a polyethylene plant which has been based there largely on Canadian research. The process of the production of polyethylene was Canadian-research oriented. This plant is unique in the world because in order to meet American requirements in Canada this plant was engineered to produce a wide range of polyethylenes. So, the plant is a unique plant as far as world production is concerned. With regard to polyethylene, we make a variety of resins which are different in properties from those of other manufacturers and which have unique applications, not only in Canada but in other countries. As a consequence, we do enjoy the export of these resins because of the fact they have particular properties which are not available elsewhere. So, competitively we are in a good position there.

However, basically we have difficulty on the scale of manufacture of polyethylene in this country which has been very thoroughly studied by one of the other Government departments. This obviously entails disadvantages, and it is not possible to compete in the export market across the whole spectrum of products, including the low price ones.

Another example is that our company exports nylon polymers. We can do so only because we are technically efficient and have done what I think the industry generally tries to do, and that is to increase profitability by decreasing costs through technical innovation; and, therefore, we remain a world-wide competitor.

However, again, in most of these products you cannot expect to find a continuing export business opportunity. Much of it is expedient in character because of the world-wide shortages which prevail from time to time. Each nation tends to be pretty well self-sufficient in this industry, and there are barriers which exist in the chemical industry in other countries, and, during periods of surplus, export markets are either impossible or extremely difficult to come by.

Dr. Hillary: Might I ask Dr. Rowzee to make a further comment on that question?

Dr. Rowzee: I think that Senator Robichaud is looking for some bright spots, and perhaps I might point out that a large measure of the success of Polymer Corporation has been through its ability to adapt through its technology, through its research—I do not know whether it would qualify specifically as innovation, but to change and adapt a part which was built in wartime to the manufacture of a wide range of products which were capable of export.

Why were they capable of export? Because, generally speaking, rubber, both natural and synthetic, moves freely in the world of commerce. There are exceptions, such as Australia, India and certain developing countries; but, generally speaking, rubber moves freely at either a no-tariff or a very low tariff situation throughout the world. Consequently, Polymer is an example of what scale can do not just for the Canadian chemical industry but for other industries as well.

It has a plant more than double the size of the needs of the Canadian market. It has consistently exported more than 50 per cent of its output. This is perhaps not typical of the Canadian chemical industry generally, but suggests that Canadian industry is capable of providing this access to other world markets.

The Chairman: I certainly hope that the success of Polymer was not only due to the fact that it was a Crown corporation.

Senator Robichaud: Mr. Chairman, I will direct my next question to the Canadian Pulp and Paper Association. The first recommendation on page 3 of the brief expresses concern regarding the need for great consultation and co-ordination on research matters, amongst Government, private industry, and the universities. It also suggests that some formal agency be organized to correct the difficulties that arise from the multitude of Government departments and agencies engaged in pulp and paper research. At the bottom of page 3 the industry states that its own research effort is co-ordinated and integrated to a degree unusual amongst industries in Canada. In other words, it cites the pulp and paper research institute as an example of what can be done regarding co-operation and co-ordination between government, universities, and industry.

My question is: In this co-operative scheme what is the share of the Government as compared to the share of the industry? What percentage of its gross product, or its total value, does the pulp and paper industry devote to research? We were told yesterday that the mining industry, for example, devotes approximately 1.5 per cent of its total sales to research. What is the figure for the pulp and paper industry?

Dr. Pierre Gendron, President, Pulp and Paper Research Institute of Canada: The total pulp and paper research expenditure is of the order of $25 million, and this has been so for the last six or seven years. It has remained fairly steady at that level. This includes the contribution of the industry to the Pulp and Paper Research Institute, and also the expenditures that individual companies make in their own laboratories.

To answer the question with respect to greater co-ordination between government, industry, and the universities, we do point out that the Institute is an example of such co-operation. However, we believe that still greater co-ordination can be achieved, and we wanted to bring to the attention of this committee the fact that it is possible to achieve this.

The Chairman: Would you have the amount spent by the federal Government on R & D in forestry and forest products?

Dr. Gendron: I believe that their research expenditure is of the order of $23 million, and this goes for all the various industries. Not all of it is for the pulp and paper industry. Some of it is for the lumber industry and the plywood industry. But, you have got to remember that the pulp and paper industry is vitally interested in all aspects of research that the Department of Forestry carries out in respect of the forests themselves, since these are the source of the raw materials we use. We are very much interested in that part, and we do carry on some research at that level ourselves, although it is small.

Senator Robichaud: Are the relations between the industry and the universities satisfactory—that is, in respect of what co-operation does exist in research between the industry and the universities?

Mr. Fowler: To answer that I would start by saying that the relations that do exist are satisfactory, but they are not enough. In our own case we have a direct and very useful relationship with McGill university. We have been engaged in specific projects with the University of British Columbia, with Queen's University, and with a variety of other universities, although I do not think this has been extensive enough. I do not know what other industries would say about it, but if you are asking if it is satisfactory then I will say: Yes. If you are asking if it is enough, then I will say no.

Dr. Wigle: I would like to invite Professor Belleau to comment on the relationship between the pharmaceutical manufacturing industry and university research.

Dr. Bernard Belleau, Pharmaceutical Manufacturers Association of Canada: In this particular area I do not believe there is anything like the same extent of co-operation between university research and the pharmaceutical industry's research. It is, perhaps, incipient at best. That is about what it boils down to. There is very little of this kind of co-operation.

Mr. Fowler: Mr. Chairman, perhaps I could add a few more words on this. The whole point that we were trying to make on this that there is not that sort of automatic and speedy interchange of information on research matters between the universities, the industry, and government that you see down in the Boston area and in California. It depends in part upon the institutions, and it also depends upon the attitudes of people. In Canada I think we are working far too much in little separate compartments.

The Chairman: Are you saying that we have not only two solitudes but, perhaps, three?

Mr. Fowler: This is correct.

Dr. Gendron: In our case it has to be remembered that the Institute was fostered by McGill University away back in 1914, and up until 1963 it was located on the McGill campus, where we still occupy a building. We have been conducting a graduate program there for years, with roughly 44 graduate students this year who are working on fundamental problems which are dictated by the Institute and, therefore, by the industry. This is probably the only case of where an industry has a direct in-put into university work, but this is a very special case and it dates back to 1914 or 1915.

Dr. Wigle: Perhaps Professor Belleau did not understand, but I should like to point out that there are areas in which the industry has co-operated thoroughly with universities. I am thinking specifically of the creation of Chairs in clinical pharmacology across Canada. There have been four such professorships established across Canada through the efforts of the industry within the last five or six years. Co-operation does exist in such areas, but we would like to see more of it.

Mr. A. R. T. Hailey, Canadian Electrical Manufacturers Association: I would like to associate myself, on behalf of the electrical industry, with the comments that have been made. There is indeed a flow of information both ways between the industry and the universities. I would not want the impression to be left that the electrical industry is not co-operating with the universities.

The industry recognizes the need for an increased effort in this direction, and I am sure too that the universities recognize the fact that if they are going to turn out useful graduates to the industry there needs to be an incentive program. The National Research Council recognizes this, and, indeed, we are hoping to see this built into the program in order to bring the universities and the industry closer together in this area of research.

Senator McGrand: What is the comparison of the annual wages of employees in the pulp and paper industry and the annual wages of those employed in the goods producing industries in the Atlantic provinces?

Mr. Fowler: I have not the precise figures. I would suspect that the annual wage level for the pulp and paper workers in the Maritimes would be higher than in the goods producing industries; I think probably higher in both rate and continuity of employment.

Senator McGrand: The increase in the price of pulp and paper products is not reflected in the price to the producer of wood pulp in the Atlantic provinces. Is that right? The price of newsprint goes up but the price to the producer of the natural wood does not go up very much.

Mr. Fowler: These are not automatically tied. It is some time since I personally have looked at it, but I can recall at least one occasion when the price paid for the pulp wood went up and the price charged for the newsprint did not go up.

Senator McGrand: How long ago would that be?

Mr. Fowler: This is three or four years ago.

Senator Grosart: First, I should like to compliment those who have appeared before us today, particularly those who prepared these briefs. From my point of view, this could well be the best set of briefs we have had before us, because they get down to cases on national science policy in many places rather than following what has been the pattern of some groups, to use this committee as a broad shoulder to cry on about the lack of federal funding.

The Chairman: You must not criticize those who are not present.

Senator Grosart: I am not criticizing them. I am merely making the comment. I have some sympathy at any time with anybody who wants to cry on my shoulder; I always assume he has a good reason.

One of the essential questions that seems to come out of what I read in these briefs is the relationship between total government funding for R & D, particularly in respect of the low level in industry, and secondly the level of industry's own funding of R & D. I think it is a fact that we simply do not know how much industry is devoting to the funding of R & D. Looking through the briefs we find all sorts of different figures. Admittedly they do not always refer to the same years. The chemical industry gives us a figure of $260 million. By doing some arithmetic on their percentage, the electrical industry gives a figure of $345 million for industry funding. Even making a very rough addition of some of the broad figures we have had, my impression is that industry is doing much, much better itself than it has taken the trouble to demonstrate.

My first suggestion would be that it would be very useful to this committee if somebody on behalf of industry would undertake to do a real survey. Not a DBS survey. I have every respect for DBS; they do their best under very difficult circumstances, but they obviously leave out a lot of things in their arithmetic on R & D that industry would put in. I would suggest that instead of the figure being $345 million, or $350 million, it might well be $0.5 billion at least, and I would think more. We discussed this very briefly last night with representatives of the Canadian Council on Urban and Regional Research, who told us they had not the faintest idea of the industry figure. They knew the government figure, they knew what they were getting. This, I need hardly say, is the kind of problem we in this committee simply have to deal with, and we must have facts. I therefore recommend to industry, if somebody is willing to undertake it, that you give us a good guess as to the total.

The brief of the Electronic Industries Association came to us quite late. I am not blaming them. I am merely saying that it got to me and other members of the committee late. Yet, if I may say so, it contains in Part 9, on page 17, the best summary I have seen to date of the problem before the committee. I would suggest, Mr. Chairman, that you might consider lifting Part 9 out of the brief, where it will be buried in the back of the report, and put it in the body of today's discussion.

I throw this out for comment. In rough summary it says that we have no real science policy today. To quote the exact words it says that a national science policy "cannot be stated on a long-term basis". The Science Council will be interested in that as their only function is to state it on a long-term basis. They say that political control of the funding and administration of R & D should be similar to the use of monetary policy to control; they say that the mechanism of a national science policy can be stated in precise terms.

The Chairman: Do we want to have another Coyne affair?

Senator Grosart: They say that the question as to the proper use of money in R & D remains unanswered; they say that the Science Council and the Science Secretariat tend in their studies to be specific rather than overall; they say that Mr. Drury's famous statement that God's in his heaven and all's right with the world, as far as our present science policy mechanism is concerned, certainly tends to "put science in its place." This part of the brief concludes with the statement:

> We believe that if your Committee will suggest a solution on how the gap can be filled it will have performed a service which will endure for many generations for the benefit of all Canadians.

Would anybody care to comment on these very positive statements, any or all of them? Have we a science policy? Can it be stated in specific terms? Can it be stated in the long-term? Can a mechanism be defined in precise terms? We have some contrary views in the briefs.

The Chairman: This is a fairly central set of issues and questions.

Mr. Fowler: I will attempt to answer it. Personally, I would be inclined to agree with the statement that we do not have any clear-cut articulated science policy today in Canada. I think this is correct. This is, after all, what a lot of the present debate is all about and what we are trying to get. I agree that it cannot be stated on a long-term basis in detail. You cannot, in other words, lay out a science policy in detail that is going to operate for the next five or 10 years. I would suspect you could lay out some long-term policy in principle.

Let me illustrate it and take, as an example, someone who is not here at the moment. Should universities confine themselves to pure science, the basic research end only, or should they have what you might call an economic orientation? This kind of thing could be stated one way or the other. Should governments who are doing research, which gets into the applied or nearly applied—I am not talking about the real applied work, but applied where you are getting out of the test tube and getting on into something a little further. Should that be done and continue to be done in university laboratories or should it be farmed out to industry or universities? Our own feeling is that that kind of thing is best done where you have people who are close to the firing line at the practical end of things. There is a grave danger that people and scientists are inclined to go on and on in an investigation. This is natural in the animal and you cannot completely stop it. When a thing is being done at an industrial laboratory you do have, at least, something of the cost benefit analysis that is very difficult to do at the Government level.

The dear old profit motive still gets into this act and I think this tends to sharpen and speed up the process when you are getting away from the pure science into the developmental and so on.

Senator Grosart: May I interrupt you in order to ask a question to clarify the purpose of my original one. When such decisions are made to constitute a national science policy would you suggest that there should be a political decision (assuming you have all the input of advice) as to the percentage of federal funds related to total funding that go into the main performing sectors? Should there be a national science policy laid down politically which says, "This year such and such a percentage is going into funding research and development in industries and universities, and Government in-house"?

Mr. Fowler: Senator Grosart, I would doubt whether you could make an overall simple statement on this thing. You would have to get down to the particular type of research that you are talking about.

Senator Grosart: You would have all the input of advice and all the data. Do you recommend that there be a political decision?

Mr. Fowler: I feel there has to be a political decision as to what the Government is going to spend.

Senator Grosart: In each sector?

Mr. Fowler: In each sector. It is also important to know how the Government is going to spend it, because it may be different from one sector to another.

Senator Grosart: Would you go one step further and recommend the allocation of federal funds between say, basic, applied, development and innovation?

Mr. Fowler: I should like Dr. Gendron to answer that. I think these terms are very fuzzy.

Senator Grosart: I know that, but the science community invented them. We did not invent these terms and we are told over and over that they are very fuzzy terms. These are the ones you brought to us and asked us to consider.

The Chairman: To make broader categories between research and development.

Dr. Gendron: I do agree with Senator Grosart. I do not think he suggested it, but I agree that there should be some kind of decision, at least on broad lines, as to the proportion of funds that could go towards what we call fundamental research, applied research and development. I think that everyone will recognize as well as my colleagues from other industries, that the greatest lack of funds in Canada today, as far as the innovation process is concerned, is in the development side. Surely, if we want this country to go forward, we need to increase this area a great deal more.

If I might link this to a prior question of Senator Grosart as to whether we have a science policy in Canada, I sincerely believe that we have not got one. Since 1945 or the end of the war, there was, however, one shape of a policy which added a tremendous effect in Canada and was evolved by the

National Research Council which was to build up fundamental research in the universities. That was a policy decision. The increase in grants that were made by the National Research Council over that period was definitely to produce more scientists so that they could be used by industry later on. Unfortunately, I think this policy has not worked as well as it was intended to, because what has happened is that we do produce a great number of qualified scientists in Canada, but mostly they go back to the universities to build up a university machine. In my opinion, this has tended to give the universities the attitude of an ivory tower where the application of research has been cut out. If there had been more interchange between industry and the universities at an earlier stage of this program I think probably the situation would be somewhat better than at this stage.

Senator Grosart: Mr. Chairman, the examples taken by Dr. Gendron go to the root of my question. I have read the history of the NRC and if my recollection is correct, the decision to divert half of the NRC funds into universities was not in the sense that I am using it, a political decision. It was a decision of one of the agencies of Government. This is my whole point. Should it be left to these agencies to make these major decisions on an ad hoc basis and then add them up to "a national science policy"?

I would suggest, as I have said before, that we have a national science policy. It may be a dreadful one and full of imbalances, but we do have it.

The Chairman: We have one by accident.

Senator Grosart: Mr. Reisman of the Treasury Board said, "We have one by accident, but we have one."

The Chairman: Are there any other comments?

Dr. Wigle: I believe one of our delegates, Mr. Taylor, should like to make a comment.

Mr. Maurice Kenyon Taylor, Director, R and D, Ferranti-Packard Ltd., Representing Electronic Industries Association of Canada: I think that perhaps you have not had too much of a chance to read our brief. In the brief there is a paragraph which will amplify what Dr. Gendron has said. On page 10, under the heading "The University—Its Dual Role," it says as a place of learning the university is supported in general by the provincial government as a fundamental research establishment and it is supported to a considerable extent by grants from the federal Government.

I am pointing out that there is a dual role in the university education and post graduate research. It was to post graduate research that this paragraph referred. It continues:

> Students who are at the top of the classes in the sciences have a temptation to remain in the comfortable academic environment and carry out research there. The result of this is an expansion of the post graduate research facilities and an ever increasing demand for more and better research workers and money for their support. In short, the universities have a positive feedback tendency to absorb a fraction of their own output in good students and therefore to need more and more federal money for their support. As this seems to be a positive feedback situation, it is evidence that the increase is likely to be exponential in character.

Honourable senators, you can see this exponential curve in the DBS report, whether you believe them or not. That shows very clearly there. The brief continues:

> Unless steps are taken the situation may well get out of hand in the future. The electronics industry...

Which I represent...

> ...is affected in two ways. The availability of the better scientists to industry is reduced, and the availability of technology funds left for industrial aid is also reduced.

Senator Grosart: If I might add to that, there is a statement in the same brief, that industry funding is residual to Government in-house and university funding.

I wonder if the industry really believes this, or if the industrialists who are here believe that the others get what they want and that what is left is given to industry. Is this really the belief of the industries represented here, that this is the way the funding of industry fits in today into national policy? That is on page 9 of the report, that is what was indicated to us:

> 2.5 Currently, the money available for technological upgrading of industry is a small part (14.5 per cent in 1965) of the total Federal funding available for

research and development purposes, and is residual to the money spent on universities, Government operated laboratories and on natural resource technology grants to the provinces and to provincial research institutions.

Do industries really believe this?

Mr. Sutherland: We are very concerned about the share of research funds that we have, and we are equally concerned that the trend seems to be continuing. From the latest figures of the Dominion Bureau of Statistics—inaccurate though they may be—nevertheless they show the trend.

Senator Grosart: They show the trend?

Mr. Sutherland: It is indicated there that, since 1965, industry's share is going down, whereas in the same period, 1965 to 1968, the share to universities has doubled.

Senator Grosart: I wonder if I might suggest to you that you read that paragraph into the record, because it is a very important one. It is on page 6. Perhaps you would begin at the words "if we eliminate". It is only a few lines, but it is a very important statement.

Mr. Sutherland: This is on page 6 of our brief, halfway through the paragraph:

> If we eliminate the 1967 and 1968 IRDIA grants from the DBS figures for purposes of comparison of the years 1965 through 1968, we find that Government R & D support to industry has dropped each year from a level of $68.2 million in 1965 to $59.5 million in 1968. Meanwhile, support to government institutions has increased each year, from $171.5 million in 1965 to $260.7 million in 1968, and similarly, support to universities has increased each year from $41.8 million in 1965 to $99.3 million in 1968.
>
> 1.5 In other words, the share of Federal R & D funds directed to industry is getting smaller year by year, from 24 per cent in 1965 to 14 per cent in 1968. This trend runs contrary to almost every piece of advice the Government has had over the past several years regarding expenditure of its R & D funds.

Senator Robichaud: Does this affect the comparison? If we disregard altogether the IRDIA grant—after all, it is part of it.

Mr. Sutherland: I have explained that because these figures which I am talking about do include IRDIA for the two years—1967 and 1968, I believe. However, in the years prior to that, industry had another form of incentive, which was a tax abatement, and because it is a tax abatement these figures do not appear on funds spent by the Government in respect of R & D.

Senator Grosart: It is a substitute for Section 72, of the Income Tax Act, and it only amounted in 1968, the whole IRDIA expenditure, to $13 million, so it would not affect your figures greatly.

Mr. Sutherland: You have to put these figures on a comparable basis. If you were to put the tax abatement in for the earlier years, 1965 and 1966, the trend would still show that expenditures in industry were decreasing from 1965 through to 1968.

Since in the years of tax abatement the reference year in determining the abatement was 1961, there is reason to believe that the rebates would have been as large as the IRDIA grants in the later years.

Senator Grosart: May I ask, Mr. Chairman, if it would be the recommendation of the groups here that this trend be reversed, as future national science policy?

The Chairman: I think you will have unanimity on this.

Senator Grosart: I would like to have it.

Mr. Fowler: I hope you will have support, but it seems to me that your specific question as to whether Government grants to industry tend to be residual in their approach depends on how you work on it, and how you motivate this kind of thing.

Senator Grosart: That is what we are dealing with here, how you work on it.

Mr. Fowler: Apart from certain things, such as PAIT, which has its difficulties, it has advantages so far as the pulp and paper industry is concerned, as mentioned here today. Apart from that, there is no general concept in the federal program of funding out research to laboratories.

We think this has been shown to be a very useful production method in the United States, that this begins to get the involvement between universities and industry and Government. But there has not been a concept of large farming out of research. We think there should be such, and we think you will get better research if you do. To that extent, I have not detected any disagreement around the group that is here.

Senator Grosart: Are you suggesting we can follow the American pattern of farming out more R & D by contracting out, more total projects?

Mr. Fowler: Absolutely. I think this should be done.

Mr. Hillary: The chemical industry group felt very strongly on this and felt, as was mentioned, that contract research on a total project is desirable. This is the means of helping industry to help itself. It is not just a plain handing out of money, it means you have to do something to get it, by your efforts you have to develop an organization and build up scientific and engineering strength. This is what we need.

Senator Grosart: We have been talking about percentages of Government funding. There seems to be some difference of opinion as to whether it is part of national science policy that there should be determined the total adequate dimension of Government funding. Mr. Fowler's organization, the Canadian Pulp and Paper Association, makes the very safe statement that at the present time it is neither excessive nor inadequate. That does not help us very much.

CEMA at page 5 of their brief say that there should be no fixed percentage, but that there is a tremendous lag.

Is it possible to have a national science policy for next year without there being a political decision that X number of dollars or X percentage of GNP must go into R and D?

Mr. Fowler: I don't think it is possible, because this is the way the tap gets turned on. There is no other way. The other question that arises is how that sum is determined. Is it going to be determined as an over-all concept of supporting science from the federal Government? There is the further question as to how you spend it. Is it merely going to be the accidental sum total of recommendations having to do with science coming up from a multiplicity of departments?

Senator Grosart: That is the question. Which should it be? Assuming you have the maximum of the science community's input of advice, should it be a part of national policy to say that we must spend X number of dollars, if we are to stay in the science and technology race?

On page 6 of your brief, Mr. Fowler, there is the following statement:

> However, it was estimated in the recent Economic Council of Canada study that 64 per cent of the increase in producitivity in Canada from 1955 to 1962 was accounted for by the advance of knowledge and its application.

Would you mind elaborating on that? Because the Science Council told us they found it absolutely impossible to find any relation between research and development expenditures and productivity.

Do you say that there is a real relation between funding of research and development and productivity?

Mr. Fowler: Actually, it is broader than that. In the Economic Council, we are trying to get at the factor inputs that have gone towards increased productivity. A lot of work was done on this subject by a man named Dennison.

Incidentally, that 64 per cent includes not only research and development but education expenditures generally. This is one of the identifiable items in the productivity increase progression. I don't think you can take the 64 per cent as R and D only.

Senator Grosart: Is there a relationship between research and development expenditures and national productivity? I am not asking you what it is.

Mr. Fowler: I think there is. I don't think there is any doubt about that. On your general question, Senator Grosart, whether you should set up a great big federal Government pot and then scratch around as to how you are going to spend it, I have some doubts.

Senator Grosart: I am not suggesting that. Interestingly enough, in your opening phrase I knew what your answer was going to be. If you had started to say that it was absolutely necessary that the science community feed in the necessary information, then I would have known you were coming down on the other side. Nobody is suggesting a pot of money and then deciding how to spend it. Obviously, it is the input of science that will determine that amount.

Is there a relationship between the multiplicity of views of the science community? Some say there should be an increase of 20 per cent every year and some say there must be an increase of 35 per cent every year. Somebody else uses the phrase "massive infusion" of Government funding. We have all of these phrases in the briefs before us. What I am asking is should national science policy, adding up all of these input components, arrive at a total figure that we can say we have got to spend in order to stay in the race?

The Chairman: We have that figure anyway.

Senator Grosart: Yes, we have it. We have it by accident, and nobody really knows what it is. This is the amazing thing. Nobody really knows what the total funding of research and development in Canada is, largely because the private sector figures are just not available.

Dr. J. J. Green (Electronic Industries Association of Canada): I should like to point out, however, that there ought really to be some sort of machinery for establishing the total amount of money for research and development, because occasionally when the decision-making process is very difficult, as in the case of ING and the telescope, the Government saves the money and puts it back in the till and it does not get spent at all. I think that, if we find this decision-making process difficult, we are not going to be able to spend tte types of money we have to spend in Canada to remain technologically advanced.

I should like to return to a problem that Senator Grosart raised a little earlier, which concerns the decision-making process. It seems to me that there is essentially lacking at the moment a definite political decision on where money should be spent between the conflicting demand of different disciplines. It seems to me that we have the mechanism set up for advising the Government to listen to the scientific community to have expert scientific people like Dr. Solandt advising the Government.

Then the question is who makes the division of the funds, and it reminds me of a meeting in the United States where the director of the Bureau of the Budget said, "Gentlemen, the problem we have to face is where are we going to put each funds. Which projects? What are going to be the priorities? If you don't recommend the priorities, we have to do it, and we are less capable of doing it than you."

Senator Grosart is touching on a very sensitive question. Should the decision be completely in the political realm? I feel that it should to the greatest extent, but that it should be backed by impartial advice by people co-ordinating the requirements of the different sectors and the different disciplines of science.

Those of us who have been in research most of our lives are aware that before the war the amount of research and development in Canadian industry was almost negligible. We are seeing emerging and evolving a situation here that, since the war, the capability of industry has been enormously increasing. Today it is many, many fold more capable than it was right after the war. We have the situation where the Government has been spending its money in Government establishments, and we have sympathized with the problem of reducing that in comparison with the expenditures in the private sector. I think this is an evolutionary process.

The Chairman: What do you envisage as a possibility in the field of industrial research in relation to co-operative research? Suppose industries had industrial research campuses that they shared among industries as, for instance, in the case of the Sheridan model?

Do you think it would be desirable for Canada to develop such campuses in various regions of the country, where different firms in different industries could decide to locate some of their laboratories on one campus so that they could inter-exchange their views?

Dr. Green: According to one report I saw on the research park in the United States, it was concluded that it had not been very successful. On the other hand, I understand that our own Sheridan Park looks very promising and that they are breaking down in Sheridan Park the initial resistance between one company and another to share their problems. I think, on the other hand, where you have the best co-operation between industries is when two or more industries get together to bid on some large government contract. This has often led to good co-operations and that is going on in Canada right now.

The Chairman: I gather there are one or two others who would like to make some comment on this.

Mr. Hailey: I think it would be presumptive on my part to say anything about the Sheridan Park Association particularly since they are all so closely associated in what they are doing. Not being a member of the Association I think we can be a little bit cautious about the concept that is involved and about the impression that we may be leaving with the committee today. The Sheridan Park Association is not in the true sense an example of the co-operation in the electronics industry. I cannot see that industries can completely band together to share their ideas when they are profit-motivated. In my view the electronics industry is rather unique in that it is a rather tight-lipped association, but this characteristic may be shared by other industries. But the concept of a research association is not, I believe, acceptable to the electronic association.

Dr. Hoerig: I would like to add a few remarks on this point. I think in the twentieth century research and development is part of entrepreneurship and therefore it becomes a very competitive effort. This is good for the economy because it results in a striving for efficiency and eventually cuts down on costs of operation.

The Chairman: On this point I think we should make the record clear. I must recall here that the Sheridan Park Association, and I am not trying to sell the formula at all, is not a kind of co-operative effort of people in the one industry. I think all the labs there—and they have ten labs—all come from different industries.

Dr. Hoerig: But geographically they are all together.

The Chairman: But they are all from different industries, not from the same industry.

Senator Grosart: I want to make a final comment and in doing so I want to draw your attention to table II following page 3 of the brief submitted by the Electronic Industries Association of Canada. It gives some figures from DBS and they show, roughly, that of a total of $337 million funding of intramural research and development industry is contributing internally 77.1 per cent and government is contributing 13.9 per cent. Now I contrast that with the statement we often hear that Canadian industry is lagging behind in its funding of research and development. The fact of the matter seems to be that the industrial sector percentage is much higher than that of any of the other leading performance sectors.

The Chairman: I would like to raise a final question. As far as I am concerned in the course of our public hearings in the last few weeks we have met a number of professional associations of scientists and researchers such as the Association of Physicists, the Chemical Institute of Canada, all kinds of associations related to biology and to medical research—and we have been told, although we do not know exactly, that in Canada there are from 75 to 100 of these associations.

These associations were complaining about their relationship with the Government, and they apparently also were working in complete isolation, one from the other—the chemists never speaking to the physicists, and the biologists being completely isolated too.

We suggested to them at some stage that perhaps they should begin to meet together to discuss not only their differences but also their common problems, with a view to trying to reach some kind of consensus, and then to make much more efficient and more regular representations to Government regarding national science policy.

Some of these associations have already taken the initiative by calling a meeting which will probably take place at the end of July here in Ottawa, with a view—and it is still very vague—to perhaps organizing a national conference on science, just as we have in Canada a national conference on the arts, where the artists meet regularly each year, discuss their common problems and make representations to the Government.

I wonder if it would not be possible to think about a kind of parallel organization for industries, and it would be for those industries which are really interested in research and Government science policy, to do more or less the same thing, to gather together. I do not think there is any similar kind of organization now in existence.

I was speaking two weeks ago to the Canadian Manufacturers Association. I suggested to them as Senator Grosart and others have said this morning, that we know much more about the Government science effort and the university science effort than we do about the industrial sector. It might be something you might think about when you leave here.

I am sure this is one of the first meetings of different industries coming together before a parliamentary committee to discuss science policy, to discuss your needs and to discuss what you would like the Government to do. I think that if this kind of process were to be a little more systematic it might be useful to your respective industries. It would certainly be much more enlightening for the Government officials and ministers who ultimately have to make the decisions with respect to our science effort. Would any of you care to comment on that before we adjourn?

Dr. Green: Mr. Chairman, may I speak to that? We have the Canadian Research Management Association in Canada which meets once a year. I have the honour of being the Vice-Chairman of this association. Dr. Lincoln Theismeyer, who was well known in Pulp and Paper, was one of our most distinguished presidents. The organization is composed of roughly 100 members. It is predominantly industrial, but it has as members outstanding university and government research management people.

We meet in different parts of Canada each year. We are meeting in the Maritimes this year when we will discuss two themes. The theme for the first day is devoted to problems of national interest. We are having people like Mr. J. Warren, Deputy Minister of Industry, Trade and Commerce, and Dr. Gaudry, Vice Chairman of the Science Council, and Mr. Hiscocks, the Vice President of the National Research Council, with us to discuss national problems. The next day will be devoted mainly to the oceanographic problems.

Last year we met in Edmonton and dealt with the petrochemical industry, and so on.

This group is not a lobbying group, if I may use that word. We are a group of people who are interested in common problems of research management in government, industry, and the universities, and we get together to discuss these mutual problems. We are hesitant to be a group that would interfere in the advice that is being given to government by bodies presently constituted for that purpose.

Senator Grosart: Why would you be afraid to do that?

Mr. Green: One good answer, Senator Grosart—perhaps I should not say this—is that we would probably find it very difficult to reach a consensus.

The Chairman: It is because of your composition. Some of your members are government people.

Senator Grosart: I do not care whether some of their members are Government people. I do not think it is good enough in respect of such a matter to say: "We cannot get a consensus." The Canadian Manufacturers' Association consists of importers and exporters. It would be pretty difficult to find two groups with more divergent interests. But, they discipline themselves, and they go before the Government annually and say: "Here are some of the things we agree upon." I would like to see a parliament of science like this parliament of industry, because we read its in-put into the decision-making. Surely, the various sectors of the science community could get together and find some things upon which they can say: "We are agreed upon this, and we are going to tell the Government that we agree." I will go beyond that and say that once they are agreed, they should say: "We are going to influence Government, and if we have to march then we will march."

The fact is that national science policy is a new problem. The farmers have for years been getting their views through to government, and so has labour and the veterans. They have learned how to do it. The science community has not learned how to do it. My suggestion is that if the science community does not, then we are still going to have science policy established by accident—or by the Treasury Board, which is the same thing.

Mr. J. C. R. Punchard, Assistant Vice President, Northern Electric Company Limited: Mr. Chairman, I would like to take this opportunity to mention two other organizations which are not too well known. First of all, there is the Canadian Organization for Joint Research, which was formed under the presidency of Dr. John Chapman. This organization was formed for the express purpose of fostering co-operative research activity between government, universities, and industry. It has not really been too successful over the past two years, but there is no reason why it cannot be made to be successful. I just wanted to mention this because there is an existing organization set up which needs more effort from industry put into it.

The Chairman: I was speaking of something that would not involve government people at all.

Mr. Punchard: There is another organization called the Canadian Radio Technical Planning Board, of which I happen to be the President. This has now been operating for 24 years. It consists of all associations representing all the most powerful radio organizations in Canada. This organization works directly with the old Department of Transport, now the Department of Communications, in advising the department on how to carry out technical matters relating to the use of the radio spectrum in Canada. This organization has been so valuable to the Government that we actually receive a small grant in order to support a small office here in Ottawa.

The Chairman: Perhaps you were too dangerous!

Mr. Punchard: Too dangerous? I do not think the Government could possibly operate this sector of its operation without this organization, because the administration of the radio spectrum is so complex that no one sitting here in Ottawa could possibly satisfactorily administer the whole work of the operation. In another brief with which I was associated we suggested that the Canadian Radio Technical Planning Board be looked at as a model organization which could form the kind of organization to provide an interface between government and all industry on matters pertaining to research and development. I think it should be studied. The CRTPB is not an organization but it represents a model that we just do not have in Canada of organized interface.

Dr. Green has suggested the Canadian Management Research Organization, which was not really set up for this purpose, but it does include the universities as well as industries. I feel we should have an exclusively industry organization working with the Government, because our problems are different from those in the universities, and perhaps the universities should have their own organization.

Senator Grosart: The trouble is that we seem to have about as many interfaces as we have faces.

The Chairman: Can we hear the other comments?

Mr. K. H. Rapsey, President, Canadian Electrical Manufacturers Association: These comments about large central planning organizations, research people in industry speaking as a whole and, how much government should spend, are all very well, but something that is far, far more important to the economic growth of Canada is that industry should be encouraged, presumably by incentives, tax rebates of some kind, to spend more money on development work, product development type of work. This should be decided not on a national basis, not on an industry basis, but by an individual company. This is the most important thing for us to be striving for if we are aiming for the economic growth of this country.

The Chairman: But in order to get that you must have a proper environment that would lend itself to the initiative of individual companies to do the work and to receive the assistance.

Mr. Rapsey: Right, but this does not require a national decision. It requires local, individual decisions.

The Chairman: In the meantime you must have bad programs, so that individual companies will not be able to do anything positive.

Mr. Fowler: Mr. Chairman, any answer to a question like this has to be a personal one and I am not speaking for the whole industry. It has not been considered. Firstly, I think that behind the question lies the fact that within individual industries, the amount of thinking about what you might call a science policy is pretty recent and it is not too well developed. To some extent the mere existence of your hearings has induced a lot of people to think about this subject in a more consistent way. I think it is true that the interchange between different industries as to their thinking and opinions is almost nonexistent. I am quite sure that I did not send this brief to the other associations that were here this morning nor have I seen Mr. Balcer's brief. There is a complete lack of communication here.

The Chairman: Yes, we have quite a consensus of views.

Mr. Fowler: Precisely. We happened to wind up with a lot of things saying the same thing.

Senator Grosart: And some contradictions.

Mr. Fowler: The idea of trying to construct something which would be an overall industry approach to science policy, I must confess that I am a little inclined to doubt this as being practical. We happen to be all in business of some kind, but we are really not the same. I do not want this to be regarded as critical, but the big overall organizations, such as the Canadian Chamber of Commerce in which I spent seven or eight years of my life working very hard had the same difficulty and that was to get a Canadian Chamber of Commerce policy on any of the real issues that mattered. This was simply because of the divergence of views within the group. I would be afraid that if we were to construct tomorrow a big all-in industry group that would be trying to hammer out an industry science policy we would end up with a lot of cliches and platitudes and have little more. I think there should be more interchange and that we should know what other people are saying.

The Chairman: How do you accomplish that? Everyone has something to say.

Mr. Fowler: I think an exchange is certainly desirable but I think the ultimate analysis with in-puts of many people's thinking and industry thinking is that each industry has to go to the Government with its own particular scientific problems.

Senator Grosart: Are you saying, Mr. Fowler, that you regard it as impossible for the industry to find a common ground about $400 million or $500 million of R and D funding? Are you saying it is impossible for them to get together and give a joint brief to the Government on, say, the incentives programs that are criticized throughout here in different terms and from different angles, or to give a common view to the Government on the percentage of total funding that should go into R and D? Are you saying this is impossible?

Mr. Fowler: I am not sure what your numbers are there.

Senator Grosart: I am saying the total funding.

Mr. Fowler: By all industries?

Senator Grosart: The total funding of R & D in industry. I am saying that we have here the figure of $350 million, $400 million or maybe half a billion. Are you saying it is impossible for industry to get together and say how this should be channeled into the best possible kind of operation in industry?

Mr. Fowler: No, I do not think it is impossible, but rather complex. This is pretty amorphous—

Mr. Punchard: We recognize in the CRTPB that I mentioned before, the difficulty of obtaining a consensus. It is almost impossible when you are dealing with engineers, who are formally working on a scientific basis. This is due to the fact there are commercial interests involved in the use of the radio spectrum in Canada and it has always been so. At least, we have in the Canadian Radio Technical Planning Board an organized method of presenting these views to the Government. We do not do it on the basis of voting. We gave that up years ago. A majority vote does not really mean anything. We give an idea of the people who generally agree with a certain problem. But we also state, in the returns that go back to the Government departments, the actual opinions, of those who are perhaps in minority. So the Government has set before it a carefully considered statement—you can call it policy, in some cases; in other cases, it is a matter of technical parameters for a specification.

I realize the difficulties of doing this. We have thought about this many times. I think we need to do something like that in Canada and we can make it work. You can never get a consensus but you can organize in this way, that we can present a far far better picture than we are able to present now, even as a group of associations, of which this group is only a relatively small part in Canada.

The Chairman: I was not suggesting that this group here would get together. This is a very interesting sample, but only a sample of what is going on in Canada.

Senator Grosart: I knew a very great political leader once who, when he was faced with such problems, always said to one of his assistants: "Tell them to knock their heads together and come up with a consensus of their views, and tell them that if they do not, they'll have to live with my guess".

The Chairman: I think we should adjourn on this historical note. Before doing so, on behalf of the members of the committee I wish to thank you very much indeed, especially those who prepared these interesting briefs and who have been with us this morning, in spite of the failure of our air conditioning system.

The committee adjourned.

APPENDIX 139

BRIEF TO THE SENATE SPECIAL COMMITTEE

ON

SCIENCE POLICY

Submitted by

THE CANADIAN CHEMICAL PRODUCERS' ASSOCIATION

MARCH 1969

CONTENTS

INTRODUCTION

The Canadian chemical industry makes a major contribution to the country's economy. The extensive program of research and development to which the industry is committed plays an important role. The annual cost of this activity approximates $37.4 million; i.e., 1.7% of the industry's sales of $2.2 billion, or 12% of all the private R and D undertaken in Canada today. In terms of the amounts of their own funds which they devote to R & D, a number of the larger C.C.P.A. members are committed on a scale that considerably exceeds the 1.7% average*.

Given the necessary conditions, R and D could contribute even more to the economic progress of the nation and the industry. With this end in mind, the C.C.P.A. presents this paper on behalf of its 44 member companies as a means of focusing attention on certain factors influencing the growth and effectiveness of the industry's R and D in Canada.

For the convenience of the reader who may wish more or less detail the material in this paper is arranged so that it can be grouped into what can be described as a short and a long version. The short version consists of the summary of recommendations and highlights - a condensation of essential information. For the reader requiring more detail there is a lengthy discussion, and the full text of recommendations and appendices.

* Appendix 1

SUMMARY OF RECOMMENDATIONS

1. Improve the industry's economic environment.

2. Encourage the import of foreign technology to Canada.

3. Encourage the export of Canada's technology.

4. Incorporate IRDIA regulations in PAIT, regarding exploitation of R and D results in foreign markets; delete PAIT terms which allow assignment of results of unsuccessful projects to the Canadian Government.

5. Initiation by the Science Secretariat of a joint government-industry study on stimulation of Canadian industrial research and development. It is suggested that grants for research should not be tied exclusively to increments in research carried out by companies.

6. Award government-sponsored research contracts to industry.

7. Improve technical information services.

8. Establish new research institutes only after careful study.

9. Survey university graduations and industry's manpower requirements.

10. Retain present legislation on patents and trade marks.

HIGHLIGHTS

1. Economic Environment

The primary justification for industrial research lies in the expectation of future profits. These in turn depend very largely upon the stability and hospitability of the economic environment. While every industry is constantly exposed to the influence of this environment, the Canadian chemical industry is particularly affected by several conditions which call for effective action soon; e.g., availability of markets, size of competitive manufacturing units, combines legislation, tariffs, non-tariff trade barriers, dumping, taxation, patents, and the costs of capital, raw materials, and construction, as well as the cost of R & D itself.

2. Import of Technology

In common with most other countries, Canada is able to produce only a small proportion of all the technology essential to an industrial state that plans to be internationally competitive. Therefore the policy of the Canadian chemical industry is to import the best and latest technology, adapt it for domestic application, and use it as a basis for further advances. Such a policy obviously requires a strong technical staff capable of detecting and recognizing relevant new developments, then adapting and applying them to Canadian needs. Because all of this is in the economic interests of the country, the government should actively encourage and support its industries in their efforts to locate the most advanced technology in the world, and to bring it to Canada as rapidly as possible through purchase, licence, or exchange.

3. Export of Technology

Although most of the Canadian chemical industry's R & D is applied domestically, additional benefits are often gained by exporting research results to larger market areas. Besides exporting through sale or licence, the industry finds it particularly useful to exchange the results of Canadian R and D for foreign technology that is suitable for commercialization in Canada. In view of these very considerable benefits, Canada should encourage its industries to sell,license, or trade its own technology abroad, whenever such procedures are clearly not opposed to the national interest.

4. R and D Incentive Programs

Support of industrial R and D is an accepted government responsibility today, and Canada has taken a number of preliminary steps in the right direction. The Industrial Research and Development Incentives Act (IRDIA) administered by the Department of Industry, and the Industrial Research Assistance Program (IRAP) administered by the National Research Council, have both contributed to their declared objectives by assisting many companies to raise the level of their R and D commitments. Hopefully the next step will comprise the provision of support for the more mature R and D organizations, taken in context with other government policies affecting costs, to provide them with a cost-opportunity base equivalent to that of their foreign competitors.

The Department of Industry's Program for the Advancement of Industrial Technology (PAIT) has been useful to certain sectors of Canadian industry, and with modifications it could be made attractive to the chemical industry as well. Regarding the exploitation of R and D results in domestic and foreign markets, PAIT should be altered to incorporate the regulations of IRDIA, deleting any existing terms of PAIT which might then be contradictory. A further essential improvement would be the deletion of terms that allow the results of unsuccessful projects to be assigned to the Canadian government.

5. Future Stimulation of Industrial R and D

Since a significant sector of the chemical industry has already achieved a mature level of R and D, it would be highly advantageous to the country's economy for the Science Secretariat to initiate a study by appropriate government and industry representatives to develop a formula for further stimulation of industrial research and development. The terms of reference of such a study would include the determination of (1) the most appropriate type of supports which Canadian industry needs to reach and maintain an appropriate level of R and D, and (2) a suitable formula to administer such support. The many varied aspects of incentive schemes and the complexity of government and industry interests make it beyond the scope of this brief to put forth more specific proposals.

6. Government-sponsored Industrial Research Contracts

In Canada, a large proportion of government-sponsored research has been carried out in university and government laboratories, with a great deal of valuable work being accomplished in both these spheres. In attempting to attain some of the national objectives now being defined by the Science Council of Canada, the government should consider contracting out a larger part of its R and D to industrial organizations. Besides their competence to do an effective R and D job, these organizations have the major advantage of being in the most strategic position possible from which to recognize and exploit any commercial "fall-out" appearing from the research performed under contract. While maximizing the potential benefits of carrying out an R and D program in close proximity to a business operation, such contracts should also have a synergistic effect in reinforcing industry's own R and D commitments.

7. Research Institutes

Canada has a variety of needs for research facilities among its industries: smaller companies may be unable to afford their own research laboratories; larger companies may require some specialized research for which they have inadequate staff or equipment; while companies with mature R and D organizations usually are capable of handling most of the research they require. Thus, there is a place for a variety of Canadian research organizations: the university industrial research institutes recently established by the Department of Industry; the independent research councils and foundations; and the mission-oriented research institutes such as the Pulp and Paper Research Institute of Canada. Since the long-established councils and foundations are not always used to their full capacity, and since the potential benefits of an institute appear to be greatest when it concentrates on a specific field with related industries participating closely and continuously, it would be desirable for Canada to seek a reasonable balance among the different types of research organizations and to support the establishment of new university institutes only after a need has been thoroughly demonstrated.

8. R and D Personnel

For its present R and D operations, the Canadian chemical industry employs a variety of personnel ranging all the way from technicians to post-doctorates. Although the industry anticipates a growth in demand for R and D personnel in general, the present concerns are principally a major shortage of technologists and bachelors, and a potential over-supply of doctorates and post-doctorates. Since various factors could alter this situation appreciably, and since a factual background is needed for attempting to keep the supply and demand in reasonable balance, Canada should undertake a continuing comprehensive survey designed to forecast (1) the number of graduates of all academic levels and disciplines, and (2) the particular manpower requirements of the nation's employers.

9. Patents and Trade Marks

The Canadian chemical industry favours the retention of present legislation as an essential means to encourage industrial R and D.

DISCUSSION

For certain sectors of Canadian industry, the rapid growth of industrial R and D is no doubt essential to continued prosperity. The C.C.P.A. supports the Science Council's view "that the pattern of industrial research in Canada will not be exactly the same as in other highly industrialized countries. In most of our industries we have a unique combination of widespread geographical dispersion, extensive foreign ownership and unusually easy access to new technology for import. Secondary industry has the additional problems of limited domestic markets and of many small companies". (Annual Report, June 1967, p. 16).

In looking at these various problems and challenges, the present discussion examines the purpose of research and development in the Canadian chemical industry; the problems that need to be solved in order to increase the fruitfulness of this R and D effort; and the solutions which the industry is either applying or anticipating with a view to maximizing the economic benefits to all of Canada.

Purpose of R and D in the Canadian Chemical Industry

Statistics compiled by the Dominion Bureau of Statistics have shown a significant growth in the amount of money devoted to research and development by the chemical industry in Canada. This is not surprising, for the chemical industry has been predominantly characterized by growth, and it uses R and D as a means of introducing new technology to Canada, for the purpose of creating profitable new investment opportunities. In contrast to academic or institutional research which may be conducted for its own sake, industrial research must be carried out as a part of a company's total operations. In other words, the primary purpose of the industry's R and D expenditure is profit, either short or long term.

At the same time, the chemical industry is aware of the fact that spending more on research and development is not by itself a guarantee of improved profits.

"Those who equate R and D expenditures with innovative accomplishment, are not looking at the innovative process the way businessmen must. For the main concern of businessmen is the total cost and the total profitability or loss of the entire venture". (Panel on Invention and Innovation, "Technological Innovation: Its Environment and Management", U.S. Department of Commerce, 1967, p. 11).

The same report refers to "the indiscriminate use of statistical aggregates purporting to show the comparative innovative performance of various countries - in particular, statistics comparing R and D expenditures as a percentage of gross national product... We believe such data to be an inappropriate index of innovative performance...If R and D percentages of GNP were an appropriate measure of innovative performance...data compiled by OECD would imply that innovation is as significant a factor in the non-military, non-space sectors of the United Kingdom (1.4%) and Belgium (1.5%) as it is in the United States (1.5%). However, it is clear that these countries are not running a close race with respect to innovative successes and economic growth. Such R and D data are obviously misleading when they are relied upon as indexes of innovative capability or accomplishment."

Although there is no measurable direct and necessary connection between R and D investment and either innovation or prosperity, the chemical industry has through long experience achieved an understanding of the importance of R and D to long term growth. Realizing that Canada cannot expect to produce more than a part of all the new technology developed in the world and needed in Canada, the chemical industry is selective in establishing objectives and priorities in spending significant amounts of its own money on R and D.

This is done primarily to effect improvements in existing products and processes; to develop new processes for existing products; and to develop new or modified products for new and existing markets. At the same time, Canadian R and D operations provide a vital means for recognizing and exploiting opportunities to import new foreign technology for which the market development has already been accomplished elsewhere. Entirely new chemical products are frequently developed by Canadian research, but commercial exploitation is often difficult because of the high cost of market development, the limited Canadian market, and the general impracticability of developing foreign markets. Hence R and D programs are carefully scrutinized for their promise of yielding an economic return on the investment.

Of course, there are many other means for endeavouring to improve a company's profitability; in fact for a given set of circumstances, some may be better than R and D. Improved profitability can often be achieved by effecting improvements in areas such as organization, labour relations, cost control, procurement, quality control, inventory control, materials handling, financial management, plant engineering, product mix, distribution, pricing and selling. With limited resources, management's job is to decide on the best proportion of investment to make in these various fields.

R and D is just one facet of management's total effort to bring about change, growth, productivity, efficiency, and profitability. Additional funds are invested in R and D when the industry's political and economic environments are reasonably stable and predictable, thus encouraging and rewarding the commitment of long-range expenditures of various types, including money for R and D.

As a means of introducing new technology, a company's own R and D effort might not always be the most effective instrument of progress in a given situation. The main sources of new technology, besides one's own R and D, are buying from chemical contractors; procuring a licence for a new process or product; and in the case of Canadian subsidiaries of foreign firms, exploiting the parent's technology in Canada. The choice between the various sources is determined by a company's needs and resources at the time.

Briefly then, the purpose of R and D in the Canadian chemical industry is the introduction of new and profitable technology with maximum rapidity and minimum cost. A company's own R and D effort is one of several available means for introducing new technology to the Canadian market with a view to improving profitability.

Problems

R and D Costs

Successful R and D must be continuous, and this requires a large investment in buildings, equipment, and staff. Thus the cost of R and D is high, with the laboratory stage requiring but a fraction of the total effort involved in taking an idea from conception to market. It has been estimated that for every dollar spent on laboratory research, at least ten are needed to bring the project through the pilot plant stage, and perhaps a hundred more are needed to get it into commercial production. Not until this stage is reached do the initial research expenditures begin to return some earnings to the investor. Thus the high cost of R and D is a major problem facing every Canadian chemical producer.

Limited Markets

The limited Canadian market is another major problem closely related to the first. Since R and D costs are high, the manufacturer must be able to anticipate a market sufficiently large that the economic returns will cover expensive R and D commitments. For this reason, the minimum R and D program required to support a newly developed product in Canada is frequently prohibitive in cost. Normally, in the international chemical industry about three to five percent of sales is regarded as an appropriate R and D expense for a new product. The Canadian market is often of such a limited size that this expenditure would be entirely inadequate, yet a higher rate could not be supported.

International Competition

The chemical industry is highly competitive on an international scale, and this has numerous ramifications for Canadian producers. Lacking the resources for producing more than a small part of all the new technology developed around the world, Canada must somehow find the means for taking full advantage of this new technology, regardless of where it is developed. To retain and improve our position as a country and an industry selling in the markets of the world, we must as a matter of policy continue to import the best technology as rapidly as possible and at minimum cost.

The situation in Canada where government research activities are largely divorced from industry should be compared with other major industrial countries where a large proportion of government-sponsored research is carried out by industry. In such countries, private industry involvement maximizes the opportunity for turning the results of government-oriented research to national commercial advantage, and helps the participating companies to maintain and enhance the quality of their own R and D operations. Conduct of research on the scene of business operations provides the likeliest environment for the recognition and exploitation of commercially valuable "fall-out", whether from basic or applied research.

Canada's tax incentive programs designed to stimulate and assist industrial R and D have in many cases been effective in increasing the level of the industry's research activities. In this connection, it is important to note that two of the most important of the existing programs of support for industrial research, namely, IRDIA and IRAP, make their greatest contribution in stimulating industrial R and D when a company is increasing its R and D commitment rather rapidly, and a negligible contribution when the company's expenditures have begun to flatten out.

Furthermore, the Canadian chemical industry finds it virtually impossible to take advantage of PAIT, because of the restrictive terms which nullify its applicability to companies with international affiliations. Reference here is made to section 5(4) of the General Terms of the Shared Cost Development Assistance Agreement for PAIT.

"The Company will not transfer technical data or inventions whether or not patented, methods and processes resulting from the project to any other Government or to any person, company, partnership or firm outside of Canada for the purposes of production, without the prior consent of the

Minister; and will place the same restriction on any transfer it may make to another Canadian company, firm, partnership or person."

Another restrictive clause is 5(2).

"If the Company, in the opinion of the Minister, fails to so exploit the results of the project, the Company shall, if directed by the Minister, at no cost to Her Majesty, transfer and deliver to Her Majesty ownership and custody of the technical data, inventions whether or not patented, methods and processes, and the Minister may, at his discretion sell the same at a price considered reasonable by the Minister in which event Her Majesty will share the proceeds of such sale with the Company in the ratio of the respective shares of Her Majesty and the Company in the cost of the project as set out in Section 3 of the Agreement, but the amount paid to the Company from such proceeds shall not in any event exceed the sum expended by it towards the total cost of the project as set out in Section 3 of the Agreement."

It would be neither practical nor desirable to assign to the government the research results of an unsuccessful project because: (1) it is difficult to disassociate such results from related technology, (2) the research results may involve technology belonging to others thus the company is not free to assign it, (3) the project might be reactivated at a later date if conditions change.

Modifications to the incentive programs are needed to increase their effectiveness and at the same time the international competitiveness of the industry.

R and D Personnel

Since R and D represents only a fraction of a manufacturer's operations, the personnel requirements for research and development are numerically small in relation to the numbers needed in non-research activities. Nevertheless, the Canadian chemical industry often faces a shortage of technologists and bachelors, not only for its general operations but also for its R and D programs. At the same time, there are indications of a potential over-supply of doctorates and post-doctorates.

The advantages of maintaining a reasonable balance are obvious, and the lack of such a balance is a matter of concern to the Canadian chemical industry. In view of the continuing shortage at the lower levels and the trend to an over-supply at the higher levels, the questions naturally arise, is government support of university research sufficiently discriminating? Is this government support being wasted by the absence of concomitant measures for the development of sophisticated industries to utilize the more highly trained graduates? Over the last decade the rapid expansion of our universities has provided employment opportunities for our doctorates and post-doctorates. Now with these institutions turning out larger numbers of post-graduates and the growth rate of universities beginning to level off, there could be a surplus. It would be economically unfortunate for Canada if government commitments were to generate imbalance, with support at the graduate levels contributing to a loss of Canadian scientists to the U.S.A.

Legislation on Patents and Trade Marks

Canada's existing patent laws afford deserved protection to the originator of products and processes, and thus constitute an incentive of vital importance not only to R and D itself, but also to the industrial investment which may be the result of commercially successful research. Recent attempts to modify the present legislation are viewed by the Canadian chemical industry as a potential threat to the present and future level of expenditure on research and development in this country, and in the chemical industry particularly.

RECOMMENDATIONS

Economic Environment

The best stimulants for R and D in the Canadian chemical industry are to be found in those endeavours which will increasingly produce an economic environment which is hospitable to new investment of every kind. Balanced economic growth resulting from the effective management of tariff, fiscal, monetary, competition and patent policies, will encourage the chemical industry to increase its investment in plants and equipment, and in research and development as well.

Import Technology

One of the best means for meeting the R and D needs of Canadian chemical companies is to take advantage of foreign technology. This can be acquired by outright purchase, licensing or sharing of the costs of joint programs with affiliated companies, in particular foreign parents. Such arrangements have been responsible for bringing to Canada a great deal of the world's best and latest technology, enabling this country to enjoy the results of R and D performed at very low cost to the Canadian manufacturer.

Research Costs and Incentives

The expansion of Canadian R and D will depend to a very considerable extent upon the prospects for a significant lowering of the costs of doing research and development in Canada. Government incentives can certainly make a partial contribution in this regard; in fact, the nature of the international competition facing the industry today means that such stimulation may well prove to be crucial.

As the Science Council has pointed out, industrial R and D expenditures cannot be increased indefinitely and a number of the existing Canadian government incentive programs are tied to <u>increments</u> in R and D, e.g., IRDIA and IRAP. When the level of R and D reaches a plateau, the support tapers off and long-range planning is possible only for the level of research which industry can support without this incremental type of support. It is suggested that support not be tied exclusively to increments.

Furthermore, PAIT, another of the government's programs, has proved to be of limited value to the chemical companies of Canada, most of whom have extensive and valuable connections with foreign corporations, principally their parent organizations. The restrictions regarding exploitation in Canada and the assignment of unsuccessful results to the government, continue to prevent this program from making any kind of significant contribution to the advancement of industrial technology in the Canadian chemical industry. While admitting there may be considerations which make it difficult to alter the existing provisions,say, to incorporate the terms of IRDIA, the chemical industry is nevertheless of the opinion that the limitations inherent in the present terms of reference for PAIT, further emphasize the necessity for a new approach to the problem of government support for the company having a mature R and D organization, and with international affiliations.

How to modify the various R and D tax incentive programs to provide the required degree of stimulation and support to keep Canada internationally competitive is of vital concern. The complexity of the interests of both government and industry make this a difficult task. In the industrial sector these vary from one type of industry to another, and even within an industry itself. The number and variety of ideas put forth has forced this Association to the realization that it is beyond the scope of this paper to present more specific proposals. Thus, the recommendation that the Science Secretariat set up a joint government-industry study to determine the most appropriate type of support for Canadian industry and develop a suitable formula to administer such support.

Contracted Research

To date, the Canadian government has committed itself, on only a limited scale, to a policy of building up industrial research establishments by contracting research to companies on projects of national interest. This policy has been a successful feature of the U.S. scientific scene, and it could well be just as effective here in Canada.

There are several pressing problems facing the nation at present; e.g., pollution, transportation, housing, water resources, northern development, etc. The Science Council is currently undertaking to recommend the broad allocation of the country's limited manpower and money among the various competing needs, to ensure that appropriate organizational and institutional arrangements are available for the most effective use of our resources. It is timely, therefore, that in deciding upon a number of national objectives in such areas, the Science Council should also recommend to the government that an increasing number of projects of vital concern to the country, be assigned to industrial R and D organizations.

Information Services

To benefit from the developments in foreign technology as rapidly as possible, high priority should also be given to the expansion and improvement of the scientific literature services provided by N.R.C., particularly for the benefit of the chemical producer with a limited R and D establishment. Thought should be given to the following possibilities: (1) the operation of large information centres in all of the country's major cities; (2) the maintenance of complete patent files covering all the major industrial countries of the world; (3) the utilization of indexing and retrieval systems to make this information readily available; and (4) the expansion of translation services to facilitate the assimilation of the foreign literature.

Research Institutes

With respect to the problem of apportioning the proper support to the various kinds of research organizations in Canada, the chemical industry is inclined to suggest that a solution be sought in the light of several related considerations.

Research councils, research foundations, and university research institutes can provide smaller industries with a means of conducting research economically, and larger industries with expertise and facilities in areas of investigation which do not warrant permanent private investment. In all cases, sufficient contact with industry is essential if the institutes are to be really effective. Standing advisory bodies of competent personnel could be used to achieve this contact.

"Mission-oriented" research institutes associated with universities are logical and desirable organizations to conduct research in fields of basic science requiring equipment too expensive for the normal university budget. The Pulp and Paper Research Institute is an excellent example. Extension of this concept to (e.g.) textiles, ceramics, plastics, metals, paints, rubber, printing, packaging, acoustics, electronics, may be desirable, but in each instance should be justified through industry, government, and university agreement on need.

Other university-affiliated research institutes have more questionable claims to support. While the university staffs provide a valuable source of technical knowledge upon which industry can draw, possibly this source could be tapped without the establishment of institutes. With the possibility that the interests of some staff would be divided between institute and university, there could be a weakening of the latter, and for this reason, some universities are believed to be opposed to the research institute idea.

University-affiliated research institutes which are not mission-oriented, will almost certainly solicit industrial research contracts and thus find themselves in competition with provincial research councils and foundations, while these latter are not being used to their full capacity.

With the foregoing points in mind, the C.C.P.A. would recommend that any proposed research institutes to be associated with a university, should be carefully considered on an individual basis. Before it is given government support, convincing evidence should be presented that it will fill a need not readily satisfied by any other route.

Manpower

In connection with the problem of balancing the supply and demand of personnel for the industry's R and D endeavours, the C.C.P.A. would strongly favour a continuing and comprehensive survey designed to keep a running count on the numbers of graduates forecast in various academic disciplines and at different levels, this to be compared with a complementary survey of employers, designed to forecast the manpower requirements for various occupations. Such a survey would provide a factual basis for making decisions having an influence on the type and number of graduates, and could conceivably lead to a more appropriate balance in the nation's commitment to its various types of R and D establishment.

APPENDIX I

Canada's Chemical Industry and Its Benefits to the Canadian Economy
(Extract from C.C.P.A. Position Paper on Taxation, 19th August 1968)

1. The Canadian chemical industry is highly productive in terms of its use of manpower, energy, and raw materials.
2. The industry provides important employment opportunities for highly educated professional staffs and other trained workers.
3. The industry is research-oriented. It accounts for 12% of all the private R & D carried on in Canada today.
4. The industry is strategic in nature, a fact which the major powers have recognized since the turn of the century. The United States, Germany, England, and France each took positive steps to ensure the industry's viability as a strategic consideration in the event of national emergency. Since World War II, the U.S.S.R., Japan, and Italy have adopted similar measures. Canada found itself sadly lacking in this respect in both world wars when new chemical processes and products had to be introduced by means of crash programs. While the historical strategic aspect of defence is still important, there are other strategic considerations which also require the development of a self-reliant chemical industry. This industry plays a vital role in the health of the nation's citizens, in growing and processing food, in extracting resources, and in controlling environmental quality. It also has a strategic value in contributing to the strength of secondary industry.
5. The industry contributes to the productivity of other industries; e.g., agriculture, the extractive industries, and the primary and secondary manufacturers. As a vigorous domestic industry, it spends a great deal of its time and effort evolving processes and products tailor-made to fit Canadian customers' use. These uses may be different from those of consuming industries elsewhere, either because of climate, raw materials, or the applications and techniques employed. Should Canada permit the chemical industry to

fall short of its potential through lack of encouragement, or through policies which actively discourage it, all Canadian industry would have to rely more and more on imported chemicals, which would be a retrogressive step. In the long run, the industries using chemicals would then be required to adapt their methods and precedure to those developed for industries in the exporting country. This would put the Canadian manufacturer at a distinct disadvantage in having to adapt to the technology of others rather than procuring what suits his own needs best. This also might penalize the Canadian using industry with respect to the cost paid for late entry into the market place.

6. The presence of an active, scientifically advanced chemical industry brings to the country other advanced sciences which help to improve the productivity of other industries. For example, the chemical industry is responsible for the build-up of a large fund of knowledge in high-pressure techniques, which have application in many other industries.
7. Compared to most other industries, the chemical industry is capital intensive. A high proportion of the capital is in process equipment which is highly sophisticated, and which undergoes continual modification through the development of new techniques. This continuous high demand for capital stimulates design engineering and equipment manufacturing, as well as the more advanced segments of the construction trade.

APPENDIX 2

C.C.P.A. Viewpoint on Science Council Objectives

The Canadian Chemical Producers' Association commends The Science Council of Canada for its endeavours in performing the "Duties" assigned in The Science Council of Canada Act, Section II, especially its duty to "assess in a comprehensive manner Canada's scientific and technological resources, requirements and potentialities and to make recommendations thereon...."

The C.C.P.A. welcomes the continuing efforts of the Council to fulfil the purposes described in its annual report of June 1967: "to ensure that Canada has a strong and competent, alert and growing scientific community and to advise the Government on how best to use science in the solution of the economic and social problems of Canada....to identify and define major problems, to recommend the broad allocation of manpower and money among competing needs and to ensure that appropriate organizational and institutional arrangements are made for the most effective use of these resources". (p.1)

In particular, the C.C.P.A. shares the opinion of the Council that "Canada's needs in research and development differ substantially from those of most countries (p.14)....Our resources of money and manpower are limited; therefore we must apportion them wisely, concentrating them in areas that are important to the nation, socially, economically, or scientifically. We must also raise our commitments to research and development to a level commensurate with our needs.... We should realize that the allocation of resources that is best for Canada may be substantially divergent from the patterns that are evolving in other countries. The right prescription for Canada cannot be determined by any simple formula or transposition to Canada of someone else's solution. Careful consideration will be needed of the different elements of our Canadian social and economic fabric that interact with science and technology before an appropriate pattern and scale of support can be developed".(p.15).

The C.C.P.A. supports the Council in emphasizing that "the pattern of industrial research in Canada will not be exactly the same as in other highly industrialized countries. In most of our industries we have a unique combination of widespread geographical dispersion, extensive foreign ownership and unusually easy access to new technology for import. Secondary industry has the additional problems of limited domestic markets and of many small companies" (p.16).

The Association also supports the Council's view "that several major programs aimed at the application of science and technology to pressing social and economic problems will have to be initiated or expanded" and it welcomes the suggestion that "much of the actual work on these programs may well be done in industry" (p.17).

The Council is to be specially commended for the warning issued in its first annual report: "research expenditures tend to be characterized by a period of rapid increase followed by a period of slowed growth if not actual levelling off.... this rapid rate of expansion cannot continue forever. When the time comes it should be slowed rationally and with forethought"(p.19).

A further warning appeared in the first and second annual reports, and with this the C.C.P.A. is again in precise agreement: "we must be sure that enough of our research and development effort is successfully directed toward profitable projects to ensure the continuity of the production which supports all our research.... if our industry becomes unprofitable there will be no money for any kind of research" (June 1967, p.19; June 1968, p.10).

APPENDIX 3

Economic Environment
(Extract from C.C.P.A. Position Paper on Taxation, 19th August 1968)

The Canadian Chemical Producers' Association believes that, given the proper environment, it should be possible for the Canadian chemical industry to grow at a rate matching the high world growth rate of the industry and so reverse the present worsening adverse balance of trade on chemicals. Deficit on chemical trade, excluding fertilizers, increased from $182 million in 1962 to $315 million in 1967 (D.B.S. 65-002, 65-005).

The Department of Industry has been conducting a comprehensive, in-depth study of the Canadian chemical industry. This study by the Department of Industry is being done with the cooperation of the C.C.P.A. In light of the data available, the C.C.P.A. considers that there are three general interrelated factors which inhibit the attainment of growth and a favourable balance of trade:

(1) The conditions governing the movement of chemicals across international borders; e.g. tariffs, non-tariff barriers and anti-dumping regulations.

(2) Those factors determining scale of optimum operation. Here access to markets sufficient in size and concentration to justify large scale units are affected by both Canadian and foreign combines legislation as well as by the level of research and development which can lead to specialization so that longer production runs may reduce costs.

(3) The conditions governing competitive costs at equal scale are influenced by such factors as the cost of raw materials, the cost of construction, the cost of capital, and the level of taxes.

APPENDIX 4

Description of The Canadian Chemical Producers' Association

The Canadian Chemical Producers' Association was founded in April 1962. It has a membership of 44 companies, comprising Canada's major chemical producers. The organization represents the vast majority of Canada's basic chemical manufacturers, whose plants are located from coast to coast in an exceptionally wide variety of locations. To be eligible for membership, a company must be currently engaged in the operation of a chemical manufacturing plant within Canada and in selling to others in the open market a substantial portion of the products of such plant.

The following are the members of the Association:

Allied Chemical Canada Limited
Aluminum Company of Canada Limited
ADM Chemicals, Division of Valvoline Oil Company of Canada, Limited
Armour Industrial Chemicals Limited
Atlas Chemical Industries Canada Limited
Bate Chemical Corporation Limited
H.L. Blachford Limited
Borden Chemical Company (Canada) Limited
Brockville Chemical Industries Limited
Canadian Hoechst Limited
Canadian Industries Limited
Canadian Titanium Pigments Limited
Chemcell Limited
Clough Chemical Company Limited
Cyanamid of Canada Limited
Dominion Colour Corporation Limited
Domtar Chemicals Limited
Dow Chemical of Canada Limited
Du Pont of Canada Limited
Electric Reduction Company of Canada, Limited
Emery Industries (Canada) Limited
Ethyl Corporation of Canada Limited
Gulf Oil Canada Limited
Harchem Limited
Hercules Canada Limited
Hooker Chemicals Limited
Howards & Sons (Canada) Limited
Imperial Oil Limited
Lignosol Chemicals Limited
M&T Products of Canada Limited
Mallinckrodt Chemical Works Limited
Monsanto Canada Limited
National Silicates Limited
Nopco Chemical Canada Limited
Polymer Corporation Limited
Shawinigan Chemicals Limited
Shell Canada Limited
Standard Chemical Limited
Texaco Canada Limited
Tioxide of Canada Limited
Union Carbide Canada Limited
UNIROYAL Limited
VirChem of Canada Limited
Witco Chemical Company, Canada, Limited

The Association has the following aims and objectives:

(a) to promote the interests and development of chemical producers in Canada.

(b) to provide a forum for the exchange of views and recommendations on any problems and needs of large and small chemical producers in Canada.

(c) to promote and maintain good relations between members of the Association and government authorities, other segments of the economy, and the public.

The Canadian chemical industry is one of Canada's key industries with assets of $\$2\frac{1}{2}$ billion, an annual gross value of shipments of $\$2\frac{1}{4}$ billion and exports of $400 million. It pays $500 million in salaries and wages each year to some 74,000 employees, a high percentage of whom are technically and professionally trained.

APPENDIX 140

SENATE COMMITTEE ON SCIENCE POLICY

Comments by

THE MACHINERY & EQUIPMENT MANUFACTURERS' ASSOCIATION
OF CANADA

26 March, 1969

Machinery & Equipment Manufacturers' Association of Canada,
116 Albert Street,
OTTAWA 4, Ontario.

SENATE COMMITTEE ON SCIENCE POLICY

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COMMENTS TO THE SENATE SPECIAL COMMITTEE ON SCIENCE POLICY

1. INTRODUCTION - Our Association

The Machinery and Equipment Manufacturers' Association of Canada wishes to express its appreciation for the opportunity to submit comments on Science Policy as it affects our industry. Our members include most of the companies in Canada whose principal business is the manufacture of industrial machinery, but exclusive of agricultural, automotive, aircraft and office machinery. Our sales exceed $300,000,000 of which 5% is for export markets. Our 16,000 employees include a high proportion of technically trained people, engineers, designers, draughtsmen, patternmakers, machinists and other skilled trades.

As industrial manufacturers our member companies are very much alive to the fact that their dependence upon constantly improving technology is one of the essentials to competitive survival. They are equally conscious of the extent of the research needed and the wide range of specialists required to cope with the demands of modern technology, and of the fact that few individual companies or organizations can handle these demands without external help.

Most companies have a Research and/or Development program as part of their product development and improvement plans, but these are necessarily limited in scope by the size of budget available. The Canadian Government recognizes the need to assist industry in this area, and our members make use of its assistance and incentives programs when they offer advantages.

Assistance Programs

(a) The Industrial Research & Development Incentives Act (IRDIA)

Basically IRDIA provides grants amounting to 25% of all capital expenditures made in Canada in the year on R & D facilities, and 25% of the amount by which eligible current expenditures made in Canada in the year for R & D exceed the average of eligible current expenditures in the preceding five years. While this is essentially a generous form of assistance, users or potential users report the following drawbacks:

(i) a firm may fail to qualify for aid at the very time its need is greatest, i.e, when suffering a downturn in business, with consequent inability to increase its R & D expenditures over those of previous years;

(ii) the time lag between application for, and receipt of, assistance, along with the preparation of lengthy and detailed reports in support of the application;

(iii) some of the information required by the administrators of the program can be of a type which private companies are reluctant to give -- information which may constitute in effect, trade secrets.

(b) National Research Council

The type of direct aid which may be available from the National Research Council is a highly worthwhile form of assistance, particularly to the small manufacturer. In one specific case, a manufacturer approached N.R.C. for engineering and technical advice on some problems relating to a proposed plant expansion. N.R.C. sent a professional engineer to the plant and gave detailed advice, with excellent results. While it is evident that this type of aid has a limited field of application, its direct, informal, unbureaucratic approach produced a truly appreciative response from the manufacturer and extension of this type of service could be beneficial.

Basic vs Applied Research

Without engaging in discussion on the relative importance of basic research and applied research, it would benefit the machinery manufacturing industry if it had access to a greater degree of applied research. An expanded program of direct aid to industry by an agency such as N.R.C. would be well received and would undoubtedly produce effective results.

4. Accessibility of Information

It is evident that a wealth of scientific information is being generated each year by a wide range of scientific and technical bodies. It is likely that a high proportion of this information does not reach the machinery manufacturers at all, and certainly not in a form which can be understood and used by them. There may be a very considerable gap between the two groups -- the scientists, and industry, -- and it would clearly be to the advantage of both if communications between them were better. This would appear to be an area in which government might take the initiative in coordinating and collating scientific and research information on the one hand, and ensuring its useful distribution to potential areas of application in machinery manufacturing and other industries. By the same token, industry might use this channel to acquaint the scientist more thoroughly with its needs and priorities.

5. Importance of Timing

Certain industries such as machinery manufacturing, do not have the continuous flow characteristic of consumer goods products, and most machines destined for industrial application, have a working life of from 10 to 40 years. With such a long working life it is therefore important that each new machine incorporates the latest performance and capacity improvements resulting from innovation and discovery. If companies are unable to carry out the development and research programs necessary to convert their ingenuity into practical application because of lack of their own funds or because their present program is below their five year average, technological improvement may be delayed for a number of years.

Such delays may not only work to the disadvantage of productivity gains in the domestic market but may result in missed opportunities to take a good position in the export market in the early stages while the information is new and generally not available to others.

6. Conclusion

Our Association appreciates the interest the government has been showing in development and administration of plans designed to encourage research and development by industry.

While we recognize that certain basic qualifications are required for administration purposes, we recommend that many research and development projects should be considered on their own merits and assistance made available without reference to five year averages or other restricting conditions.

Respectfully submitted,

MACHINERY & EQUIPMENT MANUFACTURERS' ASSOCIATION OF CANADA

26 March, 1969

APPENDIX 141

BRIEF TO THE

SPECIAL SENATE COMMITTEE ON SCIENCE POLICY

PRESENTED BY THE

CANADIAN PULP AND PAPER ASSOCIATION

AND THE

PULP AND PAPER RESEARCH INSTITUTE OF CANADA

March 1969

BRIEF TO THE
SPECIAL SENATE COMMITTEE ON SCIENCE POLICY
PRESENTED BY THE
CANADIAN PULP AND PAPER ASSOCIATION
AND THE
PULP AND PAPER RESEARCH INSTITUTE OF CANADA

Scientific activities help to shape every aspect of Canadian life. They affect not only our standard of living, but our attitudes and behaviour; not only our economic growth and development but our stature as a nation, measured in terms of its contribution to the enrichment of man's knowledge.

It is with a particular aspect of these scientific activities that this brief to the Special Senate Committee on Science Policy is chiefly concerned, namely, research which has relevance for the Canadian pulp and paper industry. But because the science policy of the federal government is formed and implemented by so many Departments and agencies, and serves such a variety of purposes, the brief attempts primarily to set forth a framework within which government and industry could work most effectively.

The brief is submitted to the Committee by the Canadian Pulp and Paper Association and the Pulp and Paper Research Institute of Canada, on behalf of their member companies. These two organizations, their history, and their role in the technological development of the pulp and paper industry, are described in Appendix A. In Appendix B, for the information of the Committee, is a summary of the rather considerable contribution which research in Canada already has made to pulp and paper manufacturing technology and forest management. The benefits of this research have appeared in a more complete and more efficient use of Canada's forest resource; in the continuing growth of an industry which is of fundamental importance to the Canadian economy; and in a greater variety of cellulose products useful to man.

Such benefits will continue to flow from the research expenditures of the pulp and paper industry, which now amount to some $30 million annually in Canada. But they can be multiplied and enlarged, we suggest, if the research activities of the federal government and the industry can be more effectively meshed.

There is an urgency to this problem. It arises from the fact that pulp and paper is a world industry characterized by vigorous competition amongst the various producing regions. The total demand for its products is increasing rapidly, and probably will double during the next 15 years. But the extent to which Canada will share in this increase will depend not merely on the magnitude of our forest resource, but on the cost of exploiting it. And this, as is set forth as greater length in Appendix C, will depend to a considerable degree on the effectiveness of our efforts in research, relative to those elsewhere in the world.

The chief points which we wish, in this brief, to place before the Committee, are these:

1. We consider that there is an urgent need for greater consultation and coordination between government and private industry concerning the research requirements of industry, the priorities to be given specific research projects, and the appropriate agencies to be used in carrying out those projects.

2. We suggest, further, that federal government research activities, and indeed research philosophy, receive the most careful study with a view to determining whether they reflect an adequate concern with the potential economic benefits of research to the Canadian economy.

3. We suggest that the federal government seriously consider having a greater portion of its research carried out in the laboratories of industry. This pertains especially to applied research and development work which, as a general rule, is best performed nearest the point of application.

4. Finally, we suggest that existing federal government programs for the encouragement of industrial research in Canada be strengthened, in part, to broaden their scope and increase their usefulness, and in part, to alter their direction so as to reward successful research.

These recommendations would help, we suggest, to steer federal government research on a course somewhat different from that on which it has been embarked. They would involve no drastic reshaping of current programs, and no sudden and sizable increase in government expenditures. Rather, they would require a change in attitude and thus in emphasis, a deeper concern with the economic returns to be gained from research, and a greater reluctance to build up the federal research establishment if adequate facilities exist already in other areas of the economy or if it seems that they might better be established outside the federal government.

The first of these recommendations concerns the need for greater consultation and coordination on research matters, amongst government, private industry, and the universities. Such a need seems almost self-evident and yet, surprisingly, it has not been recognized to the extent that an adequate and continuing rapport has been established.

We therefore suggest that some formal agency be organized to correct this deficiency. It should comprise senior representatives of government, both federal and, where appropriate, provincial; of the industry; and of the universities. Its task would be to coordinate and rationalize those scientific activities which have broad relevance for the pulp and paper industry as a whole, or for large portions thereof. Its goal would be the optimum utilization of our human and capital resources.

We recognize that there are difficulties inherent in this course. They arise in part from the multitude of interests that must be considered and reconciled. Within the federal government, not only is the Department of Forestry carrying out research in many fields of interest to pulp and paper, but some divisions of the National Research Council also have projects relevant to the industry. Again, several of the provincial governments, and a number of the universities in Canada, pursue research in matters pertaining to pulp and paper. Finally, there is the work of the Pulp and Paper Research Institute of Canada, and of the individual pulp and paper companies.

Considerable benefits surely would flow from a closer coordination of these efforts. In this regard, moreover, the experience of the pulp and paper industry itself is perhaps instructive. Its own research effort is coordinated and integrated to a degree unusual amongst industries in Canada. Thus, the objectives of the Pulp and Paper Research Institute, which is a partnership of the federal government, the pulp and paper industry, and McGill University, are to supply the industry with fundamental knowledge concerning pulp and paper and the raw materials used, and also to initiate new processes or improve existing ones. When, as a result of its research, a process or piece of equipment is conceived which may be of use to the industry, the Institute has a responsibility to bring it to the stage where it can be licensed either to the member companies or to equipment manufacturers for further development and commercialization. The companies individually have generally conducted research in areas which are highly competitive, such as product development, and in problems peculiar to their own operations. However imperfect or incomplete the results of this coordinated approach may seem thus far to have been, it does at least represent an attempt to organize research activities on a rational basis.

Our second and our third recommendations concern the role of the federal government in research. We do not suggest that the present level of expenditure on research by the federal government is either excessive or inadequate. Rather, we consider that substantial benefits would result from a change in its direction.

Government should undertake studies which companies, acting either collectively or individually, cannot pursue; studies such as forest entomology, pathology, and genetics, subjects in which, incidentally, provincial governments also have a responsibility. Most of the applied research and development work, in which there is an urgent need for greater emphasis, should be assigned to industry.

Of Canada's total research and development expenditures, a much smaller portion pertains to development than in most of the leading industrial nations. And this certainly contributes to the fact that, of the patents awarded in Canada in recent years, only some 5 per cent have been issued to residents.*

Basic research is, of course, vital to progress in every field. Moreover, Canada's peculiar circumstances, combining a small population with vast distances and a harsh climate creates a need for many basic studies

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*"Canada - An Appraisal of Its Needs and Resources", University of Toronto Press, 1965

not carried on elsewhere. Nevertheless, a proper balance must be struck. We suggest that basic research is receiving a disproportionate share of the resources available, and that the potential contribution of research to the growth of the Canadian economy is not being realized.

Comparing scientific activities in Canada and the United States, for example, it seems clear that the widest gap lies with the financing of new developments. This, rather than fundamental studies, is the really expensive phase of industrial innovation. Yet its importance can scarcely be over-emphasized; for research benefits the economy only when it is carried forward to the stage of successful development.

We hope that in any new science policy which the government might develop, applied research and development would receive a priority higher than it now enjoys. We hope, too, that in giving greater importance to these activities, the government would assign a larger portion of its research work to the laboratories of private industry, by way of grants or contracts. Here again, the experience of the United States, where applied industrial research exerts such tremendous thrust to economic growth, is interesting.

In the U.S., the research activities of government are half as large, proportionately, as those of industry. In Canada, they are twice as large.

We do not suggest that Canada necessarily should emulate this research pattern of the United States. Our nation has developed under a different blend of economic and social conditions and needs, and government, for a variety of reasons, has always had a larger place in our lives.

We do suggest that it would be reasonable to expect a somewhat better balance in the distribution of federal government research activities. This is particularly true of applied research and development work in the industrial field. We submit that in general, this work is most effective when performed close to the point of application, where there is a better appreciation and a wider knowledge both of the goals to be established and of the problems to be overcome.

An additional comment on the relationship of scientific activities to the economy is, perhaps, in order.

We recognize, of course, that there are a number of purposes served by science and a number of possible goals for national scientific efforts. We believe, however, that emphasis should be given to economic goals in formulating policies affecting science. Growth of the economy has been and will continue to be of great concern in Canada. Science policies should assure that our scientific efforts make their maximum contribution in support of this growth.

The extended application of science and technology has been the principal factor in raising economic productivity during the past 200 years - the modern economic era. It has not so far been possible to measure accurately the direct impact of science and the increase of knowledge on economic growth. However, it was estimated in a recent Economic Council of Canada study that 64 per cent of the increase in productivity in Canada from 1955 to 1962 was accounted for by the advance of knowledge and its application. Estimates made for other countries are of the same order of magnitude. Scientific research is one of the main contributors to this increase of knowledge.

Canada has obtained from other countries much of the scientific and technological knowledge applied here. It will continue to do so. Nevertheless, scientific work carried out in Canada has been essential to the development of the economy. Many of our resources, agricultural, mineral and forest, owe a large part of their development to the application of science in discovering new uses for them and new methods of using them. The modern pulp and paper industry is a direct result of the application of science to the fields of resources and industry.

Canada's scientific effort has been growing rapidly in recent years and we believe that further growth at a rate somewhat faster than the economy in general is justified and will pay economic dividends. But it is imperative to assure that Canada's science resources are applied so as to provide the greatest economic and social benefits. We are a small country economically and cannot devote resources right across the scientific spectrum. We are better off to develop a few well selected fields of science properly than to have mediocre performance in all.

We are aware that the Science Council of Canada recently suggested several broad areas which, it felt, should have priority in research. But we suggest that these should be examined very carefully indeed before the government commits itself to them. For surely the most advantageous deployment of science in support of economic development is with activities in which we have a natural advantage such as the resource industries, and in particular, pulp and paper. By reinforcing these advantages, the impact of new scientific discoveries will be returned quickly and in significant magnitude.

As the Economic Council of Canada said, in its 5th Annual Review, asking itself what should be Canada's response to fast growing world demand for high-technology products, "it should be, on the one hand, to support, in part by appropriate strengthening of technology, the great resource industries in which Canada already possesses substantial comparative advantages..."

Our fourth recommendation concerns the existing federal government programs for the encouragement of industrial research in Canada. The government, after it decides upon a science policy, may wish to reshape these programs extensively, altering some that are old and adding others. In the meantime, we suggest that as a stopgap, the existing programs should be strengthened, to broaden and increase their usefulness and to promote successful research. Here we reiterate certain of the recommendations made by the Canadian Pulp and Paper Association during 1968 in a submission to the Science Secretariat. These are as follows:

a) The Industrial Research and Assistance Program

The Industrial Research and Assistance Program (IRAP) has proven to be an excellent incentive to many Canadian companies to increase their research effort. Nevertheless, its requirement that additional staff be engaged is an undesirable limitation. In some instances, for example, a project might usefully be instituted under IRAP by utilizing existing staff. It is therefore recommended that this program be continued but with no increase in staff being required in order to participate.

b) Industrial Research and Development Incentives Act

Under the Industrial Research and Development Incentives Act, (IRDIA), all capital research expenditures are eligible for a tax-free grant of 25 per cent. IRDIA thus has provided industry with a clear policy on which capital research expenditures may be planned most economically and effectively, and will undoubtedly help to produce an orderly growth of industrial research facilities in Canada.

As for operating research and development expenditures, a similar tax-free grant of 25 per cent has been made available. It applies, however, only to the increase in expenditures over a base comprising an average of the expenditures incurred during the previous five-year period. This restriction means that it becomes difficult to share in the benefits of the program during periods of recession, when funds are not as readily available to increase research expenditures. It also means that the program tends to ignore an important problem, namely, that of preserving the existing level of research. With some companies, this level may already be relatively high.

It is therefore recommended that all capital and operating research and development expenditures, as defined under IRDIA, automatically be eligible for a tax-free grant of 25 per cent with no deductable base period.

c) Program for Advancement of Industrial Technology (PAIT)

The purpose of the Program for the Advancement of Industrial Technology (PAIT) is to assist in the development of new industrial processes in Canada. It provides that any technology developed under PAIT should be applied in Canada. However, if a process has been applied successfully in Canada, and is applicable elsewhere, it appears logical to permit its use in other countries under licence. The pulp and paper industry has followed this procedure in the past, with the result that some Canadian inventions are used all over the world, and, conversely, the industry in Canada has benefited from developments elsewhere. Technology can be, indeed, a substantial and profitable export for a nation, and is recognized as such by a number of the leading industrial countries.

For competitive commercial reasons, it is usually desirable to patent a novel process or apparatus, if only to establish security of ownership. If patents are not applied for and obtained in other countries, then the invention becomes public property in those countries. If the process is patented outside of Canada where it may also be used profitably, a compulsory licence may have to be issued in due course. It is therefore recommended that the restriction which prohibits exportation of technology developed under PAIT (clause "5(4)") be revised to allow Canadian companies to export the technology to foreign countries.

d) Government Contract Research

We recommend that the government support and coordinate research programs on scientific problems of national interest, the research to be carried out under contract by university and industrial laboratories in cooperation with corresponding specialists in the National Research Council, or one of the other government laboratories.

e) National Benefits

We recommend that, as a matter of broad policy, the support of industrial research by the federal government should be considered not as a cost but as an investment from which a worthwhile national return can be expected.

We are grateful for this opportunity of presenting our views to the Special Senate Committee on Science Policy. We are hopeful that they will assist the Committee in the important task which it has undertaken. And we trust that, in the end, its studies will suggest a science policy for Canada which is at once practical, imaginative, and adventuresome.

Appendix A

1. Canadian Pulp and Paper Association

The Canadian Pulp and Paper Association was established some 56 years ago to promote the interests and development of the Canadian pulp and paper industry. Its member companies, today numbering 55, account for more than 98 per cent of the pulp and paper manufactured in Canada.

CPPA has always pursued a strong technical and scientific policy, which has helped to improve the technical competency of its member companies and thus to strengthen Canada's position as a leading world producer of pulp and paper products. Its activities in this field are carried on, for the most part, through two professional societies which are a part of the Association. These are:

a) The Technical Section

The Technical Section of the Canadian Pulp and Paper Association was established in 1915, to stimulate interest in the science and technology of pulp and paper in Canada; to provide a means for the interchange of information and ideas; and to encourage original investigations.

The membership of the Section approximates 4,000 and is drawn from all levels of management in the pulp and paper industry, and in related industries and engineering firms. The pulp and paper industry has been characterized by an unusually free exchange of technical information. Thus meetings of the Technical Section have become important international forums for discussion of new developments. Through them, moreover, because some 20 per cent of the members are from foreign countries, the Canadian industry obtains access to important information developed elsewhere in the world.

b) The Woodlands Section

The Woodlands Section of the Canadian Pulp and Paper Association was established in 1917, to provide a medium for the exchange of scientific and technical information on the growing and harvesting of the pulp and paper industry's wood requirements. Its members, numbering approximately 1,600, include professional and technical personnel employed by the pulp and paper industry, other forest-based industries, government

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resource departments, universities, and manufacturers and suppliers.

Members from outside the industry who endorse and support the objects of the Section make a substantial contribution to the collection, compilation and analysis of data and in the implementation of cooperative action. Thus, the prime object of the Section, to foster the development of the best methods of managing and operating the woodlands of the CPPA member companies, is attained through cooperative action amongst members, governments and the general public.

2. Pulp and Paper Research Institute of Canada

The Pulp and Paper Research Institute of Canada is a partnership of the government of Canada, McGill University, and the Canadian pulp and paper industry. Its history may be traced to the establishment in 1913 of a Montreal Branch of the Federal Forest Products Laboratory at McGill University. In 1927, the industry's central research activities were established with those of the Forest Products Laboratory and with McGill University's graduate training and research program in wood chemistry. In 1950, the Institute was incorporated as a non-profit research and educational corporation, with a full-time President and a Board of Directors appointed by the three partners.

The objectives of this cooperative enterprise have been, to engage in research of importance to the industry as a whole, and to train scientists for the industry, government, and universities. It has grown into an organization with a staff of nearly 200, with 40 postgraduate students, and with a program directed to every phase of the pulp and paper industry's operations.

Each of the three partners plays a different role. The government provides a \$5-1/4 million laboratory facility in Pointe Claire, Quebec. McGill participates through a postgraduate training program, which is carried out primarily on its campus. Those McGill students who select thesis topics of interest to the industry do their research under the direction of Institute staff holding concurrent honorary posts at McGill.

The role of the industry, as exercised through the Canadian Pulp and Paper Association, is a major one. The Institute's activities are entirely financed by the industry, and the budget is subject to review and

Appendix A

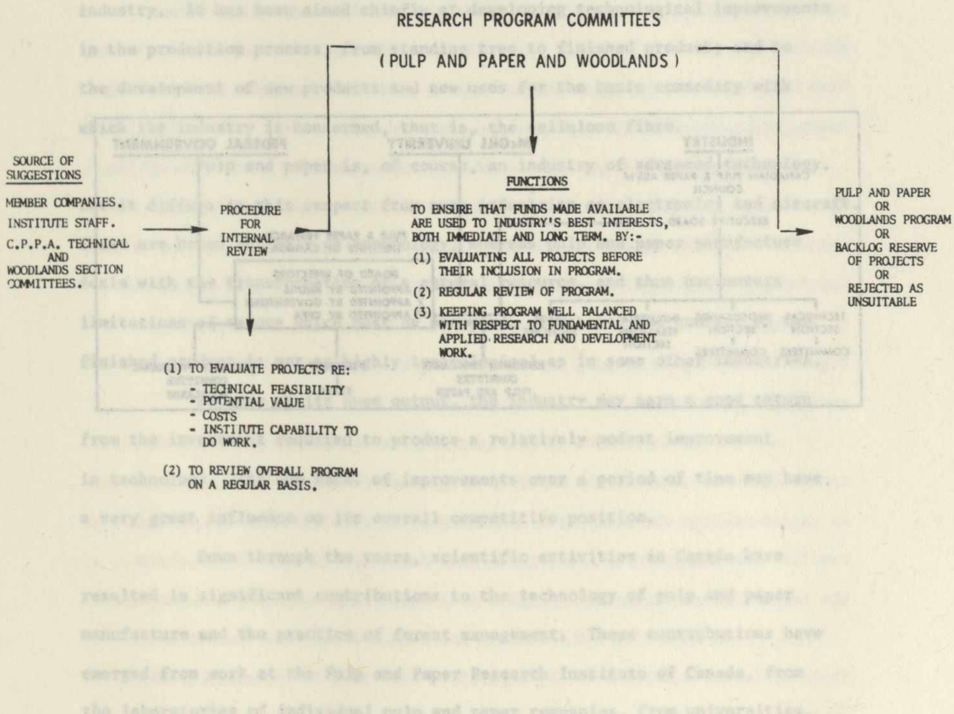
approval both by the Institute Board of Directors and by the Executive Board, Canadian Pulp and Paper Association. The budget needs are then met by a combination of grants from CPPA, and direct assessments on those pulp and paper companies which are Maintaining Members of the Institute. The contribution that each supporting company makes to the Institute is, in effect, a supplement to its own research and development program.

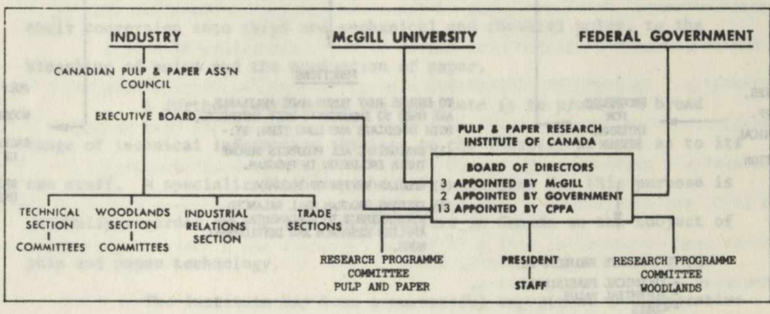
The Institute program is concerned primarily with studies having a broad impact. These may be fundamental in nature, or they may be applied investigations which are of such magnitude or general interest that no single company could well justify undertaking them alone. The program is dynamic, and its emphasis has changed over the years to meet the needs of the industry. Its overall scope continues to be broad, and includes projects ranging from the growth and harvesting of trees through their conversion into chips and mechanical and chemical pulps, to the bleaching of pulps and the production of paper.

A further function of the Institute is to provide a broad range of technical information services to the industry as well as to its own staff. A specialized library which it maintains for this purpose is generally regarded as the most comprehensive in Canada on the subject of pulp and paper technology.

The Institute has been a successful experiment in cooperative enterprise. It was one of the first institutions in the world in which industrial research and the training of graduate students along lines of specific interest to industry were carried forward under the joint sponsorship of a national government, a world-renowned university, and a major industry. The Institute's pattern of organization has become a prototype for institutions of similar sort, not only for the pulp and paper industry, but for other industries in various parts of the world.

PROGRAM SELECTION AND REVIEW




INDUSTRY
McGILL UNIVERSITY
FEDERAL GOVERNMENT
CANADIAN PULP & PAPER ASS'N COUNCIL
EXECUTIVE BOARD
PULP & PAPER RESEARCH INSTITUTE OF CANADA
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INDUSTRIAL RELATIONS SECTION
TRADE SECTIONS
RESEARCH PROGRAMME COMMITTEE PULP AND PAPER
PRESIDENT
STAFF
RESEARCH PROGRAMME COMMITTEE WOODLANDS

APPENDIX B

Canadian Research and Technological Advancements

Expenditures on research by the Canadian pulp and paper industry have increased gradually over the years, and now total some $30 million annually. Of this, some $2.5 million represents the budget of the Pulp and Paper Research Institute of Canada, and the balance comprises the research expenditures of the pulp and paper companies individually. An additional $2 million is spent on research and development by supplier companies to the pulp and paper industry.

Research has played an important role in the growth of the industry. It has been aimed chiefly at developing technological improvements in the production process, from standing tree to finished product; and to the development of new products and new uses for the basic commodity with which the industry is concerned, that is, the cellulose fibre.

Pulp and paper is, of course, an industry of advanced technology. But it differs in this respect from such industries as electronics and aircraft. These are based entirely on technology, whereas pulp and paper manufacture deals with the transformation of a natural resource, and thus encounters limitations of nature which must be accepted. In short, the content of the finished product is not as highly technological as in some other industries.

Because of its huge output, the industry may earn a good return from the investment required to produce a relatively modest improvement in technology. The sum total of improvements over a period of time may have a very great influence on its overall competitive position.

Down through the years, scientific activities in Canada have resulted in significant contributions to the technology of pulp and paper manufacture and the practice of forest management. These contributions have emerged from work at the Pulp and Paper Research Institute of Canada, from the laboratories of individual pulp and paper companies, from universities, and from research work within the federal and provincial governments.

There is widespread recognition of the technical contributions by the Institute to many areas of the industry's operations, among them the production of groundwood and refiner pulp, chemical pulping techniques, pulp bleaching, the forming and drying of paper, basic studies of logging systems, and forest nutrition. The contributions of the Institute over the years are

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too numerous to detail here, but it is worthwhile noting a few which have contributed significantly to the progress and development of the Canadian industry.

Over a period of several years, the Institute carried out basic studies on increasing the yield of pulp from sulphite pulping. These studies resulted in a genuine impetus for commercial development and have brought substantial increases in the yield in a number of mills, thereby reducing wood costs through fuller wood utilization. The Institute has also developed fundamental information in groundwood pulping, has maintained world leadership in basic investigations in this field, and has extended its studies to the production of chip refiner groundwood, a process which appears to have considerable potential merit. New techniques of pulp bleaching have recently been discovered which appear to have a real potential for reducing bleaching costs, and producing higher yields and improved pulp quality.

In papermaking, studies of the factors causing short life of the wire screens on which newsprint is formed resulted in recommendations to the industry which led to appreciable cost reductions. More recently, the Institute has developed a new type of machine for the forming of paper. It is expected that the commercial model of this development will result in significantly higher speeds, lower operating costs, improved quality, and savings in plant space.

At the other end of the spectrum, an example of the potential commercial value even of the fundamental graduate student thesis research is represented by the early work conducted by an Institute student on the vanillin-forming process. This basic work formed the foundation on which the commercial production of vanillin from waste pulping liquor was built.

In forestry, the Institute has done considerable work in the field of forest nutrition which, hopefully, will lead to increased growth rates and a reduced cost of wood to the Canadian mills. In logging, the Institute has conducted several studies which have led to providing basic engineering data essential to the economic design of pulpwood holding grounds and mechanized logging equipment.

Some of the more important developments in pulp and paper manufacture and forest management have resulted from the scientific activities of the pulp and paper companies themselves or, in other instances,

Appendix B

the universities. These have included, for example, basic inventions which stimulated the rapid growth of the kraft pulp industry all over the world: first, the black liquor recovery furnace which was probably the most important element in rendering kraft pulping economic; and later, bleaching methods which opened vast new markets for kraft paper and paperboard.

Research scientists in Canadian pulp and paper companies have developed new sulphite pulping methods which have increased the yield of fibre, broadened the range of tree species that can be used, and brought significant improvements in pulp quality. They have also taken a leading part in the development of refiner groundwood, mentioned earlier, which is really the first fundamental change achieved in mechanical pulping in more than a century.

Paper making, too, has changed considerably down through the years, owing to a constant flow of improvements, many of which have emanated from Canadian mills. The paper machines are wider and faster than ever before, with greatly increased productivity. Their control systems grow increasingly elaborate and sophisticated, and there has been a steady improvement in the quality of the products they manufacture. As compared with a few years ago, for example, Canadian newsprint is brighter and more opaque, with a better finish and improved runability on the press.

If technical progress in the mills has been substantial, in the forests it has been little short of revolutionary. Thousands of wheeled vehicles designed especially to move wood from the stump to the roadside have appeared in Canadian forests, and indeed in forests all over the world, in recent years. They incorporate a design which was a development of Canadian industrial research, that is, an articulated frame combined with very large wheels which give these vehicles the ability to move easily over difficult terrain.

Today, new multi-purpose logging machines are coming into operation in Eastern Canada. These mark a new stage in the mechanization process, and are expected to increase productivity dramatically. They are, for the most part, the products of industrial research and development in Canada, and they have established our nation among the world leaders in logging technology.

In addition to logging, many Canadian pulp and paper companies do significant studies in forestry, sometimes in cooperation with government research programs. Their studies encompass a broad field, from forest fertilization to forest protection, and from improved methods of reforestation to long term studies on natural regeneration. The results of such research in forestry matters are often unspectacular, but make a substantial contribution to our knowledge of Canada's forest resource and our ability to utilize it properly.

In general, it is certainly true that Canadian engineering, operating, and research skills both in pulp and paper manufacture and in forest management are of a high order. They have contributed much to the growth and progress of the pulp and paper industry in Canada, and their role in the years to come will be a very significant one.

APPENDIX C

Prospects for the Canadian Pulp and Paper Industry

An effective program of research and application of science in the Canadian pulp and paper industry must be based on the situation that will face the industry in the coming decades. This environment will be one of great and expanding opportunities but also of changing and increasing competition. The opportunities arise from the growing world demand for pulp and paper on the one hand, and our vast forest resources on the other.

World consumption of paper and paperboard has doubled in the last fifteen years, and the Food and Agriculture Organization of the U.N. predicts that this rate of increase will continue for the foreseeable future. Total production of paper and paperboard in the world was 110 million tons in 1965. The FAO has predicted that world demand in 1980 will rise to 225 million tons.

Figures on production of wood pulp show Canada's place in the world cellulose picture. In 1967, world production of wood pulp was 95 million tons, of which Canada produced 15.6 million tons or 16½ per cent.

We have not made specific forecasts for the purpose of this presentation, but it may be noted that a continuation of the strong growth trend of the past few years would result in a doubling of wood pulp production in Canada by 1980. The fact that the large markets for pulp and paper in Europe will show a substantial growth in consumption, while Europe's forests are not considered to be adequate to meet her future needs, lends support to the possibility of a bright outlook for production in Canada.

Our forest resources are ample to support such an increase in production and, in fact, to sustain increases well beyond the 1980 figure if they are managed correctly. Nevertheless, while future possibilities for the industry are very promising, much work must be done to realize them. Policies to provide an environment suitable for the expansion of industry must be adopted. Having no monopoly on forest resources, we face strong competition from a number of areas. On the very productive forest lands of the Southern United States, pulpwood can be grown much faster than in Canada. There are also large reserves of timber in the tropics that conceivably could appear on world markets within a decade or so. Up to now, these forests have not been developed for pulp and paper to any large degree.

Appendix C

In tropical areas where suitable wood is available, investment has lagged because of favourable opportunities in other areas having greater political and economic stability and an advanced technological base.

This situation could change. We have seen the power of science and technology when efforts are concentrated on a particular problem. Already the Japanese industry is transporting wood chips from the tropics to Japan in large ships designed for the purpose, and a number of European and North American companies are giving increased attention to the tropics. Large scale development of the tropical forests for pulp and paper production would considerably alter the world fibre demand-supply picture.

Our Canadian pulp and paper industry also must adjust to new circumstances in which the emphasis on marketing will increase. Consumers and industrial users now have a far wider range of materials from which to choose to meet any particular need. New products have been developed, many of them by the pulp and paper industry, and this trend probably will accelerate in the years ahead. Industry must therefore pay greater heed to the specific needs of consumers, to define these needs, and develop products to meet them cheaply and efficiently. Pulp and paper faces strong competition in this field from a number of other materials.

The main emphasis of our scientific activity for many years was in the development of increasingly efficient methods for producing more or less standard products. In the future, much more attention will have to be given to end-product characteristics. Increased scientific activity and research will be needed to accomplish this.

The Canadian industry also will be meeting greater competition in the sale of paper and paperboard in Canada, owing to the reduction of tariffs agreed upon in the 1967 GATT settlement. Canadian tariffs on paper and paperboard are being reduced in stages from general levels of 20 or 22½ per cent to 12½ or 15 per cent. This is causing important and difficult adjustments. Government policies in a number of areas will, it is hoped, assist the industry to adjust to the new circumstances. However, scientific research will have an important role to play.

Some believe that Canada eventually will be able to export large volumes of many kinds of paper and paperboard in addition to newsprint. We export only relatively small amounts of these other products at present.

Appendix C

The extent to which we may be able to increase our shipments to world markets is not yet clear. If it were to become possible, however, a marked expansion of research and scientific activities devoted to these products certainly would be needed to meet the strong competition of United States and European mills.

In summary, the Canadian pulp and paper industry faces very attractive opportunities, in the form of a rapidly growing world demand. The extent and speed of its future growth, however, will depend to a great extent on its ability to meet competition both from other pulp and paper producing regions of the world, and from other materials. In the strengthening of this ability, research will be of steadily increasing importance.

APPENDIX D

PROFESSIONAL STAFF EMPLOYED IN PULP & PAPER RESEARCH IN CANADA, 1965-66 SURVEY

	Bachelors	Masters	PhD's	TOTAL	Engineers	Chemists	Other
P.P.R.I.C.	27	10	24	61	11	23	27
18 Industrial Labs*	292	61	101	454	180	174	100
8 University Labs	**			124	66	58	
9 Government Labs	21	8	26	55	8	40	7
				633	254	272	107

*includes PPRIC

** 15 Post Doctorates
50 PhD Students
27 Masters
32 Faculty

Non-professionals	
PPRIC	127
Industry University Government	Approx. 1400

APPENDIX 142

BRIEF

to the

SPECIAL COMMITTEE ON SCIENCE POLICY
OF THE SENATE OF CANADA

Submitted by the

Pharmaceutical Manufacturers Association of Canada

141 Laurier Avenue West, Ottawa

May 1, 1969

PMAC

PMAC

Pharmaceutical Manufacturers Association of Canada
1110 Gillin Building • 141 Laurier Avenue West • Ottawa 4, Ontario
613 236-9993

May 1, 1969

The Honourable Maurice Lamontagne, P.C.,
Chairman,
Special Committee on Science Policy,
The Senate,
Ottawa, Ontario.

Dear Sir:

Herewith please find a formal presentation of the position of the Pharmaceutical Manufacturers Association of Canada in relation to Science Policy for Canada.

The research personnel and legal advisers who have prepared this brief would be very pleased to appear before your Committee at its convenience. We believe that the vital nature of our type of research and its relation to Science Policy obliges us to ensure that the Committee is as completely informed as possible.

If it is your wish that we appear, we shall supply the pertinent curricula vitae prior to the time of our appearance.

Trusting this is in order, we shall await your advice.

Respectfully yours,

Wm. W. Wigle

Wm. W. Wigle,
President.

WWW:me

B R I E F

TO THE SPECIAL COMMITTEE ON SCIENCE POLICY

OF THE SENATE OF CANADA

SUBMITTED MAY 1, 1969 BY

THE PHARMACEUTICAL MANUFACTURERS ASSOCIATION OF CANADA
141 Laurier Avenue West, Ottawa 4, Ontario

TABLE OF CONTENTS

1.1 Mr. Chairman, Honourable Senators - It is indeed an honour and a privilege for us to have the opportunity to make a presentation to this Committee. You are to be commended for embarking on such a broad-ranging public analysis. It is to be hoped that your deliberations will point the way to improved contact, co-ordination and direction between organizations like the Science Council of Canada and the Cabinet Committee for Scientific & Industrial Research. We feel that the definition and adoption of a policy for all aspects of science in Canada is vital to our nation's continuing advancement.

1.2 The pharmaceutical manufacturing industry in Canada is a science based, research-oriented industry. As such, we feel it is our duty to make a presentation to you regarding the nature of our industry, the place of research and the need for an environment to assist the growth of an industry vital to Canadians. In accordance with the directions for the presentation of information to this Committee, we will summarize our recommendations, our Association, our industry and its activities.

SUMMARY OF RECOMMENDATIONS

1.3 We recommend:

a) that research in the pharmaceutical industry be encouraged in Canada;

b) that interaction and co-operation between industry, university and government researchers be fostered;

c) that scientific activities of the federal government be co-ordinated as much as possible;

d) that every opportunity be sought to explain and communicate to the "public" the role, activities and benefits of science, scientists and scientific endeavours;

e) that Canada, as a technologically evolved nation, uphold her international relationships by recognizing the importance and value of the Patent Act in creating the proper incentive and environment for research in Canada;

f) that pharmaceutical manufacturers with substantial Canadian investment, employment, taxes, purchases, research and development not be discriminated against by encouragement of importers;

g) that recognition be given to the fact that only to the extent that patent protection permits, will publication of research findings by scientists continue to be a tool in retaining scientists in Canada;

h) that government assistance for industrial research take the form of tax allowances with carry forward to future years for loss years;

i) that tariffs for scientific equipment and chemicals used in research, but not made in Canada, be done away with.

THE PRESCRIPTION DRUG INDUSTRY IN CANADA

2.1 The Pharmaceutical Manufacturers Association of Canada, (P.M.A.C.), with offices located in Ottawa, is a voluntary organization now over 50 years old in Canada, functioning as a scientific trade association. We represent 58 Canadian companies - both large and small - responsible for the manufacture and distribution of 85 per cent of Canadian prescription medicines. Membership in P.M.A.C. is open to any research-oriented pharmaceutical manufacturer with exacting standards of quality control to ensure drug safety and efficacy. Some of our companies are Canadian owned, while many are truly international in scope, conducting research and manufacturing activity in many countries. P.M.A.C.'s membership comprises American, British, Canadian, Dutch, French, German, Swiss and Swedish companies who have invested heavily in Canada.

2.2 The objectives of the Association have been to upgrade the standards of quality in the manufacturing of pharmaceuticals in Canada; to encourage members to market products to the professions of medicine and pharmacy on an orderly, factual basis by following codes of marketing and advertising practices; to encourage research, and to further the highest possible health standards for Canadians.

Membership is based on the agreement that the qualified applicant is prepared to follow the principles of ethics and objectives of the Association.

2.3 Some of the activities which the Association has successfully undertaken are:

(i) continuing co-operation with the Food and Drug Directorate throughout the years in the development of improved methods of inspection for pharmaceutical manufacturers and the establishment of effective, valid standards to be used during such inspections;

(ii) co-operation with the Canadian Government Specifications Board in the development of a standard (74-GP-1b) for the use of those agencies purchasing drugs for governmental programs;

(iii) continual liaison with the Food and Drug Directorate in the development of regulations under the Food and Drug Act;

(iv) assistance to the Canadian Pharmaceutical Association in the development of the Compendium on Pharmaceutical Specialties as a complete, unbiased information volume on drugs for the use of the health professions in Canada;

(v) collection of information related to the industry in Canada for the use of various committees and commissions at all levels of government;

(vi) the provision of information and representatives to the Canadian Drug Advisory Committee which advises the Minister of National Health and Welfare;

(vii) development of a program for drug identification codes by which it is hoped that eventually all solid dosage form medicines will be marked by the manufacturers, such that the country of origin, the manufacturer, the active ingredient, and the dosage form will all be easily and accurately ascertained by reference to the code number in an index, widely provided to hospitals, physicians, pharmacists, emergency centres, poison control centres, etc.

(viii) establishment of a program to supplement company training of sales representatives with a series of courses and examinations provided by a Board for the Accreditation of Medical Service Representatives. These courses will ensure that salesmen will be even better able to serve the health professions;

(ix) established a Code of Marketing Practice for high standards governing journal and direct mail advertisements to the medical profession. They are regularly screened by an Advertising Review Committee - a pioneering self-regulatory system unmatched by any other industry;

(x) on the initiative of our Medical Section, launched the Canadian Foundation for the Advancement of Therapeutics - noted for its work in establishing clinical pharmacology in Canada.

USEFUL STATISTICAL INFORMATION - most recent survey data

3.1 - Number of employees - about 12,000

- Number of Canadians dependent directly on this industry for their livelihood - close to 50,000 people
- Number of Canadians for whom jobs are created in providing supplies and services to this industry - estimated 25,000 people
- Manufacturers' sales of human pharmaceuticals - $250 million estimated for 1968
- Manufacturers' sales income spent in Canada - 80%
- Our industry ranked 40th in sales in Canada, 24th in value added and was Canada's 32nd leading employer (out of 183 industries)
- Assets of PMAC companies in Canada - over $165 million
- PMAC companies export sales - $28 million
- Net profit - $11.9 million
- Income taxes paid in Canada - $12.8 million
- Research and Development Expenditure in Canada - over $12 million
- Number of employees in Research - more than 700
- Number of university graduates - 2,500
- The largest share of research expenditures in our industry falls into the applied research plus development total.
- Of all Canadian industries, the pharmaceutical manufacturing industry devotes the highest percentage of its R & D funds to basic research.

- Of all Canadian industries we invest the highest ratio of company-financed research and development to net sales.
- Of all Canadian industries we employ the highest ratio of R. & D. scientists per thousand employees (40.7 per cent compared to 3.9 average for industry in general)
- One in 5 employees in pharmaceutical R. & D. is a Ph.D., compared with 1 in 20 for industry generally.
- Our industry showed more than twice the rate of growth for intra-mural R.& D. expenditures from 1957 to 1966 as compared to all industry - 490% increase as opposed to 219%.
- Since 1957 pharmaceutical industry R. & D. expenditures have more than doubled every 5 years.
- The Canadian pharmaceutical industry financed more than 96% of its R. & D. with its own capital compared to 76% for industry in general.
- Clinical research in Canada is also increasing at a fast rate - from $288,000 in 1957 to $2.7 million in 1967.
- The Canadian Foundation for the Advancement of Therapeutics (see Appendix A), organized and supported by P.M.A.C. since 1963, had granted $395,000 by 1969.
- All industry in general paid $27.6 million outside Canada for patents, licenses and know-how and received $3 million.
- Of this total, our industry paid $1.2 million outside Canada for patents, licenses and know-how and received $924,000.
- The Canadian pharmaceutical manufacturing industry is the second highest recipient of payments from abroad for patents, licenses and technical know-how.
- The Canadian pharmaceutical industry spends the third highest amount on current R. & D. expenditure as a percentage of value added in Canada.

THE PHARMACEUTICAL INDUSTRY AND SCIENCE

4.1 The latest survey of our member companies research activities indicates that in 1967 there was an expenditure in Canada by this industry of over $12 million in research - over a million dollars a month!

4.2 Over $500 million annually is expended by this industry in research throughout the world. We feel that the Canadian expenditure is a significant one and are proud that the expenditures have been increasing annually. We believe that it is to the credit of the industry that its self-financed expenditure on research as a percentage of sales is higher than any other industry in Canada.

Comparing P.M.A.C. data with D.B.S. data, some industries spending less on R. & D. as a percent of sales in 1965:

Packaged human pharmaceuticals	*7.7 %*
Scientific and professional equipment	3.25%
Other chemical products	1.48%
Rubber	1.48%
Petroleum and coal products	0.93%
Primary metals	0.82%
Paper	0.80%
Average for all industries	*0.70%*
Mines	0.36%
Textiles	0.19%
Food and beverages	0.12%
Transportation and other utilities	0.08%
Wood	0.03%

4.3 The pharmaceutical industry is a science-based industry.

4.4 The scientific nature of the pharmaceutical industry in Canada can be demonstrated by the following facts:

(i) it is an industry where the percentage of sales revenues invested in research is the highest among industries;

(ii) the pharmaceutical industry employs scientists from a variety of disciplines such as chemists, biochemists, engineers, microbiologists, physiologists, pharmacologists, clinical investigators, pharmacists, veterinarians, physicians.....etc.

(iii) the pharmaceutical industry requires a large proportion of highly trained personnel. Whereas some industries may function well by having one Ph.D. supervise their entire research department, the pharmaceutical industry requires a much greater proportion of Ph.D.'s as well as scientists with post doctoral experience;

(iv) the proportion may vary between the different companies within P.M.A.C., but typically one Ph.D. requires an average of four supporting technicians

(v) All the operations of the pharmaceutical industry such as research, clinical investigation, quality control, manufacturing, production, marketing and sales involve a substantial scientific content.

THE NATURE AND VALUE OF PHARMACEUTICAL RESEARCH

5.1 The pharmaceutical industry is mission oriented. Its mission is very specific - to contribute to the world effort toward better health through a search for new and/or improved medicines. This is what the pharmaceutical industry can do very well by carrying through the whole process from innovation to the market place in a co-ordinated sequence of events. This, of course, is a very simplified way to describe a very complex situation. It is well known that it takes approximately 4 to 10 years (averaging 7 years) to cover the span between the innovation and the market place, depending on the nature of the new product.

Dr. W.G. Schneider of the National Research Council has commented: "I do not feel that you can have a strong industrial country without having a strong indigenous science as well, because they go together."

5.2 Research carried out by Canadian companies maintains in Canada a pool of scientists that are knowledgeable in the health field. This is reflected by the formation within the Chemical Institute of Canada of a Medicinal Chemistry Division. The membership of this division is largely made up of individual scientists employed by the Pharmaceutical Industry.

5.3 Due to the activities of the Medicinal Chemistry Division the following major international conferences were held in Canada:

1. Progress in International Drug Research (Montreal, June 1967).
2. Medicinal Chemistry Symposium organized by the American Chemical Society and held for the first time outside the U.S. (Quebec City, June 1968).
3. An International Conference on Drugs Affecting the Central Nervous System is now being organized and it will be held in Montreal, June 1969.

5.4 We are very pleased to be able to refer your Committee to the Report of the Medical Research Council of Canada, Report No. 2, 1968, Section 20, Research in the Pharmaceutical Industry. That there is a substantial research activity in this industry in Canada is attested to by this document from an outside agency, objectively reporting the activities of our industry in Canada, (Appendix B).

5.5 Essentially, the value of industrial pharmaceutical research is to synthesize and test new groups of compounds for useful biological activity.

5.6 The value of pharmaceutical research in industry in the developing of new drugs should be stressed. There is a tendency in academic and some Government circles to feel that industrial research is largely wasted, and that no new advances can be directly attributable to industry. This is misleading, in that it glosses over the fact that without the industry and its potential for production and marketing, a lot of conceptually good ideas would die. Sir Derek Dunlop has stated that 57 of the 66 most valuable drugs discovered in the past 25 years have come from the laboratories of the pharmaceutical industry. Of the 40 leading prescription drugs in Canada (single chemical entities), 38 were discovered by the industry. In the U.S.A., of all new drugs marketed from 1940 to 1966, 87% came from industry research labs and 13% from universities, hospitals and government agencies.

5.7 Therefore, the value of industrial research may be that it is closer to the realities of production and marketing than it is ever possible to be in government or university. Whatever the actual reasons for this, there is no doubt that the value of industrial research in the pharmaceutical industry is proven many times over. Dr. O.M. Solandt, Chairman of the Science Council of Canada, has said: "...the first test as to whether it is good research is whether it is relevant. That is, if you get the answer, is it going to solve some important problem, social or economic?" This point is well described by Nobel Laureate, Professor E.B. Chain, and a copy of his talk "Academic and Industrial Contributions to Drug Research" is attached. (Appendix C).

UNIVERSITY vs. INDUSTRIAL RESEARCH

6.1 Does one exclude the other, or do they complement each other? We know the nature and the aims of industrial research. It consists of an intelligent or educated investment in novel future products useful to society. For the scientist at the bench, it is an intellectual challenge of very considerable magnitude. It is fairly easy to discover exceptions to general rules, to establish new relations between established principles, etc.... However, it is an entirely different matter to discover relations that lead to useful marketable products. It is in this respect that industry research differs from the university type.

6.2 Until now, the role of the Canadian academician has consisted in the teaching of principles and training of students in so-called fundamental research. In general, practical aims may not be associated with this type of effort, even though public funds are used to support it. One can assume that a culturally evolved society is committed to supporting intellectual endeavours of a purely educational character since better citizens should be the result. However, this leaves the graduate unprepared for the much more difficult task of producing practical results that are of immediate relevance to the actual needs of society. Worse still is the lack of awareness,especially by Canadian society, of the potential value of its science graduates in the betterment of everyone's lot. The end result is that a genuine Canadian technology is still lacking, even though a large number of science graduates is produced each year. The university's role is to help society achieve its goals, a major one being the development of a solid, lucrative, and competitive industry providing full employment, high standards of living, and cultural fulfillment. In the absence of healthy and creative industrial research, university science remains largely sterile with regard to the real needs of society.

6.3 This is not to say that industry can do without the university. On the contrary, industry must have access to trained scientists of high calibre and must frequently rely on the fundamental results of academicians in order to develop economical products and processes. Industry depends on the university for the scientific standards of its accomplishments and the scientific value of its personnel; on the other hand, university research can only appraise its relevance to the goals of society by maintaining close contact with industrial research. This is an aspect of our educational system which requires reappraisal.

6.4 In some countries, like Switzerland, these problems <u>have</u> found solutions, with extreme benefit to all. For its size, Switzerland has one of the strongest pharmaceutical and chemical industries in the world. Its universities are of a very high calibre, and house an impressive number of Nobel Laureates. It is an established fact that many of these academic scientists have traditionally held joint appointments with the Swiss industries and have supplied them with graduate students academically prepared to contribute positively to industrial research. Some of the Nobel prizes were awarded for accomplishments intimately associated with industrial interests.

6.5 Our universities are in critical need of fertilization by strong industrial research. On the other hand, the latter must count on the wholehearted co-operation of the universities. This is the only available mechanism to validate the scientific standards and the social relevance of both types of research institutions. With regard to the pharmaceutical industry, who is to judge the quality of drug research and the virtues of established drugs in the absence of academically competent research scientists? How can one purposefully train such scientists without close contact with strong industrial research?

6.6 We believe that further justification for our appearance before this Committee is contained in that sentence of the concluding paragraph from the Medical Research Council report, in which it stated, "it will be sufficient now to say that the industrial complement of the country's research effort is an essential one, and that the strengthening of pharmaceutical research would be an important development for the health sciences in Canada"

6.7 We feel that science policy must encourage research and development in this industry and investigation into all health problems. The Economic Council of Canada recommended:

(1) that *innovation* -- the crucial stages beyond R & D -- be given greater recognition in "science policy";

(2) that the capacity for Canadian business management to undertake successful innovation be strengthened;

(3) that new and more effective means be developed to harness information on science, technology and innovation, both from abroad and from Canadian sources, in both the public and private sectors;

(4) that Canada's indigenous scientific and technological effort be strengthened, particularly in industry.

6.8 Only true co-operation among all the three important sectors of our society can bring the results that will permit us to meet society's expectations. Each sector has its own unique contribution to make: <u>government</u>, through its financial resources and its capabilities to assess national needs and help formulate national goals; <u>the academic world</u>, by its tradition of scholarly excellence and scientific freedom; <u>industry</u>, through its great developmental capabilities and long established record for ingenuity and creative application.

THE INTERNATIONAL ASPECTS OF RESEARCH

7.1 The Research of the Pharmaceutical Industry, as with many other industries must, of necessity, be internationally oriented. No industrial research and development effort that is worth anything could operate only on the basis of Canadian scientific knowledge. There must be access, availability and use of knowledge developed in other parts of the world.

7.2 Health benefits available to one segment of the world's population must be available everywhere and only in this way will the health interests of the people of the world best be served.

7.3 It is only logical that the research developments of an internationally oriented industry will take place in those countries where the conditions are favourable. Where development is encouraged in a certain country, surely it is there that the research investment would more logically be made.

7.4 We believe that the approach of the Canadian government should be broadened in its encouragement of industrial research. Government should not be primarily concerned whether certain research projects will, in themselves, benefit Canada, but instead, should help set the climate and conditions for good research in Canada.

7.5 It has been obvious from the evidence which has been given to this Committee by some that it is impossible to completely divorce a science policy from an economic policy or an education policy or even a political policy generally. It is a legitimate concern when politico-economic factors provoke discrimination against the continuance of this research oriented industry in Canada.

THE PRESENT SYSTEM

8.1 There is no need to emphasize the fact that research is an investment in the future. In order to encourage investment of every kind, responsible governments have always provided legal protection for investors. In the case of the research investment, legal protection in the form of patent laws and patent systems is provided by most technologically advanced countries. The rewards of research are, in this way, guaranteed to the investor. The importance and value of patent systems has recently formed the subject of a report by a committee of experts appointed by the Council of the Royal Society (London). The committee's view of patent systems is a highly favourable one. It pointed out in particular:

(a) the active incentive to competitive improvement and stimulus to invention which the system affords;

(b) the patent system, far from being detrimental to the progress of knowledge, protects and encourages the possibility of publication;

(c) the important return on investment in research that is possible through royalties and in other ways under the patent system, particularly in the case of patenting overseas;

(d) the bargaining value of patented inventions for the United Kingdom in the highly competitive climate of international industry existing today.

8.2 It is clear that the bargaining value of patented inventions for Canada can only exist within the framework of the patent system. The highly competitive character of the pharmaceutical industry has produced a phenomenal number of useful and life-saving drugs over the past 10 to 15 years. Without an effective patent system, returns on individual investments would not be guaranteed and, as a result, the pharmaceutical industry would not have developed. Another very important long-range consequence would be the irremediable loss of fundamental knowledge in the field of life sciences and the loss to society of a whole generation of scientists and technologists who are intellectuals devoted to the progress of the life sciences through pharmaceutical research. It should be emphasized here that much of the fundamental progress in the life sciences can be traced to the discovery of new chemicals, drugs and synthetic methods by the pharmaceutical industry. Unlike most developed countries, without the effective patent system for medicinal and related agents, there might not develop the urge to invest in Canadian pharmaceutical research.

8.3 We believe that this Committee should be fully acquainted with the possibilities arising from legislation endangering research and development of this country.

8.4 Mr. James Rhyne Killian, Jr., Chairman of the Corporation, Massachusetts Institute of Technology, was quoted to this Committee (page 215, Proceedings): "I do not think the economic measure, as for example in the field of health and so on, is necessarily a good measure for the amount of basic research". We mention this observation by Dr. Killian, to emphasize the fact that the amount of expenditure in a given year by this industry in research in Canada should not, in our opinion, be the deciding factor as to its worthiness. As we have stated above, however, we are justly proud of the $12 million expenditure from our most recent survey. We believe that Dr. Killian was trying to indicate that, in his opinion, the consideration of problems of economics and costs should not outweigh more important considerations in this field of health.

8.5 Previous evidence given to this Committee has indicated that the increasing complexity of medical care and the prevention of disease, as well as the introduction of new materials into the environment, make it fundamental that health research be increased everywhere in the world. It is part of our social responsibility.

8.6 We shall now direct our attention to two main areas which we feel are vital to the continuation of the research oriented industry in this country. First, the importance of the Patent Act and its amendments and administration to the incentives to research in Canada in this industry. Secondly, the other methods of incentive which might be utilized to stimulate even more research by this industry in Canada.

THE PATENT ACT AND ITS ADMINISTRATION IN CANADA

9.1 We believe that it is significant that one of the previous consultants who appeared before this Committee, Dr. Richard R. Nelson of the Rand Corporation (page 256) has pointed out that the first major beginning in the United States of a conscious science policy was the institution of a patent system and the financing of research.

Since 1875, 164 new drug products were discovered in countries with product protection, while only 12 were discovered in countries without any form of product protection. Italy ended patent protection in Mussolini's time in 1939 and hasn't produced a really significant new pharmaceutical since then. Where it does have strong patents, such as in the related chemical area, industry in Italy has become a leader in product innovation.

9.2 It seems paradoxical to us that, although a strong patent system is recognized as important in the establishment of a science policy for science and industry generally, that very principle and the incentive therein are sacrificed in relation to Section 41(3) of the Patent Act which allows compulsory licences to be granted against patents on pharmaceuticals, but does not allow any such infringement on the patent rights of other discoveries, whether they be for or against health.

9.3 History indicates to us that this section granting compulsory licences against pharmaceutical patents was originally implemented in England, then in Canada, in order to encourage pharmaceutical production in those countries. It is regrettable, in our opinion, that amendments to this section, in the hope of effecting economies in one small segment of the field of health care, may be at the possible expense of production, employment and research in this country, as well as hindering new discoveries.

9.4 We are faced with a dilemma in which one arm of the government is encouraging production and research in Canada, and another arm is encouraging importation and discrimination against the discoveries and expansion of Canadian industry Dr. G. Malcolm Brown, Chairman of the Medical Research Council, stated: "It is impossible to import new knowledge and new science and use it, unless you yourself have a good scientist; you must have the ability to receive. You do not have this ability to receive without scientists who are doing research. And, without research, you will have second-rate doctors, second-rate teachers and there will be second-rate practitioners."

9.5 To put it briefly, we believe that any science policy for Canada which would encourage Canadians to participate in and develop further research in Canada is not compatible with the granting of compulsory licences against pharmaceuticals, and especially for the importation of products under such licences.

9.6 It is our hope that this Committee might make recommendations to the government regarding regulations and safeguards which might be implemented under both the Patents Act for the Commissioner of Patents, and the Food and Drugs Act for the Food and Drug Directorate in relation to the granting of compulsory licences and importations with concern for a continuation of the research-oriented industry in Canada.

9.7 We are concerned that there is a lack of guidance for those items which the Commissioner of Patents is required to consider when he grants a royalty to be paid by a compulsory licensee. We feel that all of the activities of the patentee should be considered in the granting of this royalty, including the research and development, toxicology and clinical work, the provision of information, the establishment of the market, and the continuation of a recall system, as well as co-operation in the adverse drug reaction reporting program. The Act presently requires the Commissioner to consider only research. We feel this is inadequate and offer the guidelines followed by the British Patent Office as a working model (see Manual of Office Practice 37-37, U.K. Patent Office - Appendix D).

9.8 In addition, the nature of the licensee's product line should be considered. A higher royalty would seem appropriate if the licensee planned only to make the largest volume and most profitable dosage forms, leaving the unprofitable and low volume, but often essential ones to the patentee. If a patent system is to encourage new discoveries, then there must be safeguards for the patentee in the granting of royalties so that the economic considerations are not allowed to lessen the incentives granted by a science policy designed to encourage discovery.

9.9 Furthermore, without an adequate patent protection, the industry would have to revert to absolute secrecy. Such a situation would make it extremely difficult to retain our best scientists since their main incentive is to be given the opportunity to publish their research results. In the past decade, Canadian industrial pharmaceutical researchers have published over 200 accounts of their work in internationally-read scientific journals.

9.10 Concerning patents, the following comments made by Dr. C. Cavallito in a recent article (published in Progress in Drug Research Vol. 12, page 43) are quite relevant:

> "The opportunity to seek patent protection for new drug discoveries has been a strong incentive for innovative medicinal chemical research. By and large, the countries which have contributed most to advances in medicinal chemistry have been those with patent systems permitting a degree of limited exclusivity for commercialization of the discovery. The medicinal chemist, more than any other health scientist, whether in industry or in academic institutions, recognizes the importance of patents in providing the incentive for someone to assume the resource risks required to develop a useful drug product from a chemical substance."

INCENTIVES

10.1 In the foregoing, we have attempted to establish the real value of pharmaceutical research and the need for strong research effort in Canada. If one accepts this desirability then one should ask - should the government specifically assist the pharmaceutical industry's research efforts? The basic justification for government assistance is that any successful research and development effort in Canada will bring greater benefits to the country and the people than the benefits which will be derived by any one industrial firm.

10.2 The present programs of government grants-in-aid make it difficult for the pharmaceutical industry in that there must be agreement to practical exploitation of discovery in Canada before any allowance can be granted. Also, they are not very effective because of the possibility of controversy of ownership that could arise should an important discovery result from such a direct government-supported project.

10.3 The businessman or industrialist who is willing to risk investing capital in industrial research is a rare phenomenon in Canada. The cost of modern research is very high and the return on investment is far from immediate or guaranteed. An unusual degree of comprehension and patience is required on the part of the investor before tangible rewards are produced. The same qualities are essential to the bench scientist. Help, therefore, should be provided especially during the unrewarding phase of industrial research.

10.4 Our recommendations in this connection are that government assistance for industrial research take the form of tax allowances with appropriate provisions for carry forward to future years of research costs incurred in unprofitable or loss years. These allowances should not be tied to prior approval of specific projects, projects which are deemed to stimulate development of other factors in our economy, such as manufacturing or exports. Encouragement of strong free-moving industrial research will bring rewards which, in themselves, will help our economy.

10.5 Also, we recommend that all tariffs on scientific equipment and chemicals used for research be abolished. Most of the material and equipment needed by research organizations is purchased abroad and subject to import duties. Tariffs should not apply when equipment purchased abroad is not available in Canada.

10.6 The minimum incentive that should be provided is government protection of inventions through a strong patent system. One can only wonder as to how England and Switzerland could have ever developed a profitable chemical and pharmaceutical industry without an effective patent system and without close co-operation between industrial and university research scientists. Progress is always made at the crossroads of scientific discipline. The Canadian Association for Research in Toxicology (C.A.R.T.), with membership comprised of the pharmaceutical industry, university departments and members of government sponsored organizations, is a prime example of this. Public funds should be applied to favour convergence by these groups and not divergence as is presently the case so many times.

10.7 We believe that strong industrial property rights, represented by the country's patent and trademark statutes, are necessary adjuncts to encourage, among other things, research and development and exports, therefore furthering the economic progress of the country to the ultimate benefit of the general public.

10.8 The task of seeking a better understanding of life processes and the diseases that threaten them requires the prying of secrets from the microscopic world of the cell. The design of effective new medicines is the mission of the research-based pharmaceutical manufacturing industry.

Respectfully submitted

The Pharmaceutical Manufacturers Association of Canada

EDITORIAL

The Canadian Foundation for the Advancement of Therapeutics

THE FOUNDATION, which is the subject of Dr. Walter Murphy's article in this issue, is probably not a household word in medical circles in Canada. It deserves to be better known. Dr. Murphy, formerly the Foundation's secretary, has performed a valuable service in preparing this account which, it is hoped, will receive wide circulation through the pages of *Applied Therapeutics*.

This Foundation, although operated by an independent board of directors, owes its existence and continued viability to the Canadian pharmaceutical industry. Like the medical profession, this industry finds itself the object of close examination and study, particularly by government. Both ships have met with changing winds and steering at times is difficult and uncertain.

The pharmaceutical industry of Canada has provided this country with a high standard of product and service and whatever the future holds, these will continue to be its chief guidelines. In no small way the Pharmaceutical Manufacturers' Association of Canada (PMAC) and its member firms have been responsible for this.

In 1963, the medical section of the PMAC, composed of the industry's physicians, conceived and successfully established the Canadian Foundation for the Advancement of Therapeutics. This Foundation was incorporated in 1964 and began its activities the same year. As Dr. Murphy points out, our universities contained faculties of pharmacy and departments of pharmacology, but the discipline of clinical pharmacology, especially in teaching hospitals, was not well-established on a departmental basis.

In the few years of its existence, the Foundation, in co-operation with the hospitals and other organizations, such as the Medical Research Council, has made considerable progress in the training of clinical pharmacologists and the setting up of clinical pharmacology departments. The funds of the Foundation have come almost exclusively from the PMAC of which 44 members contributed last year.

BRUCE CHARLES

M.D.; F.R.C.P.(C); F.A.C.P.; Chairman Editorial Board; Chief of Staff, Toronto East General Hospital.

At the PMAC's annual meeting in June, 1968, Dr. F. S. Brien, chairman of the Foundation, presented a detailed report of its activities and indicated the careful and responsible manner in which the directors have guided its progress. Except for the secretary and the treasurer, the directors are in no way connected with the pharmaceutical industry and all are outstanding Canadian doctors. The late Professor R. F. Farquharson was the first honorary chairman.

The growth and influence of this Foundation on Canadian medicine will be watched with great interest in the years to come.

The Editorial Board of *Applied Therapeutics* is indebted to Dr. Murphy for his prompt response to its request to prepare this account. The Journal feels that the medical profession should be aware of the existence and purposes of this Foundation. The PMAC is deserving of congratulations for its vigorous and useful offspring. It is worthy of note that there is a sister organization of similar origin called the Canadian Foundation for the Advancement of Pharmacy.

PERSPECTIVE

Origin and Growth of a Research Foundation

INTEREST in improved methods for drug evaluation has increased steadily over the past 25 years, coincident with the discovery and use of more potent and specific therapeutic agents. Concomitant with the wider range of therapeutic usefulness which newer chemicals have provided, there has been an increase in the number and severity of side effects such chemicals can cause, so that the need to establish methods of investigation which would define the risk/benefit ratio has become imperative.

Throughout the world the principles governing biological research, with their emphasis on controlled experiments, careful definition of aims, and statistical treatment of the results, have been slow to be applied to clinical investigation, including drug trials. However, in some countries, particularly the United States and Great Britain, a systematic study of these principles has started, and their application has given rise to what is now known as clinical pharmacology. The term has suffered much from the lack of a definition acceptable to all, and the discipline itself has not yet resolved such organizational questions as to where it stands in the university-hospital setting in relation to the other medical disciplines. Nevertheless, undefined, and to some extent unstructured, clinical pharmacology has managed within a few years to show that it embraces a body of knowledge essential to the proper evaluation of drugs in man.

Clinical pharmacology has been slower to develop in Canada than in the United States and Great Britain. A limited number of physicians were interested in pursuing a career in clinical pharmacology, and a few managed to undertake postgraduate training in the United States, but the growth of the discipline in Canada was hindered both by a lack of funds for support during the period of postgraduate training and by a lack of suitable appointments in Canadian teaching hospitals.

On the other hand another group of physicians was also very much aware of the need for the development of clinical pharmacology in Canada. Physicians working full-time in the pharmaceutical industry, with the responsibility for organizing drug evaluation trials, knew how difficult it was to set up studies which would answer reliably the questions asked of such trials — questions related to safety and efficacy, both relative and absolute. To some extent the difficulty was due to a lack of interest on the part of clinicians to undertake drug evluation studies. To perhaps an even larger extent it was due to a lack of knowledge of how to proceed.

With this in mind — the awareness on the one hand of the paucity of skilled investigators of drugs in Canada, and on the other hand of the growing interest in clinical pharmacology—the industry physicians, members of the Medical Section of the Pharmaceutical Manufacturers' Association of Canada (P.M.A.C.), considered whether or not there was something which they could do to hasten the development of this discipline in Canada. The result of their deliberations was the creation in 1963 of the Canadian Foundation for the Advancement of Therapeutics. The following year the Foundation was incorporated, and began its activities.

During the organizational period of the Foundation, much valuable advice was received from such

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Year	Total	Number of Companies
1963	$57,000	36
1964	58,000	37
1965	61,000	39
1966	69,000	41
1967	75,000	41
Total	$320,000	

The figures for donations have been rounded to the nearest thousand. Virtually all of the donations have come from member companies of the Pharmaceutical Manufacturers' Association of Canada.

Table 1. — Donations made to the Foundation.

leaders of the medical profession as the late Dr. R. F. Farquarson, Chairman of the Medical Research Council at the time of his death, and first Honorary Chairman of the Foundation. The general aim of the Foundation, as expressed in its charter, was to encourage the study and development of therapeutics, and it proposed to do this by stimulating, co-ordinating and aiding research in drug evaluation, by assisting in the training of investigators in this field, and by any other means that seemed appropriate.

The chief organizers of the Foundation were members of the pharmaceutical industry and it seemed to them that the industry would be one of the bodies most interested in contributing financially to the aims of the Foundation. As a result of the approval of the Foundation by the P.M.A.C., its funds to date have come almost exclusively from the majority of the member companies of that Association (Table 1).

At the same time it was realized that the Foundation, if it were to accomplish its aims, must be administratively completely independent. This independence has been achieved by assigning the control of the Foundation to a board of directors, responsible only to itself for carrying out the functions of the Foundation in accordance with its by-laws and within the limits of the budget available to it. The majority of the board consists of physicians and basic research scientists drawn from medical schools across Canada; two of its members are physicians appointed by the Medical Section of P.M.A.C.

As its first task the Foundation saw the necessity to encourage the recruitment of interested and capable investigators to the field of cliical pharmacology, and consequently decided to embark upon a program of Fellowship support. Since 1964, the total number of Fellowships awarded by the Foundation has been 26. Summer studentships have also been awarded, in an endeavour to arouse interest in the discipline at an earlier stage, and 24 have been awarded to date. Also, from the beginning, basic research in methodology has been encouraged, the number of projects supported totalling 10. A summary of the awards made by the Foundation is given in Table 2.

As a second approach to the same problem — the arousal of interest in clinical pharmacology in Canada — the Foundation decided to organize symposia to which would be invited participants from medical schools, the drug regulatory agency and the pharamaceutical industry, for the purpose of discussing questions concerned with the development of clinical pharmacology in this country. Two such symposia have been held to date: a "Conference on Human Pharmacology" in 1964, and a symposium entitled "Problems in Clinical Pharmacology" in 1966.

As a result of these endeavours, and of a growing interest in clinical pharmacology stimulated from other sources, the Foundation has finally begun to support teams of investigators organized in, what may be called, clinical pharmacology units during their first year of formation. (As mentioned above, decisions about how best such groups may fit administratively into teaching centres have reached no unanimous conclusions, so that the word "units" should be considered as a comprehensive term, used for the sake of convenience to include a variety of organizational solutions.). Currently three such groups receive support from the Foundation.

Four years may be too short a time over which to attempt an evaluation of a program, the effects of which will not be fully felt for at least ten. However, some interesting trends have emerged, which merit comment, concerning the subsequent careers of Fellows supported by the Foundation. Fifteen Fellows have received a total of 26 Fellowships from the Foundation. Of these, three are practising as full-time clinical pharmacologists, two in Canada and one in the United States. Five others, still in training, will almost certainly become fulltime clinical pharamcologists. Two other Fellows are not yet far enough along in their training to permit any useful prediction. It is not likely that the remaining five Fellows will pursue a career in clinical pharmacology. The principal investigators of two of the clinical pharmacology units supported by the Foundation were originally Fellows of the Foundation, and their units at present, in addition to receiving general support, are training two post-graduate students, supported with Foundation Fellowships.

The part played by the Foundation in contributing to the establishment of clinical pharmacology units is also proving to be an important factor in achieving the Foundation's aims. Such units and their members contribute to improvement in therapeutics in a number of ways. They undertake drug evaluation studies, and are concerned with research in the methodology of the study of drug effects. They establish training programs, both for postgraduate students who wish to embark upon a career as full-time clinical pharmacologists, and for students who wish for other reasons to obtain some direct experience with clinical pharmacology during their specialist training program. They participate in undergraduate teaching. They concern themselves with adverse-reaction reporting programs. Finally they perform a consultant service to other departments of the hospital, either with respect to the use of a given drug, or to the best way of undertaking a given drug trial.

Year of Disbursement	Unit Support (Development Grants)	Fellowships	Summer Studentships	Research Grants	Total
1964	3,000	11,000	4,000	8,000	26,000
1965	11,000	23,000	4,000	8,000	46,000
1966	9,000	33,000	4,000	20,000	66,000
1967	37,000	36,000	7,000	23,000	103,000
1968	47,000	23,000	6,000	20,000	96,000
1969	42, 000	9,000	—	8,000	59,000
1970	5,000	—	—	3,000	8,000
TOTAL	154,000	135,000	25,000	90,000	404,000
Total number of awards	11	26	24	10	71
Total number of recipients	5	15	22	7	49

Table 2 summarizes the awards made by the Foundation since its origin. The figures are rounded to the nearest thousand. At the time of writing the most recent awards of the Foundation had been made in 1968, so that the awards listed for 1969 and 1970 represent continuing payments on awards in 1968 or before. Total number of recipients is less than total number of awards because on several occasions awards to a given applicant have been renewed.

Table 2.—Awards made by the Foundation

Conclusion

The Foundation has been an important influence in the development of clinical pharmacology in Canada. It would present an unbalanced picture, however, to pretend that it has been the only influence.

First of all, interest in this discipline existed well before the Foundation came into being, and, in part at least, motivated its creation. Secondly, although the Foundation has contributed financially to the training and subsequent development of several clinical pharmacologists in Canada, the immense contribution made by the centres where they work in providing laboratory and office space, research equipment, salaries and ancillary personnel should not be underestimated. Similarly the Medical Research Council and other major granting agencies have contributed to the support of the individual research projects of these investigators.

Nevertheless, on balance, it may be maintained that the Canadian Foundation for the Advancement of Therapeutics has accelerated the acceptance of clinical pharmacology as a discipline in Canada. It provides funds at a time when support for training in clinical pharmacology and the establishment of clinical pharmacology units was, and still is, difficult to obtain from other sources. However, limited by the budget at its disposal, the activities of the Foundation have been, and must remain, essentially of a seeding nature. The future of clinical pharmacology in Canada, and its continuing support, will have to depend on funds made available through the major granting agencies.

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For information about the Foundation, please communicate with the Secretary, Dr. Peter Nash, 5400 Côte de Liesse, Montreal 101; Quebec.

CANADIAN MEDICAL RESEARCH:
Survey and Outlook

MEDICAL RESEARCH COUNCIL OF CANADA
Report No. 2, 1968

Section 20

RESEARCH IN THE PHARMACEUTICAL INDUSTRY

A number of industrial pharamceutical companies in Canada are actively engaged in medical research. As would be expected, and as is right and proper, their research programs are for the most part directed towards the discovery of new marketable drugs, but a small amount of research, apparently unrelated to this aim, is also in progress. The research programs of the different companies vary considerably in size. One large international company has its research laboratories only in Canada, and these are quite extensive, including separate biochemistry, pharmacology, and microbiology departments, each as large as or larger than the corresponding departments in many Canadian faculties of medicine. On the other hand, there are small companies in which a few researchers, though engaged primarily in carrying out toxicity studies of new drug preparations as required for approval by the Food and Drug Directorate, also have other research projects.

One respect in which the medical research effort of the pharmaceutical companies differs most noticeably from that in faculties of medicine is the relatively large amount of synthetic organic chemistry going on. This is, of course, associated with their research in pharmacology. Although this chemical work is directed at the synthesis of new drugs, it does include some quite sophisticated research in pure chemistry.

In some of the companies the research is closely coordinated with that of the parent company outside Canada. In other cases, the research is apparently completely autonomous. In one instance a very large foreign company with no industrial or commercial operation in Canada supports a research institute with an apparently autonomous research program. Altogether about 80 people of doctoral status, principally Ph. D. but also M. D. and D. V. M., are engaged in medical research as full-time occupation in Canadian pharmaceutical laboratories. About half of these are organic chemists, the remainder are mostly pharmacologists, biochemists, pathologists, and microbiologists or immunologists. In addition to these full-time researchers, most companies also have a medical staff who arrange for clinical trials of their new drugs by the medical community, carry out statistical surveys of the efficacy of their company's products that are on the therapeutic trial or in general use, and generally arrange the piloting of their company's products through the approval procedures of the Food and Drug Directorate.

In general, the facilities for medical research in the pharmaceutical industry are better than those in the faculties of medicine. Although a few laboratories are overcrowded, most are not, unlike most university laboratories. There is no shortage of good equipment. In most companies animal care facilities are far superior to those in most universities. Information services are better than in universities; in most laboratories the researcher merely makes a list of journal articles he would like to see and within a short time photostats of the articles appear on his desk.

The Quality of Research in the Industry

As in the case of medical research in universities, the quality of the research in the industry varies from excellent to poore. This is, of course, related to difficulties in the recruitment of staff due to the short supply of adequately trained personnel Recent significant contributions from Canadian pharmaceutical research laboratories include: the identification of 7-dehydrocholesterol as a major intermediate in cholesterol biosynthesis; the development of the first synthetic prostaglandin; and the discovery of an antibiotic now in extensive use, which in extremely minute traces will kill fish, permitting the removal of useless fish from lakes and their subsequent replacement with commercially useful fish. The research laboratories associated with the pharmaceutical companies publish a large number of scientific papers, some more than others, as is to be expected in view of the different sizes of their operations.

Current Studies

Medical research going on in the laboratories of pharmaceutical companies includes studies in the following areas: the basic mechanism of inflammation; the development of new steroid and non-steroid anti-inflammatory agents; reproductive physiology and pharmacology, including the search for inhibitors of spermatogenesis, inhibitors of implantation, and of fertilization; the physiological activities, including the biochemical mode of action, of estrogenic and progestational agents, and the development of new antiferility agents; the mechanisms by which estrogens influence blood coagulation; the mode of action of immunosuppressive agents and their development (both synthetic immunosuppressive agents and antilymphocyte serum); the mechanism of fibrinolysis and its physiological significance; the physiology of gastric acid secretion and the development of antiulcer agents, bronchodilators and antispasmodics; central nervous system pharmacology, including the role of low molecular weight amines, and the development of antiemetic and anti-motion-sickness compounds, as well as tranquilizers and hypnotics, antidepressants and central stimulants; the isolation of pituitary-releasing factors from urine; the development of tranquilizers and of antiobesity agents; the development of antihypertensive agents, including diuretics; the development of coronary dilators; the development of drugs for the treatment of dental caries and periodontitis; agents for the treatment of dermatitis; the development of oral hypoglycemic agents; central nervous system stimulants; the development of methods for the evaluation of hepatotoxicity of compounds in the very early stages, both by morphologic (electron microscopic) and biochemical procedures; the development of new urinary antibiotics; the development of antiparasitic agents, antimalarial, antischistosome, anticoccidial and amebicidal; studies of the pharmacology of prostaglandins; techniques for the routine screening of antibiotics, including an active search for tocpial antipseudomonas agent; the production and testing of antiviral agents; and research in pharmacy, including such studies as the formulation of new dosage forms of drugs and the development of more predictably disintegrating compounds.

An active program is going on the biosynthesis of cholesterol, which includes studies of factors determining whether the predominant site of biosynthesis of cholesterol is the intestinal mucous membrane or the liver. This program is of course associated with the development of antihypercholesteremic agents.

Lest it might be thought that the research of the pharmaceutical laboratories represents an endeavour altogether apart from other Canadian medical research, it is pertinent here to draw attention to the collaboration between universities and the pharmaceutical industry. Some of this is at the level of basic chemistry, pharmacology, biochemistry, pathology and physiology, and part of it is at the applied level, principally involving clinical trials of new therapeutic agents. In some instances pharmaceutical companies provide outright grants to universities for research. Some of their staff participate to a limited extent in current teaching and service programs; some hold part-time university appointments. On occasion their special facilities ar. made available to university staff with special research problems that might not be readily solvable without them. The collaboration that exists has been profitable and it is to be hoped that more will develop. From the point of view of the medical schools, and schools of pharmacy, much would be gained by many faculty members from increased contact with their colleagues in industry.

The volume of research in the Canadian pharmaceutical industry has often been commented on. It will be sufficient now to say that the industrial complement of the country's research effort is an essential one, and that the strenghtening of pharmaceutical research would be an important development for the health sciences in Canada. Over and above the addition it would in itself make to our total scientific resources in the health field, it would result in an enlargement of view and opportunity for medical scientists in our universities.

ACADEMIC AND INDUSTRIAL CONTRIBUTIONS TO DRUG RESEARCH

The Trueman Wood Lecture

by

ERNST B. CHAIN, F.R.S.

THE ROYAL SOCIETY OF ARTS
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ACADEMIC AND INDUSTRIAL CONTRIBUTIONS TO DRUG RESEARCH

The Trueman Wood Lecture by

ERNST B. CHAIN, M.A., Ph.D., D.Phil., F.R.S.,

Professor of Biochemistry, Imperial College of Science and Technology, *delivered to the Society on Wednesday, 19th June, 1963, with the Rt. Honble. Lord Nathan, P.C., T.D., F.B.A., Chairman of Council of the Society, in the Chair*

THE CHAIRMAN: It has been the custom in this Society ever since this Trueman Wood Lecture was instituted to regard it as a central point in the year's programme, and so an occasion when the Chairman should himself take the Chair. Sir Henry Trueman Wood was Secretary of the Society for a period of nearly forty years from 1879 until 1917, and this lecture was founded to commemorate his extraordinary activity and service. Throughout, the Trueman Wood Lecture has had a special scientific flavour. I have just been looking at the names of some of those who have delivered it in the past. They include Sir Oliver Lodge, Lord Rutherford, Sir Harold Spencer Jones, Lord Adrian, Sir Robert Robinson, Sir Bernard Lovell and Sir John Cockcroft. By some strange chance, with the exception of Sir Oliver Lodge, I have the distinction of having had some acquaintance—even though in some cases slight—with each one of them. Some of you here perhaps may have met Lord Rutherford. He was an amazing figure. Rather a rubicund, square man—bucolic almost—you would have thought of him as a man of brawn rather than a man of brain. He made a most remarkable contribution to scientific thought and action.

If you were to look at Professor Chain here to-day I don't know that your first idea would be that he was a scientist of the first order. He is rather bird-like in some ways! His eye moves swiftly, his hands flutter; but they only flutter until they are in action—and then they are as purposeful as the wings of a bird. He has a high sensitivity. He can sense a theory far ahead. He can even sense a fact, which is even more difficult, and—most difficult of all—he can sense an atmosphere. He has been remarkably right over a long period of years. You know, of course, because you are largely an audience of scientists whom I, a layman, am addressing, you know his achievements. You know that he is occupying the Chair of Biochemistry in the Imperial College of Science and Technology, the Wolfson Chair. You know that he is a Fellow of the Royal Society. You know, no doubt, that with Sir Alexander Fleming and Sir Howard Florey he is one of the Nobel Laureates—in respect of the discovery and the application of Penicillin. He has for a good many years past been working in Rome at what is one of the most remarkable set of laboratories to be seen anywhere. Now he is coming back to London: a great gain, I believe, to scientific work in this country. Those of you who know him won't need me to expand upon his merits and his achievements. Those of you who don't, have your chance this evening of finding out and assessing for yourselves the quality of man that he is.

The following lecture was then delivered.

THE LECTURE

INTRODUCTION

Let me first absolve my formal duty—to express my gratitude to the Chairman and the Council of this distinguished Society for the invitation to address you this afternoon. As a matter of fact, in this particular case this expression of thanks is not at all a mere formality; I experience a very real sincere pleasure to speak here under the chairmanship of Lord Nathan with whom I am not only linked by ties of personal friendship now stretching over a period of more than twenty-five years, but for whom I have a very great admiration as a public servant, devoted to his duties with inexhaustible energy and utter disregard of any considerations of personal comfort, and endowed with an incredible capacity for hard work. As a scientist, I am very conscious of the fact that as one of the creators and as the present Chairman of the Wolfson Foundation, he has made notable and most important contributions towards the development of British science, which have already had important consequences, but the full impact of which in all its wide ramifications will only gradually become apparent, and not least in the field of science to which this lecture is devoted.

The Value of Drugs to Mankind

The subject of this lecture, the development of drugs, is one in which I am very interested and to which I have devoted a lot of my time.

I wonder, however, if my enthusiasm about drugs is shared by all members of this Society, for the climate of public opinion with regard to drugs is cool—to say the least; the word drug has acquired almost a derogatory tinge. In the minds of many people—and some of them in high places—drugs are immediately associated with deformed thalidomide babies, and those who take a more lenient view, still consider them as rather expensive, dangerous chemicals of somewhat doubtful value with which they are overdosed and which are urged on them, or their doctors, by the persuasive voice of commercial propaganda; and as to drug manufacturers, these are downright suspect, and the picture of nasty vulture-like greedy creatures, predatory and thriving on human pain and disease, comes to the mind of lots of people.

Well, Mr. Chairman, Ladies and Gentlemen, this is exactly the reason why I am giving this lecture. I, for one, believe that drugs are one of the greatest blessings—perhaps *the* greatest blessing—of our time.

I could do without any of the means for fast locomotion which modern technology has made available to us, be it motor cars, trains or jets, I could live very nicely without a wireless or television set and, in fact, do, and could at a pinch even do very well without electric light—but I shudder at the thought of having to undergo the torture of the extraction of a wisdom tooth without a local anaesthetic, or, much worse still, of having a limb amputated, or even to undergo an appendectomy without a general anaesthetic. I should certainly hate to be in the position in which we all were before the armoury of modern drugs and vaccines was available to therapeutic medicine, when I might have had to helplessly watch my wife dying from child-bed fever, or my friends going down with diabetes or tuberculosis, or my children being crippled with rickets, or—worse still—paralysed by poliomyelitis. When people talk to me with regret or nostalgia about the 'good old times', Victorian or even earlier, I wonder whether they have paused to give these facts just a little consideration.

The Purpose of this Lecture

Having thus pleaded the case for the great value and usefulness of drugs to humanity, I come to the central theme of this talk; where and how are drugs discovered and developed?

Drugs are fine chemicals, either synthetic or of natural origin. Consequently, chemical research has played and must always play a predominant rôle in their development. But the biological aspects of drug research are equally important. Some of the most important groups of drugs were discovered through physiological, pharmacological, nutritional, microbiological and, in some instances, clinical investigations, and certainly the quantitative assessment of the activity of drugs and their testing, which of necessity must precede the clinical use in order to ascertain the absence of harmful effects, needs the extended applications of biological methods. It is therefore clear that both chemical and biological research is required for the development of drugs.

The question which I should like to analyse to-day, as objectively as I can—*sine ira et studio*, as the saying goes—is where does this research take place? Research activities take place in the universities and outside the universities in laboratories attached to private industrial enterprise. What are the relative contributions from academic and industrial laboratories in the specific field of drug research? Have the most important advances originated in university or industrial laboratories? Who are the people to whom we owe gratitude for the great advances in drug therapy which we have witnessed during our own lifetime? What, in particular, is the rôle of the much abused pharmaceutical industry in this connection?

In the analysis which I have set myself as task in this lecture I speak as a scientist who has spent his whole life in academic non-industrial laboratories, but who has lived since his early childhood in the milieu of chemical industry and knows well its atmosphere, inner workings and problems, and is particularly familiar with the pharmaceutical industry with which he has had for many years close associations.

The Developments of Academic and Industrial Research in this Century

It is generally assumed that it is to the academic laboratories (in universities and in pure research institutes) that the lion's share in scientific research, both chemical and biological, has fallen, and that the really important discoveries have emanated from them, whereas the industrial laboratories were mainly concerned with immediate production problems or routine research of a lower grade, referred to often as 'applied research'.

This may have been true until the beginning of this century, but it is certainly not true any longer since then. In the last fifty years the pattern of the organization of scientific research has undergone a marked change, and the pace of this change

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has become increasingly rapid. Industrial research laboratories, many of which are much larger and better equipped than university laboratories, have come into being in many countries, and play an increasingly important rôle in scientific research, often actually surpassing that of the universities. This applies not only to all fields of chemistry, inorganic, organic, physical and biochemical, and to a particularly large measure to the section of chemistry specifically concerned with drug research, pharmaceutical chemistry, but also to the biological sciences, pharmacology, physiology and microbiology.

I hope to be able to prove in this talk that the university laboratories hold by no means the monopoly in the field of drug research, but that both university ***and*** industrial laboratories have made equally important contributions, each in its own specific manner, and that the best results have often been obtained in the past, and are likely to be obtained in the future, by the closest collaboration between academic and industrial research laboratories. The deciding factor for success in scientific research is not the place where it is carried out, but the qualities of the man who is carrying it out.

As for the term 'applied science', often applied in a derogatory manner to industrial research, I can do no better than to quote the words of Louis Pasteur, one of the greatest 'pure' scientists of all time, and the creator of the field of chemical microbiology in which I have been active for many years: 'Il n'y a pas des sciences appliquées. L'union même de ces mots est choquante. Mais il y a des applications de la science, ce qui est bien différent.'

DEVELOPMENT OF SOME IMPORTANT FIELDS OF PHARMACEUTICALS

Let us now proceed to consider as concrete examples a few selected important fields of pharmaceuticals and analyse whether their origin and development stemmed from academic or industrial research laboratories.

I can do no more than this, for the drug field is immense and I cannot hope to give you in one short lecture more than a very superficial and inadequate glimpse. It would need a whole course of lectures—and a long course at that—to treat the theme of my talk in a comprehensive manner.

Mild Analgesics: Aspirin, Phenacetin, Pyramidon

The two most widely used antipyretics and mild analgesics are phenacetin and aspirin. Both preparations were developed in an industrial laboratory, that of the German chemical firm Bayer, and became the financial pillars for the development of the pharmaceutical section of this firm which in later years was to become world-famous through its discoveries in the field of chemotherapy. Phenacetin arose from the necessity to find an industrial use for the large quantities of p-nitrophenol which accumulated as a by-product of a process for the preparation of certain dyes. p-Nitrophenol is readily reduced to p-amino-phenol and one of the young chemists of Bayer, Dr. Carl Duisberg, who in later years became one of its directors and chairman of the board, was responsible for the initiative to investigate the antipyretic properties of derivatives of p-amino-phenol, on the basis that the related aniline and acetanilide had already been shown to possess antipyretic properties in the 1860s, but were too toxic for use. Phenacetin proved to be the desired product and became almost immediately popular.

Aspirin was discovered in attempts to produce a salicylic acid derivative which was more palatable and better tolerated than salicylic acid itself, whose analgesic properties in rheumatic pains have been known for centuries. One of the organic chemists of Bayer, Felix Hoffman, who worked on methods of acetylating various organic compounds, discovered an easy way of acetylation of salicylic acid with acetic anhydride, and recognized its value in therapeutics. Hoffman's acetylation work led, among other compounds, to the synthesis of heroin, the diacetyl-derivative of morphin, a powerful narcotic, but quick to induce addiction.

A third substance with antipyretic activity in very wide use is Pyramidon. This substance was developed in the laboratories of another great German chemical firm, the Höchster Farbwerke (formerly Meister Lucius und Brünning) by F. Stolz, a pupil of A. von Bayer. Pyramidon is the result of the study of a long series of pyrazolone derivatives, the first of which was discovered by the famous organic chemist Knorr in 1883. In this case the first impulse came from a university laboratory; Knorr followed up reactions of phenylhydrazine, a most important reagent discovered eight years earlier by E. Fischer, with ketoesters. It was a long and laborious way, however, from Knorr's antipyrin to the very much better antipyretic pyramidon, and the study leading to this compound is a typical example of industrial pharmaceutical research.

Local Anaesthetics

Let us now consider for a few moments another extremely important group of drugs, the local anaesthetics. Until the end of the last century the alkaloid cocaine was exclusively used for this purpose. This substance is expensive and addiction forming, and attempts to find a simple synthetic substitute were made. Success was achieved by Einhorn, of the University of Munich, who discovered that derivatives of the simple p-amino benzoic acid had the desired properties. In this case the basic discovery was made in an academic laboratory. To develop this field further, a collaboration between Einhorn and the Höchster Farbwerke, already mentioned in connection with the synthesis of pyramidon, was started and the result of this collaboration was that in 1909 the local anaesthetic Novocain (procaine) came into industrial production, which had found the most widespread use and after over fifty years is still one of the most extensively used local anaesthetics. This substance was the starting point for an enormous amount of work, mainly in industrial laboratories, to find similar or better substances, and virtually thousands of compounds in this series were synthesized and tested. In 1932 an important further progress was realized through the work of Miescher at the research laboratories of the Swiss firm Ciba which led to the discovery of percaine, the first long-lasting local anaesthetic, which has a structure quite different from that of the substances of the procaine type and was the result of careful and laborious pharmacological and chemical research.

The following sequence of events, which is characteristic for this type of work, outlines the way in which percaine was developed.

The starting point was the search for a new antipyretic. In view of the well-known antipyretic properties of acetanilide (see above) it was decided to test the cyclic analogue of this substance oxindol, and its ring analogue, dihydrocarbostyril. The latter proved to have local narcotic effect. A large number of derivatives of carbostyril were then made, and of these the amides of carbostyril carboxylic acid proved to be particularly interesting. They were devoid of antipyretic properties for which they had been originally planned, but exhibited strong local anaesthetizing action. Substitution of the amide group by basic radicals and introduction of ether grouping in 2-position led to very powerful long-lasting local anaesthetics, of which percaine is a representative which at one time was widely used in clinical practice.

Finally, mention must be made of the local anaesthetic xylocain, developed by Löfgren in collaboration with the Swedish pharmaceutical firm Astra, which is probably the best of the local anaesthetics at present available. It is a derivative of the aforementioned acetanilide, one of the oldest synthetic drugs which was known to have mild local anaesthetizing action in addition to its antipyretic properties.

General Anaesthetics

Of the general anaesthetics the barbiturates are perhaps the best known and most widely used. The original idea that diethylbarbiturate was endowed with strong hypnotic properties came from a practising physician, von Mehring. The compound was synthesized by E. Fischer in 1902 and was found indeed to possess the predicted properties. This observation opened up the way for a large-scale industrial attack on this class of compounds, and a host of analogues were synthesized and tested. One of these, phenylethylbarbiturate, synthesized by scientists of Bayer and known under the name of luminal, was found to possess an important property which veronal did not have: it was effective in epilepsy, and is still the drug of choice in this condition. An important development in the field of gaseous anaesthetics is the introduction of fluothane, by I.C.I. chemists and pharmacologists. Fluothane, like chloroform, is a halogenated hydrocarbon, but is almost completely non-toxic, and endowed with potent anaesthetizing power. An additional advantage is that it is non-inflammable and non-explosive.

Neuropharmacology, Allergy and Psychopharmacology

I come now to one of the most important chapters of modern drug research, the field of neuropharmacology. By far the biggest impulse in this field, the impact of which is as yet far from being spent, came in the first decade of this century from an industrial research laboratory, this time a British one, the Wellcome Physiological Research Laboratories, and the chief authors of the discoveries were the physiologist Sir Henry Dale and the late organic chemist Professor Barger, both employed at that time at this firm.

Adrenalin: Sympathomimetic Drugs

Towards the end of the last (1897) and the beginning of this century (1900-1903) a pharmacologically very active substance was isolated from the medulla of the adrenal gland which was termed adrenaline and which produced the same effect as did stimulation of the sympathetic nervous system. This work and the determination of its structure was accomplished in university laboratories by Abel, Takamine, v. Fürth, and others. The substance was synthesized in 1905 by Stolz in the laboratories of the Höchster Farbwerke. Pharmacologically active substances secreted internally by glands into the blood stream were given the name hormones, and adrenaline was thus the first hormone to be synthesized. This important advance was made in an industrial laboratory. Adrenaline was shown to be chemically a derivative of the dihydroxybenzol catechol, and it was at first believed that the pharmacological activity of the substance was anchored in its catechol moiety. In 1910 a paper by Barger and Dale, which has now become classical, appeared from the Wellcome Physiological Research Laboratories, in which the synthesis of a whole series of amines, aliphatic and aromatic, were carried out and their pharmacological activity tested, and it became clear that many of them exhibited pharmacological activity very similar to that of adrenaline, though they were not derivatives of catechol. Barger and Dale coined the term 'sympathomimetic drugs' for these substances because they mimicked the action of sympathetic nerves, when stimulated, on the muscle innervated by them, and it became, in fact, subsequently clear that adrenaline and related substances were actually produced at the endings of sympathetic nerve fibres or were the chemical 'mediators' for their action. The field of sympathomimetic drugs has acquired an enormous importance not only as an almost inexhaustible source of potent drugs, nearly all developed in industrial laboratories, but also from the theoretical point of view. Pages could be filled with the formulae of substances related to this group which were found to possess important pharmacological activity. Of the vast number I should only like to mention the group of pressor amines and of 'energizers' of which ephedrine, amphetamine and benzedrine are generally known representatives.

Lysergic Acid Derivatives

Two other discoveries in the field of pharmaceutical chemistry of the greatest importance, which came out from the Wellcome Laboratories, must be mentioned here, each of which has opened a vast chapter of theoretical and practical pharmacology. Both are the outcome of a systematic study by Dale and Barger of the pharmacologically active constituents of ergot, a fungus growing on rye which produces serious intoxications in man and cattle—a typical industrial research project. The components chiefly responsible for those effects are the ergot alkaloids deriving from lysergic acid. One of these was isolated by Barger and given the name of ergotoxine; it was later found to be a mixture of two substances. Other members of this group were isolated by Stoll and his collaborators at another industrial laboratory, that of Sandoz, in Basle; the most important of these are ergotamine and ergometrine which have a potent constricting effect on the uterus and are widely used in gynaecology. Synthetic derivatives of lysergic acid, also developed by Sandoz, are among the most effective drugs against certain forms of migraine.

Histamine and Allergy: Antihistaminics: Tranquillizers

But I mention the lysergic acid development only in parenthesis. Therapeutically important as it is, and very much to the point as far as my main theme is concerned as another example of important contributions to drug research from industrial laboratories, it is completely overshadowed in importance by two other pharmacologically active constituents of ergot. Both of these were isolated in the Wellcome Research laboratories and both of them have given rise not only to the development of a vast number of important drugs, but have also proved immensely important from the theoretical point of view and have led to some of the greatest advances ever made in the sciences of pharmacology and neurophysiology. One of these two substances is the base histamine isolated by Barger and Dale. The pharmacological properties of this substance, studied by Dale and Laidlaw, revealed that it induces most powerful spasms of the uterus, the intestine and the bronchii, and in general resembles in its action the symptoms of anaphylactic shock. It was, in fact, demonstrated by Dale and collaborators, as well as by many other workers, that histamine is released from the tissues in anaphylactic shock and is responsible for its symptoms, as well as numerous other pathological conditions. The importance of its discovery for the understanding of allergy can hardly be overemphasized. This led in later years (1938) to the discovery by Bovet at the Institute Pasteur of the first histamine antagonist, antergan, the first effective drug in hay fever and similar conditions. A new class of pharmaceuticals became thus available, the antihistamines which were developed at first mainly by Rhône-Poulenc in France, but very soon many industrial laboratories all over the world took part in this development, with the result that a large number of very effective antihistamines is now available for use in allergic conditions, sea sickness, nausea in general, etc. A by-product of this industrial drug research is the discovery of another important group of pharmaceuticals, the tranquillizers. It was observed that some of the antihistaminics possessed pronounced sedative action and a systematic attempt was then made to modify the structure of these substances in such a way as to intensify this sedative property. The studies led to positive results, with the discovery of chlorpromazine, in the laboratories of Rhône-Poulenc, a substance in which the antihistaminic properties were less pronounced, but which revealed itself as a powerful tranquillizer which has found widespread use. As we are talking of tranquillizers, I should like to mention a second important class of these substances which has nothing to do with antihistaminics, but is also the result of research in an industrial laboratory. This is the class of compounds deriving from one of the Rauwolfia alkaloids, reserpine, which was discovered in 1952 by Schlittler and collaborators, in the research laboratories of the Swiss firm Ciba. It has turned out to be a very important psychopharmacological drug.

Parasympathomimetic Drugs

But, returning to the work of Dale on the active constituents of ergot in the Wellcome Physiological Laboratories, I have now to relate another epoch-making discovery with perhaps even greater repercussions, if that is possible, than the histamine discovery. Dale noticed that some samples of ergot showed pharmacological effects which were different from those of the known components, the lysergic acid containing alkaloid ergotoxin and the bases tyramine and histamine.

He suggested to one of his chemical collaborators, Ewins (who in later years was to become famous as research director of the British pharmaceutical firm May and Baker for the discovery of sulphapyridine), that he make an attempt to isolate the substance responsible for the peculiar pharmacological effects which he had observed, and Ewins succeeded in doing so. He was able to isolate in very small amounts a pharmacologically very active substance which he showed was acetylcholine. This substance was shown a few years earlier to possess pharmacological activity by Hunt, but Dale in a comprehensive pharmacological study published in 1914 extended these observations to a very large extent and showed that it produced effects very similar to those produced when the vagal or parasympathetic nerves were stimulated. He suggested later that it could be the chemical mediator for the parasympathetic nervous system in the same way as adrenaline or related substances were shown to be the mediators of the sympathetic nervous system.

In 1923 Loewi actually demonstrated that acetylcholine was secreted after vagal stimulation of the heart, and, as is well-known, for this discovery of the chemical mediator of the parasympathetic nervous system Dale and Loewi were jointly awarded the Nobel Prize in 1936. The discovery of acetylcholine as chemical mediator of the parasympathetic system not only kept theoretical neurologists and neurochemists busy for decades—even to-day it is still one of the most popular subjects of study in this field—but stimulated a tremendous amount of drug research designed on the one hand to synthesize analogues of acetylcholine with parasympathomimetic action, but also to obtain inhibitors to the acetylcholine splitting enzyme, choline esterase, which Dale also had discovered to be produced at the nerve endings, in order to prevent an accumulation of acetylcholine. As in the field of sympathomimetic drugs, one could fill pages with substances related to acetylcholine or inhibiting choline esterase. The muscle-relaxing drugs succinylcholine, discovered by Bovet and independently by Philips at the research laboratories of Burroughs Wellcome, and dekamethonium, discovered by Paton and Zaimis, are examples of acetylcholine esterase inhibitors which have found wide clinical use. Rarely can a contribution from a university laboratory have exceeded in theoretical or practical importance the discoveries which originated in the industrial Wellcome Physiological Research Laboratories.

In the field of hormones many of the original important observations came from physiological studies mainly in university laboratories and also from clinical observations, but as the field developed to the immense dimensions it has attained now, contributions from university and industrial laboratories became of equal importance, both in the chemical, physiological and pharmacological aspects.

The term hormones was coined by Starling, one of the greatest physiologists of this century, to denote pharmacologically active substances internally secreted by glands in order to regulate the metabolism. The blood-sugar regulating insulin is such a substance, and, as is well-known, it was isolated by Banting and Best in 1923 in the Institute of Physiology at Toronto, following older observations by Minkowski, in a German university laboratory, that pancreatectomy leads to diabetic symptoms. Industrial laboratories have worked out practical methods for the mass production of insulin, and the pioneers in this field were the Eli Lilly Laboratories who collaborated closely with the Toronto scientists. Furthermore, the important development of the long-lasting protamine-zinc insulin preparation in the research laboratories of the Danish firm Loewen is noteworthy.

Steroid Hormones

We must now consider briefly the vast and intricate field of steroid hormones. In no other drug field has there been closer interplay between university and industrial research laboratories than in the vast field of steroid drugs, and it is impossible to draw a sharp line of demarcation between the two or to attribute greater merits to the achievements of one or the other form of scientific organization.

There are several aspects of steroid research which must be considered separately: 1. The recognition of their physiological activity, 2. the isolation and determination of their chemical structure, and 3. their synthesis and the synthesis of their analogues. The latter aspect is of particular importance in view of the fact that most of the steroid hormones are produced in Nature in minute amounts only and cannot become drugs of practical usefulness unless they, or their analogues, have been made accessible in larger quantities by synthetic methods.

The recognition of the physiological activity of the two main groups of steroid hormones was made through physiological and clinical observations from academic investigators. That of the sex hormones was discovered by Aschheim and Zondek, who observed that the urine of pregnant women induced oestrus in mice and rats. This observation forms the basis of the famous Aschheim-Zondek pregnancy test. The first indication that the adrenal cortex, the source of the second great group of steroid hormones, the adrenocorticosteroids, is involved in hormonal activity came from the clinical observations of Addison, who discovered that dysfunction of the adrenal cortex leads to a well circumscribed pathological syndrome, which later became known as Addison's disease.

The first successful attempts for the isolation of the oestrus-producing hormones from urine and the recognition of their steroid nature came from academic laboratories, that of Butenandt in Germany and Doisy in St. Louis, and important contributions came from the laboratories of Marrian in England, Laqueur in Holland and Girard in France. The first male sex hormone, androsterone, was isolated by Butenandt, and its structure determined in 1932. Three years later, Laqueur announced the isolation of the more potent male hormone testosterone. A year earlier, in 1934, four different laboratories, that of Butenandt, of Wintersteiner, of Slotta and of Wettstein of Ciba, reported the discovery of the corpus luteum hormone progesterone.

It is important to recall here that right from the beginning the academic investigators received much assistance from industrial research organizations in their isolation studies of the sex hormones which necessitated the extraction and working-up of very large quantities of urine. In fact, it is fair to state that this work could not have been completed without close collaboration between academic and industrial research workers and represents one of the classical examples of the fruitfulness of this collaboration.

Over thirty important steroids were isolated from the adrenal cortex, and in this field Reichstein in Basle, Kendall at the Mayo Clinic, Wintersteiner and Pfiffner, first at Columbia and then at the Squibb and Parke, Davis laboratories, were particularly active. A big impulse to this field was given by a clinical observation, that of Hench of the Mayo clinic, who discovered that one of the corticosteroids, termed by Kendall Compound E, 17-hydroxy 11-dehydrocorticosterone, later termed cortisone, had pain-reducing activity in arthritis and later was found to possess general antiinflammatory activity.

A further very important discovery was the recognition by Simpson, Tait and Bush in Dodds' laboratory, of the sodium-retaining steroid hormone aldosterone, the structure of which was elaborated by these workers in collaboration with Reichstein and a team from the Swiss firm Ciba under Wettstein.

We come now to the third aspect of work on steroids, the synthetic one. Here academic laboratories were active at the beginning, and in the field of sex steroid hormones the laboratory of Ruzicka, who worked in close association with Ciba, was particularly prominent, in addition to Butenandt. The field of sex hormones has a great importance not only for the regulation of sexual functions, but has also close bearing on the cancer field. Huggins in Chicago, a surgeon, showed that breast cancer in mice can be inhibited by oestrogens. It was therefore of particular importance that a relatively simple synthetic substance with oestrogenic properties became available through the work of Dodds and Robinson, who showed that the readily accessible stilbene derivative stilbestrol, possessing a structure much simpler than that of the steroid oestron, exhibited oestrogenic action. This substance not only proved as effective in the treatment of breast cancer as was oestron, but also in the treatment of cancer of the prostate gland, and is still the drug of choice in cancers of this type—it is, in fact, so far the only drug really therapeutically effective in any kind of cancer.

As the field of steroids developed, particularly that of the adrenocorticosteroids, industrial laboratories became more and more active in the synthetic field, and very soon the overwhelming majority of synthetic steroid drugs originated in industrial laboratories. In a catalogue of over 1,400 synthetic steroids listed in a recent monograph, more than 1,300 were made in industrial laboratories. This represents a truly monumental synthetic effort and a dazzling display of chemical ingenuity. It is impossible to mention all the industrial laboratories which have played a prominent part in this development, but the following selection of names of firms, each of which is associated with some important development in the steroid field, must suffice: Ciba, Glaxo, B.D.H., Pfizer, Merck & Co., Schering, Upjohn, Syntex, Searle, Parke, Davis, Lederle, Squibb, Organon, Olin Mathieson, Sterling Winthrop. It is impossible to describe in any detail the individual contributions of the different organizations in the field of steroid synthesis, but mention must be made of the spectacular *tour de force* of the synthesis of cortisone in the laboratories of Merck & Co., under Sarett in collaboration with Kendall of the Mayo Clinic, involving thirty-three steps, twelve of which were concerned with shifting the OH group in twelve position in the starting material, desoxycholic acid, to the position eleven.

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It is perhaps not generally realized that without this synthesis, the development of which was made at the cost of over one million dollars, the discovery of the physiological effects of cortisone and the whole corticosteroid therapy development which stemmed from it, would in all probability not have been made at all, or certainly would have been retarded for many years. The synthesis was the sequence of a war-time programme sponsored by the U.S. Office of Scientific Research and Development and undertaken jointly by industrial and academic research laboratories; its aim was the synthesis of some of the steroid hormones of known structure from adrenal gland extracts which, according to the rumours emanating from Germany, enabled pilots to fly at high altitudes. This rumour was shown to be without foundation by 1943, and the Government lost interest in the project. However, this work led to the synthesis of one of the cortical steroids, Kendall's compound A, by Kendall himself; this substance, later termed dehydrocorticosterone was made available in quantities sufficient for clinical testing by Merck & Co. The compound proved disappointing not only from the aviation point of view, but also in influencing the symptoms of Addison's disease. Despite these disappointments, the synthetic studies on adrenal steroid hormones were continued by Kendall and Merck & Co. and their effort was concentrated on Kendall's Compound E, later termed cortisone. The synthesis of this compound, similar in structure to dehydrocorticosterone, except for the presence of an oxygen atom in position 17, proved to be a very difficult and costly proposition. The incentive to this enterprise was essentially pure scientific interest, for all that could be hoped for at this stage, under the best conditions, was to find the active principle responsible for the therapeutic effect of adrenal gland extracts in Addison's disease, a relatively rare pathological syndrome which could in any case be treated by the crude extracts. Eventually, the laborious synthetic method referred to above was worked out, and slowly, over the course of several years, about one kilo of synthetic material was accumulated and distributed for clinical testing to various clinical centres. The first results reported were in no way spectacular and certainly did not warrant the enormous effort spent in obtaining the material. Eventually, a lot of 1 gm, the three-hundred-and-first of the synthetic lot which had been accumulated by Merck & Co., was sent to Dr. Hench of the Mayo Clinic at his request. Dr. Hench, on the basis of clinical observations, for some years had had the hunch that a constituent of the adrenal gland was implicated in the syndrome of rheumatic arthritis and had expressed the wish to experiment in this connection with Kendall's Compound E once it became available in sufficient quantities. With the synthetic specimen he treated a case of rheumatoid arthritis with the results that the world knows, and which earned him the Nobel Prize in 1950, together with two of the prominent organic chemists in the field of adrenocorticosteroids, his colleague at the Mayo Clinic, Dr. Kendall, and Dr. Reichstein, Professor of Organic Chemistry at the University of Basle.

It is interesting to reflect that Dr. Hench's discovery might never have been made if the supply of synthetic cortisone accumulated by Merck & Co. had been exhausted at the three-hundredth gram. It is most doubtful if the enormous synthetic effort would ever have been repeated a second time by another commercial organization, with no other incentive than to find the active principal for the treatment of Addison's disease. The discovery of the anti-inflammatory effect of cortisone not only is a typical example of the value in the field of drug research of close collaboration between academic and industrial laboratories, and the great importance of the original scientific contributions coming from the industrial laboratory, but represents one of the cases where the discovery could not possibly have been made without the active participation in the research programme of an industrial research organization. The cortisone synthesis was gradually improved and the product became available at a much lower price. A most important contribution in the field of cortisone synthesis and of fundamental importance for steroid synthesis in general came from scientists of another industrial research laboratory, the Upjohn Co. As was pointed out above, one of the difficulties in the cortisone synthesis was the introduction of the hydroxy group in the eleven position of the steroid ring system. Twelve steps, each with a low yield, were necessary for this operation in the first synthesis of Kendall and Merck & Co. The Upjohn workers found that it was possible to introduce the hydroxy-group in the eleven position in a steroid much nearer in structure to that of cortisone, progesterone (which had become readily available from Mexican plant material), by a degradation process involving only six steps in one single step and a yield of over 90 per cent, and this made possible the development of a cortisone synthesis involving only seventeen steps, with a corresponding reduction in price. Later, using different micro-organisms for different oxidation steps, the cortisol synthesis from progesterone could be achieved in only four steps. As a footnote to the epic of the cortisone synthesis, it must be mentioned that cortisone, very soon after its introduction in medicine at great effort and cost, was rendered almost completely obsolete by the discovery of prednisone, a steroid with better physiological and pharmacological properties, differing from cortisone by two hydrogen atoms. This is a typical example of one of the professional hazards which drug manufacturers have to face and to take into account in the price of their products, and people who complain about the high cost which they have to pay for some small quantities of a drug would be well advised to take these facts into consideration before coming to hasty and erroneous conclusions.

As the result of the great industrial effort in the field of steroid synthesis we have now at our disposal a wide range of powerful therapeutic agents in a variety of metabolic disorders. The sexual dysfunctions both in the male and female have already been mentioned, as well as breast cancer and cancer of the prostate, which are now amenable to treatment by sexual hormones. But sex hormones such as testosterone or their analogues are also widely used in medicine to stimulate synthetic metabolic reactions in general. Metabolic disorders amenable to treatment with adrenocortical hormones and their analogues comprise allergy in all its manifestations—and it must be remembered that some forms were fatal before the introduction of steroid therapy—inflammatory conditions such as arthritis, non-specific eye inflammation, oedema, hypertension, certain blood diseases and general stress syndromes. Some of the synthetic steroids have a much more powerful and more specifically direct pharmacological action than the natural hormones, and some have a strong antagonistic action to the natural hormones. In this way modification of the sex hormones which stimulate ovulation has led to powerful inhibitors of ovulation, that is to say these substances are oral contraceptives (though it should be emphasized that it is by no means yet established that the presently available products are safe in practical use). Other synthetic steroids have anaesthetic and sedative effects and are used in mental disorders.

In the development of this kind of drug the biological testing poses problems at least as complex and difficult as the chemical problems. Most elaborate pharmacological and physiological techniques have to be employed for the purpose, and in this field, too, contributions came from academic and industrial laboratories. The pharmacological set-up necessary for work in the steroid fields is so complex and needs such an elaborate and intricate organization that few academic laboratories have adequate facilities to enable them to cover more than one or two sections of the vast field. I shall have some further comments to make later in this lecture on the question of pharmacological testing in industrial laboratories.

Vitamins

One of the greatest advances in raising the standard of health of vast numbers of people all over the world was the discovery of the vitamins. These are substances present in trace amounts in food, the absence of which leads to serious pathological disturbances. The original discoveries of the vitamins as a class of drug were made by two academic investigators. The Dutch physician Eijkman discovered that the disease beri-beri, which was widespread particularly in countries of the East, was caused by people eating polished rice and could be cured by adding extracts of rice hulls to the diet. The second important discovery in this field was the now famous observation of F. G. Hopkins that rats would not grow on a calorically adequate diet of proteins, fat and carbohydrates unless the diet was supplemented daily by 2 ml of milk. The recognition of vitamins is done in nutritional tests on animals or micro organisms and does not require any special equipment except that routinely available in the normal chemical and microbiological laboratories. The isolation of the vitamins, however, nearly always requires working-up processes of large quantities of starting material from which in the end only a few hundred milligrams of the active principle are obtained. For this type of work the normal university research laboratories are not equipped and industrial research laboratories are much better suited. For this reason vitamin research has usually followed a characteristic pattern; the recognition of the majority of vitamins was made in academic laboratories, while in the isolation and the structural studies industrial laboratories have played an important part. This was the case of the vitamins B_1 (thiamine) (R. R. Williams and K. Folkers and coll. of Merck & Co.), Vitamin B_6 (pyridoxine) (P. György and K. Folkers and coll. of Merck & Co.), biotine (Kögl, György, du Vigneaud and K. Folkers and coll. of Merck & Co.), pantothenic acid (R. J. Williams and K. Folkers and coll. of Merck & Co.), lipoic acid (E. E. Snell, G. W. Kidder, R. J. Williams, I. G. Gunsalus and Lederle and Eli Lilly) and folic acid (E. E. Snell and Lederle). Some important vitamins were discovered, isolated, and their structure elucidated exclusively in academic laboratories, for instance, ascorbic acid, riboflavin, nicotinic acid, vitamin K and tocopherol. The antipernicious anaemia factor, vitamin B_{12}, on the other hand, was isolated entirely in industrial research laboratories (Merck & Co. (K. Folkers and coll.) and Glaxo (Lester Smith and coll.)).

A theoretically most important contribution, though of no practical use, was the isolation and the elucidation of the structure of a bacterial growth factor from 'distillers solubles' by a team of scientists of Merck & Co. (K. Folkers and coll.). This substance, termed mevalonic acid, has played a most important rôle in advancing our understanding of the pathways of biosynthesis of the steroids, of rubber, the terpenes, the carotenes and many other natural products.

The syntheses of the vitamins were developed both in academic and industrial laboratories, but in most cases the methods of synthesis which made the vitamins accessible in large quantities as drugs of practical use were worked out in industrial research laboratories.

To summarize, in the vitamin field, as in the hormone field, collaboration between academic and industrial research laboratories has led to many fruitful and important results.

Antiprotozoal Chemotherapy

I have left to the end of this talk the field of drug research with which I personally have been most concerned, the field of chemotherapy.

Arsenicals against Syphilis

As everyone knows, the first major impulse to the development of this field came from the laboratory of Paul Ehrlich, who got his first inspiration from his histological studies while still working as a research student in the University of Breslau, and later as a collaborator of R. Koch in the Robert Koch Institute of Berlin. These were the halcyon days of the aniline dyes, a British invention like many others, enormously developed industrially in Germany, and Ehrlich had at his disposal a large number of new dyes for staining his histological specimens. He was impressed by the selective staining of different cells and of different parts of cells which he observed, and conceived then the idea that it might be possible to clad substances such as arsenic, which was known to be toxic to parasites, but also toxic to the animal body, in the clothes of the structure of aniline dyes in such a way that they would retain their toxicity to the parasite, but lose their toxicity to the host. As is well-known, he was successful with this idea in the synthesis of salvarsan, an arsenical of a structure similar to that of the azodyes, which was effective in the treatment of syphilis. In this project he collaborated right from the beginning with the chemical industry, Georg Speyer and later the Höchster Farbwerke. Industrial methods for the production of salvarsan were developed, and this was followed by a vast industrial research programme to find arsenicals with improved properties, of which the drug neosalvarsan is one of the outcomes.

Antimonials against Kala-Azar

After the success with organically bound arsenic as a chemotherapeutic agent it was natural to try the same with the chemically related element antimony. A large number of organic compounds containing tri- and pentavalent antimony were developed in the laboratories of Bayer and other pharmaceutical houses, and in this way drugs became available for the treatment of the tropical diseases Kala-Azar, caused by a protozoon, Leishmania donovani, and Schistosomiasis (or Bilharziasis) caused by a parasitic fluke.

Antitrypanosome Drugs

Ehrlich had found that certain aniline dyes, among them the azodyes trypan blue, trypan red and afridol-violet, were effective in mice against species of another important, pathogenic protozoon, the trypanosomes, transmitted to man and cattle by the tsetse fly and causing severe and often fatal diseases, such as sleeping sickness in man. However, these had no curative activity in trypanosome infections of man and cattle. Further systematic work in this field, mainly in industrial research laboratories, led to the discovery of colourless effective drugs against trypanosomes. In this connection the drug suramine (or Bayer 205) must be mentioned. This has revealed itself as a long-lasting and very effective prophylactic against human sleeping sickness. However, it had little effect on trypanosome infections in cattle, which represent a very serious problem in the tropical regions of Africa. Here very important progress was made in the I.C.I. laboratories through the development, by Curd and Davey, of antrycide, which has proved to be a very effective curative agent in trypanosome infections of horses and cattle.

Antimalarial Drugs

One of the most widespread and most debilitating infectious diseases is malaria, caused by a pathogenic protozoon, plasmodium, and transmitted by a mosquito. The only effective remedy known until 1926 against this disease was quinine, an alkaloid constituent of the cinchona bark which has been used for centuries in folkloristic medicine in the East against the 'common ague'.

As it became clear that the chemical constitution of the quinine molecule was too complicated to achieve a ready synthesis, concerted attempts were made to obtain simpler synthetic products with antimalarial activity. These attempts were made both in academic and industrial laboratories; an enormous number of substances were synthesized for the purpose and success was achieved in the end. The three successful products which have had wide clinical use were all developed in industrial laboratories. The two first of these were plasmoquine (pamaquin) and atebrine (mepacrine), both developed in the laboratories of Bayer by Hörlein and Schuleman; the third, paludrine, in the laboratories of I.C.I. by Curd and Rose and their collaborators. These compounds are the result of systematic organic-chemical chemotherapy research, i.e., of systematic attempts to modify features of molecules known by experience to possess some chemotherapeutic effect.

For instance, in the development of plasmoquin and mepacrine the discovery by Bayer chemists that a basic dialkylamino-alkylamino side chain enhanced the antimalarial properties in a molecule such as methylene blue, found by Ehrlich to be endowed with some antimalarial activity, played an important rôle. Paludrine is the result of attempts to devise a molecule retaining some features, such as the chlorine atom in the benzene ring and the basic side chain, of mepacrine, known to be an effective antimalarial, but containing the pyrimidine ring system, in view of the fact that the pyrimidine sulphonamide, sulphamethazine, was known to possess some weak antimalarial action. In the final product the pyrimidrine ring was opened, one carbon atom eliminated and the other replaced by an imido group, leading to the formation of a biguanide.

Virtually hundreds of compounds were synthesized and screened in this type of work, which is both laborious and very expensive, but the ultimate result is that malaria can now be effectively controlled, and this justifies all efforts and expenses. While the contributions from industrial laboratories in this field of malarial chemotherapy—as in other sections of tropical chemotherapy—were of the greatest importance, it must be remembered that much of the biological work which was at the base of the chemical work and of vital importance for the understanding of the whole problem was carried out in academic laboratories.

The malaria parasite has a complicated life cycle in which different sexual (gametocytes forms, merozoites, exoerythrocytic forms, schizontes) forms appear. The aforementioned antimalarial drugs differ in their activity against the different forms and therefore differ in their chemotherapeutic efficacy. For instance, plasmoquine is active mainly against sexual forms and therefore not effective against tertiary malaria caused by the a-sexual forms, but it destroys gametocytes and is therefore an effective prophylactic. Mepacrine, like quinine, is a powerful schizontocide and therefore curative in tertian attacks of malaria. Paludrine is active against both preerythrocytic forms and schizontes, and therefore both a prophylactic and curative of tertian malaria.

We owe much of our knowledge of the life cycle of the malarial parasite to the work of academic scientists; and the same applies to our knowledge of the trypanosomes, leishmania and other tropical parasites. Important contributions in this field came from Ross, Laveran, Shortt, Yorke, Leishman, Manson and many other biologists; however, industrial laboratories too contributed much of value towards progress in the biological field, particularly as far as the development of new testing methods is concerned.

Before we leave the field of tropical chemotherapy, mention must be made of one development which came from an industrial laboratory, and which, though not strictly speaking a chemotherapeutic one, has had a most profound influence on the eradication of a number of insect carriers of tropical diseases. I am referring to the discovery, by Müller of the Geigy Laboratories in Basle, of DDT, which, as everyone knows, is a powerful insecticide. This was followed by the even more powerful gammexane, an I.C.I. development. There is hardly any need in this audience to dwell for any length of time on the enormous benefits which mankind derived from these discoveries. Not only were whole areas freed from the malaria-carrying anopheles, but an effective means also became available for combating at the source, so to say, other insect-borne diseases, for instance the mice-borne typhus. In the course of time some insect strains resistant to these substances have emerged, and therefore they have become in certain cases less effective. However, this serious setback has been overcome by the development of another class of very powerful insecticides in the laboratories of Bayer, the organic phosphate esters of which parathion represents one example.

Antibacterial Chemotherapy: Sulphonamides

We come now to the field of bacterial chemotherapy. Here again, the roots of the development can be traced back to Paul Ehrlich, who had discovered that some of the aniline dyes he used for staining his histological specimens had strong antibacterial activity, and this led to a systematic search in the laboratories of the great dye concerns for an antibacterial dye effective in systemic bacterial infections. This search proved unsuccessful for many years, despite the enormous effort expended, for while many dyes were discovered which killed bacteria in high dilutions, all of these were too toxic for internal use. However, a number of powerful local antiseptics were discovered in this way, of which the acridine and crystal violet dyes may be mentioned as examples. In 1935 came the great breakthrough in the laboratories of Bayer with the discovery of Domagk that the azodye prontosil had the properties foreseen by Ehrlich and was capable of curing bacterial infections, such as childbed fever. This discovery marked the beginning of the era of bacterial chemotherapy. A few months after this discovery was announced, a group of French scientists, the Trefouels, Bovet and Nitti, found that the chemotherapeutic effect of prontosil was not due to the dye character of this substance, but to the fact that it was broken down in the body to sulphanilamide, one of the constituents of its molecule, and it was this sulphanilamide moiety which was responsible for the chemotherapeutic action of prontosil. Sulphanilamide is a very simple molecule which can readily be chemically modified. A big effort has now started in many industrial research laboratories to obtain derivatives of sulphanilamide with improved properties. Thousands of compounds were made and the work has not yet come to an end. All the sulphanilamides used clinically at present came from industrial laboratories; to mention only a few of the best known, sulphapyridine (May & Baker, the famous M. & B. 693), sulphathiazole (Ciba and Astra), sulphaguanidine, not well absorbed from the intestine and hence active against gram-negative bacteria causing intestinal infections such as dysentery bacilli (Burroughs Wellcome), and sulphamethazine (I.C.I. and Merck & Co.) may be listed.

As a corollary of the sulphonamide development it must be mentioned that at an early stage of their clinical use it had been noticed that some of the products, in particular the urea substituted sulphonamides, had a blood-sugar lowering effect, similar to that of insulin. Following up this observation two German pharmaceutical commercial houses, Boehringer and the Höchster Farbwerke, produced substances of this kind or a similar kind of chemical structure which exhibited the blood-sugar lowering effect to a pronounced degree. These products, known under the name of carbutamide and tolbutamide, are in fact used extensively in the clinic for the treatment of certain relatively mild forms of diabetes; they can be taken by mouth and obviate the necessity of frequent insulin injections. They act by stimulating the production of insulin by the pancreas gland in cases where the insulin producing cells are still in partially functioning condition.

Another important therapeutic development stemming from the sulphonamides is the discovery of the powerful diuretic action of some members of this class of compounds. The observation which started off this development was a clinical one; patients treated with sulphanilamide, the mother substance from which all sulphonamides are derived, showed acidosis. This phenomenon was shown by Keilin and Mann, of the University of Cambridge, to be due to the inhibitory action of sulphanilamide on the enzyme carbonic anhydrase which catalyses the hydrolysis of carbonic acid to carbon dioxide and water. In the presence of sulphanilamide the enzyme does not function and carbonic acid accumulates leading to acidosis. This, in turn, leads to an excessive loss of sodium and water in the urine by interfering with ion exchange reactions in the kidney.

After the fact that sulphanilamide causes diuresis in animals and man had been securely established, an intensive search was made in industrial laboratories for more effective derivatives. These studies were successful and led to the discovery of several very powerful diuretics of which diamox (American Cyanamid Company) and in particular chlorothiazide (Merck & Co.) have found wide clinical use in a variety of diseases in which disturbances of water and electrolyte metabolism are a prominent feature. The discovery of the sulphonamides was a major triumph of chemotherapy, but had a disastrous effect on the section of pharmaceutical industry concerned with the production of antisera against bacterial infections, which was rendered obsolete overnight. One of the firms, Lederle in the United States, was hit particularly hard; it had invested large sums of money in the construction of a vast complex of animal houses for the accommodation of horses and rabbits for the production of sera which had simply to be scrapped. I mention this as a second typical example of a professional hazard to which the pharmaceutical industry is exposed.

The antisera were replaced by the sulpha drugs, and these, in turn—as everyone knows—were superseded to a large extent by the antibiotics. This meant that once again many manufacturing houses had to change their research activities and line of business.

Antibiotics

Antibiotics are antibacterial substances produced by micro-organisms. The fundamental phenomenon of microbial antagonism, i.e., that one species of micro-organisms produces substances lethal to others, was described for the first time by Pasteur and Joubert as long ago as 1867, and many examples of this were later found in bacteriological laboratories, all non-industrial, of which the one known to everybody is Fleming's mould penicillium notatum producing the antibacterial agent penicillin, which he described in 1929.

About ten years later, Florey and I, then working at Oxford, decided to study this penicillin in greater detail, i.e., to isolate it from the culture fluid and study the pharmacological and antibacterial properties of the purified product. About a year later, in 1940, we discovered, together with our colleagues, that the purified penicillin has remarkable curative powers in very severe bacterial infections in animals, and in 1941 we could demonstrate that it was equally effective in man. This heralded in the era of antibiotics which has brought under control all major bacterial infections.

The crucial discovery in this case, that penicillin could cure experimental and clinical infections, was made in an academic laboratory. However, the discovery of the chemotherapeutic power of penicillin, dramatic as it was, did not signify that a drug of practical use had become available. Fleming's mould produced about 5 units of penicillin, i.e., about 3 micrograms per milliliter of culture fluid. This meant that the amount required for the treatment of one severe case, requiring about 1 g. of penicillin, was contained in 300 l. of culture fluid and at least double this amount would be required for its preparation, taking into account extraction losses. This was an entirely impractical proposition, and, in fact, most pharmaceutical manufacturers at that time, in Britain as well as in the United States, though they showed polite interest in what was undoubtedly a very striking and most remarkable experimental result, considered the idea to develop the biological production process of penicillin to the stage where the substance could become a drug of practical value, as completely unrealistic and Utopian. On the other hand, many scientists in both industrial and academic research laboratories took a view that a synthesis of penicillin could be achieved which would solve all production troubles, and a very large effort was expended in this direction.

A few hundred chemists were engaged in this effort for a period of over five years. Estimating the annual cost of each chemist plus research expenses modestly at £5,000, this effort to synthesize the penicillin molecule, which proved a failure, has cost a total ot several million pounds—yet another good example, the third I have given, of the professional hazards encountered by the pharmaceutical industry. Fortunately, there were industrial enterprises with more experience in the field of microbiological production methods than the main manufacturers of classical drugs, for whom this field was completely new and unknown, and these took another view. Among them the firm Chas. Pfizer & Co. were particularly active, and they had many years of experience in the microbiological production of citric acid, affected by a mould of the Aspergillus niger group. Meanwhile, a better strain of penicillin producing Penicillium, belonging to the species P. chrysogenum, having higher and more reproducible yields than Fleming's original strain, was found, as well as a better culture medium, in a Governmental research laboratory specialized in fermentation, the Northern Regional Research Laboratories in Peoria, Illinois, by Moyer. On the basis of these facts Pfizer, under the direction of Mr. John McKeen, its present president, built what they called a pilot plant, but what would be called in Europe a fair size production plant, consisting of a series of 10.000 l. fermenters, and, using their experience in the citric acid production process, developed the biological penicillin production process by submerged fermentation, which is to-day basically the same as it was then, and is used for the production not only of penicillin, but of all other antibiotics.

Many new engineering techniques had to be worked out for the penicillin production process, not only for the fermentation process proper, but also for the large scale working-up methods and confectioning operations under sterile conditions. The contributions in the field of microbiological engineering towards the large scale production of antibiotics came almost exclusively from industry, and the industry undertook this costly pioneering job with its own resources; the major firms were offered American Government funds, but did not accept the offer.

But the industrial contributions in the field of antibiotics were not limited to the development of engineering methods for submerged fermentation.

In 1944 Waksman and his colleagues at Rutgers University isolated the antibiotic streptomycin which later was shown by Feldman to be active against experimental tuberculosis in guinea pigs and by Feldman and Hinshaw to be chemotherapeutically active in many forms of human tuberculosis. Merck & Co. developed a production process for this important antibiotic, which included strain and culture medium improvement and the elaboration of extraction and purification methods of a substance which was insoluble in all the usual organic solvents. A considerable amount of ingenuity had to be applied to make streptomycin into an industrial product for clinical use.

A vast screening effort for new antibiotics was begun after the discovery of the curative power of penicillin and streptomycin, mainly in industrial laboratories. The result of this was the discovery of a whole range of new and most important chemotherapeutic drugs: the tetracyclines by Lederle, Pfizer and Bristol, chloramphenicol by Parke Davis & Co. both active against the gram-negative bacteria causing infection of the urinary and intestinal tract, the group of the so-called macrolides, of which erythromycin (Lilly), magnamycin (Pfizer) and oleandomycin (Pfizer) are examples, the polymixins, active against pseudomonas (Burroughs Wellcome), cycloserine (Merck & Co.), kanamycin (Umezawa and Meiji Seika Kaisha) and griseofulvin, active against pathogenic fungi (I.C.I. and Glaxo).

In the chemical studies of the elucidation of the often unusual and complex structures of many of these antibiotics industrial research teams played a very prominent part.

The latest important development in the field of antibiotics is the introduction of semisynthetic penicillins by the Beecham Research Laboratories, derived by acylation of the penicillin nucleus which was shown by this group to be accessible by fermentation or enzymatic splitting of benzyl-penicillin. This development, with which I myself have been closely associated, led to the discovery of the penicillinase-resistant penicillins which have solved the problem of the penicillin-resistant staphylococcus which has assumed menacing proportions, particularly in hospital wards, and, in addition, a whole series of new penicillins with improved properties has become available. As the result of the work on antibiotics in which industrial laboratories have played a predominant part, most of the severe bacterial infections can now be effectively controlled.

Antibacterial chemotherapy has had a dramatic effect on the mortality rate for infectious disease, as is shown in the following table:

ACADEMIC & INDUSTRIAL CONTRIBUTIONS TO DRUG RESEARCH

DEATH RATE 1920 TO 1960 FROM SELECTED CAUSES

Causes of Death	*Death Rate per 100,000 Population*				
	1920	*1930*	*1940*	*1950*	*1960*
Tuberculosis, all forms ...	113·1	71·1	45·9	22·5	5·9
Dysentery, all forms ...	4·0	2·8	1·9	0·6	0·2
Diphtheria	15·3	4·9	1·1	0·3	0·0*
Whooping Cough ...	12·5	4·8	2·2	0·7	0·1
Meningococcal infections	1·6	3·6	0·5	0·6	0·3
Measles	8·8	3·2	0·5	0·3	0·2
Influenza and Pneumonia, except pneumonia of newborn	207·3	102·5	70·3	31·3	36·6
Gastritis, Duodenitis, Enteritis, Colitis ...	53·7	26·0	10·3	5·1	4·2
Deliveries and complications of pregnancy, childbirth and puerperium	19·0	12·7	6·7	2·0	0·8
Certain diseases of early infancy	69·2	49·6	39·2	40·5	37·0

* 1959 (figure for 1960 not available)

As a result of drug therapy and improved hygiene the average life expectation has been extended for about ten years:

AVERAGE LIFE EXPECTATION

Year	*Number of years*
1930	59·7
1940	62·9
1959	69·7

GENERAL OBSERVATIONS

This brings me to the end of the technical part of this lecture. I hope to have demonstrated clearly what I had set out to do: both academic and industrial research laboratories have made contributions of enormous importance to drug research. Both kinds of approach, the academic and the industrial, are indispensable and complement each other. This ought to be better understood by the academic research workers, the industrialists, the civil servants, and the general public. The contemptuous and conceited attitude of many academic research workers towards industrial research is quite unwarranted and should be speedily abolished. The standard and quality of the best industrial research is as high as that of the best academic research, and of equal value, as I hope to have amply shown in this lecture. On the other hand, industrialists must understand that many fundamental advances in drug research came from academic investigations of no apparent practical value and should modify their somewhat derisory attitude towards the impractical 'up in the clouds' academic investigator who is far removed from and has no understanding of the troubles of this world. In fact, it is of the utmost importance that both Government and industry give much more support than they have done so far to research projects not favoured by fashion and of no apparent even distant usefulness, particularly in the biological field. It is frequently quite difficult to raise funds for this kind of investigation—and this applies not only to Europe, but also to the United States—and yet nearly all the great advances in drug research have their origin in observations of biological phenomena.

As I said at the outset of this lecture, close collaboration between industry and the university is the best and the most secure way to success. Each has his own methods of approach and fails if he tries to adopt the other's methods.

Characteristic Features of Academic and Industrial Drug Research

It is impossible for even the largest academic laboratory to muster the resources of man-power and material available to a large industrial research laboratory for specific purposes, such as large-scale screening for new antibiotics, large-scale pharmacological testing, the synthesis of a vast number of analogous or related substances with the aim of improving one or the other property of a drug. The academic laboratory which tries to imitate the activities of an industrial research laboratory will do the job inefficiently and will fail in the purpose for which it was designed, that is to break fundamentally new ground towards a better understanding of the laws of Nature and in this way to lay the basis for eventual industrial exploitation of the scientific discoveries emanating from its work. On the other hand, the industrial laboratory that spends more than a small fraction of its resources on problems of theoretical importance only, cannot remain an economically viable entity. Of course, a certain small proportion of routine work in the research work of an academic laboratory is permissible and often essential; the proportion of fundamental research which an industrial organization can afford will depend on its size and profits.

Value of Pharmaceutical Industry

The public must understand that the pharmaceutical industry is life saving and as such fulfils a public function of very great importance. Let it be clearly understood that I refer here, of course, only to those industrial organizations which are actively concerned with drug research and production. This type of industry is essentially productive, and not parasitic, in nature and one of the most positive assets to our form of society. Unfortunately, this is not the image of the pharmaceutical industry in the public opinion and it is time that those whose job it is to influence public opinion should understand these basic facts and take energetic, appropriate measures to get it corrected. I cannot visualize how the industrial pharmaceutical research laboratory could adequately be replaced by any other non-industrial structure, and those who wish to abolish it by nationalization for theoretical reasons, or impede notably its freedom of action, must know that in taking such steps they are conjuring up a major health hazard, much more dangerous than a virulent epidemic. No pharmaceutical industry—no new drugs; this, in a nutshell, is the situation. It is of course theoretically conceivable to create a state-controlled organization for drug research on the lines of the present private industry; but before tampering with the present system which we know produces results, though maybe imperfectly, let us first make sure and doubly sure that the new system will really function as well as the present one, which it is designed to replace. Theoretical arguments are not sufficient; the only decisive criterion for the acceptability of a new system for drug research is the acid test whether it produces in practice new drugs in satisfactory numbers or not.

The results so far obtained in the countries where drug research has been completely state-controlled are very meagre indeed and therefore not very promising; one can say without exaggeration that not a single really novel drug in any field of pharmaceutical industry has come from these countries, and this was not because of lack of effort spent. One has not very far to look for the reasons. It is difficult to imagine a civil servant who will take the risk of spending one million dollars or more on the development of a drug which may lead to no result; he can never be accused of *not* having done something, but may expose himself to the criticism for a positive step which has cost money but which has failed to be successful. These are not just academic remarks, but could be fully documented on the basis of my own experience in the penicillin field.

Lack of competition is another retarding factor of great importance in state-controlled drug research. It is of course realized that the profit motive is not the only incentive to new discoveries and developments in the drug field, but it is a powerful one and one of the most general appeal to a large cross-section of the average scientist, of the most varied background and character, and so far has not been successfully replaced in state-controlled drug research institutes. Unless incentives can be introduced which will make one state-controlled drug research institute compete vigorously with another (and in this case the difference between private and state-controlled drug research will shrink into insignificance), one of the most important factors for the success of drug research in the Western countries will be lacking.

By making these statements, I am fully aware that I have left the technical aspects of my theme and have entered the field of politics. But this seems unavoidable when one speaks of drugs. It is characteristic of the drug field that it has a number of corollary aspects with strong economic, social and political implications; strangely enough, when people talk of drugs or drug manufacturers they become strongly emotionally involved; people seem to feel more strongly about drugs than they do about food or clothes, though the latter have a much bigger impact on human health than drugs. Therefore, these non-technical arguments about drugs have always news value and for this reason represent, and are frequently used, as powerful political ammunition.

It is not possible in this lecture to deal more than fleetingly with these non-technical aspects, which in fact, could easily fill another lecture, or even several lectures. But I should like to say most emphatically that the economic, social and political aspects of drug research cannot be discussed rationally except against the background of the basic technical facts. Without taking these into account, any conclusions reached must, of necessity, become distorted.

This applies to the three main criticisms levelled against the pharmaceutical industry: excessive prices, excessive advertising and promotion of a useless multitude of drugs with essentially identical properties.

It is not within the scope of this lecture to discuss these controversial questions in detail, but I should like to make the following brief comments.

Price Structure of Drugs

The price structure of any article is a complex matter; highly technical considerations must obviously play a predominant part and this applies naturally to drugs too. To say that this or that drug is too expensive, has no meaning; the question is—expensive in relation to what? To the production cost? To the purchasing power of the buyer? To the value of its effect?

It is impossible for the layman to assess the price structure of a drug, just as it is impossible for a non-technologist to express an opinion on the price of a motor car or a typewriter.

As I hope it will have become abundantly evident from the material presented in this lecture, it is impossible to cost a drug without taking into account the large amount of research and development work which is frequently required, and without discounting the many failures in this work, the professional hazards, some of which I have mentioned, and the fact that in the normal course of events and as a general routine one drug is replaced by a better one and therefore has only a limited life time as a commercially profitable article. Naturally, the price of any article is subject to discussion and this also applies to drugs, and it may well be in the one or other case that reductions are possible or even called for. But generalizations such as 'drugs are too expensive' should be avoided, as they can only do harm. Furthermore, as the result of research—competitive research—the manufacturing costs of drugs are often drastically reduced, as for instance, has happened in the case of vitamins B and C, the steroid hormones and the antibiotics penicillin and streptomycin, where the price was very high at the beginning, but now has come down to a level which represents practically cost price and leaves only an exceedingly small profit margin.

In connection with the question of the price structure of drugs the cost of sales promotion is pertinent. In view of the fact that the pharmaceutical industry is a highly competitive one, and progress is stimulated by and depending on competition, some advertising of drugs is obviously essential. How much, is a matter for discussion among specialists, but it is of interest to remember that the total cost of drug advertising in this country is estimated to be of the order of £7 million. Even if this were reduced by half, it still would not influence significantly the bill for the National Health Service, which is around £860 million per year, of which only £96 million represents drugs.

Toxicity Testing

An accusation levelled against the pharmaceutical industry which is of a much more serious nature than that of seeking excessive profits and which recently had a wide echo in consequence of the thalidomide tragedy, is that the industry, in order to make quick profits, is callously launching new drugs too rapidly, without subjecting them to a sufficiently prolonged and careful toxicological testing. Whoever is familiar with the exceedingly painstaking and elaborate system of pharmacological testing of a new drug routinely practised in the laboratories of any pharmaceutical firm of repute before it is released for clinical use, knows that there is no substance in this accusation. Naturally, misfortunes such as that of the thalidomide tragedy cannot be completely avoided because it is always possible that even with the most careful testing on animals a drug may exhibit some toxic effect on man in certain conditions which cannot be reproduced in animals. This was the case in the thalidomide story; by far the large majority of specialists agree that it was quite impossible to predict its unfortunate effect on a small percentage of pregnant women in a certain period of pregnancy, by the conventional animal tests. Before the teratogenic effect of thalidomide became known, it was generally considered an excellent drug, and many firms of great repute vied with each other to put it on the market. Further progress in the science of pharmacology and toxicology will teach us to devise tests to prevent the occurrence of incidents such as happened with thalidomide. But it is important not to exaggerate their significance by alarming and irresponsible assertions. Every year 40,000 people are killed by motor cars in the United States alone—this does not mean that the motor car manufacturers have to be penalized for this or that the use of motor cars must be abolished. In comparison to the beneficial effects of drugs the harmful ones represent an insignificant fraction.

Conclusion

This brings me to the end of my lecture: I hope to have made it quite clear that notwithstanding the many important contributions from university laboratories, drug research and development without the active participation of the pharmaceutical industry is impossible. No doubt, as in any sphere of human activity, there is room for much improvement also in this particular industry. But one must be careful, in judging and assessing the whole situation, not to allow oneself to be swayed and carried away by irrational emotions.

I am the last person, and not naïve enough, to claim that everything is of a pure white within the pharmaceutical industry, but I am also quite certain that it is not all black. As in any collection or community of human beings, there are good and bad types in this industry, but it would be unrealistic to assume that these do not exist in academic, or Government circles. No doubt, there have been failings and abuses. This is unavoidable, owing to human nature. However, when one draws up the balance sheet of the positive achievements and the negative aspects, the credit side overwhelmingly overbalances the debit side, and I, for one, prefer to have an active pharmaceutical industry and life-saving drugs, accepting in the bargain a few abuses, than to have a system in which theoretically no abuses are possible, but which produces no drugs.

Let us, once and for all, accept the indisputable fact which the history of drug research teaches us through innumerable examples of which I hope to have given a fair selection in this lecture: that the best results in the field have been obtained by close collaboration between industrial and academic laboratories.

This collaboration is, in my view, of the utmost importance also for the future, and the emphasis of its necessity represents the essence and the keynote of this talk.

Let us then stop the sterile and futile quibble as to which type of laboratory has made contributions of greater value towards the promotion of the subject, let us put an end to prejudiced, irresponsible and tendentious denigration of the pharmaceutical industry and let us work quite intentionally and consciously towards creating an atmosphere which destroys distrust and promotes understanding between the industry, government and university circles and the general public, and which ensures opportunities for still closer and more intensified contacts and collaboration between academic and industrial scientists. Let us be sure to deploy *all* our available resources, intellectual and material, in the most expedient manner so that we can give the scientists concerned with drug research, both in the universities and in industry, the most favourable conditions in which they can advance more speedily and with the least impediment towards their one great aim, to which they devote their lives and in which all of us have the highest stakes: to combat and conquer pain and an ever-increasing range of diseases through the discovery of new and more efficacious drugs.

Upon the proposal of the Chairman, a vote of thanks to the Lecturer was carried with acclamation, and the meeting then ended.

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OTTAWA

EDITOR'S FOREWORD

In presenting this manual to the public, the Editor wishes to emphasise the position explained in the Introduction, that statements do not derive any authority merely from their appearance in the manual. It is not intended that publication of the manual shall make correct (or incorrect) any practice which previously would have been regarded as incorrect (or correct); the intention is that the normal practice will be found conveniently set out here and that by referring to the manual, applicants for patents, patentees and patent agents will find their work facilitated and their relationship with the Patent Office improved.

The first edition of such a manual can hardly be expected to be completely free from error. Efforts have been made within reason to make it accurate but to make sure of such a result readers are invited to tell the Editor of any error which they find. Nor can it be expected that all readers whether inside or outside the Office, will agree with what is said as explanation of the practical significance of the Act and Rules, and of decisions published in the Reports of Patent, Designs and Trade Mark Cases and elsewhere, or to the Editor's expressions of opinion of what is normal practice in the exercise of the Comptroller's discretion, but it is hoped that the publication will enable applicants, patentees and agents to take into consideration the likely attitude of the Office in particular circumstances and thereby come more speedily to satisfy the Official requirements.

Anyone who wishes to point out any error of fact in the manual or to show that any statement found in it does not correctly express what Office practice is, is invited to write to the The Editor, Manual of Office Practice (Patents), Patent Office, 25 Southampton Buildings, London W.C.2., when the matter will be considered and suitable amendments made as necessary. Amended pages will then be made available to purchasers of the manual at a price and in a manner which will be published in the Official Journal (Patents). The Editor can only consider whether the manual explains correctly what Office practice is. Under no circumstances can the Editor express a view on whether Office practice itself is correct, either in general or as applied to particular cases. It is the Editor's job to explain what Office practice is, not what it ought to be. On the other hand, it needs to be equally stressed that no person, be he applicant, patentee, agent, examiner or other member of the Office staff, is bound by anything written in the manual, merely because it appears in it. The justification of Office practice must be sought elsewhere. Consequently, while it will be reasonable for the contents of the manual to be discussed in connection with any action concerned with patents, it cannot be regarded as binding authority for any action.

Application for Licence under Patent for Food or Medicine

S.41(1) 37,30 The Comptroller normally grants a licence on such terms as he thinks fit, to any person interested (see paragraph 37,48) who makes application for one under a patent relating to the production and use of food, medicine and surgical and curative devices.

S.41(3) 37,31 The licence is granted for no other purpose than to entitle the licensee to make, use, exercise and vend the invention as a food or medicine, or for the production of food or medicine or as part of a surgical or curative device.

Refusal of Licence for Good Reasons

37,32 Since the object of Section 41 is to ensure that food, medicines and surgical and curative devices should be available to the public at the lowest prices consistent with the patentees deriving a reasonable advantage from their patent rights, the onus is on the opponents (see paragraphs 37,51 to 37,63) to show that the grant of a compulsory licence is against the public interest. It is insufficient for the patentees merely to show that they can supply all the demand in this country.

37,33 In determining whether there are 'good reasons' for refusing the application, consideration is paid to the case of *Smith Kline and French Laboratories Ltd.'s Patent*, [*1965*] F.S.R. 332 in which it was stated that the sole question for consideration is whether or not any reason put forward for refusing to make an order is sufficient to override the public interest in the grant of a licence. From this it follows that to resist the grant successfully, a patentee would have to establish that any substantial damage to his interest, or injustice which would otherwise result, is of a kind which could not be met by appropriate means when settling the terms of the licence under subsection (2), and which is sufficient to outweigh any possible advantage to the public.

Ss.46, 47 37,34 The existence of Crown Rights under Sections 46 and 47 does not establish a sufficient reason for refusal of an application for a compulsory licence (*Geigy S.A.'s Patent*, [1966] R.P.C. 250).

37,35 In the case of applications for a licence to import, consideration must also be given to the fact that importation for sale is an abuse of the monopoly. However, the onus is still on the opponents to establish that the balance of public interest is against the grant. In both *Pfizer and Co. Inc.'s Patents* [1966] F.S.R. page 226 and *Farmers Marketing and Supply Co. Ltd.'s Patents*, [1966] R.P.C. page 546 applications for licenses to import were refused on the grounds *inter alia* that the applicants selling price would not be sufficiently below that of the patentees. In the former it was stated that there was not sufficient price advantage to outweigh the damage to home industry.

Calculation of Royalties

37,36 In *Geigy S.A.'s Patent*, [1964] R.P.C. page 391, royalties on a pharmaceutical product were calculated according to the following principles:-

37,37 The royalty should be made up of the following three elements:-

(1) An allowance for research. Having regard to the general nature of the research operation it is generally impossible to estimate the cost of research in producing a particular drug. Moreover such an estimate would not take into account abortive expenditure on unsuccessful research. It was decided that the allowance for research should be obtained by spreading the current costs of research evenly over the total sales of all drugs sold by opponents and should be expressed as a percentage of the opponent's sales of the drug in question.

(2) An allowance for promotion. The prospective licensee is only liable to contribute to such of the promotion expenses as are of benefit to himself, i.e. the cost of medical representatives and their area and field management, the activities of a doctor engaged in queries relating to the drug and a proportion of the administration expenses; but not for any publicity or advertising project. This element is made up of two parts; first, a part to take account of the benefit the licensee would derive from the continued activities on the medical side expressed as a percentage of opponent's costs to sales; and secondly a part to take account of the patentee's expenditure (subject to exclusions mentioned above) in establishing the drug as suitable for treatment for a particular ailment, and assessed by determining the lump sum involved and spreading it over its estimated sales' life from the date of establishment. Owing to the impossibility of forecasting the sales' life in this case, the remaining patent life was substituted here.

(3) An allowance for an element of profit to service the capital employed in research and promotion.

37,38 The patentee's contention that the royalty should be expressed as a fixed rate per kilogram was rejected in favour of expression as a percentage of the selling price. On appeal it was held that the selling price to be taken into consideration was that of the applicant's, which would be expected to be somewhat less than that of the patentee's, since some price differential would be necessary in order for the applicants to enter the market in a field in which the patentees were already well-established.

37,39 The Comptroller's decision is followed by detailed explanations and formulae for use in calculation of the royalty.

APPENDIX 143

Brief to the Senate of Canada

SPECIAL COMMITTEE ON SCIENCE POLICY

Submitted by

THE CANADIAN ELECTRICAL MANUFACTURERS ASSOCIATION

10 PRICE ST., TORONTO 5, CANADA

BRIEF

TO

THE SENATE OF CANADA

SPECIAL COMMITTEE ON SCIENCE POLICY

Submitted by

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10 PRICE ST., TORONTO 5, CANADA.

March/mars 1969.

INDEX

INTRODUCTION

1. The Canadian Electrical Manufacturers Association (hereinafter called the Association) with its head office at 10 Price Street, in the City of Toronto, was incorporated under the predecessor of the Canada Corporations Act and is, as its name indicates, an Association of electrical manufacturers who are engaged in the manufacture of electrical products or who are engaged in promoting the sale and manufacture of those products in Canada. The electrical manufacturing industry in Canada had an output in the year 1968 with an estimated value of $2.3 billion and currently employs 139,000 Canadians. A total of 163 electrical manufacturers are members of the Association and the Association represents more than 90% of the Canadian electrical manufacturing industry. A list of the members and of the officers and Directors of the Association is attached.

2. The objects of the Association as set out in the Letters Patent of Incorporation are as follows:

(a) To increase the amount of electrical service to the public and improve the quality of this service;

(b) to promote the standardization of electrical products;

(c) to collect information relating to the electrical industry and to disseminate such information to the members of the Association and to the public;

(d) to appear for the members of the Association before and to co-operate with legislative committees, governmental departments and agencies and other bodies in regard to matters affecting the industry;

and

(e) to promote a spirit of co-operation among the members of the Association in the attainment of improved production, enlarged distribution and increased efficiency in the use of electrical products.

Magnitude of Research and Development in the Electrical Manufacturing Industry

3. The following figures indicate the magnitude and the spectacular growth of research and development effort in the Canadian electrical manufacturing industry.

Research and Development Expenditures

Electrical Manufacturing Industry in Canada

Millions of Dollars

Years	Source CEMA Survey of Members	Source DBS	Source Dept. of Industry Amounts claimed
1961	12.0		
1962	28.9		
1963	34.9	38.6	
1964		48.8	
1965		63.0	
1966		71.5	
1967			83.8

4. In 1966, the total expenditures by Canadian electrical manufacturers amounted to almost 25% of all industrial R & D expenditures in Canada. They represented the largest single expenditure in this field among all industries.

5. More than in any other industry, technological advances in electrical and electronic products have set the pace for the scientific revolution that has characterized the pattern of modern economic growth.

6. The speed with which scientific discoveries are translated into technology and into practical application stems from the tremendous competitive pressures within the electrical manufacturing industry and raises, quite naturally, the question as to the industry's future capacity to keep pace with the ever increasing rate of innovation.

7. Indeed, in this competitive world, a Nation's output of scientific discoveries and its rate of technological innovation becomes the yardstick of its continued capability for economic achievement.

Distribution of R & D between Government, Universities and Industry

8. The members of this Association are generally in agreement with the definition of research and development contained in Section 2(2)(d) of the regulations under the Industrial Research and Development Incentives Act. Reference to R & D in this submission is intended to mean research and development so defined.

9. During the past several years, many organizations and individuals have given thought to the correct proportion of research and development which should be carried out by Government, Universities and industry. In the view of this Association, there is no fixed proportioning in amounts to be spent in these three sectors. Similarly, there is no fixed percentage of the gross national product which should be spent, in total, on research and development to guarantee satisfactory economic growth of the country. As others have already noted, Canada's total R & D expenditure does lag behind that of other progressive countries and every possible means of increasing it should be explored.

10. This Association lays particular stress on the importance of development activity, as compared with research activity. It is the expansion of development activity in industry which will give most support to the government's determination, and we believe that of all Canadians, of improving Canadian industry's world competitive position as well as maximizing and stabilizing Canada's level of employment and prosperity.

R & D in Government

11. The Government should assume responsibility for large, imaginative research programs which cannot be economically performed elsewhere, and also programs of national interest which are not being carried out in universities nor can be justified in industry. In general, Government R & D programs should be restricted to fundamental or basic research with development work minimized and limited to specific areas of activity.

12. The development of equipment to meet the specific requirements of Government departments should be assigned to industry on the basis of fully paid development contracts including expense plus the price of the equipment in production quantities. Not infrequently, the number of units required can be too small to allow absorption of the development expense as part of the cost of the product. Unless the development expense is fully paid, industry would not consider the programs to be a commercially viable venture and would not undertake such a contract.

13. The sub-contract procedure with fully paid development would probably be less expensive to the Government than development in government laboratories with subsequent sub-contract to industry for production. Costly redesign or re-development prior to production can be avoided by sub-contracting the development to industry. As a general condition, the transfer of design information between two organizations is an expensive matter. This expense is minimized by performing development and manufacture within one organization.

14. The Association suggests the following guidelines be used in determining programs to be carried out in Government laboratories.

Government laboratory programs should be authorized if:

(a) they do not compete with work being performed in universities or industry

(b) the results will probably benefit the maximum number of people and yet would not ordinarily be done in industry. (e.g. agricultural research).

(c) the work cannot be performed economically in industry or universities because of lack of specialized tools or equipment or because of the requirement for large capital investment which cannot be justified (e.g. aeronautical research involving wind tunnels, nuclear research).

(d) they provide areas of research for the training of research scientists to give them experience and specialization with the intent that they would later go into universities or industry.

(e) the programs relate to safety of life which would not normally be carried out elsewhere.

(f) they have a defence connotation which may demand unusual military security classification or which would not ordinarily be carried out elsewhere on a long term basis. (e.g. radio propagation studies, Alouette Satellite).

(g) they relate to research on how research programs should be chosen, although some of this type of work should be done by universities and industry.

R & D in Universities

15. During the period 1953-54 to 1967-68, university research expenditure in the sciences and engineering has grown from approximately $5 million annually to $110 million. A very high percentage of these funds has come from Government grants. These figures indicate the very rapid build-up of university facilities from a position of inability to turn out the number of science and engineering post-graduates required to stimulate R & D activity in the country to where there is some indication that universities are now capable of turning out an

over supply of Ph.Ds by 1971. It is also estimated that universities will employ 70% of the total employed Ph.Ds in Canada by 1973. The Association does not suggest that government expenditures for research grants in the universities should be decreased from present levels, but it does suggest that very careful study and thought should be given before increasing these grants significantly forthe next 3 or 4 years. Such grants should be directly geared to the future requirements for engineers and scientists with masters of Ph.D degrees. If a proper relationship between supply and demand is not maintained, research in the universities and the training of Ph.Ds to do more research in the universities will become an end in itself. Such escalation will result in still further demands for increased government grants.

16. Because the university environment is most conducive to research activities, it is reasonable to believe that most pure, fundamental or basic research should be done in the universities. Research personnel in universities are not affected by the economic pressures common in industry and business. In this environment, creative minds can follow their particular interest without regard to the economic consequences of their work. The purpose of such research should be to increase fundamental and basic knowledge and to train post graduates to the Ph.D. level with the expectation that many of these higher qualified people will later go to the government or industry.

17. Universities and industry should be encouraged to continue to search together for more effective ways of coupling their R & D activities.

R & D in Industry

18. As the Economic Council of Canada has said, research by itself may add nothing to economic growth. It is the innovation process - beginning with an industrial management decision to proceed with development, engineering, design and all of the succeeding stages - which brings new products, processes and services into use and which contributes to growth. The Economic Council of Canada also states "there is danger that policy-makers will concentrate on support of R & D leaving the rest of the process to take care of itself."

19. It has been said by some that Canadian industry does not have the capability to undertake major technical developments in a number of areas. It is our belief that industry can marshall the capability, if given the opportunity.

20. Therefore, the Association believes that industry should carry the main responsibility for applied research and development. Only by doing the work close to the manufacturing and marketing functions can development, in particular, be efficiently performed. Only in industry can all the considerations affecting development be brought to bear on a particular project; designing, tooling for manufacture, facilities for manufacturing, testing, costing, selling and marketing installing, operating and maintaining. Product development carried out by government laboratories is seldom in an environment which allows all of these factors to be taken into consideration. For this reason, the Association recommends that a minimum amount of product development be carried out in government laboratories.

21. Every possible avenue for increasing the amount of applied R & D to be carried out in industry should be explored. The important and guiding principle should be for government to create an environment in which industry is encouraged, in very positive ways, to carry its own R & D programs. The financing of R & D programs can only be accomplished from funds derived from profits or the return of part of these profits from direct government support such as tax incentive plans, grants or R & D contracts.

Comments on Government R & D Incentive Programs

Industrial Research Assistance Program (IRAP)

22. This program, administered by the National Research Council, pays the salaries of additions to scientific staff. It is in the order of 50% of the project cost. It has been intelligently administered. The National Research Council has shown the flexibility necessary to encourage good research programs. Although funds available under IRAP have expanded since the program was implemented in 1962, it is the Association's view that the funds have not expanded rapidly enough to meet the needs of industry for this worthwhile program.

Defence Industrial Research Program (DIR)

23. This program, administered by the Defence Research Board, has been active and useful for member companies engaged in the production of defence products. There has been some tendency to institute these programs strictly on the basis of direct and immediate military interest, which in Canada provides a very limited available market.

Present programs receive up to 50% support.

Program for Advanced Industrial Technology (PAIT)

24. Some members of this Association, who have investigated the possible use of this program, have found it unattractive. Others have used it successfully.

25. One member states that taking into consideration the fact that the incentive payment under IRDIA and the tax savings resulting from the expenditures are deferred until the loan is repaid, the pay-back of the Government's 50% share, if the project is successful, results in an effective interest rate considerably higher than that currently available through private borrowing.

Department of Defence Production VOTE-5

26. This program is primarily for the development of military hardware for export. It is being used by member companies and the terms and conditions are generally favourable. The Association recommends that it be continued and that it be expanded to provide support to the development of commercial products, which are considered to have characteristics suitable not only for military applications but also for commercial sale in both domestic and export markets.

Industrial Modernization for Defence Export (I.M.D.E.)

27. This program under Vote-20 has served a useful and valuable purpose. We recommend that it be continued in its present form and expanded whenever and wherever possible to encourage the establishment of manufacturing facilities for special complex products which will benefit the Canadian economy.

The Industrial Research and Development Incentive Act (IRDIA)

28. This program, administered by the Department of Industry, is, without doubt, potentially the most significant of the several government sponsored incentive programs for research and development. It is the successor program which, commencing in 1967, replaced the previous incentive provided under Section 72 (A) of the Income Tax Act.

29. It is the Association's opinion that IRDIA is not entirely realistic, and we suspect not fully effective, in advancing research and development in Canada. Its effectiveness may become fully evident when the final figures for 1967 become available and we learn what proportion of the applications for assistance under this program by this industry totalling $83.8 million are approved.

30. The requirement for individual project application and approval is fundamentally wrong. A decision to engage in an industrial research and development program is an entrepreneurial decision of the highest order. It involves consideration of available human resources, physical resources, capital, potential markets, prices, an estimate of the competitive situation several years in advance. Decisions of this kind can best be made and can only successfully be made by thousands of individual business executives with the knowledge and experience available to them through their daily activity in a competitive environment. To expect such decisions to be made intelligently in a single location in Ottawa is a fundamental mistake in concept.

31. The Canadian Government, in its recent White Paper on Policies for Price Stability, recognized the impracticability of attempting to centralize such decision making in Ottawa when it said

32. "Moreover, to undertake a comprehensive surveillance and review of the thousands of price and income decisions occurring regularly in all parts of our economy would require the services of a vast bureaucracy. Such a bureaucracy could operate only on the basis of highly simplified rules and standards which would conflict with the needs of a dynamic growing economy. For all these reasons, detailed review of specific price and income decisions would be highly inadvisable, and the Government rejects this approach."

33. An example of the oversimplified rules and standards which occur when an attempt is made to centralize decisions of this kind arises in the interpretation which the Department of Industry appears to be giving to the phrase "likely to result in benefit to Canada if it is successful" which words appear in Section 3 sub-section (2) of the Act. No company producing in Canada, is likely to undertake research and development with its attendant high cost, which will not be to its benefit and therefore of measurable benefit to Canada in many ways.

34. The present procedure under IRDIA adds significantly to costs in preparing documents for examination by the Department of Industry. The procedure leads to decisions from the Department of Industry which might be inconsistent with the encouragement of research and development. It leads to serious delay of up to a year or more in payment of millions of dollars of incentives which is, of course, additional substantial cost to the companies involved.

Recommendations concerning R & D Incentive Programs

35. The Canadian Electrical Manufacturers Association recommend the modification of the present IRDIA program to conform more closely with the specific recommendations to Economic Council of Canada, in December 1965, of its Advisory Committee on Industrial Research and Technology. Specifically we recommend the following;

(1) The requirement for prior approval of specific projects and programs should be eliminated.

(2) There should be no base period provision for eligible current expenditures.

(3) Current and capital R & D expenditures should receive equal benefits.

(4) The incentive benefits under the program should be in the form of tax credits which are available either in regard to present taxes or carried forward against taxes in future years, and/or payment of a grant, at the option of the applicant.

36. Generally we find the following programs to be helpful in appropriate situations and recommend their continuance.

Program for Advanced Industrial Technology

Industrial Research Assistance Program

Defence Industrial Research Program

Department of Defence Production VOTE-5

Industrial Modernization for Defence Export

37. We recommend that increased funds be made available under IRAP.

F. G. Samis,
General Manager

K.H. Rapsey
President.

March 1969

APPENDIX A

LIST OF CEMA MEMBER COMPANIES

NAME OF COMPANY	OFFICIAL REPRESENTATIVE
Acme Division, Polygon Services Ltd.	E.C. Hamlin
Allen-Bradley Canada Limited	K.H. Rapsey
Allen West (Canada) Ltd.	K.J. Trudgen, (1st Alt)
Alpin Otis Elevator Co. Ltd.	G. Fecteau
Aluminum Company of Canada Ltd.	M. Emmett
Amalgamated Electric Corp. Ltd.	N.A. George
Appleton Electric Limited	G.A. Barrett
The Arborite Company	E.L. Crossman
Arrow-Hart of Canada Limited	I.Y. Morrison
Ascolectric Brantford Ltd.	F.E. Lewis
Automatic Sprinkler Company (1964) Ltd.	B.E. Ruscoe
Bay Bronze (1962) Ltd.	M.S. Wallace
Bedard-Girard Limited	J. Phaneuf
A. Belanger, Limitee	T. St. Laurent
E.W. Bliss Company (Canada) Ltd.	G. Montgomery
British Columbia Transformer Co. Ltd.	H.N. Burgess
Brown Boveri (Canada) Ltd.	W.O. Rowan
Burndy Canada Ltd.	F.H. McLenaghan
Canada Wire & Cable Co. Limited	J.H. Stevens
Canadian Admiral Corporation Ltd.	S.D. Brownlee
Canadian Allis-Chalmers Limited	B.T. Ellis
Canadian Armature Works Corp.	V. Zyto
The Canadian Chromalox Co. Ltd.	V.N. Stock
The Canadian Coleman Company Limited	I.D. Campbell
Canadian Controllers Limited	S.A. Musselman
Canadian General Electric Co. Ltd.	A.F. Johnston
Canadian Ohio Brass Co. Limited	E.R. Davey
Canadian Phoenix Steel & Pipe Ltd.	A.D. Morris
Canadian Porcelain Company Limited	E. Ladesich
Canadian Sterling Electric Limited	J. Hawes
Canadian Westinghouse Company Ltd.	W.J. Cheesman
Canadian White Star Products Limited	W.E. White
Canron Limited	C.A. Shupe
Cansfield Electrical Works Limited	P.D. Smith
Carrier Air Conditioning (Canada) Ltd.	W. Smallwood
James B. Carter Limited	D. Sprague
CEB Limited	R.J. Geleziunas
A.B. Chance Co. of Canada Ltd.	W.H. White
Chrysler Airtemp Canada Limited	B.E. Naylor
Commercial Enclosed Fuse Company (Canada) Ltd.	B.F. Hahn
Conduflor Canada Limited	H.J. Hoseason
Conduits National Company Ltd.	J.H. Hall
Crompton Parkinson Electrical Ltd.	T.L. Berridge
Crouse-Hinds Company Limited	C.F. Graham
Cutler-Hammer Canada Limited	C.A. Wilde
The Danby Corporation	J.B. Miller
Darling Brothers Limited	A. Hynd
Dominion Cutout Limited	D.C. Ferguson
Dover Corporation (Canada) Ltd.	F.S. Harwood
F.X. Drolet Inc.	A. Belanger
Eagle Electric of Canada Ltd.	N.W. Leddy
Eastern Wire & Conduits Limited	H.E.R. Merker
Edwards of Canada Limited	R.A. Yates
Electric Power Equipment Limited	R. Bartholomew
Electrical Mfg. Co. Ltd.	C. Rousseau
Electroheat Limited	A.B. Johnson
Electroline Manufacturing Co. Ltd.	A. Berniker
Electromode Division, Singer Co. of Canada	
Electrovert Ltd.	J. Gogan
Emerson Electric Canada Limited	M.K. Douglas
Enamel & Heating Products Ltd.	G.M. Ross
English Electric Co. of Canada Limited	H.B. Style

The Enterprise Foundry Company Limited	E.M.S. Fisher
Esna Limited	J.R. Lindsay
Fairgrieve & Son Limited	D.M. Fairgrieve
Federal Pacific Electric of Canada	B.W. Ball
Federal Wire & Cable Company Ltd.	D.E. Mussell
Ferranti-Packard Limited	T. Edmondson
Fiberglas Canada Limited	A.J. Fisher
Fieldscraft Lamps Limited	J.W. Kerr
Findlays Limited	A.J. Illingworth
Fittings Limited	H.G. Palmer
Franklin Manufacturing Co. (Canada) Ltd.	P. Salipante
Frigidaire Products of Canada Ltd.	E.V. Rippingille, Jr.
Furnas Electric Canada Ltd.	N.E. Brown
General Freezer Limited	J.R. Goodwillie
General Steel Wares Limited	F.R. Johnson
General Wire & Cable Co. Ltd.	K. Fabricius
Gilson Manufacturing Co. Ltd.	A.J. Kendrick
Great Lakes Electrical Specialties Ltd.	H.D. Young
Hamilton Porcelains Limited	A.V. Mason
Harvey Hubbell of Canada Ltd.	D. Houston
Heron Cable Industries Ltd.	R.A. Phillips
The Holophane Company, Limited	A.R. Parrish
Honeywell Controls Limited	J.C. Cowdrey
Horn Elevator Limited	E. Horn
Hupp Canada (1961) Limited	Y. L'Heureux
Iberville Fittings Limited	V.N. Longtin
Ilsco of Canada Limited	D.M. Ottmann
Industrial Wire & Cable Limited	G.D. Zimmerman
John Inglis Co. Limited	H. Nuttall
I-T-E Circuit Breaker (Canada) Ltd.	R.R. Farrell
ITT Wire & Cable	C. Desjardins
Kearney National (Canada) Ltd.	G.R. Raisbeck
Kelvinator Sales Corporation Ltd.	N.H. Leach
Klockner-Moeller Ltd.	W.B. Peterkin
Kondu Mfg. Company Limited	D.H. Kirkwood
Lacal Industries Limited	R.C. Walker
Leeds & Northrup Canada Ltd.	J.M. Jackson
Leonard Refrigerator Co. of Canada Ltd.	N.H. Leach
Lewis-Shepard (Canada) Ltd.	E. Best
Lincoln Electric Company of Canada Ltd.	M.N. Vuchnich
Manitoba Bridge & Engineering Works	D.N.S. Hodgson
Markel Electric Products, Ltd.	D. Markel
Marr Electric Limited	D.P. Marr
Moffats Limited	J.C. Cooper
Moloney Electric Co. of Canada Ltd.	G.E. Dunfield
Montgomery Elevator Company Ltd.	J.F. Roelofson
Murray-Jensen Mfg. Ltd.	N.W. Leddy
McGraw-Edison of Canada Ltd.	T.G. Quance
National Fibre Company of Canada Ltd.	H.A. Frankel
National Porcelain	E. Dodd
Northern Electric Co. Ltd.	V.O. Marquez
Otis Elevator Company Limited	G.H. Blumenauer
R. Payer Company Limited	R. Payer
The Peelle Co. Ltd.	J.N. Sproule
Permali (Canada) Limited	R.J. Yates
Philco Ford of Canada Ltd.	R.A. MacDonald
Phillips Cables Limited	T.A. Lindsay
Pioneer Electric	T. Shkordoff
Pioneer Electric Brandon Limited	J.B. Thorsteinsson
Pioneer Electric Ontario Limited	R. Noonan
Pirelli Cables Limited	D.G. McKay
E.W. Playford Company Limited	E.R. Hickman
Powerlite Devices Limited	D.S. Young
Nepco Division, H.K. Porter Co. (Canada) Ltd.	J.A. Segsworth
Powertronic Equipment Ltd.	D.E. Bawden

Pyle National (Canada) Limited	A.J. Sherrard
Pyrotenax of Canada Limited	A.J.C. Ward
Railway & Power Engineering Corp. Ltd.	P. Davidson
Ranco Controls Canada Ltd.	G.E. Downie
RCA Victor Company Ltd.	R.H. Girouard
Reliance Electric & Engineering (Canada) Ltd.	C.E. Hugus, Jr.
Renfrew Electric Co. Limited	J.R. Longstaffe
Reynolds Cable Company Limited	J.D. Murphy
The Robbins & Myers Co. of Canada, Limited	E.G. Jones
Wm. Roberts Electric Limited	H.C. Scott
Robertson-Irwin Limited	K.C. MacKenzie
Rucker Electronics	D.W. Nestor
Sangamo Company Limited	L.C. Collingwood
S & C Electric Canada Limited	A.R. Morrison
Siemens Canada Limited	W.B. Waite
Simplicity Products Limited	R.J. Collins-Wright
Slater Steel Industries Ltd.	D.F. Grant
Smith & Stone Limited	D.R. Peppall
Square D Company Canada Limited	C.R. Verrier
The Steel Company of Canada Ltd.	F.I. Baine
Swift Devices Limited	D.M. Horn
Tappan-Gurney Ltd.	C.R. Lair
Taylor Electric Mfg. Co. Ltd.	M. Eagle
Telemecanique Canada Ltd.	B.V. Marcoux
Temco Electric Manufacturing Company	F.J. Ryan
Thomas & Betts Limited	R.E. Bailey
Trench Electric Limited	R.W. Eden
Unelco Limited	C.J. Pratt
Unifin Division, Keeprite Products Ltd.	F.S. Brown
Universal Wire and Cable Co. Ltd.	E.D. Perry
Walkerduct of Canada Ltd.	F.P. Thorpe
Ward Leonard of Canada Limited	J.H. Kluge
W.W. Wells, Limited	J.E. Kennedy
Westeel-Rosco Limited	D.A. Young
The W.C. Wood Company Limited	W.C. Wood
P.M. Wright Electrical Co. Ltd.	B.M. Wright

Total number of companies 163

APPENDIX B

CANADIAN ELECTRICAL MANUFACTURERS ASSOCIATION

EXECUTIVE COMMITTEE OF THE BOARD OF DIRECTORS 1968-69

PRESIDENT	* K.H. Rapsey	President, Allen-Bradley Canada Limited, 135 Dundas Street, GALT, Ont.
1st VICE PRESIDENT	* T.A. Lindsay	President, Phillips Cables Limited, King St. West, BROCKVILLE, Ont.
2nd VICE PRESIDENT	W.G. Ward	Executive Vice President, Canadian General Electric Co. 214 King St. West, TORONTO 1, Ont.
3rd VICE PRESIDENT	K.C. Hague	General Manager, Electrical Division, Canron Limited, 160 St. Joseph St., MONTREAL 32, P.Q.
Other Members	* J.H. Stevens	President, Canada Wire & Cable Co. Ltd., Postal Station "R" TORONTO 17, Ont.
	J.G. Little	Executive Vice President, Northern Electric Co. Ltd., P.O. Box 6123, MONTREAL, P.Q.
	* W.J. Cheesman	President, Canadian Westinghouse Co. Ltd., P.O. Box 510, HAMILTON, Ont.
TREASURER	* C.F. Graham	President, Crouse-Hinds Company of Canada, 1160 Birchmount Road, SCARBOROUGH, Ont.
SECRETARY	* C.R. Verrier	President, Square D Company Canada Limited, 120 Industry Street, TORONTO 15, Ont.
IMMEDIATE PAST PRESIDENT	R.M. Barford	President, General Steel Wares Limited, Box 426, Terminal "A", TORONTO 1, Ont.

*Official representative for Company

BOARD OF DIRECTORS 1968-69

C.A. Albini	Product Manager, Outdoor Lighting, McGraw-Edison of Canada Ltd., 3595 St. Clair Ave.E., SCARBOROUGH, Ont.
* B.W. Ball	President, Federal Pacific Electric of Canada, 19 Waterman Avenue, TORONTO 16, Ont.
R.L. Cliff	President, British Columbia Transformer Co., 1740 One Bentall Centre, 505 Burrard St., VANCOUVER 1, B.C.
* J.C. Cooper	President, Moffats Limited, Gibson & Wright Avenues, WESTON, Ontario.
* R.J. Geleziunas	General Manager CEB Limited, 950 Warden Avenue, SCARBOROUGH, Ont.
* F.R. Johnson	Vice President, General Steel Wares Limited, Box 426, Terminal "A", TORONTO 1, Ontario.
* Y. L'Heureux	President, Hupp Canada (1961) Limited, L'ASSOMPTION, P.Q.
H.A. Martin	Executive Vice President, Smith & Stone Limited, 50 St. Clair Ave. West, TORONTO 7, Ont.
* I.Y. Morrison	President, Arrow-Hart of Canada Limited, 81 Industry Street, TORONTO 15, Ont.
J. Newell	Vice President, Canadian Westinghouse Co. Ltd., P.O. Box 510, HAMILTON, Ont.
* H.Nutall	President, John Inglis Co. Limited, 14 Strachan Avenue, TORONTO 3, Ont.
D.D. Panabaker	Secretary-Treasurer, Otis Elevator Co. Ltd., 414 Victoria St. North, HAMILTON, Ont.

APPENDIX 144

BRIEF

TO THE

SENATE COMMITTEE

ON

SCIENCE POLICY

MAY 1969

ELECTRONIC INDUSTRIES ASSOCIATION
OF CANADA
200 St. Clair Avenue West
Toronto 195, Ontario

FOREWARD

In submitting this brief on behalf of the Electronic Industries Association of Canada, we believe we are offering suggestions which in some respects may be similar to those which the Committee will be receiving from other Science based Industries, but which in the main are evolved from the study of our own problems. The Electronic Industries Association of Canada is grateful for the opportunity to state its views on Science Policy in Canada and in this brief we will try to show how our Industry is affected by such policy, and by the ways in which the Federal Government's intentions are carried out in practice.

It is also apparent that such opinions as we do express are likely to differ substantially from the opinions of scientific workers in Academic and Government operated laboratories. For this difference we may be considered biased and indeed it would be futile to deny it, for it is our business to ensure as far as possible that the Electronics Industry will thrive and expand under better conditions than exist at the present time.

There are many facets to the Electronics Industry, which include classes of work vital to the Canadian economy. These are in the areas of Data Processing, Data Communications, Social Communications (including telephone, telegraph, television and radio), modern education systems, armed services' electronic requirements, transportation, weather forecasting and medicine. These areas are, themselves, divided into various sub-trade areas such as Electronic Components, special equipment and instrumentation, and so on which are common to all classes and which are described in some detail in a bilingual booklet prepared by our Association entitled 'Canada's Electronics Industry'. Appendix A attached.

It is usually considered an aim of Government to do what the economy allows in improving the well-being, happiness and living conditions of the people. The Electronics Industry is directly concerned with this aim in several ways. Firstly, by providing devices which the public can use for its day-to-day business, entertainment and education; secondly, by increases in direct employment and the payment of good wages; thirdly, by the export of electronic products and equipment and services to obtain earned foreign money.

To do all these things better, a National Science Policy is required which provides priorities, not necessarily exclusive commitments, to programs which are in line with these basic aims and we believe that such a policy should take into account the unique requirements of Canada in the particular areas of communication, atomic energy and natural resources indigenous to the Country. The encouragement by suitable means of the Electronics Industry in whole and in part is in line with this aim.

PART 1
RESEARCH AND DEVELOPMENT IN THE CANADIAN ELECTRONICS INDUSTRY

1.1 Viewed statistically, the Canadian Electronics Industry expends more dollars on research and development, and is accelerating its growth of expenditure in this area more rapidly than any other segment of the manufacturing industries. Table I shows the current expenditures on intra-mural R and D for the years 1963 - 1968 (DBS Source), using 1963 as the base line or 100%. This table indicates the growth in the various areas of manufacturing and for non-manufacturing industries. The electrical products show a consistent growth throughout the years and the highest growth of any of the reported activities, with petroleum products second, and non-manufacturing third. The electrical products industry is significantly in excess of the average, which was 197.39%.

1.2 Table II shows the sources of funds for intra-mural R and D for the year 1967 (DBS Source). For electrical products, about 76.5% of the source of R and D funds are derived internally, and only about 17.8% is provided by the Government of Canada.

1.3 These figures show that the Electronics Industry is aggressively pursuing research and development, and is certainly paying for the greater portion itself, although it does receive a reasonable portion from the Government. The Electronic Industries Association of Canada has been vitally concerned with the effectiveness of its own R and D and the means whereby the Canadian Government can encourage our industry to innovate through a National Science Policy and specific incentive programs.

1.4 One might be encouraged by a cursory review of a Dominion Bureau of Statistics release dated May 7, 1969, which reported:

Reference Sec. 6
DBS Daily April 25th, 1969.

TABLE I

CURRENT EXPENDITURES ON INTRA-MURAL R AND D

	1963		1964		1965		1966		1967		1968	
	$	%	$	%	$	%	$	%	$	%	$	%
Manufacturing												
Paper	11.0	100.0	14.6	132.73	15.0	136.36	19.0	172.73	18.5	168.18	19.5	177.27
Primary Metal	12.9	100.00	13.8	106.98	16.3	126.36	17.1	132.56	20.0	155.04	18.1	140.3
Aircraft	32.2	100.00	43.1	133.85	57.2	177.64	50.0	155.28	40.0	124.22	41.6	129.19
Elec. Products	31.8	100.00	41.8	131.45	57.8	181.76	68.8	216.35	83.2	261.64	85.8	269.81
Pet Products	7.7	100.00	8.7	112.99	11.6	150.64	13.6	176.62	16.6	215.58	20.1	261.03
Chem. Products	22.5	100.00	26.0	115.56	30.6	136.00	37.0	164.44	41.1	182.67	39.6	176.00
Other Manufacturing	26.0	100.00	29.3	112.69	34.1	131.15	42.6	163.85	51.1	196.54	54.8	210.77
Sub-Total	144.1	100.0	177.3		222.6		248.1		270.5		279.5	
Non-Mnfg.	9.1	100.0	12.1	132.96	14.2	156.04	18.3	201.09	22.3	245.05	22.9	251.64
TOTAL CURRENT	153.2	100.00	189.4	123.63	236.8	155.57	266.4	173.89	292.8	191.12	302.4	197.39
TOTAL CAPITAL	27.2		37.6		50.5		50.7		44.9		44.1	
TOTAL	180.4		227.0		287.3		317.1		337.7		346.5	

Reference Sec. 6
DBS Daily April 25th, 1969.

TABLE II

SOURCES OF FUNDS FOR INTRA-MURAL RESEARCH AND DEVELOPMENT, 1967

	Internal	Related Companies (1)	Government of Canada (2)	Millions of Dollars		
				Other Canadian	Foreign	Total
Manufacturing:						
Paper	20.8	1.2	0.8	2.5	0.9	26.1
Primary Metals	24.1	0.9	0.9	0.2	0.1	26.3
Aircraft	20.8	-	18.8	0.2	1.1	40.9
Electrical Products	72.3	3.2	16.8	0.1	2.2	94.7
Petroleum Products	20.7	-	0.1	-	0.7	21.5
Chemical Products	41.7	0.2	1.7	-	3.4	47.0
Other	42.9	0.7	5.8	0.4	6.5	56.1
Sub-Total	243.3	6.2	44.9	3.4	14.9	312.6
Non-Manufacturing	17.2	1.5	2.1	2.1	2.2	25.1
TOTAL	260.5	7.7	47.0	5.5	17.1	337.7
Percentage of Total (%)	77.1	2.3	13.9	1.6	5.0	100.0

(1) Canadian only. Non-Canadian related companies are included in "Foreign".
(2) Excluding grants received through the Industrial Research and Development Incentives Act.

"The total expenditures of the Federal Government on scientific activities for 1967-68 increased by 20 per cent over the 1966-67 level. A further increase of 13 per cent is expected for 1968-69. Comparison of total current expenditures over the six years 1963-64 to 1968-69 yields annual increase of 11 per cent, 22 per cent, 13 per cent, 20 per cent and 15 per cent."

A seemingly commendable improvement. However, a closer examination of the figures indicates the increased expenditures are not being made in industry -- where expansion is essential to sustain and enhance our national economic growth -- but rather in government institutions and the universities where expenditures have little impact on stimulating economic expansion. If we eliminate the 1967 and 1968 IRDIA grants from the DBS figures for purposes of comparison of the years 1965 through 1968, we find that Government R & D support to industry has dropped each year from a level of $68.2 million in 1965 to $59.5 million in 1968. Meanwhile, support to government institutions has increased each year, from $171.5 million in 1965 to $260.7 million in 1968, and similarly, support to universities has increased each year from $41.8 million in 1965 to $99.3 million in 1968.

1.5 In other words, the share of Federal R&D funds directed to industry is getting smaller year by year, from 24 per cent in 1965 to 14 per cent in 1968. This trend runs contrary to almost every piece of advice the Government has had over the past several years regarding expenditure of its R&D funds.

1.6 To make a simple comparison with our neighbour to the South, it is forecast that 1968-69 R&D expenditures by the U.S. Federal Government will be in excess of $20 billion. Fifty-two per cent of this sum will be spent in industry, and this percentage is higher than that of the two previous years.

1.7 The R&D picture, in summary:

In Canada: Federal Funds in support of R&D in 1968-69 $427 million, with 14 per cent spent in industry, and percentage declining.

In the U.S.: Federal Funds in support of R&D in 1968-69 greater than $20 billion, with 52 per cent spent in industry, and percentage increasing.

PART 2
INDUSTRY AND THE FEDERAL GOVERNMENT

2.1 The Federal Government, by its many support programs, encourages industries to improve their technological capabilities in order that it may compete more fully in foreign markets or supply a home demand otherwise filled from abroad. The Electronic Industries Association of Canada has made their views known to the Canadian Government by several documents and presentations, copies of which are attached as appendices and enumerated below:

Appendix "B" "Brief to the Government of Canada on the Need for Increasing the Technological Capability of Canadian Industry".
This brief was presented to several ministers of the Cabinet on March 17, 1969, along with other subjects concerning Excise Tax and Dumping.

Appendix "C" "Brief to Department of Industry, Trade and Commerce re Industrial Research and Development Incentives Act (IRDIA)" with covering letter to A. G. Kniewasser, Senior Assistant Deputy Minister, Industry and Trade Development Branch, dated March 12, 1969.

Appendix "D" "Electronic Industries Association of Canada Presentation to Cabinet Ministers, Ottawa, March 17, 1969. (Charts)".
The form of this presentation utilized flip charts with various summarizations.

2.2 The above-noted documents indicate in detail the position of the Electronic Industries Association concerning R and D and show that the Electronics Industry in Canada is a viable secondary industry, ready to take its place as a partner with the Canadian Government in forming and processing through the future, that portion of a Science Policy in which this industry has the necessary expertise, experience and will, to provide.

2.3 A general observation can be made about the various grant programs now in existence. Some grants are very good for the purposes intended, but the purposes are rather limited. Their goodness arises from their ease of application and because they appear to rely on the basic honesty and integrity of the Companies which accept them. Hence, there is a minimum of non-essential paper work. In this category are the DIR and IRAP Programs. There are other grants and incentives available to industry which are less satisfactory in various ways; these are IRDIA, Vote 5 and PAIT. Appendices B and C deal with these quite specifically, and there is no need to elaborate on them here.

2.4 In the past, there appears to have been a general lack of communication and dialogue on both sides, Government and Electronics Industry, but it is now recognized that the agencies of the Federal Government are working hard to overcome this deficiency and the Electronics Industry is reciprocating so that future programs should become more effective.

2.5 Currently, the money available for technological upgrading of industry is a small part (14.5% in 1965) of the total Federal funding available for research and development purposes, and is residual to the money spent on universities, Government operated laboratories and on natural resource technology grants to the provinces and to provincial research institutions. This, of course, affects the Electronics Industry as a whole and is detailed in the R and D Brief (Appendix "B") noted above.

PART 3
THE UNIVERSITY - ITS DUAL ROLE

3.1 The historical view of a University as a place of learning and a fount of fundamental knowledge sacrosanct from control or interference was no doubt a correct view prior to 1939. It is open to debate whether it is the proper view today. Of the value of the University as a place of learning there can be no question, but the duality of the teaching and research functions merits consideration. As a place of learning, the University is supported by the Provincial Government. As a fundamental research establishment it is supported to a considerable extent by grants from the Federal Government. This leads to an interesting conclusion which affects Industry. Students who are at the top of the classes in the Sciences have a temptation to remain in the comfortable academic environment and carry out research there. The result of this is an expansion of the post graduate research facilities and an ever increasing demand for more and better research workers and money for their support. In short, the Universities have a positive feedback tendency to absorb a fraction of their own output in good students and therefore to need more and more Federal money for their support. As this seems to be a positive feedback situation, it is evident that the increase is likely to be exponential in character. Unless steps are taken the situation may well get out of hand in the future. The Electronics Industry is affected two ways. The availability of the better scientists to industry is reduced, and the availability of technology funds left for industrial aid is also reduced.

3.2 Questions should be asked about what these people actually do for the economy in return for what the public spends on them.

3.3 We do not wish to go to extreme lengths in this type of argument because specific cases can always be found to refute it. But the fact remains that the rate at which fundamental knowledge is being obtained is greater than that which can be economically absorbed and clearly some control is needed to maintain a good balance between the supply of information and its useful absorbtion.

PART 4

COMPETITION FROM GOVERNMENT LABORATORIES

4.1 With regard to Government Research Laboratories, the Electronics Industry finds from time to time that applied research being carried out by them could have been pursued in Industry and preceded by meaningful market surveys. Twenty years ago the Electronics Industry was little more than a producer of goods to blueprints from parent organizations or from the Department of National Defence. In those circumstances the small efficient laboratories operated by the services through the Defence Research Board and the National Research Council were very valuable, but now things have changed and very knowledgeable people, many with international reputations, are available in industry. There is, therefore, less need than formerly for Federal Government requirements to be met by their own laboratories.

4.2 It may be easier because of contractual formulae and because of geographical locations for Federal Government Agencies to have as many as possible of their requirements dealt with in Government laboratories, and if this is true, some enquiry into the detailed reasons appears desirable. The important point here is that the Electronics Industry is very dependent on its R and D capability, and that any detraction of a non-industrial kind is hardly conducive to industrial progress.

4.3 In addition, we should point out that if the work performed on behalf of the Federal 'Government is to result in ultimate manufacture, even of small quantities, it is much more difficult to transfer the knowledge acquired during the development phase from a Government laboratory to an Industry, than would be the case had the work been carried out by that Industry in its R and D facility.

4.4 The cost of such work in industry is likely to be no more expensive than in a Government laboratory if cost comparisons are properly made. For example, the cost per scientist at N.R.C. from the figures in their 1967 Review, is about $34,000, which is about the same as the industrial average at that time.

PART 5
THERE IS MORE THAN R and D

5.1 A figure frequently quoted, and which appears to the members of the Electronic Industries Association to be reasonable, is that the cost of inventing a new device or product and of demonstrating that it works is about 5% to 10% of the overall cost involved in bringing the device through the various intermediate stages and into production. Another way of expressing this is to say that the total innovative process is between ten and twenty times the R and D cost as ordinarily considered. This cost has to be borne by product sales from future years and is therefore a discouraging factor which works against the efforts of the various Government Agencies who endeavour to sponsor R and D.

5.2 There are two ways of tackling the problem: The first and more obvious way is to cease limiting industrial grants and incentives to the base R and D processes and extend them further and further along the production road. Such grants should be made after proper examination of market potential and to those companies who have shown, or are likely to show, enthusiasm for the type of product involved. There are sections of the Electronics Industry who find it necessary to check out a new process by pilot plant production before launching on an expensive main production program. This pilot plant operation is akin to that in general use in the chemical and petrochemical industry and is experimental in nature. It would be most helpful to such industries if grants could be made available for such purposes.

5.3 The second way of dealing with the problem is more complex, more expensive, but far more beneficial because its effects are more general in application. In this solution a hard look is made at why it should cost ten to twenty times the R and D cost to reach production. On the horizon today are various electronic and electromechanical aids which cut across traditional production engineering methods. These aids include automatic draughting, data transfer from design to machine and, in some instances, electronic aesthetics, and many other short cuts which are products or branches of the computer age.

5.4 However, it is difficult for the smaller industrial units to think this way because of the high initial expenditures and because of the inevitability of dislocation in their industry. Grants to encourage this kind of improvement in product cost would not only reduce the cost to consumers of many existing products but would greatly simplify the production of new and better products resulting from R and D efforts.

PART 6
AIM FOR ORIGINALITY

6.1 In the export field the market place is highly competitive. It is therefore clear that there is a far better chance of selling abroad if the products offered for sale are not the same, but are better than, or different from those already available. To achieve this kind of product, special encouragement should be provided and extra care taken by the granting agencies to see that extraneous or routine influences do not stifle originality of this kind. It is suggested that grants having higher Government share percentages than usual be provided on a basis of reports by competent Federal Government examiners in such cases.

PART 7
NEED FOR NATIONAL GOALS

7.1 To quote from our R and D Brief, "There is an urgent need to determine specific areas of technology where 'fields of excellence' should be developed. In this connection both industry and the Government are handicapped by the almost complete absence of stated national goals on which Government policy could be formulated."

7.2 "We are aware that the Science Council has been considering the question of a science policy in support of the economic and social goals of the nation, which have yet to be defined. In the last few years the fragmentation of the Electronics Industry due to lack of defined goals and limited supporting funds, has led to a very thin distribution of the funds over a large area comprising many fields of technology. National goals would permit us to refrain from being mere imitators of the United States and would lead to strengthening of specific areas of technical interest to Canada. Certain Departments should play a strong part, in consultation with industry, in determining such areas of technology where excellence should be developed. With this type of leadership, based on national objectives, industry could better shape its own destiny with the hope of a more stable and promising future."

PART 8
NATIONAL PROGRAMS

8.1 Again, to quote from our R and D Brief, "The Electronic Industries Association believes there are many policies and programs which could be examined jointly by Government, Industry and the Universities for possible implementation in Canada. It is believed that a careful selection of such programs could invoke further dynamic response from industry. Large and imaginative programs may well provide the needed challenge to our youth and could bring advantages to all citizens. Such programs will involve the spending of public funds in industry as contractual expenditures from which predictable advantages will accrue to the nation. We firmly believe this is the best way to stimulate the growth of industrial technology. Much of the progress in technology and the industrial strength of the United States derives from their undertaking of major national programs and not, we maintain, because the United States Government has, in some general way, supported R and D. Two of these programs, Defence and Space, have created a huge market for new technology and new products. The key action here was the decision by the United States Government to invest a significant part of the national resources in these programs. This created the demand and stimulated technological growth. The result in terms of general improvement in the United States economy have been staggering, in spite of the fact that neither the Defence nor the Space program has any real lasting social value in itself. It is also interesting to note that this type of program is now being followed by other foreign countries, notably France, Japan, Germany and Great Britain."

8.2 In Canada, the Electronics Industry has developed into world prominence in those fields where the peculiar environment of this country has placed severe demands. We refer here to such areas as communications, electrical power and electronics associated with transportation.

8.3 In other areas of electronics, Canada's environment is particularly adaptable. For example, our exceptionally long coastline would suggest a concentration in oceanology and our highly valued water resources demand concentration in pollution problems. In both of these cases, there is also a potentially viable administrative climate to foster programs which other countries may not be in a position to undertake.

Electronics has an important role to play in both of these fields.

8.4 The environment to foster growth in other areas would have to be improved. Whereas there is a growing demand for educational and medical electronic devices, the fragmentation in the administration of these fields in Canada is so severe that it is virtually impossible to find an agency of sufficient size or strength to underwrite the high R and D costs of entering these promising world markets.

8.5 Other specific programs in which the electronics industry is vitally interested are detailed in our R and D Brief (Appendix B), Pages 7 and 8.

PART 9
ABSENCE OF SCIENCE POLICY DIRECTION

9.1 Although we understand that we are, at the moment, looking for a Science Policy to meet today's needs, and that we have to do so because hitherto there has really been no real Science Policy, we subscribe to the view that this is a continuing dynamic process. We do not think a policy can be laid down for all time, except in the most general terms; viz., that there must exist such a policy. It cannot be stated on a long term basis. It is a shifting thing. Its proper use in the hands of the most competent people available should be much the same as the way in which monetary policy is used, as a control on predictable situations for the benefit of all Canadians.

9.2 We do not believe that Science Policy ought to be defined or a definition attempted on a long term basis, but rather that it should be an essential control and recognized as such to ensure our future well-being.

9.3 Nevertheless, the mechanism through which such control is carried out can, we submit, be studied and defined in more or less precise terms. We do not attempt to do this in this brief, but rather would draw the attention of the Committee to the fact that at the present time there are no bodies who have the power to control or even to indicate the direction of science with the possible exception of financial controls through the Treasury Board, and this amounts to a question of how much is asked and how much is available for granting.

9.4 The important question - "What is the proper use for such money as is available" - remains unanswered because the system is such that a wide variety of agencies filter the requests of a still wider variety of scientists, all of whom want more aid at all times.

9.5 It seems that in this type of system even the Science Advisors to the Government - The Science Secretariat and the Science Council - appear to study the specific rather than the overall questions and provide advice that this project is a good thing and that one is not. This hardly assists in determining the balance needed today between, for example, fundamental and applied research or between medical and physical science.

9.6 In fact, at the recent conference sponsored by the Canadian Institute on Public Affairs, the president of the Treasury Board, the Hon. Mr. C. M. Drury, is reported as saying "Within Government itself, I do not see any new structures being established to implement Science

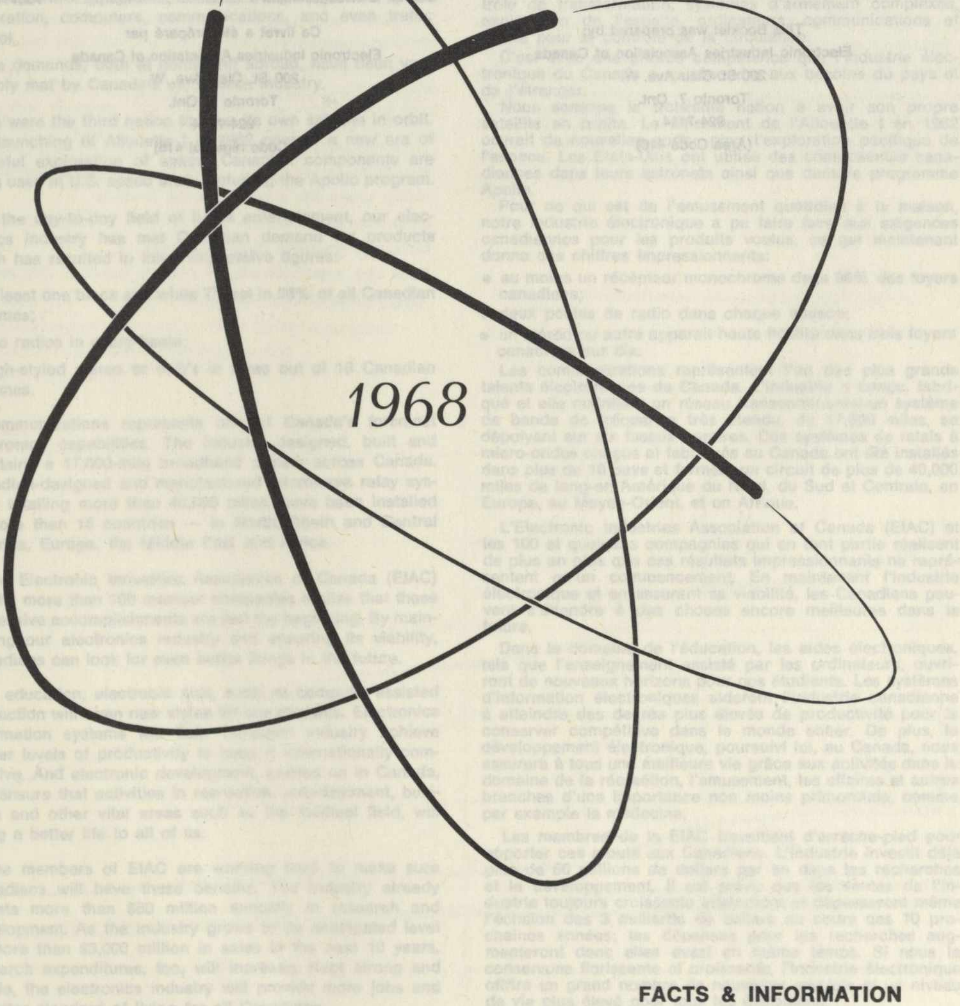
Policy. In fact, I do not see how Science Policy can be considered as an entity, and to set up any special structure would run counter to our recently instituted system of planning, programming and budgeting."

9.7 This approach is certainly one to put science "where it belongs" in the well documented, computer operated society. But it takes us even further from answering the question about the absence of any high level control of Science and Science Policy. We would like to draw the attention of your Committee to this gap at the top because we believe that the importance of instituting a means for formulating and controlling National Science Policy transcends both party politics and the push-button mind. We believe that if your Committee will suggest a solution on how the gap can be filled it will have performed a service which will endure for many generations for the benefit of all Canadians.

APPENDIX "A"

CANADA'S ELECTRONICS INDUSTRY

CANADA'S ELECTRONICS INDUSTRY
L'INDUSTRIE CANADIENNE DE L'ÉLECTRONIQUE



FACTS & INFORMATION
FAITS ET RENSEIGNEMENTS

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TABLE DES MATIERES

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CANADA'S ELECTRONICS INDUSTRY

Canada has always been in the forefront of world electronic research and development. Since 1901 when Guglielmo Marconi opened a new era in communications by sending the first long-distance wireless message from Great Britain to Signal Hill in Newfoundland, Canadians have maintained deep interest and involvement in electronics progress.

Canada contributes far more than is generally realized to the world's electronics knowledge. Our capabilities are demanded by more industries in more countries every day. We are among the leaders in designing and manufacturing electronic components and systems for machine tool and process control equipment, complex weapon systems, space exploration, computers, communications, and even traffic control.

The demands, both at home and abroad, have been very capably met by Canada's electronics industry.

We were the third nation to have its own satellite in orbit. The launching of Allouette I in 1962 opened a new era of peaceful exploration of space. Canadian components are being used in U.S. space craft, including the Apollo program.

In the day-to-day field of home entertainment, our electronics industry has met Canadian demand for products which has resulted in these impressive figures:

- at least one black and white TV set in 96% of all Canadian homes;
- two radios in every home;
- high-styled stereo or hi-fi's in three out of 10 Canadian homes.

Communications represents one of Canada's foremost electronic capabilities. The industry designed, built and maintains a 17,000-mile broadband system across Canada. Canadian-designed and manufactured microwave relay systems totalling more than 40,000 miles, have been installed in more than 18 countries — in North, South and Central America, Europe, the Middle East and Africa.

The Electronic Industries Association of Canada (EIAC) and its more than 100 member companies realize that these impressive accomplishments are just the beginning. By maintaining our electronics industry and ensuring its viability, Canadians can look for even better things in the future.

In education, electronic aids, such as computer-assisted instruction will open new vistas for our students. Electronics information systems will help Canadian industry achieve higher levels of productivity to keep it internationally competitive. And electronic development, carried on in Canada, will ensure that activities in recreation, entertainment, business and other vital areas such as the medical field, will bring a better life to all of us.

The members of EIAC are working hard to make sure Canadians will have these benefits. The industry already invests more than $60 million annually in research and development. As the industry grows to its anticipated level of more than $3,000 million in sales in the next 10 years, research expenditures, too, will increase. Kept strong and viable, the electronics industry will provide more jobs and a better standard of living for all Canadians.

L'INDUSTRIE ELECTRONIQUE AU CANADA

Le Canada a toujours été au premier rang en ce qui concerne les recherches et le développement de l'électronique, ceci, dans le monde. Depuis le jour où, en 1901, Guglielmo Marconi ouvrait de nouveaux horizons dans le domaine des communications en réalisant la première liaison par ondes hertziennes entre l'Angleterre et Signal Hill, Terre-Neuve, les Canadiens ont conservé un intérêt très soutenu pour les progrès de l'électronique.

Les contributions du Canada aux connaissances mondiales de l'électronique dépassent de beaucoup ce qu'on serait porté à croire. Tous les jours un nombre croissant d'industries de plus en plus de pays font appel à nos talents. Nous sommes en têtes de file pour la conception et la fabrication de composantes électroniques et de systèmes électroniques pour l'équipement de machine-outils et contrôle de transformation, systèmes d'armement complexes, exploration de l'espace, ordinateurs, communications et même pour le contrôle de la circulation.

C'est avec une grande compétence que l'industrie électronique du Canada a su répondre aux besoins du pays et de l'étranger.

Nous sommes la troisième nation à avoir son propre satellite en orbite. Le lancement de l'Allouette I en 1962 ouvrait de nouvelles portes pour l'exploration pacifique de l'espace. Les Etats-Unis ont utilisé des composantes canadiennes dans leurs astronefs ainsi que dans le programme Apollo.

Pour ce qui est de l'amusement quotidien à la maison, notre industrie électronique a pu faire face aux exigences canadiennes pour les produits voulus, ce qui maintenant donne ces chiffres impressionnants:

- au moins un récépteur monochrome dans 96% des foyers canadiens;
- deux postes de radio dans chaque maison;
- un stéréo ou autre appareil haute fidélité dans trois foyers canadiens sur dix.

Les communications représentent l'un des plus grands talents électroniques du Canada. L'industrie a conçu, fabriqué et elle maintient un réseau transcontinental-un système de bande de fréquence très étendu, du 17,000 miles, se dépolyant sur six fuseux horaires. Des systèmes de relais à micro-ondes conçus et fabriqués au Canada ont été installés dans plus de 18 pays et forment un circuit de plus de 40,000 miles de long-en Amérique du Nord, du Sud et Centrale, en Europe, au Moyen-Orient, et en Afrique.

L'Electronic Industries Association of Canada (EIAC) et les 100 et quelques compagnies qui en font partie réalisent de plus en plus que ces résultats impressionnants ne représentent qu'un commencement. En maintenant l'industrie électronique et en assurant sa viabilité, les Canadiens peuvent s'attendre à des choses encore meilleures dans le future.

Dans le domaine de l'éducation, les aides électroniques, tels que l'enseignement assisté par les ordinateurs, ouvriront de nouveaux horizons pour nos étudiants. Les systèmes d'information électroniques aideront l'industrie canadienne à atteindre des degrés plus élevés de productivité pour la conserver compétitive dans le monde entier. De plus, le développement électronique, poursuivi ici, au Canada, nous assurera à tous une meilleure vie grâce aux activités dans le domaine de la récraétion, l'amusement, les affaires et autres branches d'une importance non moins primordiale, comme par exemple la médecine.

Les membres de la EIAC travaillent d'arrache-pied pour apporter ces atouts aux Canadiens. L'industrie investit déjà plus de 60 millions de dollars par an dans les recherches et le développement. Il est prévu que les ventes de l'industrie toujours croissante atteindront et dépasseront même l'échelon des 3 milliards de dollars au cours des 10 prochaines années; les dépenses pour les recherches augmenteront donc elles aussi en même temps. Si nous la conservons florissante et croissante, l'industrie électronique offrira un grand nombre de nouveaux emplois et un niveau de vie plus élevé pour tous les Canadiens.

INDUSTRY HIGHLIGHTS, 1968*

Total Canadian consumption, electronic products	$1,082 million
Total value of factory shipments	$ 886 million
Total value of material used by the industry	$ 390 million
Total shipments of television sets	$ 115 million
Total shipments of radio-phono combinations, radios incl. auto	$ 73 million
Total shipments of portable record players	$ 5 million
Total shipments of all other electronic equipment (incl. computers)	$ 612 million
Total shipments of electronic components	$ 81 million
Total imports of electronic products	$ 438 million
Total value of Canadian electronic exports	$ 242 million
Total employed by the industry	54,000
Total Wages and Salaries paid	$ 300 million

*Industry estimates

FAITS IMPORTANTS EN 1968*

Consommation canadienne totale, produits électroniques	$1,082 millions
Valeur totale des expéditions de l'usine	$ 886 millions
Valeur totale des matériaux utilisés par l'industrie	$ 390 millions
Total des expéditions de téléviseurs	$ 115 millions
Total des expéditions de radio-phono combinés, radios (radios pour automobiles compris)	$ 73 millions
Total des expéditions de tourne-disques portatifs	$ 5 millions
Total des expéditions d'équipement électronique divers (ordinateurs compris)	$ 612 millions
Total des expéditions de composantes électroniques	$ 81 millions
Total des importations de produits électroniques	$ 438 millions
Valeur totale des exportations de produits électroniques canadiens	$ 242 millions
Nombre d'employés dans l'industrie	54,000
Total des appointements et salaires payés	$ 300 millions

*Evaluations de l'industrie

FACTORY SHIPMENTS OF ELECTRONIC PRODUCTS

In 1968, Canada's electronics industry will produce approximately $890 million in electronic and related equipment and components, ranging from everyday products such as television sets to such esoteric products as complicated guidance equipment for satellites and rockets.

Since 1960, output from Canada's more than 100 electronic manufacturing plants has more than doubled — from $370 million in 1960 to almost $890 million in 1968.

Recognized as a high growth industry, the annual rate of increase in value of shipments has been well above that for all manufacturing and for the Gross National Product.

This buoyant growth rate is due to constant and growing demand from consumers, from industry and commerce, demanding new capital machinery and equipment, and from the export market. Heaviest demands have been made on communications, industrial and commercial equipment, with consumer products and components in second and third place respectively. This continuing demand means that value of manufacturers shipments during the next 10 years should triple to an annual level of almost $3,000 million.

EXPEDITIONS DE PRODUITS ELECTRONIQUES DE L'USINE

En 1968, l'industrie électronique du Canada aura produit pour une valeur approximative de 890 millions de dollars d'équipement électronique ou connexe et de composantes, en allant des produits ordinaires tels que les téléviseurs à des produits ésotériques et compliqués tels que l'équipement de téléguidage des satellites et des fusées.

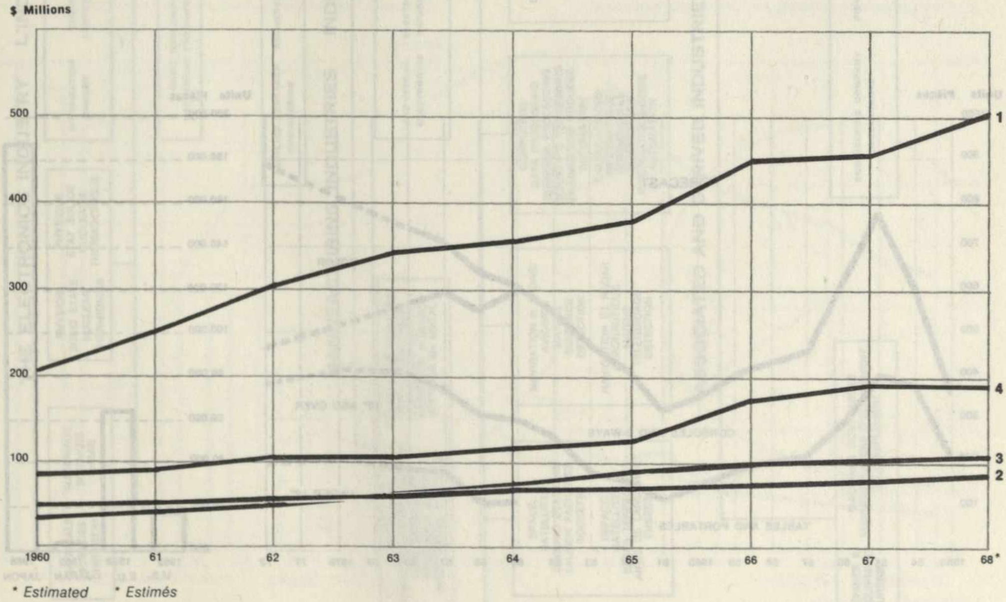
Depuis 1960, le rendement des 100 et quelques usines de fabrication éclronique a plus que doublé — de 370 millions de dollars en 1960 à presque 890 millions de dollars cette année.

Reconnue en tant qu'industrie croissant rapidement, le taux annuel de croissance de la valeur des expéditions a bien dépassé celui de toute la fabrication et celui de la production nationale brute.

Ce taux de croissance soutenu est dû à la demande constante et grandissante du marché de l'exportation et des consommateurs de l'industrie et du commerce qui réclament de la nouvelle machinerie et de l'équipement, perfectionné. Les demandes les plus grandes ont été faites dans le domaine de l'équipement industriel et commercial pour les communications, avec les produits au consommateur et les composantes occupant respectivement les deuxième et troisième place. Cette demande continue signifie que la valeur des envois manufacturés devrait tripler pendant les 10 prochaines années pour atteindre un niveau très proche des 3 milliards de dollars par an.

1. Broadcast, communications, industrial and commercial equipment
2. Replacement parts, components, tubes, contract maintenance
3. Computers and related equipment (estimated)
4. Consumer products

1. Equipement de radio et télédiffusion, equipement industriel et commercial
2. Pièces de rechange, pièces constituantes, lampes, contrats d'entretien
3. Calculatrices et matériel similiraire (estimé)
4. Produits aux consommateurs



* *Estimated* * *Estimés*

SALES OF TELEVISION SETS, 1953-72

Within the next four years, the number of television sets s annually in Canada should reach approximately 900,000, the highest level since 1955. Almost half this total will be for color sets which should reach a total of more than 400,000 units annually giving Canada a color set in three out of every 10 homes by 1972.

These projections carry great portent because television production is an important segment of overall electronic industries production and supports substantial manufacture of electronic components in Canada.

In an effort to maintain a viable domestic television production facility, manufacturers have pursued vigorously cost control programs to overcome problems of import penetration. Despite this effort, the flood of imports has grown alarmingly in recent years, with the import share of Canadian sales rising from approximately 8% in 1962 to more than 30% in 1968.

Canadian electronic manufacturers are concerned about this dismaying trend because it could bring about a repetition of the fate which befell the manufacture of small radios — today supplied almost entirely from foreign sources.

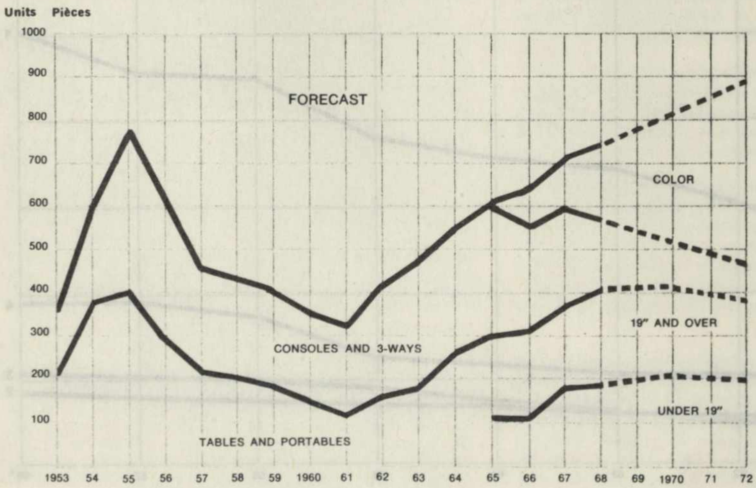
VENTES DE TELEVISEURS, 1953-1972

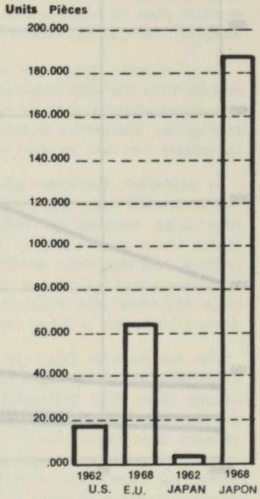
Pendant les quatre prochaines années, le nombre de téléviseurs vendu annellement au Canada devrait presque atteindre 900,000 unités, l'échelon le plus élevé depuis 1955. Presque la moitié de ce total représente la vente de télécouleurs, le chiffre prévu étant de 400,000 récepteurs par an, ce qui signifie qu'en 1972, trois foyers sur dix posséderont un téléviseur-couleurs.

Ces estimations ont une grande signification car la production du matériel pour la télévision est un segment important de toute la production de l'industrie électronique et supporte une partie substantielle de la fabrication de composantes électroniques au Canada.

Dans le but de maintenir et de conserver la production de télévision domestique, les manufacturiers ont recherché des moyens pour contrôler le coût de la production et ainsi surmonter les problèmes que cause la vente de produits importés. Malgré cet effort, le déluge d'appareils importés a grandi d'une façon alarmante pendant les quelques années passées; le pourcentage des ventes d'appareils importés au Canada s'est élevé d'environ 8% en 1962 à plus de 30% en 1968.

Cette tendance inquiète les manufacturiers d'électronique Canadiens car elle pourrait bien causer la répétition de l'histoire de la fabrication des petits radios — aujourd'hui ces derniers viennent presque tous de sources étrangères.





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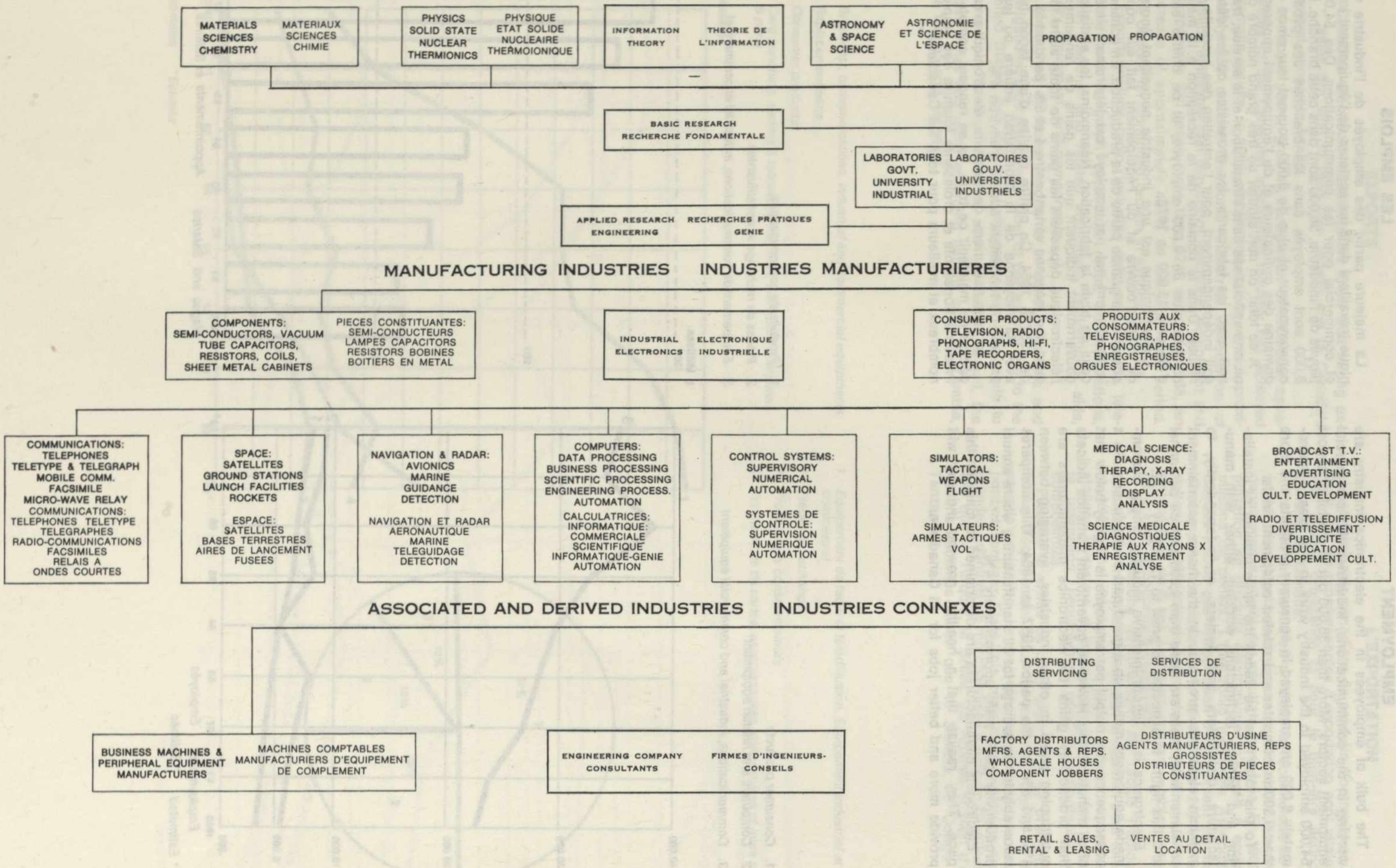
THE ELECTRONICS INDUSTRY L'INDUSTRIE DE L'ELECTRONIQUE



EMPLOYMENT

The bulk of employees in the electronics industry are working in the communications, industrial and commercial equipment sectors. More than 36,000 out of a total of almost 54,000 employed in the industry work in this area. Approximately 8,000 are employed in consumer products and more than 9,500 in computer and related equipment fields.

To this total must be added the large number of installation and service technicians working, either with manufacturers, distributors and dealers, or independently, to maintain electronic products. In the home entertainment consumer field, there are more than 9,000 service personnel and this figure is expected to grow to 13,000 by 1972.

Electronics is a labour-intensive industry where custom-made equipment makes up a good part of production. As a consequence, net output per employee is slightly below that of all manufacturing. However, government statistics indicate that productivity gains by electronics manufacturers are outstripping gains in other industries, averaging between 4% and 5% in the period 1957 to 1964. This compares favourably to the average for all manufacturing where annual productivity gains were approximately 4%.

Electronics manufacturers are determined to maintain this pace. They realize that a healthy, growing industry will provide more and better jobs for all Canadians.

LES EMPLOIS

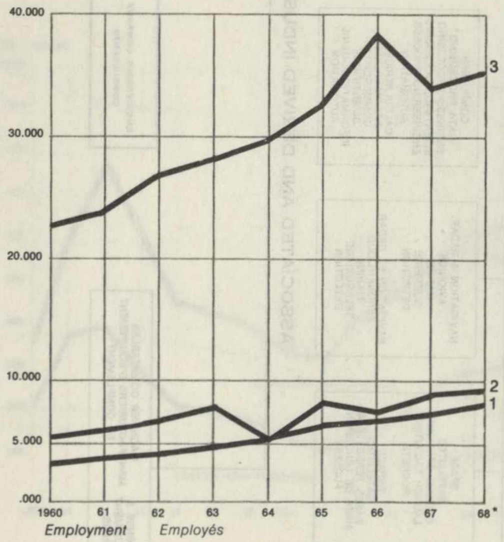
La majeure partie des employés de l'industrie électronique travaillent dans les secteurs de l'équipement industriel et commercial pour les communications. Des 54,000 employés de l'industrie, 36,000 sont dans cette branche. Environ 8,000 sont employés dans les branches des produits au consommateur et plus de 9,000 trouvent leur place dans le domaine des ordinateurs et de l'équipement apparenté.

A ce total, on doit ajouter un très grand nombre de techniciens spécialisés dans l'installation et le service, travaillant soit avec les fabricants, les grossistes ou les détaillants, soit indépendamment, pour l'entretien des produits électroniques. Dans le domaine de la récréation à la maison, on compte plus de 9,000 employés, et ce chiffre est prévu s'élever à 13,000 en 1972.

L'électronique est une industrie nécesitant énormément de main-d'oeuvre et où l'équipement fait sur commande occupe une grande partie de la production. En conséquence, le rendement net par employé est légèrement inférieur à celui de toute la fabrication. Néanmoins, les statistiques du gouvernment indiquent que les gains de rendement dans l'électronique dépassent les gains de toute autre industrie, avec une moyenne variant entre 4 et 5% pendant la période de 1957 à 1964. Ce chiffre rivalise d'une façon favorable avec la moyenne de la fabrication entière où les gains annuels de rendement étaient d'environ 4%.

Les manufacturiers de produits électroniques ont bien décidé de maintenir ce train. Ils se rendent compte qu'une industrie florissante et croissante fournira des emplois plus nombreux et meilleurs pour tous les Canadiens.

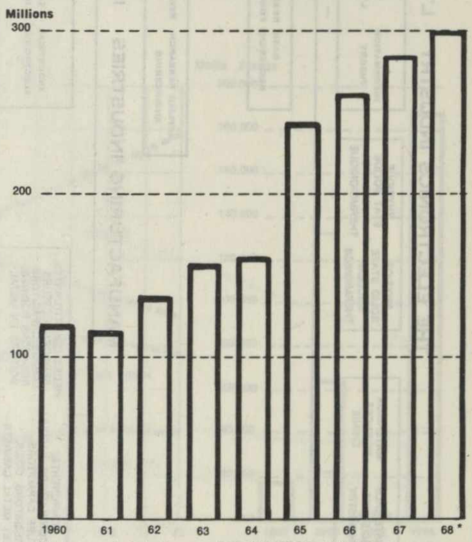
1. *Consumer products*
2. *Computers and related equipment*
3. *Communications, industrial and commercial equipment*



Employment *Employés*

* *Estimated* * *Estimés*

1. *Produits de consommateurs*
2. *Pièces de rechange et constituantes*
3. *Equipement de communications, industriel et commercial*



Wages and Salaries *Appointements et Salaires*

EXPORTS

Canadian electronic manufacturers know that strong exp sales are vital to their own growth and to Canada's general economic health.

In recent years, growing recognition of technical capabilities of the Canadian electronics industry has achieved dramatic results. In 1960, electronics exports were approximately $50 million. Electronic Industries Association of Canada estimates that exports of electronic equipment and components will reach more than $240 million in 1968, an increase of approximately 400% in the eight-year period. The outlook for continued growth in exports is bright.

Exports include radio (including auto) and TV sets, telephone and telegraph apparatus, radar, communications, earth stations and related equipment, navigational aids, x-ray equipment, and components.

About half of these exports is in communications and navigational aids equipment. Most of our exports are to the United States, but significant shipments are also made to more than 70 other countries such as Turkey, Brazil, the West Indies and many emerging nations such as Zambia, the Congo and Tanzania.

L'EXPORTATION

Les fabricants canadiens de produits électroniques savent bien que les grosses ventes d'exportation sont vitales pour leur propre croissance et pour le bien-être économique général du Canada.

Pendant les dernières années, la reconnaissance croissante des talents techniques de l'industrie électronique canadienne a atteint des résultats inespérés. En 1960, l'exportation de produits électroniques s'élevait à environ 50 millions de dollars. L'Electronic Industries Association of Canada estime que l'exportation d'équipement électronique de composantes atteindra le niveau des 240 millions de dollars en 1968, soit une augmentation d'environ 400% durant une période de 8 ans. Les perspectives semblent promettre de grands débouchés à l'exportation.

Les exportations comprennent les radios (radios pour automobiles inclus) et téléviseurs, le matériel pour téléphone et télégraphe, l'équipement pour radar, communications, stations terrestres et équipement connexe, les aides pour la navigation, l'équipement pour la radiographie et les composantes.

Presque la moitié de cette exportation se présente sous forme d'équipement pour les communications et d'aides pour la navigation. La majorité des produits que nous exportons vont aux Etats-Unis, mais nous expédions aussi de grandes quantités de marchandises à plus de 70 autres pays tels que la Turquie, le Brésil, les Antilles et bien d'autres nations récentes telles que le Zambia, le Congo et le Tanzania.

1. Broadcast, communications, industrial and commercial equipments

2. Replacement parts

3. Consumer products

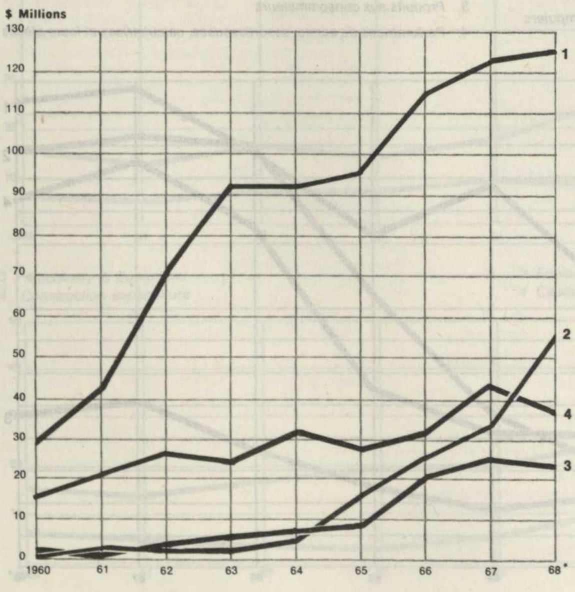
4. Card punching, sorting & tabulating machine, electronic computers & parts

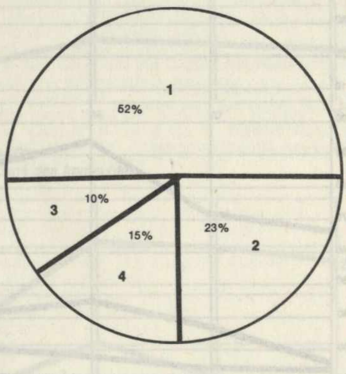
1. Equipement de radio et télédiffusion. Equipement industriel et commercial

2. Pièces de rechange

3. Produits aux consommateurs

4. Perforatrices de cartes, assortisseuses, calculatrices et leurs pièces





**Estimates *Estimés*

IMPORTS

Importation of electronic components and finished products accounts for more than 40% of Canada's overall electronics consumption. In 1968, approximately $440 million worth of communications, industrial and commercial equipment, components, consumer products, computers and data processing equipment, was shipped to Canada.

These imports came from such countries as Japan, the United States, Great Britain, the Netherlands and West Germany. Imports included home TV and radio sets, sonar equipment, radio transmitting and receiving units, navigational equipment, and components.

In the area of consumer products, the biggest import category is television receivers. Upwards of $27 million worth of television receivers will be brought into Canada this year. Almost $10 million worth of transistor radios will be imported and approximately $11 million worth of portable phonographs and other radios.

Imports of components in 1968 will total more than $130 million. All other electronic equipment imports, in 1968, will approximate $260 million.

L'IMPORTATION

L'importance de composantes électroniques et de produits finis représente plus de 40% des besoins totaux en ęctronique du Canada. En 1968, le Canada aura reçu pour une valeur d'environ 440 millions de dollars d'équipement pour les communications industrielles et commerciales, de composantes, de produits au consommateur, d'ordinateurs et d'équipement pour la programmation.

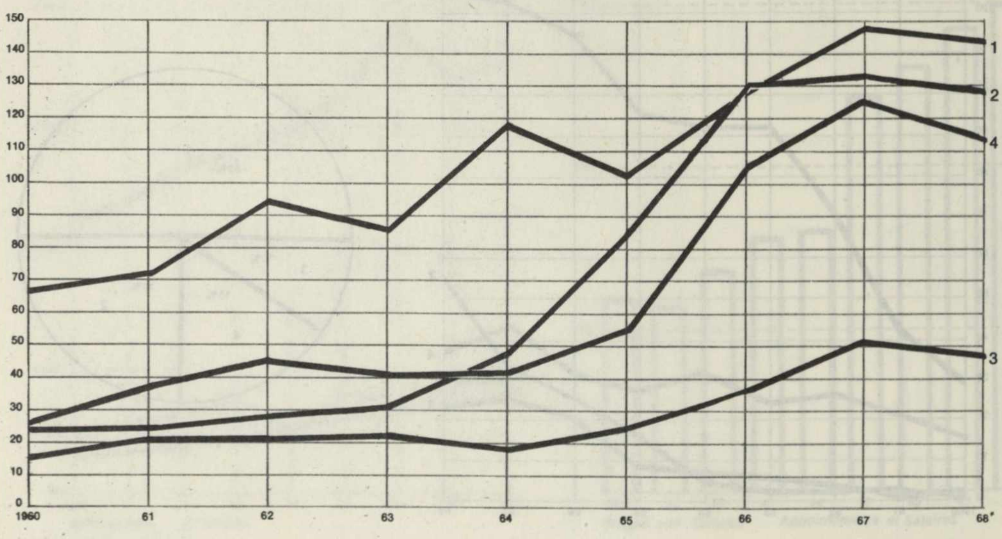
Ces produits importés viennent de pays tels que le Japon, les Etats-Unis, la Grande-Bretagne, les Pays-Bas et l'Allemagne de l'ouest. Les articles importés comprennent entre autres des téléviseurs et radios pour la maison, de l'équipement pour sonar, des unités de transmission et de réception pour la radio, de l'équipement pour la navigation et des composantes.

Dans le domaine des produits au consommateur, la majeure partie de l'importation est celle des téléviseurs. Cette année, le Canada recevra pour plus de 27 millions de dollars de téléviseurs. Nous importons aussi pour presque 10 millions de dollars de radios à transistors et pour environ 11 millions de dollars de phonographs portatifs et autres radios.

L'importation de composantes en 1968 s'élèvera à plus de 130 millions de dollars. Cette même année, toutes les autres importations électroniques rassemblées atteindront un total d'environ 260 millions de dollars.

1. *Broadcast, communications, industrial and commercial equipments*
2. *Replacement parts*
3. *Consumer products*
4. *Card punching, sorting & tabulating machine, electronic computers & parts*

1. *Equipement de radio et télédiffusion. Equipement industriel et commercial*
2. *Pièces de rechange*
3. *Produits aux consommateurs*
4. *Perforatrices de cartes, assortisseuses, calculatrices et leurs pièces*



* *Estimated* * *Estimés*

CAPITAL INVESTMENT

Since 1960, total capital spending by consumer electronic product manufacturers, as well as communications equipment manufacturers, has risen from $20.5 million in 1960 to a peak of $61.8 million in 1966, dropping *slightly* to $43.9 million in 1968. The total for the period was $290 million.

These figures include spending on construction for both new facilities and repairs to existing structures. They also include spending for new machinery and equipment, as well as for repairs to existing machinery and equipment.

Total capital spending by these industries on *new* construction and for *new* machinery and equipment (exclusive of repairs) rose from $14.4 million in 1960 to a peak of $48.5 million in 1966 and declined somewhat to $32.3 million (estimated) in 1968.

Total capital spending for construction, machinery and equipment *repairs only* rose from $6.1 million in 1960 to a peak of $13.3 million in 1966 and dropped to $11.6 million (estimated) in 1968.

CAPITAL D'INVESTISSEMENT

Depuis 1960, le capital total des dépenses des fabricants de produits électroniques pour le consommateur, ainsi que des fabricants d'équipement pour les communications, s'est élevé de 20.5 millions de dollars en 1960 à un haut de 61.8 millions de dollars en 1966, redescendant à 43.9 millions de dollars en 1968. Pour la période entière, le total a été de 290 millions de dollars.

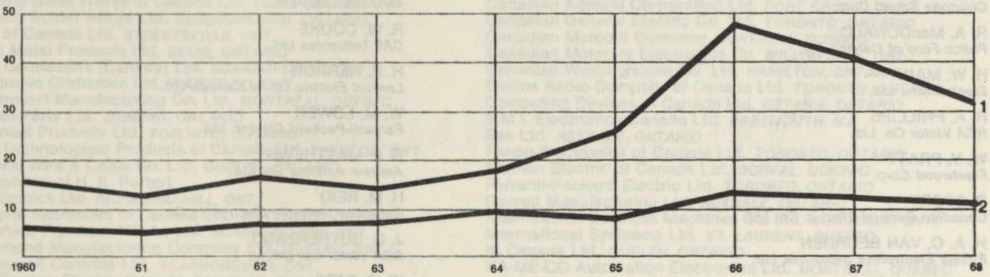
Ces chiffres comprennent l'argent dépensé pour l'expansion des usines et pour les réparations des bâtiments déjà en existence. Ils renfermement aussi l'argent dépensé pour l'acquisition de nouvelle machinerie et nouvel équipement, ainsi qu pour les réparations de la machinerie et de l'équipement déjà en usage.

Le capital total des dépenses par ces industries pour *l'expansion* des bâtiments, la machinerie *nouvelle* et l'équipement *perfectionné* (sans compter les réparations) s'élevait à 14.4 millions de dollars en 1960, atteint un haut de 48.5 millions de dollars en 1966; il redescendra néanmoins à 32.3 millions de dollars en 1968. (Ce chiffre ne représente qu'une estimation).

Le capital total des dépenses pour les *réparations seulement* faites aux bâtiments, à la machinerie et à l'équipement qui s'élevait à 6.1 millions de dollars en 1960 atteint un haut de 13.3 millions de dollars en 1966, mais on estime que ce chiffre redescendra à 11.6 millions de dollars en 1968.

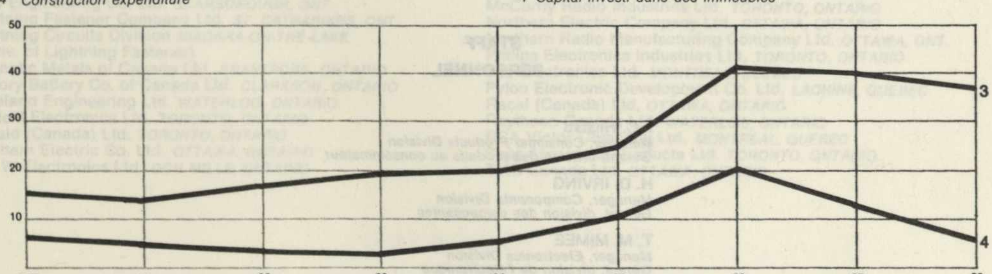
1 New capital expenditure
2 Repair

1 Nouveau capital investi
2 Reparation



3 Machinery & Equipment
4 Construction expenditure

3 Equipment et outillage
4 Capital investi dans des immeubles



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1968-69

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1968-1969

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Directeur et président du conseil

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Premier vice-président — président de la division des composantes

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Vice-président — président de la division de l'électronique

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Vice-président — président de la division des produits au consommateur

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COWAN HARRIS
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Gérant général et secrétaire

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Philco-Ford of Canada Ltd.

H. W. MAIN
Electrohome Ltd.

R. A. PHILLIPS
RCA Victor Co. Ltd.

W. Y. PRATT
Fleetwood Corp.

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Philips Electronics Industries Ltd.

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Renfrew Electric Co. Ltd.

H. S. MARMOREK
Sprague Electric of Canada Ltd.

J. McKERROW
General Instrument of Canada Ltd.

D. A. SHEPERD
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Canadian Westinghouse Co. Ltd.

E. WALTON
Cramco Solder Alloys Ltd.

H. T. WATT
Space Circuits Ltd.

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D. V. CARROLL
TMC (Canada) Ltd.

R. W. COOKE
CAE Industries Ltd.

H. R. HERRON
Lenkurt Electric Co. of Canada Ltd.

W. M. LOWER
Ferranti-Packard Electric Ltd.

R. P. MATTHEWS
Andrew Antenna Co. Ltd.

H. M. REID
Canadian Motorola Electronics Co.

J. G. SUTHERLAND
RCA Victor Co. Ltd.

W. C. TATE
Garrett Manufacturing Ltd.

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Gérant, division des produits au consommateur

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Gérant, division des composantes

T. M. MIMEE
Manager, Electronics Division
Gérant, division de l'électronique

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Electrohome Ltd. *KITCHENER, ONTARIO*
Fleetwood Corporation *MONTREAL, QUEBEC*
Philco-Ford of Canada Ltd. *DON MILLS, ONTARIO*
Philips Electronics Industries Ltd. *TORONTO, ONTARIO*
RCA Victor Company, Ltd. *MONTREAL, QUEBEC*

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DIVISION DES COMPOSANTES

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Emanuel Products Ltd. *TORONTO, ONTARIO*
Erie Technological Products of Canada Ltd. *TRENTON, ONT.*
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(Division of H. K. Porter)
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Hammond Manufacturing Company Ltd. *GUELPH, ONT.*
Honeywell Controls Ltd. *SCARBOROUGH, ONT.*
ITT Cannon Electric Canada *TORONTO, ONTARIO*
Johnson Matthey & Mallory Ltd. *TORONTO, ONTARIO*
Kester Solder Company of Canada Ltd. *BRANTFORD, ONT.*
Lake Engineering Co. Ltd. *SCARBOROUGH, ONT.*
Lightning Fastener Company Ltd. *ST. CATHARINES, ONT.*
Lightning Circuits Division *NIAGARA-ON-THE-LAKE*
(Div. of Lightning Fastener)
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Mallory Battery Co. of Canada Ltd. *CLARKSON, ONTARIO*
Marsland Engineering Ltd. *WATERLOO, ONTARIO*
McNeill Electronics Ltd. *TORONTO, ONTARIO*
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O & W Electronics Ltd. *DON MILLS, ONTARIO*
Owens-Illinois of Canada Ltd. *REXDALE, ONTARIO*
Philips Electronics Industries Ltd. *TORONTO, ONTARIO*
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Quality Hermetics Ltd. *TORONTO, ONTARIO*
Radio Components Ltd. *TORONTO, ONTARIO*
Radio Speakers of Canada Ltd. *TORONTO, ONTARIO*
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Renfrew Electric Company Ltd. *TORONTO, ONTARIO*
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Space Circuits Ltd. *WATERLOO, ONTARIO*
Sprague Electric of Canada Ltd. *TORONTO, ONTARIO*
Standard Coil Products (Canada) Ltd. *MIMICO, ONTARIO*
Superior Electronics Inc. *MONTREAL, QUEBEC*
Sylvania Electric (Canada) Ltd. *MONTREAL, QUEBEC*
Texas Instruments Inc. *RICHMOND HILL, ONT.*
Trim-Line Connectors Ltd. *WESTON, ONTARIO*
TRW Electronic Components Ltd. *TORONTO, ONTARIO*
United-Carr Canada Ltd. *STONEY CREEK, ONT.*
Varian Associates of Canada Ltd. *GEORGETOWN, ONT.*
Ward Leonard of Canada Ltd. *SCARBOROUGH, ONT.*
Welwyn Canada Ltd. *LONDON, ONTARIO*

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DIVISION DE L'ELECTRONIQUE

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Aviation Electric Ltd. *ST. LAURENT, QUEBEC*
Benco Television Associates Ltd. *REXDALE, ONTARIO*
CAE Industries Ltd. *MONTREAL, QUEBEC*
Canadian Admiral Corporation Ltd. *PORT CREDIT, ONT.*
Canadian General Electric Co. Ltd. *TORONTO, ONTARIO*
Canadian Marconi Company *MONTREAL, QUEBEC*
Canadian Motorola Electronics Co. *WILLOWDALE, ONT.*
Canadian Westinghouse Co. Ltd. *HAMILTON, ONTARIO*
Collins Radio Company of Canada Ltd. *TORONTO, ONTARIO*
Computing Devices of Canada Ltd. *OTTAWA, ONTARIO*
E.M.I. Electronics Canada Ltd. *DARTMOUTH, N.S.*
Ese Ltd. *REXDALE, ONTARIO*
Fanon Electronics of Canada Ltd. *TORONTO, ONTARIO*
Farinon Electric of Canada Ltd. *DORVAL, QUEBEC*
Ferranti-Packard Electric Ltd. *TORONTO, ONTARIO*
Garrett Manufacturing Ltd. *REXDALE, ONTARIO*
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International Systcoms Ltd. *ST. LAURENT, QUEBEC*
Itt Canada Ltd. *GUELPH, ONTARIO*
KA-ME-CO Automation Electronics Ltd. *MONTREAL, QUEBEC*
Leigh Instruments Ltd. *CARLETON PLACE, ONT.*
Lenkurt Electric Co. of Canada Ltd. *BURNABY, B.C.*
Litton Systems (Canada) Ltd. *REXDALE, ONTARIO*
McCurdy Radio Industries Ltd. *TORONTO, ONTARIO*
Northern Electric Company Ltd. *OTTAWA, ONTARIO*
Northern Radio Manufacturing Company Ltd. *OTTAWA, ONT.*
Philips Electronics Industries Ltd. *TORONTO, ONTARIO*
Pye Electronics Ltd. *MONTREAL, QUEBEC*
Pylon Electronic Development Co. Ltd. *LACHINE, QUEBEC*
Racal (Canada) Ltd. *OTTAWA, ONTARIO*
Raytheon Canada Ltd. *WATERLOO, ONTARIO*
RCA Victor Company, Ltd. *MONTREAL, QUEBEC*
Spar Aerospace Products Ltd. *TORONTO, ONTARIO*
TMC Canada Ltd. *OTTAWA, ONTARIO*

APPENDIX "B"

BRIEF TO THE GOVERNMENT OF
CANADA ON THE NEED FOR
INCREASING THE TECHNOLOGICAL
CAPABILITY OF CANADIAN
INDUSTRY

BRIEF

to the

GOVERNMENT OF CANADA

on the need for increasing

THE TECHNOLOGICAL CAPABILITY

of

CANADIAN INDUSTRY

december 1968

ELECTRONIC INDUSTRIES ASSOCIATION OF CANADA

electronic industries association of canada

The principal object of this brief is to suggest a reappraisal of the approaches to the urgent need to increase research and development activity in industry. It is our belief that a co-ordinated, planned effort in applying the fresh ideas put forward, will be more fruitful and satisfying to all Canadians and that a series of carefully organized meetings between senior government personnel and senior members of the Electronic Industries Association are essential to lay the groundwork for solutions to the questions raised. Such meetings, based on frank discussions on both sides, should lead to a complete and mutual understanding, in depth, of the problems and objectives of both government and industry. This could bring about a strengthening of the Canadian economy.

SUMMARY

- The need to increase the technological capability of Canadian industry is recognized by government and industry as major and urgent. With world demands for high technology goods growing rapidly, Canada's relative prosperity and growth depend on its ability to participate in this trade as well as to supply a significant portion of its own requirements. Canadians to a large extent, are dependent on the prosperity of our industrial economy for their livelihood and the enhancement of their standard of living. This being so, it is considered to be reasonable that the Canadian public should share both directly and indirectly in the risks attendant upon industrial development. The manner in which this is achieved, of course, is through direct Government financial participation in industrial research and development programs.

- Government assistance with tax incentives, grants and shared cost programs have been beneficial but programs of broader significance and greater impact are needed to effect a major change in the national distribution of research, design and development. Comments on these programs appear in the brief.

- The Electronic Industries Association believes that inasmuch as the problem has become national in scope, rather than industrial alone, it will be solved only by a truly joint effort on the part of government and industry.

- Able thinkers are increasingly expounding the view that innovation, technology and capital will gather where the climate or environment is conducive to the exploitation of new opportunities or challenges.

- The Electronic Industries Association considers it vital to co-operate with the government in a reappraisal of our approaches to this problem with a view to creating the desired new climate of opportunity. Outstanding Canadians in university, government and industry have in recent times suggested fresh approaches. We believe these should be examined in greater detail and many of them tried.

- We suggest the initiation of major programs of national significance and a drive towards carefully chosen "fields of excellence to offset our current fragmentation and scattered support efforts". Examples of such programs are mentioned in the brief.

- The importance of product development programs as a means of stimulating the economy deserves more widespread recognition by government and the process of following through on the inventions and discoveries turned up by Research and Development should be encouraged.

- The level of financial support by the Government for R & D in industry is inadequate and considerably less than those of other Western Nations.

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THE PROBLEM OF INCREASING THE TECHNOLOGICAL CAPABILITY OF CANADIAN INDUSTRY

INTRODUCTION

It has now been several years since the urgent need to increase research and development activity in Canadian industry was publicly recognized. This recognition has followed a realization at the political level that the standard of living and the economic health of a country depend on the productivity of its industries and their competitive position in world markets and that these in turn rest on the ability of industry to keep at least abreast of technology in most areas and ahead in others.

The general acceptance of these facts came slowly. The vast expansion of industrial technology in the last twenty years, mainly in the United States but in other countries also, together with a sharpening of competition, have driven the lesson home. Prior to this the emphasis in Canada had been on expanding the government's in-house capabilities in research and technology, the traditional route to be followed in a developing country for building up its expertise. This was pointed out by Dr. Omond Solandt in his appearance before the Special Committee of the Senate on Science Policy. He maintains that "as a country gets larger there is every reason to believe that this dominance by government ceases to be a good thing and there should be a wider distribution of activity into the Universities and particularly into industry." He went on to say, we are just at that transition point now and this change is happening. Later, he remarked that we must do more research and development in Canadian industry and this represents one of the most challenging and difficult problems.

This brief is concerned solely with increased research and development in Canadian industry and is addressed to the government since the resolution of the problem lies with the government and with industry itself.

While the comments submitted are derived from an Electronics Industry background, they apply equally well to all science based industry in Canada.

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The initial efforts on the part of the government to assist research in industry were implemented through D.R.B. and N.R.C. Separately the government introduced tax incentives and assistance programs administered by the Department of Industry and directed predominantly at product development for encouraging the initiation or expansion of industrial technology on a broad front based on a sharing with industry of the costs involved. The Federal Government itself is certainly in the best position to assess the individual and overall effects of these programs. From the point of view of industry, and making allowance for the inevitable diversity of opinions among individual companies, the schemes have been worthwhile but the objectives reached have been very limited in the light of the magnitude of the task confronting us. This brief discusses some of the possible improvements which might be made. If the Canadian Government would take these under consideration and would be prepared to sponsor modifications, where possible, there is no doubt that the programs could be made more attractive to industry and more effective in contributing to the solution of the overall problem.

The principal object of this brief, however, is not to raise questions about details but rather to suggest a reappraisal of the approaches to the urgent need to increase research and development activity in industry. We strongly believe that a co-ordinated, planned effort in applying some of the fresh ideas which have been put forward in recent times would be much more fruitful and more broadly satisfying to all Canadians than a continued reliance on financial assistance alone. However successful the various support schemes may have been in individual cases, it must be admitted that we still have a long way to go in bringing about a substantial change in the rate of increase in technology in Canada.

To survive at all the industry must have a continuing volume of production orders which can be executed to earn good profits. This ambition should be understood and should be encouraged by all levels of government since this is the basis of our economy, leading to an increase in job opportunities and tax revenues, both corporate and individual. This emphasis on profitable business is not, however, the only pre-occupation and most managements are equally aware that the creative process is a major factor in the preservation of profitable business and the growth of our economy. In working for their own survival and expansion they also share with governments the desire to do something worthwhile for Canada. It is axiomatic that leadership

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in government or industry requires men of vision, capability and integrity who operate their organizations on sound business principles and the Electronic Industry is no exception. For the retention of self-respect and a maximum of independence, managements would prefer to see the industry grow by normal business procedures with minimum reliance on subsidies from the public purse. There is a strong preference to expand R and D capabilities from profit earnings were this possible; but the magnitude of the task, the low profit margins in most cases, the wide fluctuations in business volume and the time factor, all militate against this.

In what follows, certain steps are suggested which would lead us to break out from the present frustrating situation. Some attention is devoted to the environment or background against which we are coping with these problems.

* * *

BUILDING MUTUAL RESPECT, TRUST AND CONFIDENCE THROUGH MEETINGS

We believe a series of carefully organized meetings should be arranged between senior government personnel and members of the Electronic Industries Association. Such meetings are essential to lay the groundwork for greater co-operation between government and industry. Considerable strides have been effected in this area but more effort is required on both sides to form a closer partnership with mutual respect, trust and confidence. It seems most appropriate to change this situation in the interest of strengthening the Canadian economy. The purpose of these meetings would be to conduct briefings and frank discussions leading to a complete and mutual understanding in depth of the environment, problems and objectives in the various Government Departments and industry.

The necessity of building a stronger economy is a challenge to both industry and a number of Government Departments. (As examples, Communications, Energy, Mines and Resources, External Affairs, Finance, Fisheries, Forestry and Rural Development, Industry, Trade and Commerce, Indian Affairs and Northern Development, National Revenue, Transport and the Treasury Board would all seem to be involved to a greater or lesser extent). A truly joint and well co-ordinated effort will be required to solve the problem of increasing technological capability in Canada.

Some of the comments contained herein may elicit the response that the jurisdiction or responsibility for implementation does not fall within a single government department. If, however, the proposals are acceptable as germane

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to the problem, we believe a mechanism for co-ordinated action by industry and the various Departments concerned can be established.

* * *

PLACING OF FIRM DEVELOPMENT-PRODUCTION CONTRACTS WITH FINANCIAL SUPPORT

Since the domestic market for defence oriented companies is almost non-existent, we believe the government, when seeking new devices in the electronics field, should place firm development production contracts with industry with the direct purpose of increasing industrial technological capability. We emphasize this should be a package procurement of development plus production, similar to the type of contract used by the United States Armed Forces. Obviously, items with export sales potential should be favoured, keeping in mind that the defence export market involves risks beyond the capacity of some companies to accept with only partial government support.

This concept was expounded before the Special Committee of the Senate on Science Policy by Professor V. W. Bladen and has been suggested by others including Dr. Omond Solandt. Regarding the total level of financial support for R and D in industry it can be argued that from industry's point of view it is inadequate to bring about major change or that from the government's position, it is all that can be afforded at this time. This industry believes that its allocation of R and D funds is inadequate. The Fifth Annual Review of the Economic Council of Canada quotes for a total of $351,000,000.00 in government research money, $242,000,000.00 was used in government R and D laboratories, $50,000,000.00 in industry and $57,000,000.00 for universities and the like. This is a distribution of 69% government, 16.5% universities and 14.5% industry. No other western nation has less than 50% of its expenditures for R and D allocated to industry. This remains one of the basic problems we face today. It is noted that the total Canadian R and D effort is 1.3% of the Gross National Product as compared to 3.4% of the Gross National Product for the U.S.A. and 2.3% in Great Britain.

* * *

NEED FOR NATIONAL GOALS

There is an urgent need to determine specific areas of technology where "fields of excellence" should be developed. In this connection both industry and the Government are handicapped by the almost complete absence of stated national goals on which government policy could be formulated.

We are aware that the Science Council has been considering the question of a science policy in support of the economic and social goals of the nation, which have yet to be defined.

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In the last few years the fragmentation of the Electronics Industry due to lack of defined goals and limited supporting funds, has led to a very thin distribution of the funds over a large area comprising many fields of technology. National goals would permit us to refrain from being mere imitators of the United States and would lead to strengthening of specific areas of technical interest to Canada. Certain Departments should play a strong part, in consultation with industry, in determining such areas of technology where excellence should be developed. With this type of leadership, based on national objectives, industry could better shape its own destiny with the hope of a more stable and promising future.

* * *

NATIONAL PROGRAMS

The Electronic Industries Association believes there are many policies and programs which could be examined jointly by government, industry and the universities for possible implementation in Canada. It is believed that a careful selection of such programs could invoke further dynamic response from industry. Large and imaginative programs may well provide the needed challenge to our youth and could bring advantages to all citizens. Such programs will involve the spending of public funds in industry as contractual expenditures from which predictable advantages will accrue to the nation. We firmly believe this is the best way to stimulate the growth of industrial technology. Much of the progress in technology and the industrial strength of the United States derives from their undertaking of major national programs and not, we maintain, because the United States government has, in some general way, supported R and D. Two of these programs, Defence and Space, have created a huge market for new technology and new products. The key action here was the decision by the U.S. government to invest a significant part of the national resources in these programs. This created the demand and stimulated technological growth. The results in terms of general improvement in the U.S. economy have been staggering, in spite of the fact that neither the Defence nor the Space program has any real lasting social value in itself. It is also interesting to note that this type of program is now being followed by other foreign countries, notably, France, Japan, Germany and Great Britain.

Without being either specific or restrictive, the following proposals are advanced merely as samples of the type of programs which might be studied for implementation. Such studies could well be undertaken by Canadian industry or industrial associations.

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EXTERNAL AID PROGRAMS

We recommend a step-up of the External Aid programs in order to meet the urgent needs of underdeveloped or developing nations. In the past Canadian companies have undertaken technical projects and installation contracts in these nations but participation by a greater number of Canadian companies would become possible if the programs are expanded to include electronic products. It will be appreciated also that once Canadian equipment has demonstrated its acceptability in these developing countries, a continuing market for our products can be expected.

SPACE PROGRAM

In addition to the communication type satellites discussed in the July, 1967, brief "Communication Satellite Systems" submitted to the Science Secretariat by the Electronic Industries Association in concert with the Air Industries Association of Canada and the Canadian Aeronautics and Space Institute and which is now under consideration, it is recommended that consideration be given to enlarging Canadian participation in the design, development and manufacture of other types such as earth resource, navigation, meteorological and scientific satellites. It is strongly recommended that the proposed Canadian Space Agency be established at the earliest possible date consistent with the brief "Canadian Space Agency" submitted to the Science Secretariat in July, 1967 by the Electronic Industries Association in concert with the Air Industries Association of Canada and the Canadian Aeronautics and Space Institute. Copies of these briefs are attached as Appendices A and B.

AVIONIC SYSTEMS

Canadian industry has already demonstrated capability in the field of avionic systems. However, because this is a rapidly expanding field we believe the development of an even stronger base in this important area deserves immediate attention.

OCEANOLOGY

The implementation of a broad program of oceanology would be attractive not only to the electronics industry, but also to others; e.g. shipbuilding, chemical and agriculture. The subject is receiving ever more attention in the U.S. and elsewhere, in contrast to the space programs. The potential returns are considered, at least in the long term, of great importance. Canada has already done significant work in oceanography and a national program in oceanography at a reasonable level of effort would permit this country to at least keep abreast of technology.

COMPUTER TECHNOLOGY

Canada can contribute to the two broad areas of computer technology, hardware and software, but probably not on all points. It is suggested that a rewarding role in the hardware area could be established by encouraging development

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activity in programmed controllers and computer peripheral equipment, with research activity mainly confined to the man/machine interface. In order to control at least some part of her technological destiny, Canada should build a high order of competence in system design and system software, perhaps most specifically directed to the application of computers in our primary and manufacturing industries.

AUTOMATION

We believe a broad study of industrial automation in the primary and secondary industries should be initiated by the government with a view to increasing industrial efficiency and productivity. This is in line with present government policy concerning the need for increasing productivity as a means of stimulating economic growth.

COMPONENTS

There is a good record of government-industry co-operation in the field of electronic components Research and Development. Because of the trend toward more highly sophisticated components in relatively small volumes, we believe it is desirable to consider a much increased degree of co-operation between government and industry in this area. More importantly, however, it is a task for both government and industry to ensure that the very latest component developments are integrated into industrial products, particularly for the consumer market. This point cannot be over emphasized.

TRANSPORTATION

In a country such as Canada forward looking studies in areas such as transportation are essential to the development of the country. Planning such as that being undertaken in the mid-Canada Corridor Study should be encouraged by the Government. Such studies could well affect the future of many different industries.

EDUCATION

Although education is the responsibility of provincial governments the formulation of national programs using recently identified systems could be undertaken by the federal government.

AIR AND WATER POLLUTION

This is a major Canada-wide problem. The industry can assist here in developing instrumentation and specialized hardware for research and control functions. Solutions arising from Research and Development on this subject could be a major contribution to the world-at-large.

* * *

LOAN OF SCIENTISTS

We believe it is most important for the industry and for the economy that arrangements be made for distinguished scientists and engineers in the Public Service to be loaned

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for periods of the order of one year to certain segments of the industry. This would be most desirable in the case of smaller companies, unable to establish research programs without assistance. Such personnel could make a significant contribution. Additionally the beneficial effect on the scientists and engineers of such exposure to the problems and practices of the industrial world would be equally important in cross-fertilizing the activity in government laboratories.

* * *

ELEMENTS OF NATIONAL PROGRAM

The essential elements in the formulation of national programs appear to be:

(i) Government leadership in the selection of sound National programs but based on closer consultation with the industry on which the National economic growth depends.

(ii) Maximum involvement of Canadian industry.

(iii) Full and substantial government funding compatible with the levels applied in the industrial countries with which we compete and a commitment to "stay with it".

(iv) Minimum government or crown corporation involvement in the execution of projects.

The beneficial results which would flow from such programs include a reduction or reversal of the "brain drain"; a better environment for entrepreneurial thinking in the industry; the continuation of the Canadian electronics industry as an innovative, system-oriented industry, supported by an effective structure of dynamic and flexible component manufacturers; a stronger competitive position for those industries serving the consumer market; an improved trade balance and the provision of many new jobs which, for the rapidly growing labour force, is a matter of great urgency.

* * *

IMPORTANCE OF DEVELOPMENT

Although the emphasis in government laboratories is on research and thus also in most of the government assistance programs, the importance of the design and development end of the technological spectrum should not be overlooked. Product design, development and manufacture bring the most immediate benefits to our people and to the economy. The best way of increasing export sales of manufactured products is to design and develop unique and competitive products here in Canada. The types of programs suggested in this brief should enhance this activity. This will call for money and courage, but if the programs are well chosen, the returns should justify the risks.

* * *

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NEED FOR MANAGEMENT BY GOVERNMENT

The impression in industry is that the government and its officers are behaving as if the role of government is that of an intermediary between the taxpayer and industry, utilizing with due discretion a portion of taxes to enable industry to solve some of its problems and to achieve growth and expansion. The real situation, however, as pointed out in this brief, is that the problem is not exclusively an industrial one but has become, over the years, of national concern, not the least reason being the urgent need to expand the job opportunities for the rapidly growing labour force. With responsibility for overall management of the country the government has every reason to provide both leadership and active participation in its solution yet at the same time preserving the free enterprise system with its democratic processes.

It is the view of the Electronic Industries Association that entrepreneurial and innovative ability as well as capital and technology, will always flow to where opportunity beckons. We feel that a large part of the solution is the efficient management of the Canadian economy and in order to assist Canadian industry to become competitive with the U.S.A. in our own fields of technology we must work with the government to create the environment in which we in industry can accomplish this. The present approach of exhortations and grants to encourage research and development and expansion, is not achieving its purpose nor, is it likely to. The answer to this problem is to create the environment for industry in Canada to be sufficiently profitable so that entrepreneurs, capital and innovators, and through them new technology, will flow to industry.

* * *

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COMMENTS ON THE PRESENT GOVERNMENT ASSISTANCE PROGRAMS FOR INDUSTRIAL R AND D

CRITICAL MASS

The Department of Industry, Trade and Commerce support programs have been beneficial in promoting R and D in industry, which in turn has led to production and sales. The programs call for substantial cost-sharing with the government by the companies involved. In the electronics industry the generally low level of profits makes it impossible for many companies to afford the amount of cost-sharing that is needed to support a large enough program to substantially raise the level of R and D activity. As professor Arthur Porter explained in his testimony before the Special Committee of the Senate on Science Policy, "science and technology by their very nature are regenerative processes, once you get them going. You build up hopefully from a good base — you cannot obtain this regenerative process, unless you have "critical mass". You must start from a size that is capable of taking off, and this is a very, very important point. I believe that unless one does this — unless one achieves critical mass — then, in certain areas that I shall discuss later, the nation's confidence in its scientists and technologists is bound to be undermined. We are overly fragmented in too many of these areas, and not many of them have achieved critical mass".

This statement by Professor Porter pin-points the problem which plagues many of our companies. We need major, fully funded programs rather than shared funding and tax rebates.

* * *

LONG TERM COMMITMENTS

In all cases of Government shared or funded programs, funds are committed only on an annual basis. This has many disadvantages to industry not the least being the possibility of a selected industry setting up teams of highly paid scientific and research personnel which will often take up to one year before an adequate team is ready to commence realtime work on a program. If funding is suspended or cancelled due to Governmental action, the team assembled must be disbanded. This is not conducive to good employment practice, and further, high salaried experts cannot be enticed to gamble their careers in an uncertain market. We recommend that when such programs are initiated they be funded for longer periods, up to three or five years dependent on the extent of the program.

* * *

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JOINTLY FUNDED PROGRAMS

The terms covering jointly funded or cost-sharing programs administered by the Government are, we feel, less than favourable to industry. These terms generally speaking connote a flavour of supplier/customer rather than that of a true partnership which is implied by the objectives of the programs concerned.

We feel that in the majority of cases the Government's role should be one of providing an accounting framework rather than assuming management of the development work. Clearly the electronics industry also has a role here in developing effective and good management.

Even with the present policy of cost-sharing the government decision to recover its share as soon as possible is discouraging and could be a reflection of lack of real confidence in the technological process. Professor V. W. Bladen in his appearance before the Special Committee of the Senate on Science Policy reflected our own views when he said "I am worried by some of the, possibly undue, concern to recover from industry the government investment in Research and Development. I am afraid that the terms of tax relief, and cost-sharing (subject to repayment) are not attractive enough. The contract to do a job for a price may be a more effective way of promoting the development of industrial research laboratories. The insistence in so many cases that funds be repaid might be re-thought in the light of the high rate of taxes on profits. If Research and Development pays off for the entrepreneur, the government gets its share through the corporation tax, the public gets its share through the provision of more and/or better and/or cheaper goods. Too much concern to recover the investment in Research and Development through repayment may deprive the government and the public of the benefit which might have flowed from the inhibited Research and Development".

The Association, however, recognizes the responsibility of the Government to manage the application and flow of public funds provided for industrial support.

* * *

COMMENTS ON INDIVIDUAL PROGRAMS

THE INDUSTRIAL RESEARCH AND DEVELOPMENT INCENTIVES ACT

The I.R.D.I.A. Program which replaced provisions under Section 72A of the Income Tax Act is not in our opinion entirely realistic and, we suspect, not fully effective in furthering R and D in Canada. It is based on ever increasing levels of R and D current expense. This excludes from benefit those companies which are already committed to large but relatively stable R and D programs — the companies who in all likelihood will contribute most by way of new jobs and overall production growth. Those benefitting are, generally speaking, the new and unproven organizations.

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The program involves delay in incentive payments due to the considerable amount of administrative effort and meticulous examination of the work for which expenditures are claimed, as compared to the former tax incentive scheme under Section 72A of the Income Tax Act.

THE INDUSTRIAL RESEARCH ASSISTANCE PROGRAM

The I.R.A.P. Program administered by the National Research Council pays the salaries of additions to scientific staff in industry. In general, this covers approximately 30% to 50% of the total cost of a program. The technical control is relatively permissive and less frenetic than that experienced with other government assistance schemes with the result that the programs benefit accordingly. Although the support is contingent on an increasing effort on the part of a company the program is beneficial for those companies which can afford to finance the balance of the cost. The programs can be related directly to a company's commercial business. It is recommended that the N.R.C. assistance program be continued.

DIRECTORATE OF INDUSTRIAL RESEARCH PROGRAM

The D.I.R. Program administered by the Defence Research Board has likewise proven to be useful in extending the technical capabilities of companies active in the defence business. Grants under this program are usually awarded on a roughly 50/50 split of the costs of a defence oriented research program and on the understanding that a company will increase its R and D effort as a result. These programs involve high risk on the company's part. In the first place there is either no market or a very small market offered by the Department of National Defence. In the second place, it is very difficult to exploit the end result of a program (which may or may not be a product) in the military export market.

Although the main criterion in the award of D.I.R. grants is the advance of industrial technology in areas of significant interest to defence, it should be recognized that advancing technology in areas of commercial interest is generally of vital interest to the military. It is suggested that the selection of programs to be supported by D.R.B. funds take into account both military and commercial interests.

One significant value to industry of this program, and some others, is that of proprietary ownership of the results of R and D. Recently, revisions to the Terms and Conditions of D.I.R. grants, while not altering the proprietary ownership wording, are such as to make less protectable any significant new information. We understand that these changes have been introduced to correct isolated abuses of the original Terms and Conditions. We recommend that

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D.R.B. reconsider this situation since there are alternative ways of controlling abuses than to penalize the majority who are prepared to abide by the letter and the spirit of their agreements.

P.A.I.T. PROGRAM

The Program for Advancement of Industrial Technology (P.A.I.T.) administered by the Department of Industry, Trade and Commerce, requiring pay back of the Government's 50% share, is not acceptable to some companies because the effective rate of interest charged on successful P.A.I.T. project paybacks is considerably more than through private borrowings involving profitable enterprise and does not contain the advantages of such borrowings. In essence in this program the government is acting as a lending institution without the obvious advantage accruing to industry in dealing with private outlets. Further, drawbacks to P.A.I.T. include the necessity of establishing accounting and auditing procedures not normally used by some companies, the postponing of IRDIA benefits and the advancing of tax payments. This program seems to penalize success and reward failure.

VOTE 5

The Vote 5 program which is similar to the P.A.I.T. program, except that it covers developments of prime interest to defence activities, is generally acceptable to members of the Association. The absence of interest on the funds to be repaid to the Government in the event of a successful project, distinct from P.A.I.T., is accepted favourably. Like P.A.I.T., this program appears to penalize success and reward failure in that repayment of the Government share is required on successful projects. Some improvements are desirable however in the terms under which these programs are administered, particularly as related to residual rights of industry and the government in the event of programs being interrupted or held in suspension for protracted periods.

* * *

APPENDICES

A. Air Industries Association of Canada and Electronic Industries Association of Canada and Canadian Aeronautics and Space Institute brief entitled "Communication Satellite Systems."

B. Air Industries Association of Canada and Electronic Industries Association of Canada and Canadian Aeronautics and Space Institute brief entitled "Canadian Space Agency."

Appendix A

COMMUNICATION SATELLITE SYSTEMS

The report of the Study Committee on "Upper Atmosphere and Space Research Programs in Canada" recognizes the need for communication satellites for Canadian domestic communications and recommends that "Government Policy on use of telecommunications satellites for domestic communications be developed, so as to ensure Canadian control and maximum use of Canadian capabilities for the development and manufacture of both space and ground components of the various systems". Several other briefs from within and from outside the Government Agencies urged an early development of a Canadian Communication Satellite System. There is wide recognition of the fact that if Canada is to retain control of its communications, positive action in reserving positions in space and frequency allocations at these positions is needed most urgently, and Industry welcomes the establishment of the Government Committee charged with the preparation of the final recommendations to the Cabinet in this matter. Our Associations and the Institute wish to take this opportunity to place before the Government Industry's viewpoint with respect to any Canadian Communication Satellite System.

The question of Public or Private ownership of the future system is beyond the scope of this brief. The following observations are pertinent to the implementation of a publicly owned system, without any implication of being for or against this choice.

1. Most of the space R & D work represents long-term investment without any immediate direct commercial returns. Communication satellite systems are the most notable exception. Furthermore, such systems provide a sustained demand for continuing improvements, replacement, expansion and operation, on a sound economic basis after the initial R & D outlays.

2. Such a demand can provide a solid backbone for the space activities of the Canadian Electronics and Air Industries and of the aerospace community. No other project is in sight that could fully substitute for Communication Satellite Systems in developing this technology and facilitating competitiveness in other areas.

3. As a result of the multi-million dollar expenditures of public funds and by the use of its own resources, Canadian industry acquired the capability for all aspects of communication satellite systems except launch, although much of the basic launch technology exists in Canadian industry. The Chapman Report (PP. 39-63, 81-84 and especially 89, 95 and 103-105) provides ample illustration of this capability.

4. In view of the above proven capability, we strongly urge that any Canadian Communication Satellite System projects be centered on Canadian industry. Any denial, in whole or in part, to the Canadian industries of the fullest possible opportunities for participation in such a program would most certainly negate the past achievements in building up the capability.

5. The length of the development time was a significant problem in some major Canadian development projects in the past. We feel certain that this problem can be overcome within a suitable planning and procurement framework for the new program. A strict scheduling of decisions and a recourse to firm "in principle" decisions at the early planning phase of the program would be needed.

6. The research and development part of the relevant program should be managed by a Government Agency with a considerable background of R & D experience in the area of space technology and space communications. It is expected that the responsible Government Agency will incorporate or be able to use, the available skills in such agencies as DRTE, CARDE or NRC for monitoring and technical control functions.

7. However, it is not expected that this Agency will acquire the responsibility and authority in the area which has been within the prerogatives of the Department of Transport, for example, determining the telecommunication policy, regulating the use of the radio frequency spectrum, carrying out international negotiations with respect to the use of aerospace, including, in particular, communication satellites.

Appendix B

CANADIAN SPACE AGENCY

The Report of the Study Committee on "Upper Atmosphere and Space Programs in Canada" recommends "the establishment of a central co-ordinating and contracting agency for space research and development." It is hoped that this recommendation will be endorsed by the Science Council and will be implemented by the Government as soon as possible. This means we recommend that the Government establish a Space Agency to be concerned with the co-ordination, administration, policy direction and contracting of all Government-funded research and development programs for upper atmosphere and space in Government, University and Industrial Laboratories. On behalf of the section of the Canadian industry most directly affected by the Government policy in this area, and of the Canadian aerospace profession, we wish to stress the crucial influence which this new Space Agency will have on the growth of our industry and technology. For this reason we anticipate that we will be fully consulted by the Government in the process of defining the role and structure of the Agency. We have taken steps to be ready for fulfilling this consulting role when called upon to do so. Our basic position is:—

1. The Agency should have a clear National, non-commercial status, reflected in its charter. It should also have more freedom in its personnel and procurement management than is presently possible within Government Departments.

2. In view of the above, the new Agency should not be a part of any existing Government Department. In the absence of a Minister of Science and Technology, the Agency should report to a Minister Designate, closely connected with research and development problems.

3. Since the Agency will be concerned with full integration of Canadian Industry in Canadian Space Programs (including a technological spin-off program), the Industry must be strongly represented on the policy governing body of the Agency. We recommend that no less than one-third of the members of that Body be selected from amongst industrial executives or industrial experts involved in space projects. A corresponding industrial participation in the science and technology guidance to the Agency is necessary to ensure working-level communication and support.

4. The fraction of the total Government expenditures on space R & D projects which is spent in industry, needs to be substantially increased. Thus we wish to emphasize the recommendation of the Chapman Report that such Agency should not establish new laboratory facilities where these exist or can be established in industry or universities.

5. It is understood that the Government must rely on its cadre of high-class scientific and engineering personnel for expert guidance of the space program. However, not more than the minimum work required for this purpose should be done intramurally. The current ratio of industrial to government personnel in the space program, (at the professional level) is about 1:1 in Canada, while the corresponding figures for the U.S. National Aeronautics and Space Agency are in excess of 5:1 (See NASA letter attached). Rather than draining personnel from industry and university to Government, the Agency should actively support industrial expansion to achieve an economically reasonable ratio of personnel.

Aerovox Canada Ltd., Hamilton, Ontario
Allen-Bradley Canada Ltd., Galt, Ontario
Amphenol Canada Ltd., Scarborough, Ontario
Andrew Antenna Co. Ltd., Whitby, Ontario
Audio Transformer Co., Waterloo, Ontario
Automatic Winding Corp. Ltd., Downsview, Ontario
Aviation Electric Ltd., Montreal, P.Q.
Benco Television Associates Ltd., Toronto, Ontario
Burndy Canada Ltd., Toronto, Ontario
Canada Wire & Cable Co. Ltd., Toronto, Ontario
Canadian Admiral Corp. Ltd., Port Credit, Ontario
CAE Industries Ltd., Montreal, P.Q.
Canadian General Electric Co. Ltd., Toronto, Ontario
Canadian Marconi Co., Montreal, P.Q.
Canadian Motorola Electronics Co., Toronto, Ontario
Canadian Stackpole Ltd., Toronto, Ontario
Canadian Westinghouse Co. Ltd., Hamilton, Ontario
Capacitors of Canada Ltd., Scarborough, Ontario
Centralab Canada Ltd., Ajax, Ontario
Clairtone Sound Corp., Ltd., Rexdale, Ontario
Collins Radio Co. of Canada Ltd., Toronto, Ontario
Computing Devices of Canada Ltd., Ottawa, Ontario
Corning Glass Works of Canada Ltd., Toronto, Ontario
Cramco Solder Alloys Ltd., Scarborough, Ontario
CTS of Canada Ltd., Streetsville, Ontario
Delhi Metal Products Co., Delhi, Ontario
Elco Connectors Co. Ltd., Toronto, Ontario
Electrohome Ltd., Kitchener, Ontario
Electronic Craftsmen Ltd., Waterloo, Ontario
Electrovert Manufacturing Co. Ltd., Montreal, P.Q
El-Met-Parts Ltd., Dundas, Ontario
Emanuel Products Limited, Toronto, Ontario
E.M.I. Electronics Canada Ltd., Dartmouth, N.S.
Erie Technological Products of Canada Ltd., Trenton, Ontario
E.S.E. Limited, Rexdale, Ontario
Fanon Electronics of Canada Ltd., Toronto, Ontario
Farinon Electric of Canada, Dorval, Quebec
Federal Wire and Cable Co. Ltd., Guelph, Ontario
Ferranti-Packard Electric Ltd., Toronto, Ontario
Ferritronics Ltd., Richmond Hill, Ontario
Fleetwood Corporation, Montreal, P.Q.
Garrett Manufacturing Co. Ltd., Rexdale, Ontario
General Instrument of Canada Ltd., Waterloo, Ontario
Graphico Precision Works Ltd., Agincourt, Ontario
Hammond Manufacturing Co. Ltd., Guelph, Ontario
Honeywell Controls Ltd., Scarborough, Ontario
International Systcoms, St. Laurent, P.Q.
ITT Cannon Electric Canada, Toronto, Ontario
Johnson Matthey & Mallory Ltd., Toronto, Ontario
KA-ME-CO Automation Electronics Ltd., Montreal, P.Q.
Kester Solder Co. of Canada Ltd., Brantford, Ontario
Lake Engineering Co. Ltd., Scarborough, Ontario
Leigh Instruments Ltd., Carleton Place, Ontario
Lenkurt Electric Co. of Canada Ltd., Burnaby, B.C.
Lightning Fastener Co. Ltd., Niagara-on-the-Lake, Ontario (Lightning Circuits Division)
Litton Systems (Canada) Ltd., Rexdale, Ontario
Magnetic Metals of Canada Limited, Brantford, Ontario
Mallory Battery Co. of Canada Ltd., Clarkson, Ontario
Marsland Engineering Co., Kitchener, Ontario
McCurdy Radio Industries Ltd., Toronto, Ontario
McNeil Electronics Ltd., Toronto, Ontario
Neosid (Canada) Ltd., Toronto, Ontario
Northern Electric Co. Ltd., Ottawa, Ontario
Northern Radio Mfg. Co. Ltd., Ottawa, Ontario
O & W Electronics Ltd., Toronto, Ontario
Owens-Illinois of Canada Ltd., Rexdale, Ontario
Philco-Ford of Canada Ltd., Don Mills, Ontario
Philips Electronics Industries Ltd., Toronto, Ontario
Precision Electronic Components Ltd., Toronto, Ontario
Pye Electronics Ltd., Montreal, P.Q.
Pylon Electronic Development Co. Ltd., Lachine, Quebec
Quality Hermetics Ltd., Toronto, Ontario
Racal (Canada) Ltd., Ottawa, Ontario
Radio Components Ltd., Toronto, Ontario
Radio Speakers (Canada) Ltd., Toronto, Ontario
Raytheon (Canada) Ltd., Waterloo, Ontario
RCA Victor Co. Ltd., Montreal, P.Q.
Renfrew Electric Co. Ltd., Toronto, Ontario (IRC Resistors Division)
Smallwood (S.G.) Ltd., Kitchener, Ontario
Space Circuits Ltd., Waterloo, Ontario
Spar Aerospace Products Ltd., Toronto International Airport, Ontario
Sprague Electric of Canada Ltd., Toronto, Ontario
Standard Coil Products (Canada) Ltd., Mimico, Ontario
Superior Electronics Inc., Montreal, P.Q.
Sylvania Electric (Canada) Ltd., Montreal, P.Q.
Texas Instruments Inc., Richmond Hill, Ontario
TMC Canada Ltd., Ottawa, Ontario
Trim-Line Connectors Ltd., Toronto, Ontario
TRW Electronic Components Ltd., Toronto, Ontario
United-Carr Canada Ltd., Hamilton, Ontario
Varian Associates of Canada Ltd., Georgetown, Ontario
Ward Leonard of Canada Ltd., Scarborough, Ontario
Welwyn Canada Ltd., London, Ontario

APPENDIX "C"

BRIEF TO
DEPARTMENT OF INDUSTRY,
TRADE AND COMMERCE RE
INDUSTRIAL RESEARCH AND
DEVELOPMENT INCENTIVES ACT
(IRDIA)

C O P Y

Electronic Industries Association of Canada
200 St. Clair Avenue West,
Toronto 7, Ontario

March 12, 1969.

A. G. Kniewasser, Esq.,
Senior Assistant Deputy Minister,
Industry and Trade Development Branch,
Department of Industry, Trade and Commerce,
Place de Ville,
112 Kent Street,
Ottawa, Ontario.

Subject: Research and Development Incentive Program

At the request of certain officials of your Department, the Electronic Industries Association of Canada undertook to study some of the research and development incentive programs available to the Industry from Government sources, and report on their findings.

Due to the very short time available for the studies, it was impossible to make recommendations in depth on all programs. The Association, therefore, decided to make a comprehensive study of the IRDIA program, and give general comments on some of the others.

To this effect, we attach herewith a copy of our Brief to the Department of Industry, Trade and Commerce on the Industrial Research and Development Incentives Act (IRDIA) and comment on other applicable programs as follows:

1. Defence Industrial Research (DIR)

   Basically a good cost-sharing program.

2. Program for Advanced Industrial Technology (PAIT)

   This program is unacceptable due to abnormally high effective interest rate and the administrative effort required to justify a "successful" project. It tends to reward failure, and penalize success.

3. Industrial Research Assistance Program (IRAP)

   This program provides assistance (30-50% of project cost) for basic research programs which do not include development. It has been well administered and helpful to many companies. The Association recommends it be continued and expanded in magnitude to include applied research and advanced development.

A. G. Kniewasser, Esq. March 12, 1969.

4. Vote 5 (DDSP)

It is recommended this program be continued and enlarged. Such an enlarged program could be much more effective if used to assist projects for the development of commercially saleable export products which also have military interest.

As noted previously, due to the very limited time element available for a general study, the above comments are of necessity capsule opinions. If the Government feels any useful purpose would be achieved by a study in depth of each individual program, the Association is prepared to co-operate accordingly.

In general, the Association believes there is too much preoccupation with the recovery of Government's share in assisted programs. Successful projects will bring returns to Canada through a growing scientific and technological community with attendant increase in personal and corporate tax revenue.

Yours very truly,

Cowan Harris (sgd.)
General Manager.

CH/mm
Encl.

BRIEF
TO
DEPARTMENT OF INDUSTRY, TRADE & COMMERCE
RE
INDUSTRIAL RESEARCH AND DEVELOPMENT INCENTIVES ACT (IRDIA)
SUBMITTED BY
THE ELECTRONIC INDUSTRIES ASSOCIATION OF CANADA

1. The Electronic Industries Association of Canada has studied the terms and conditions of the Industrial Research and Development Incentives Act designed to stimulate research and development in Canadian industry. In some instances, this program has been successful but has some shortcomings and is not fully effective in providing sufficient incentive.

To be effective, an incentive plan should meet three criteria:

(a) It must contribute an amount of funding significant in respect to a company's overall financial operation. Because of the narrow interpretation of the scope of the expense involved in the whole innovative development process, a plan based on paying a percentage of a fraction of a company's related expenditure, which in itself may only be a small percentage of sales, offers insufficient incentive.

(b) The support to be derived from the government funding program must be clearly evident to the company before the work is undertaken, so that the incentive may play an important part in the decision to proceed. This implies that the incentive payment must be unequivocal.

(c) To reduce the cost of financing research and development, the incentive payment must be paid to the company within a reasonable time, say no later than three or four months after submission of claim. If the processing of the claim extends beyond this period, a partial payment based on a percentage of the claim should be paid.

2. The Electronic Industries Association of Canada believes the more important difficulties in deriving benefits from this Act are:

(i) Widely diverse interpretive problems.

(ii) The incentive, as a percentage of incremental expenditure from a moving base, discriminates against companies already committed to slowly rising or stable programs.

(iii) The definition of research and development is much too narrow and restricted to provide an incentive which will stimulate the whole innovation process.

(iv) The considerable administrative effort and attendant costs required in determining the claim, because of the interpretation of the Act, detract from the main incentive.

(v) The delays in payment of claims are unreasonable and costly.

(vi) It is not practicable to carry out significant research and development in Canada without purchasing certain materials and components from other countries, yet such purchases are disallowed.

(vii) It is sometimes necessary to subcontract certain research and development to foreign companies as part of a program being undertaken in Canada. Such subcontracts are disallowed.

3. The Electronic Industries Association of Canada recommends that:

3.1 The definition of Scientific Research and Development given in Section 2 (2)(d) of the Regulations to be broadened in interpretation to include research and the whole innovative process as follows:

(i) Basic Research, namely, work undertaken for the advancement of scientific knowledge without a specific practical application in view, including experimentation, operations research and mathematical analysis.

(ii) Applied Research, namely, work undertaken for the advancement of scientific knowledge with a specific practical application in view, including technological forecasting and basic economic and technical feasibility studies.

(iii) Development, namely, use of results of basic or applied research for the purpose of creating new, or improving existing, materials, devices, products or processes. This will include all of the following areas of activity which may be involved to provide a manufacturable and saleable product which meets all its design requirements, ready for production.

(a) Basic design of a new product or improvement to an existing product, including inter alia, electrical circuitry, system compatibility considerations, packing, i.e., design of chassis, wiring, cases, finishes, panel markings) and any other mechanical features required to provide a manufacturable and saleable product.

(b) Human engineering (i.e., determination of optimum shapes, sizes, configurations, sound characteristics, etc.) related to use of the product by human beings.

(c) Technical examination or adaptation of technical information received from others preparatory to introducing new products or processes. (Technical information may take the form of purchased drawings, samples, etc. which require further technical effort before a product can be produced by the manufacturer concerned.)

(d) Environmental and qualification testing of prototype(s) including field trials and field tests.

(e) Manufacturing information preparation including drawings, test specifications, shop instructions, etc., as required for the manufacturing organization to go into production without further engineering assistance.

(f) Manufacturing process development including test set design, special machine design, special facilities design (e.g., furnaces, clean room, etc.).

(g) Manufacture of all necessary versions of prototype(s), including first tool-made sample, meeting all design requirements. This includes the innovation portion of the engineering cost of a "one of" major equipment or product where the innovative portion is applicable to future production.

(h) Mathematical analysis, computer programming and software preparation essential to research and development.

(i) Technical effort directed toward product or process cost reduction.

(j) Manufacturing unit support of product or process development including cost of shop labour, materials and equipment required to develop or prove a manufacturing process, with credit for any delivered product value at standard cost.

3.2 Scientific Research and Development does not include activities with respect to:

(i) Market research or sales promotion.

(ii) Quality control or routine testing of materials, devices or products.

(iii) Prospecting, exploring or drilling for or producing minerals, petroleum or natural gas.

(iv) The commercial production of a new or improved material, device or product or the commercial use of a new or improved process.

(v) Style changes.

(vi) Routine data collection.

* 3.3 Cost of material and components not available from Canadian sources and imported specifically for use on research and development projects, be allowed as part of the IRDIA claim.

* 3.4 The IRDIA claim be allowed to include cost of subcontracts outside the country limited to some percentage of the research and development project cost. Such an allowance would enhance research and development which might not otherwise be done in Canada.

3.5 The incentive be a grant paid as a percentage of the total company current fiscal period research and development expenditure. In addition to overcoming the difficulty referred to in (ii) on Page 2 of this Brief, the removal of the "base period" concept would also obviate the necessity for filing consolidated claims from associated companies.

* In connection with Items 3.3 and 3.4, there is ambiguity in the Act which has cuased inconsistency in its administration. Section 2 (3)(c) reads as follows:

"A reference in this Act -- to expenditures on or for scientific research and development, includes any expenditures incurred for and wholly attributable to the prosecution of or the provision of facilities for the prosecution of scientific research and development in Canada and such other expenditures attributable to the prosecution of or the provision of facilities for the prosecution of scientific research and development in Canada as may be prescribed by regulation."

The Association does not believe sufficient importance has been placed on the phrase "... attributable to the prosecution...in Canada....". Where it appears irrefutable that companies "... prosecute their scientific research and development in Canada....", and since this is a definitive section dealing with "expenditures", it must surely follow that "eligible current expenditures" mentioned in Section 5(1)(a) abide by the same definition.

To add further substance to this argument, Section 5(1)(a)(ii)(C) refers to payments "to another corporation, for scientific research and development related to the class of business of the corporation". Furthermore, Section 5(3) reads as follows - "References in this section to scientific research and development that may lead to or facilitate an extension of that business or business of that class.".

Since no geographical or residence qualification has been attributed to the "other corporation", it is obviously the intent of the Act that expenditures made outside Canada for the "prosecution" of scientific research in Canada will be classified as allowable current expenditures.

* * * * *

APPENDIX "D"

ELECTRONIC INDUSTRIES ASSOCIATION
OF CANADA
PRESENTATION TO CABINET MINISTERS
OTTAWA, MARCH 17, 1969

(CHARTS)

BRIEF

TO THE

GOVERNMENT OF CANADA

ON THE NEED FOR

INCREASING THE

TECHNOLOGICAL CAPABILITY

OF CANADIAN INDUSTRY

INCREASING THE TECHNOLOGICAL
CAPABILITY OF CANADIAN INDUSTRY

INTRODUCTION

- NUMEROUS STUDIES - GLASSCO ROYAL COMMISSION, ECONOMIC COUNCIL OF CANADA, SCIENCE COUNCIL, SENATE COMMITTEE ON SCIENCE POLICY, AS WELL AS STUDY BY OECD.

- ALL STUDIES RECOGNIZE THE NEED FOR INDUSTRY TO BE INVOLVED. THEREFORE, THE NEED TO HEAR THE VIEWS OF INDUSTRY, WHICH IS THE PURPOSE OF OUR ASSOCIATION'S BRIEF.

- THERE IS AN URGENT NEED TO DEVELOP SPECIFIC WAYS AND MEANS TO ACCOMPLISH THE OBJECTIVES REQUIRED.

THE NEEDS

INCREASED GOVERNMENT/INDUSTRY COMMUNICATION.

INCREASED R&D EXPENDITURES IN INDUSTRY

- NATIONAL EXPENDITURE ON R&D
- DISTRIBUTION AMONGST GOV'T., INDUSTRY, UNIVERSITIES.

GOVERNMENT ASSISTANCE & INCENTIVES FOR
R & D IN INDUSTRY

- PAYBACK TO GOVERNMENT IN THE FORM OF INCREASED CORPORATION AND PERSONAL INCOME TAXES.
- PAYBACK TO PUBLIC IN THE FORM OF CHEAPER & IMPROVED GOODS AND SERVICES

CONSIDERATION OF THE TOTAL INNOVATIVE PROCESS

- RELATIVE COSTS OF THE ENTIRE SPECTRUM
- NEED TO PLAN MORE OF THE ENTIRE SPECTRUM AT THE OUTSET

WAYS TO IMPLEMENT PROGRAMS

- NEED FOR NATIONAL GOALS AND FULLY FUNDED MAJOR PROGRAMS
- NEED FOR INCENTIVES FOR INDUSTRY INITIATIVES

RECOMMENDATIONS/HOW TO PROCEED

PARALLEL PATHS ARE RECOMMENDED

FULLY FUNDED NATIONAL PROGRAMS

. MAJOR NATIONAL PROGRAMS

. ESTABLISHMENT OF A NUMBER OF NATIONAL GOALS WITH PRIORITIES

. STUDIES TO COMMENCE IMMEDIATELY ON THE HIGHEST PRIORITY PROGRAMS SELECTED

. IMPLEMENTATION OF CERTAIN OF THE TOP PRIORITY ITEMS AS FEASIBILITY ESTABLISHED

. PROVISION FOR MOVEMENT OF STAFF BETWEEN GOVERNMENT, UNIVERSITIES & INDUSTRY

INDUSTRIAL INCENTIVES

. CURRENT SCHEMES - STRENGTHS & WEAKNESSES

. RECOMMENDATIONS

  . TAX INCENTIVES

  . TAX HOLIDAYS

  . COST SHARING ON ALL INNOVATIVE STEPS

IN CONCLUSION -
THE SALIENT POINTS ARE:

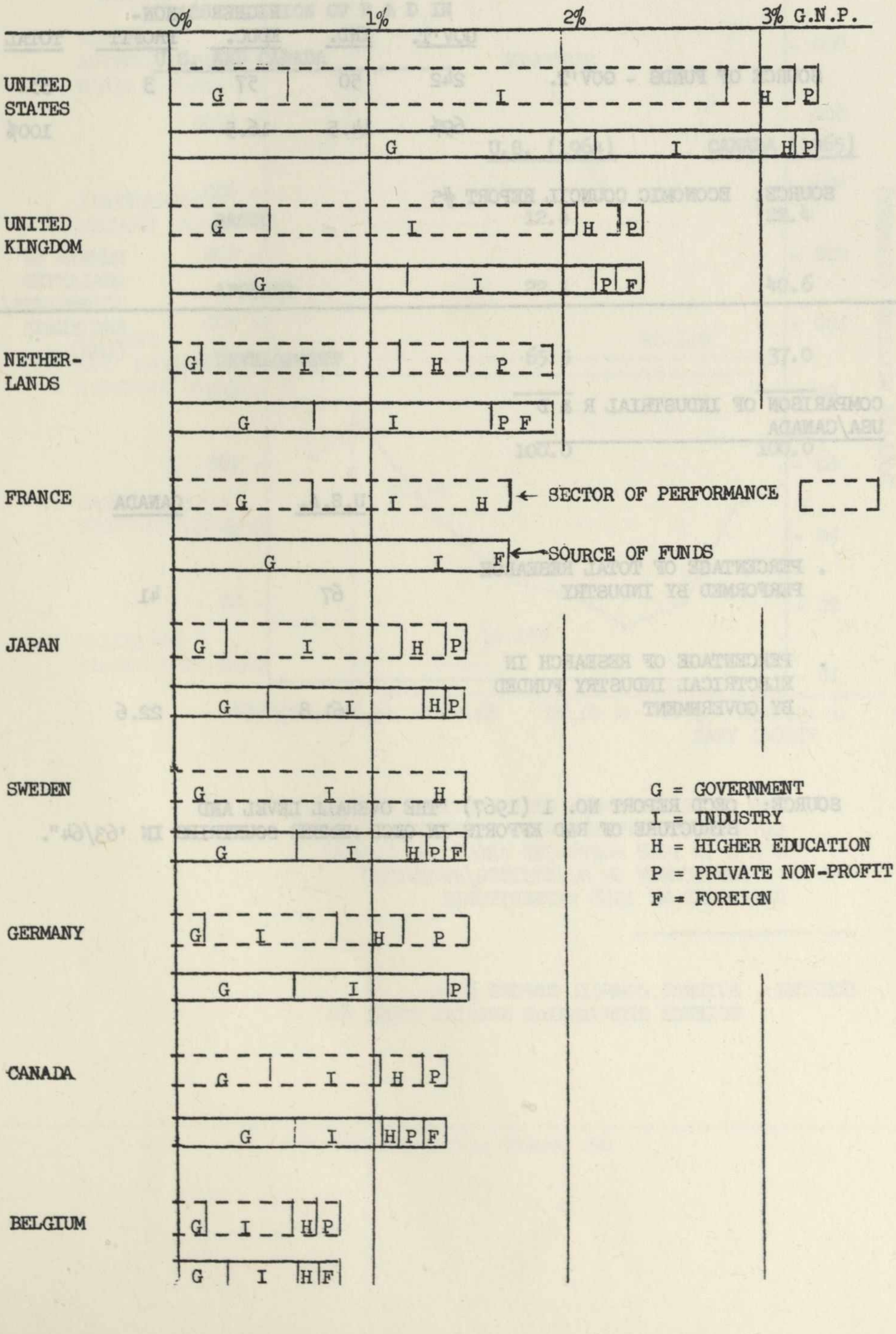
- CONSULTATION ON A CONTINUING BASIS AT SENIOR LEVELS BETWEEN GOVERNMENT & INDUSTRY
- IDENTIFICATION & PURSUIT OF FULLY-SUPPORTED NATIONAL PROGRAMS TO BE UNDERTAKEN BY INDUSTRY - BUT INVOLVING AS APPROPRIATE GOVERNMENT AGENCIES & UNIVERSITIES
- RE-EVALUATION OF ASSISTANCE & INCENTIVE SCHEMES TO ENCOURAGE - IN ADDITION TO R & D - ALL ELEMENTS OF THE INNOVATIVE PROCESS

RD - 4

SUPPLEMENTARY CHARTS

GROSS NATIONAL EXPENDITURE ON
RESEARCH & DEVELOPMENT

By Sector of Performance & by Source of Funds



DISTRIBUTION OF GOV'T. R & D
FUNDS BY SECTOR OF PERFORMANCE

(MILLIONS OF DOLLARS) SECTOR OF PERFORMANCE

	GOV'T.	IND.	HIGHER EDUC.	PRIVATE NON-PROFIT	TOTAL
SOURCE OF FUNDS - GOV'T.	242	50	57	3	351
	69%	14.5	16.5		100%

SOURCE: ECONOMIC COUNCIL REPORT #5

COMPARISON OF INDUSTRIAL R & D
USA/CANADA

	U.S.A.	CANADA
. PERCENTAGE OF TOTAL RESEARCH PERFORMED BY INDUSTRY	67	41
. PERCENTAGE OF RESEARCH IN ELECTRICAL INDUSTRY FUNDED BY GOVERNMENT	61.8	22.6

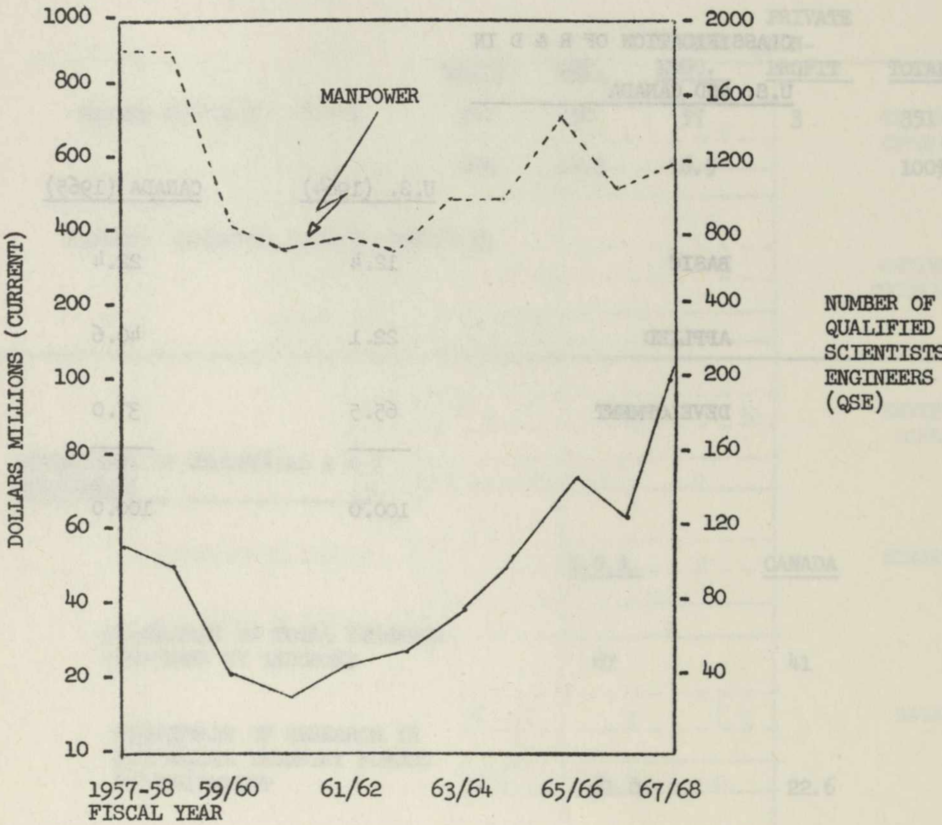
SOURCE: OECD REPORT NO. 1 (1967) "THE OVERALL LEVEL AND STRUCTURE OF R&D EFFORTS IN OECD MEMBER COUNTRIES IN '63/64".

CLASSIFICATION OF R & D IN

U.S. AND CANADA

	U.S. (1964)	CANADA (1965)
BASIC	12.4	22.4
APPLIED	22.1	40.6
DEVELOPMENT	65.5	37.0
	100.0	100.0

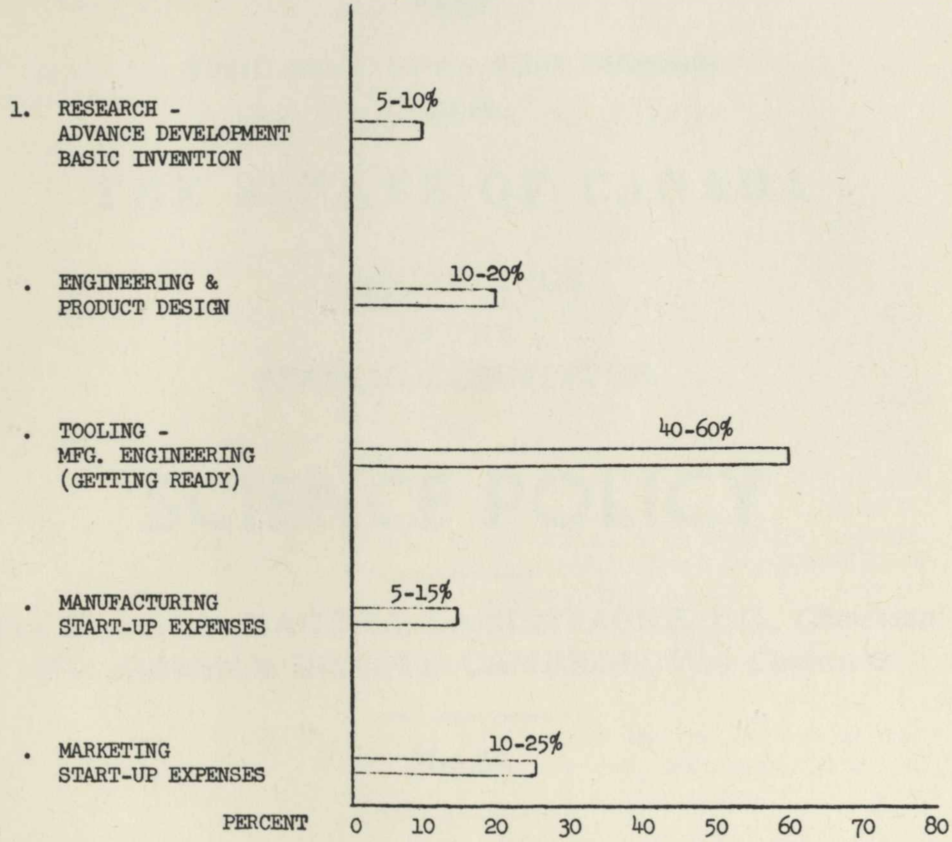
DIRECT FEDERAL SUPPORT
FOR R & D IN INDUSTRY



DUE TO "INFLATION/SOPHISTICATION" FACTORS, GOVERNMENT EXPENDITURES ON INDUSTRIAL R & D IN 1968 SUPPORTED ABOUT TWO THIRDS OF THE NUMBER OF SCIENTISTS/ENGINEERS SUPPORTED BY 1958 EXPENDITURES

SOURCES: SCIENCE COUNCIL REPORT #4 &
SCIENCE SECRETARIAT SPECIAL STUDY #6

TYPICAL DISTRIBUTION OF COSTS
IN SUCCESSFUL PRODUCT INNOVATION



The Queen's Printer, Ottawa, 1969

First Session—Twenty-eighth Parliament
1968-69

THE SENATE OF CANADA

PROCEEDINGS
OF THE
SPECIAL COMMITTEE
ON

SCIENCE POLICY

The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*
The Honourable DONALD CAMERON, *Vice-Chairman*

No. 64

TUESDAY, JUNE 17th, 1969

WITNESSES:

Canadian Standards Association: Dr. J. H. Jenkins, Mr. F. A. Sweet; Patent and Trademark Institute of Canada: Russel S. Smart, Q.C., President, Mr. Peter Kirby, Immediate Past President; National Design Council: Mr. John C. Parkin, Chairman, Mr. Philip Weiss, Design Advisor, Department of Industry, Trade & Commerce.

APPENDICES:

145—Brief submitted by Canadian Standards Association
146—Brief submitted by Patent and Trademark Institute of Canada
147—Brief submitted by National Design Council

29632—1

First Session—Twenty-eighth Parliament

1968-69

THE SENATE OF CANADA

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20652—1

MEMBERS OF THE SPECIAL COMMITTEE

ON

SCIENCE POLICY

The Honourable Maurice Lamontagne, *Chairman*

The Honourable Donald Cameron, *Vice-Chairman*

The Honourable Senators:

Aird
Belisle
Blois
Bourget
Cameron
Carter
Desruisseaux
Giguère
Grosart
Haig
Hays
Kinnear
Lamontagne
Lang
Leonard
McGrand
Nichol
O'Leary (*Carleton*)
Phillips (*Prince*)
Robichaud
Sullivan
Thompson
Yuzyk

Patrick J. Savoie,
Clerk of the Committee.

ORDERS OF REFERENCE

Extract from the Minutes of the Proceedings of the Senate, Tuesday, September 17th, 1968:

"The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That a Special Committee of the Senate be appointed to consider and report on the science policy of the Federal Government with the object of appraising its priorities, its budget and its efficiency in the light of the experience of other industrialized countries and of the requirements of the new scientific age and, without restricting the generality of the foregoing, to inquire into and report upon the following:

(*a*) recent trends in research and development expenditures in Canada as compared with those in other industrialized countries;

(*b*) research and development activities carried out by the Federal Government in the fields of physical, life and human sciences;

(*c*) federal assistance to research and development activities carried out by individuals, universities, industry and other groups in the three scientific fields mentioned above; and

(*d*) the broad principles, the long-term financial requirements and the structural organization of a dynamic and efficient science policy for Canada.

That the Committee have power to engage the services of such counsel, staff and technical advisers as may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to examine witnesses, to report from time to time, to print such papers and evidence from day to day as may be ordered by the Committee, to sit during sittings and adjournments of the Senate, and to adjourn from place to place;

That the papers and evidence received and taken on the subject in the preceding session be referred to the Committee; and

That the Committee be composed of the Honourable Senators Aird, Argue, Bélisle, Bourget, Cameron, Desruisseaux, Grosart, Hays, Kinnear, Lamontagne, Lang, Leonard, MacKenzie, O'Leary (*Carleton*), Phillips (*Prince*), Sullivan, Thompson and Yuzyk.

After debate, and—

The question being put on the motion, it was—

Resolved in the affirmative."

Extract from the Minutes of the Proceedings of the Senate, Thursday, September 19th, 1968:

"With leave of the Senate,

The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That the name of the Honourable Senator Robichaud be substituted for that of the Honourable Senator Argue on the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—

Resolved in the affirmative."

Extract from the Minutes of the Proceedings of the Senate, Wednesday, February 5th, 1969:

With leave of the Senate,

The Honourable Senator McDonald moved, seconded by the Honourable Senator Macdonald (*Cape Breton*):

That the names of the Honourable Senators Blois, Carter, Giguère, Haig, McGrand and Nichol be added to the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—

Resolved in the affirmative.

ROBERT FORTIER,
Clerk of the Senate.

MINUTES OF PROCEEDINGS

TUESDAY, June 17, 1969.

Pursuant to adjournment and notice the Special Committee on Science Policy met this day at 10.00 a.m.

Present: The Honourable Senators Lamontagne (*Chairman*), Bélisle, Bourget, Grosart, Kinnear, Robichaud—6.

In attendance: Philip J. Pocock, Director of Research (*Physical Science*).

The following witnesses were heard:

CANADIAN STANDARDS ASSOCIATION

Dr. J. H. Jenkins.
Mr. F. A. Sweet.

PATENT AND TRADEMARK INSTITUTE OF CANADA

Russel S. Smart, Q.C., President.
Mr. Peter Kirby, Immediate Past President.

NATIONAL DESIGN COUNCIL

Mr. John C. Parkin, Chairman.
Mr. Philip Weiss, Design Advisor
Department of Industry, Trade & Commerce.

(*A curriculum vitae of each witness follows these Minutes*)

The following are printed as Appendices:

No. 145—Brief submitted by Canadian Standards Association.
No. 146—Brief submitted by Patent and Trademark Institute of Canada.
No. 147—Brief submitted by National Design Council.

At 12.45 p.m. the Committee adjourned to the call of the Chairman.

ATTEST:

Patrick J. Savoie,
Clerk of the Committee.

CURRICULUM VITAE

Jenkins, John Henry, O.B.E., B.A.Sc., D.Sc.F., LL.D.: Born in Malvern, England, in 1898. 1923, B.A.Sc. University of British Columbia; 1960, D.Sc.F.(hon.) Laval University; 1964, LL.D.(hon.) University of New Brunswick; Armed Services 1916-19 *and* 1939-46; Engaged in Forest Products research with Federal Government at Vancouver and Ottawa from 1924 (Director from 1950 to retirement in 1966); Active with CSA from 1949 (elected President in 1968 for a 2-year term).

Kirby, Peter: Immediate Past President of the Patent and Trademark Institute of Canada. Mr. Kirby, age 47, was born in London, England, and received Bachelor of Electrical Engineering degree at the University of Melbourne, Australia, in 1946. He qualified in 1951 as a Chartered Patent Agent in London, England, and having emigrated to Canada, qualified as a registered patent agent in Canada in 1954. He is now practising patent agency as a partner in the Ottawa firm of Kirby, Shapiro, Curphey & Eades.

Parkin, John C.: Business: Managing Partner, Canada; Parkin Architects Engineers Planners; President, Arpac Limited; President, UPACE Limited; Vice-President, Transo Corporation Ltd.; Director, Eastern Utilities Limited. Academic: Honors graduate, Manitoba University (B.Arch.) 1944; Honors graduate, Harvard University (M.Arch.) 1947; University of Manitoba Travelling Fellowship, various other Manitoba and Harvard Scholarships, Thesis Prize '44, etc.; Lecturer, University of Toronto, 1947-48; Visiting Professor, McGill University, 1966-67; Member, Advisory Council, School of Administrative Studies, York University, 1966; Member, Board of Governors Advisory Council, Ryerson Polytechnical Institute, 1966; Member, Council of the Harvard Graduate School of Design Association, 1966-69; Lecturer, various other Universities, North Carolina, Manitoba, etc.; Member, Board of Architectural Education, Commonwealth Association of Architects, London. Professional: Cofounder and senior partner; Canada's largest firm of architects and engineers, and one of world's largest private partnerships in fields; Principal offices in Toronto, Montreal, Los Angeles; Fellow, Royal Architectural Institute of Canada; Fellow, Royal Institute of British Architects; Fellow, Society of Industrial Artists and Designers, London; Fellow, Royal Society of Arts, London; Academician, Royal Canadian Academy of Arts; Former Member, Council, Royal Canadian Academy of Arts, 1963-64; Chairman, Architectural Committee, Royal Canadian Academy of Arts, Life Member, Association of Canadian Industrial Designers; Member, Committee of Inquiry into Design of Residential Environment, RAIC/CMHC, 1959; Member, Corporation of Urbanists of Quebec; Member, American Society of Planning Officials; Member, Community Planning Association of Canada. Memberships: Member, Mount Royal Club, Montreal; Donalda Club, Don Mills; Member, Young Presidents' Organization; Member, Donalda Club, Don Mills; Member, Young Presidents' Organization; Member Board of Trade of Metropolitan Toronto; President, Young Men's Canadian Club of Toronto, 1951-52; Member, Administration Committee and National Executive, Association of Canadian Clubs; Honorary member and Patron, various Canadian societies.

Smart, Russel S., Q.C.: President, Patent and Trademark Institute of Canada. Mr. Smart was born in Ottawa in 1921; Served in the Royal Canadian Artillery in Canada, U.K. and Europe, 1941-46; Received B.A.Sc. (Chem. Eng.) University of Toronto 1946; Called to Bar in Ontario 1949; He has since practised law in matters pertaining to patents, trade marks, copyright and industrial designs. Partner in the firms of Fetherstonhaugh & Co., and Smart & Biggar in Ottawa from 1950 to date.

Sweet, Frederick Arthur, B.A.Sc., P.Eng., M.E.I.C.: Born in Humberstone, Ontario, Canada, in 1911. Graduate Civil Engineer University of Toronto 1926; engaged in mining engineering Dayton Porcupine Mines, Timmins, Ontario 1937; structural design engineering Ajax Engineering Ltd., Toronto 1938; assitant city engineer, St. Thomas, Ontario 1939; and since with the Canadian Standards Association as Chief Technical Officer 1940-1954; General Manager 1954, to present date. Member of The Association of Professional Engineers of the Province of Ontario, The Engineering Institute of Canada, the Institute of Association Executives and the Standards Engineers Society.

Weiss, E. Philip: Business: General Director, Office of Design Adviser in the Department of Industry, Trade and Commerce and Executive Director to the National Design Council. Academic: Honors graduate, Ontario College of Art, 1947. Professional: Responsible for administering the Design Canada Program and has been involved in the development of this program since the formation of the National Design Council in 1961. During this period, two permanent Design Centres have been established in Toronto and Montreal and considerable progress has been made in the application of good design practice in the Federal Government, notably in the area of government standards, procurement and accommodation. Prior position—14 years as senior designer with the Canadian Government Exhibition Commission. Memberships: Honorary member, Association of Canadian Industrial Designers; Honorary member, Association of Professional Industrial Designers of Ontario; Honorary member, Association of Quebec Industrial Designers.

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Weiss, E. Philip Business: General Director, Office of Design Adviser in the Department of Industry, Trade and Commerce and Executive Director to the National Design Council. Academic: Honors graduate, Ontario College of Art, 1947. Professional: Responsible for administering the Design Canada Program and has been involved in the development of this program since the formation of the National Design Council in 1961. During this period two permanent Design Centres have been established in Toronto and Montreal and considerable progress has been made in the application of good design practice in the Federal Government, notably in the area of government standards, procurement and accommodation. Prior position—14 years as senior designer with the Canadian Government Exhibition Commission. Memberships: Honorary member, Association of Canadian Industrial Designers; Honorary member, Association of Professional Industrial Designers of Ontario; Honorary member, Association of Quebec Industrial Designers.

THE SENATE

SPECIAL COMMITTEE ON SCIENCE POLICY

EVIDENCE

Ottawa, Tuesday, June 17, 1969

The Special Committee on Science Policy met this day at 10.00 a.m.

Senator Maurice Lamontagne (Chairman) in the Chair.

The Chairman: Honourable senators, we have with us this morning the representatives of four different organizations: The Canadian Standards Association; the Patent and Trademark Institute of Canada; the National Design Council; and the Royal Architectural Institute of Canada.

First, I will ask Dr. Jenkins, of the Canadian Standards Association, to make his opening statement.

Dr. J. H. Jenkins, Canadian Standards Association: Mr. Chairman and honourable senators, the Canadian Standards Association was formed in 1919, when Letters Patent were granted to it as a national standards body. It is non-profit and autonomous, and its original responsibility was the preparation of national standards dealing with performance and safety. Its original role has since been broadened, and now it covers these functions, the preparation and publication of national standards and testing and certification using these standards. For that purpose it has testing laboratories which are concerned with electrical and plumbing standards; the Canadian Welding Bureau, which is concerned with the certification and testing of welders and their education; the Canadian Lumber Standards Division, which is concerned with the grading and grade marking of lumber to ensure its quality; the Structural Glued-Laminated Timber Division, which has the certification of plants manufacturing this structural product so as to ensure its safety; and then a new one, which is concerned with architectural concrete.

All of our standards are voluntary, and they are established for the purpose of permitting standards in respect of products, processes, and procedures.

In establishing these standards we have representative committees on which the manufacturer, the user, and government are represented. All the members of these committees donate their services. They are all voluntary, and there are approximately 2,800 members. The financing is done through the sale of our publications, and the fees 1,900 sustaining members from industry.

The Government originally gave us a grant of $30,000. However, that was for standardization in Canada, and also for paying CSA's dues to the international organizations for which the CSA is the national body. Those international dues have steadily increased until they now amount, for the two organizations, to an annual fee of $51,150.00. In the past year our Government grant has been this sum, so that Government at present is helping us only to the extent of paying the annual fees to these two important international organizations.

The fields that are covered by our technical committees are spelled out in detail in Appendix B to our brief. I am not going to read them now.

In the international standards field the two big organizations are the ISO—the International Standards Organization—and the IEC, in the electrical field. We are represented on 70 technical committees of ISO producing international recommendations, and on 52 committees of IEC. In addition, the CSA is the designated national body for Canada to these two organizations.

These standards, after they have been prepared by the designated standards writing committee, checked by the sectional committee, with a final check by the technical counsel, are published by the CSA. They are all voluntary standards. Their use depends upon acceptance. However, there are many of the standards and codes which are made mandatory, especially by the provinces. The outstanding ones in this respect are the Canadian Electrical Code, the Boiler Safety Code, the Elevator Safety Code, and the Gas Burning Appliances Code. These are all CSA standards that have been made mandatory by the provinces that have jurisdiction.

I am sure you are all familiar with the National Building Code which now applies to over 75 per cent of the Canadian population. In the National Building Code use is made of 137 CSA standards, 23 of these by the inclusion of the complete text, and 114 by reference.

In the certification and testing field the primary object is testing for safety. Originally this testing and certification was for electrical and fuel burning equipment. However, the field has now been very greatly broadened, and it covers welding, lumber, glued-laminated timber, and architectural concrete. In this testing we are concerned with safety and quality, but we do not carry out any comparative testing.

As to the future of CSA, the factor that has to be taken into account is the proposed establishment of a standards council of Canada. This was proposed by the federal Government two years ago, and a joint steering committee, consisting of representatives from the departments of Industry, Trade and Commerce and Consumer Affairs, and representatives of the CSA was established. We have been meeting for the past two years working on this Government proposal. It was placed before a federal-provincial committee last year, and now the proposal is awaiting the necessary legislation.

In this proposal there is the setting up of the standards council which will mean that the CSA will have to surrender certain of its responsibilities that are included in its letters patent. The proposal is that the standards council should be designated the national body for Canada instead of the CSA, but the CSA will continue its activities as a standards writing body with the council having a co-ordinating role. We feel that the council, if it stays within its terms of reference, should be of benefit to the standards field as a whole. Providing that the CSA's continuing role in the writing of standards is fully recognized, we feel that we can work well with it, and that it will be of value to Canada as a whole.

Regarding the finances of the CSA, the divisions are financially autonomous at present. We have a budget of $320,000. It must be borne in mind that hundreds of people from industry, the users, and government who work on these committees donate their time and pay their own travelling expenses, so that that sum of $320,000 is simply for administration and the publication of the standards. The testing laboratories at Toronto and Vancouver have a budget of $4 million. The Canadian Welding Bureau has a budget of $317,000, and the Canadian Lumber Standards Division and the Structural Glued-Laminated Timber Division have budgets of $27,000 and $13,000 respectively. There again, with the exception of one or two paid employees, all the work is performed by voluntary service given by a very dedicated group from industry and of engineers.

We feel that during our past 50 years we have done a good job in the national standards field. We know we can do a better job if we had more money. We recently decided upon a reorganization which will group these various divisions, and we feel that we can plan for the future in order to do an even better job.

Thank you, Mr. Chairman.

The Chairman: Thank you, Dr. Jenkins. Now we will hear from Mr. Russel Smart, the President of the Patent and Trade mark Institute of Canada.

Mr. Russel S. Smart, Q.C., President, Patent and Trademark Institute of Canada: Mr. Chairman, honourable members of the committee: the Patent and Trademark Institute of Canada is a non-profit, voluntary organization, grouping together people who have a special professional interest in patents, trademarks, copyrights and industrial designs. The composition of its membership includes lawyers who have a special interest in the industrial and intellectual property field, patent agents, trademark agents and others who may intend to become patent and trademark agents. The actual membership is listed in Appendix I to our brief, the appendix being a copy of last year's proceedings of the annual meeting. At the front there is an up-to-date list of our members, for anybody who is interested in seeing who we are. Appendix II to our brief is a copy of our constitution and bylaws.

Our principal interest is to further the Canadian patent system and the Canadian trademark system, to promote good workable legislation in these fields, and to improve the working of the patent system and the profession itself. In our brief we have attempted to indicate what a patent system in this day and age might be supposed to do. Then we have attempted to analyze the Canadian patent system, to some extent comparatively with other payment systems in the world, to see whether the Canadian patent system as it stands is doing what it should be doing.

In our view, the patent system has a certain number of functions to perform at the present time. The first of these is the encouragement of investment in new production facilities and the manufacture of new products. In our opinion, this is the most significant object of patent systems today.

In conjunction with that first object, in our view the patent system encourages industrial research and invention by individuals. We place that second to the encouragement of investment in new production facilities because we think that, to the extent that it encourages investment in new production facilities and the expansion of industry, it justifies the expenditure of money on industrial research by private industry.

Thirdly, the patent system plays an important role in providing a market place for new technology. When someone obtains a patent for a new development, in a sense the patent itself becomes a package that can be dealt in—bought and sold, licensed and so forth—and the fact that the patent offices of the world issue publications indicating the existence of patents and their ownership enables industry at large to deal with this technology. Thus, in our view technology that otherwise might lie fallow gets dealt in and actually out into work, because the patent systems make it available, in a sense like a commodity that can be reasonably easily dealt in.

Another function, of course, which is well known, is that it provides a medium for the dissemination of technical knowledge. The records out of the patent offices of the world provide a very useful research facility. With the technical information being, as it is, excellently classified, the searching of patent records in patent offices is a relatively quick and relatively accurate type of searching compared with, for instance, trying to assemble the bibliography from the ordinary scientific library.

Finally, we regard the patent system from the Canadian point of view as providing a basis for the development of export markets for Canadian products that may be patented in foreign countries by the Canadian business concerned, and also for the expansion of Canadian business itself into foreign countries. Many Canadian industries have in the past been developed in such countries as the United States and Great Britain, and in Europe, under the sheltering umbrella of a patent position built up by the Canadian enterprise obtaining patents in that foreign country.

As you will see from our brief, we found that in some respects the patent system of Canada is not doing the job it could do. The idea of patents was that inventions might be encouraged by giving a limited, exclusive privilege to the person who first introduced a new and useful industry. The period of exclusive use was to start with the introduction of the new development, or the new industry, or the new machine.

Owing to the fact that the pace of technology has been increasing in almost a geometric progression in the last 30 years or so, patent offices throughout the world, and particularly our own, and the patent office in the United States, have found it impossible to operate on a current basis. They have fallen behind, and there is every indication that it will be almost impossible for them ever to catch up on the present basis, simply because the applications that come in are more complex each year, it takes them longer to be understood by the examining staffs, there are more of them every year, and in a sense our patent offices are choking with all this mass of new, undigested material.

Therefore, instead of a patent giving an exclusive privilege when a new development is first introduced, the patent may not be granted for four or five years. By that time the new development is sort of old hat in the industry and comes to be regarded as something which is in the public domain, and the granting of a patent at that stage, taking it out of the public domain for a period of 17 years, is some extent disruptive of the industry concerned and tends to dilute the purpose of granting the patent. We suggest one thing that could be done to offset that is to spend considerable effort in the computerization of patent searching and patent records, both within the Canadian patent facilities and within our own patent office, as well as in the international field in co-operation with other patent offices who are like minded.

As you will see from the section of our brief devoted to computerization, it appears that to computerize all the patent information in the world into a single facility is well within the technology of computers at the present time. This appears to be the case from the best information we have been able to get and seems to be quite an economical proposition.

Another thing which we find has been preventing the patent system in Canada from playing its full part is the uncertainty which has been creeping into the validity aspect of patents. As you know, a patent can only be enforced against an infringer in the event that the court, which has been asked to enforce it, comes to the conclusion that the patent is valid. Over the past 20 years the tendency has been, in regard to the validity of patents, to become a good deal less certain than it was previously. You have had the spectacle of quite a number of very good patents on very fine inventions being held invalid for reasons which are more technical than substantive. This brings a certain amount of discredit to the whole system and again dilutes the encouragement for investment and research which patent systems are supposed to have.

We have two other areas in which we feel Government policy might be directed. We have been quite concerned with the extent to which legislation affecting the patents appears to have been initiated in one Government department or another and brought to a stage of substantial commitment before all of the various, possibly conflicting, policies of other Government departments have been tested in order to see the effect that a particular piece of legislation might have. We had advocated setting up an interdepartmental consultative body that could be assembled, from time to time, as needed on at least an assistant deputy minister or deputy minister level. This would be to insure that the patent system is not rendered less effective by conflicting provisions creeping into the patent laws. You have one at the moment on Bill C-102, which is about to become law. Some of the provisions in that bill are directly in conflict with some of the general provisions of the Patent Act.

Finally, we have another important concern with the fact the Government at least seems to regard itself as not being in a position to legislate in certain fields, such as what might be called abuse of commercial relations, price control and various fields of that sort. When the Government feels that it should control certain practices it seems to resort either to the criminal law or to the patent law. In our view this has a very bad effect upon the patent law, because it begins to render it more uncertain and again introduces things which tend to conflict. We suggest that some kind of a study group be initiated on a non-political basis, because of the sensitivity of the subject, in order to examine the question of exactly what legislation authority is required to enable the federal Government to legislate in this area so that it would not have to resort, on the one hand, either to the criminal law and, on the other hand, to the patent head of legislative authority.

In summary, this is what our brief says. Before closing, I should like to introduce to you my colleagues, who have come here with me today. We have tried to bring you a cross section of people in our profession in case there were any questions directed to specific areas. First of all, Mr. Bernard F. Roussin, the Past President of the Institute, being President in 1962-63. He is the chief patent and trademark man for Canadian Industries Limited. He is responsible for all their patents and trademarks and, therefore, is in a position to express the corporate point of view. Also, I might say that he is the only one of us here today who is bilingual and could, if need be, answer any questions in French. We have Mr. Peter Kirby, who is Immediate Past President of our institute. Mr. Kirby is in a patent agency in Ottawa, which is a private practice and he, therefore, has daily dealings with the patent office and with Canadian and foreign clients whose affairs are before the patent office. He knows the inner workings of that very well. Mr. Kirby has just returned from the Congress of Associations for the Protection of Industrial Property, the international association of which is having its Congress in Venice.

These are the people who are responsible for putting forward amendments and bringing up-to-date international conventions. There is mention of this in our brief. Mr. Kirby was a delegate of the Canadian group and he is also a member of the joint committee that we have with this international group concerning the proposed patent Co-operation Treaty. This is a movement which is coming forward internationally for the purpose of obtaining more uniform patent laws in the various countries of the world.

Finally, I should like to introduce Mr. David Watson, who is the Member of Council of Patent and Trademark Institute of Canada. Mr. Watson is a barrister and solicitor and principally concerned with the contiguous side of law. Our principal concern with the litigious side of industrial property law, and spent a good deal of time with the correction of mistakes that others make when we find patent applications that do not say what they should.

I myself have no particular area of expertise. I did a little bit of everything in this field, so I thought perhaps I should bring a few experts with me in case anybody asks anything that should be answered by experts.

The Chairman: Thank you, Mr. Smart. Now we will hear from Mr. John C. Parkin, Chairman of the National Design Council, and a well-known architect.

Mr. John C. Parkin, Chairman, National Design Council: Mr. Chairman, honourable senators, I am joined this morning by Mr. Philip Weiss, who is Design Advisor to the Department of Industry, Trade and Commerce. Mr. Weiss will comment later on certain parts of the submission.

Madam and gentlemen, you have in front of you our detailed brief, a synopsis of which I should like to put before you.

The National Design Council was formed by statute in 1961. It consists of some 17 members, 5 of whom represent the fields of industry, commerce and organized labour. Two members are chosen from the field of the distribution of goods; 4 members are from the design professions, architecture, design, and engineering; 4 members are members of the civil service departments, of agencies of Government.

I may say that we are singularly fortunate in having the good office and presence in our deliberations of the deputy ministers of the Department of Industry, Trade and Commerce, Public Works, Supply and the Secretary to the Treasury Board; so in this most important of factors influencing the environment in which we live, Government itself, there are already important steps being taken to initiate changes in the established form of things, which is basically our objective.

It is the view of our council that the proposed science policy should be more definitively and more definitely directed to the needs of our economy, and particularly to society itself. We feel that, quite apart from the other cultures in our country, that we in industrial design—and in fact those who are practising design of all kinds—engineering, architectural and industrial designing—are at the interface of the Arts, Technology, Humanities and Science. Lord Snow, the first to put forward the concept of the two cultures, now admits to a third culture, and that includes, of course, Mr. Chairman, the area in which your original training was secured.

Scientific research and development, we believe the activities should be more closely integrated with other essential activities of the industrial and commercial processes of our country and directed to the advancement of our position in both our domestic and export markets.

We believe that critical to this whole issue is industrial design itself.

For example, we recognize the rather singular advances of Japan, from a nation which was backward in design terms and which, a generation ago, was a paragon for taking the easy path of imitation. One can no longer say that this is so. In fact, some of the most handsome and most efficient commodities in the world today are products of Japanese invention.

We believe that there should be absolute integration between form and function. This is an ancient concept, but as valid today as in the past. Design is guided by certain precepts first put forward some 2,000 years ago by the Roman architect Vitruvius, when he said that good design should consist of three things, Commodity, Firmness and Delight. To paraphrase: good design should consist of quality in function, or commodity—quality in fabrication, or firmness—and visual quality or delight.

We are not concerned with superficial surface treatment, but very much with function, and with the kind of things which are the deep concern of the preceding two gentlemen.

We are concerned with better utilization of industrial design by Canadian industry. We believe our use of design is insignificant in comparison with that of other major industrial nations. For example, our industrial design utilization is less than $3,000 per annum per manufacturing establishment in Canada. We can scarcely claim to be creative or inventive, when our average manufacturing establishment has a design expenditure of $3,000 per annum, while the expenditure of other great industrial nations seeking the international export market, is presently quite in advance of that figure.

Our lack of design innovation is due to a number of factors. The task we face is so broad that we scarcely know at what point to begin. But one can put forward such general postulates as the general lack of awareness of the value of good design in industry and in business, and particularly the lack of attention being given to human requirements in the successful marketing of products.

We believe design is, or should be, in addition to the technologist and applied scientist, very much the concern of the behavioural and the various other social scientists.

It is the responsibility of the National Design Council, then, to create greater awareness of the value of good design, to assist Canadian industry in the development of new and improved products, through education, promotion and technical assistance activities.

Our budget is of the order of $900,000 per annum. Government is increasingly taking cognizance that this is insufficient to advance in a full and proper way the state of industrial design in our country. The successful application of industrial design, not only requires input from research and development in engineering and in the sciences, but also from the social sciences, as I have mentioned.

We are, then, in the confrontation of the two cultures—art and science.

Grants are required. We do undertake major grant programs in our attempt to stimulate the advancement of education—and perhaps you will hear more of this later.

The Council recommends in our brief that:

> (a) In order to improve the competitive position of Canadian manufacturers both in domestic and export markets, comprehensive joint programs should be initiated by the federal Government with manufacturer associations and provincial governments to encourage increased design innovation and the application of industrial design.

The next point I should like to leave with you is:

> (c) Greater emphasis should be placed on basic and applied research dealing with the relationship of man to machines, systems and environments in order to overcome the lack of consideration for human requirements in the design of Canadian products and systems.

Design is indeed the most delicate of balances, whether city planning or the design of a small and quite ordinary object, in fact, a balance between all of the technologies.

Industrial design should be given greater emphasis and there should be more attention to exploiting it fully as the means of achieving governmental industrial trade development goals. Since these are rather imprecisely defined or formulated at the moment we recommend joint programs be directed to achieving specific industrial trade objectives in selected sectors. Since the program is so vast we must single out samples and take an overall view. For example, in the case of school furniture, office systems, office environment and so on. We must establish long-term and more immediate-term goals.

Such programs should be supported by the necessary scientific activity in engineering, and the natural and social sciences.

The proposed science policy, in our view, should make provision for supporting such programs.

In the field of education, always a delicate matter, we have some views which we trust are discreet. The lack of awareness of the value of good design and the minimal use made of industrial design by Canadian industry, is in part owed, we believe, to the lack of emphasis given to this subject in general education and, more specifically, in terms of developing design capability at the technical and university levels.

Here might I suggest, that while we are creating literate Canadians from a literary point of view we are at the same time creating illiterate Canadians from the visual point of view. Because of lack of visual awareness, over 60 per cent of the industrial design decisions in Canadian industry are made by engineering departments and the owners or officials of companies who have no specific knowledge or responsibility for the design function.

Other parameters and criteria are not, in our view, taken sufficiently into cognizance. The National Design Council initiates educational activities such as exhibitions, audio-visual programs and seminars; it maintains extensive library reference facilities in both Place Bonaventure in Montreal and also on Bloor Street in Toronto. We hope to extend these across the country as funding permits. Moreover, the National Design Council provides an advisory service to assist educational institutes in the formulation of design curricula.

In the matter of education, in direct support of the development of design capability, the Council sponsors an annual program of scholarships to assist students and professionals in undertaking advance design education. Although a number of educational institutes offer courses in industrial design, the majority of our students must go abroad to gain the desirable quality of education. Our educational facilities are inadequate. We have no viable post-graduate training in the field of industrial design. We have very little, in fact, in the other aspects of environmental design, at least in terms of modern concepts. The Council, therefore, recommends that stronger support should be given to the development of Canadian industrial design capability at the various levels of education oriented to the requirements of Canadian industry.

While we recognize that we are discussing science policy today, the implications of our interrelationship with the Canadian Housing Design Council, the National Research Council and the Canada Council, make our role fundamental in the formulation of the general culture of our country.

The recommendation for stronger support should be implemented in close co-operation with educational authorities responsible for science and related faculties at the technical and university levels and with industrial interests to ensure that the development of design curricula are closely interfaced with scientific education and the needs of Canadian industry. The proposed science policy should make provisions for supporting the development of Canadian industrial design capability, particularly with respect to the science-based industries.

I should like now to deal with the total environmental aspect of design. This has to do with that much bandied phrase, "the quality of life".

As a marginal note, I should mention that in the preface of the report of the Massey Commission there was a quotation from Saint Augustine's "The City of God". That quotation while apt in the original report of the royal commission leading to the inception of the Canada Council is equally apt here, because the National Design Council is also concerned with the "quality of life".

> A nation is an association of reasonable beings united in a peaceful sharing of the things they cherish; therefore, to determine the quality of a nation, you must consider what those things are.

The first point we should like to put forward is that the economic and social success of a nation, to a considerable extent, is measured by the design quality of its communities on the largest of scales, by architectural and engineering achievements on the intermediate scale and by products themselves on the smallest but by no means least scale. All of these help to add up to the total ecological or environmental system.

We are concerned with the total environment. We believe it can be demonstrated that well-designed living and working environments are conducive to social well-being and to greater productivity.

The value of good design to an economy and society can be demonstrated. Conversely, so can the negative effect of poor design. In fact, we need only look to the south of this nation to see demonstrated today the negative effect of poor design, whether it is environmental design on the scale of cities, in the scale of inadequate habitations or in the rooms in which people live out their lives.

The most undesirable implication of poor design is that it can contribute to economic and social stagnation. Poor design also can be detrimental to the basic maintenance of the economy and society. For example, poorly designed large-scale urban developments, including housing, educational and hospital facilities and transportation services, not only result in adverse social conditions but lead communities into financial crises. Poorly designed systems and products have created almost insoluble problems such as air and water pollution, traffic congestion and urban blight, which divert valuable human and financial resources from more constructive applications. It is, therefore, not only important to appreciate the value of good design, but is important to recognize the detrimental implications of mediocre and poor design.

On my way to the committee meeting I clipped an article from today's newspaper, entitled "Union Carbide". While another American innovation, we will be the richer for it eventually. Union Carbide has just developed a new system for creating underground superconducting cables for electrical power transmission to urban areas.

For too long we have been subject to the urban blight of overhead high voltage transmission lines but a utility may now find it possible for something less than the present $1 million per mile to place high voltage lines underground. This kind of scientific breakthrough, will add to the urban "quality of life". The land inventory thus created by such inventiveness will hasten the realization of parks and expressways.

All levels of governments have the major responsibility for the nation's physical environment both directly, in the implementation of their programs of public works and procurement, and indirectly, by the standards they set for the private sector. The government itself sets examples to the entire private sector, whether by an ill placed or badly designed post office, a badly designed postage stamp, an ill printed government document or anything else. We believe good design requires a total systems approach.

With a few notable exceptions, the majority of government agencies do not apply good design practice in their areas of jurisdiction, particularly as it pertains to human requirements. With the help of the four deputy ministers with whom we are associated, we are addressing ourselves to this major problem. The Council, therefore, recommends that good industrial design practice should be made mandatory in the formulation and development of governmental standards, procurement and public works policies and activities.

Since the state of our physical environment is causing such major difficulties in Canada's society, greater scientific activity should be directed to the resolution of problems and the application of better design solutions which incorporate the most up-to-date knowledge from the fields of engineering, natural and social sciences.

Science policy is very much involved in the quality of life, then, in our own environment, and should make provision for the adoption of such policy and the interfacing between science policy and the quality of life.

Finally, in respect of governmental incentive programs, the National Design Council has initiated a broad range of activities to stimulate greater design activity. While some progress has been made, it is becoming increasingly evident that persuasive and promotional means will not suffice in many important areas of industry and other sectors of the economy.

The Council, therefore, recommends that more positive provision should be made in support of industrial design in governmental incentive programs for the advancement of science, technology, industrial research, development and innovation.

One final comment, industrial design should be considered as an integral part of incentive programs, not an additive part, and should be more specifically defined as an eligible activity within the framework of existing incentive programs. If necessary these programs should be modified to give greater support to design research activity.

The Chairman: Thank you, Mr. Parkin. The three associations we have heard this morning up to now, as I am sure you will all have noticed, are related very specifically to the innovative process. As you very well know the innovative process is very closely connected with science policy.

Finally we will hear from a professional association, the Royal Architectural Institute of Canada and more specifically from its president, Mr. McMurrich.

Mr. Parkin: I am sorry, Mr. Chairman, they just do not seem to be here at the moment.

The Chairman: Well, that will shorten the first stage of our proceedings this morning. We can go into the question period. However, I am sure Mr. Parkin will be able to answer some questions in this regard because he is very well versed in this field as well.

Mr. Parkin: I am scarcely in a position to speak for an institute of which I am but one of 2,700 members. I am somewhat chagrined to think that they are late.

The Chairman: Perhaps for once it will be nice to hear from one of the backbenchers.

Mr. Parkin: Well, if there are questions concerning the role of the architect and his concern for the urban society, I can say that a number of years ago I served on a group under federal subvention which was concerned with a housing task force report which came up with many views similar to those of Mr. Hellyer—while a few were dissimilar. In the successive years the institute has become less and less concerned with the design of isolated buildings as opposed to the design of the total environment. However, I hesitate to speak on their behalf because I might, after all, be excommunicated.

Senator Kinnear: I have some questions on national design. R & D is only part of the innovation process. Without superior and acceptable design the essential aspect of innovation—success in the market place—cannot be attained. Design is important to exports today because for some product markets it is innovation and not low price which is the determining factor. Some examples where design has been well integrated with technology come to mind: computer equipment, some Japanese domestic electronic devices and, of course, Scandinavian designed household products which have had a world-wide impact, and market.

Could the witness describe the background of the Scandinavian success? Has it depended in part on "design research" or government assistance regarding same?

Mr. Parkin: Some years ago on behalf of the Council I was fortunate enough to visit a number of countries to inquire of their governments as to the evolution of design which had been exceedingly rapid, particularly in the Scandinavian countries. We are rather prone, I think, in North America, to regard the nature of the Scandinavian design as something "which has always been there". In fact what we now regard as superlative Danish furniture, Finnish crystalware, and Swedish cutlery started about 1925 in Denmark at least, when substantial government moneys were directed to the encouragement of the craft guilds and trade associations. These associations are very much like medieval guilds and in constitution they are self-disciplinary. They adopt a very hard line, particularly in Denmark, against those members in a certain commodity area who infringe the design of any other designer. This involves punitive action which is self-disciplinary in character. As a result the Danes have been allowed or encouraged to create a high system of innovation and creativity. The one thing lacking, and I hope the media will not misunderstand me when I say this, is that there has been an enormous emphasis essentially in the craft industries, each of which has a much older history in Scandinavia than we have in our country. In the Scandinavian countries the oldest design association is 140 or so years old. It was originally craft-based. Scandinavian design has not moved from the craft-based industries to white goods and manufactured articles with equal success. Design in the Scandinavian countries and also in Italy has created a great post-war export market for good design. Their governments put constraints on those exports of commodities which are anything but good in design so that the national image or national quality results in a collective and cumulative advertising or marketing thrust. I think Mr. Weiss might wish to add a word to this.

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Mr. Philip Weiss, Design Advisor, Department of Industry, Trade and Commerce for National Design Council: I think the Scandinavian situation is the one Mr. Parkin so well described. The Japanese situation is even more exciting and more contemporary. I have with me a very brief paper on the design activity in Japan. In 1958 the government established the design section now called the Export Inspection Industrial Design Section in the Ministry of International Trade and Industry, and have actually established 150 design research centres which are maintained at a national and local level. They combine science and technology in the crafts and the combined effort is directed to specific areas. They have others dealing with textiles and computers and sophisticated electronic equipment. The most interesting, along the lines Mr. Parkin mentioned, result of their concern for their standards and for their image has caused them to initiate legislation, controlled by industry itself, which prohibits the export of plagiarised designs.

They are so concerned about overcoming this negative approach of the pre-war period that it is practically a criminal offence to export a commodity the design of which has been borrowed from another country.

Their action has been extremely extensive, pre-determined and very much a thorough effort in this connection, and, of course, the results are reflected by the Sonys, the Hondas and the sophisticated equipment coming out of Japan now.

Senator Kinnear: Yet somewhere in this brief you say we should take the best of east and west. That would not go down at all well with Japan.

Mr. Parkin: I think this is a more philosophic observation, Madam Senator. Criticism may be directed at our Japanese friends, insofar as they have taken for their domestic use some of the worst and most garish aspects of western culture. We could well borrow the Oriental quality of simplicity, a redirection of the interrelationship between function—how things work—and the form of objects; developing the form around function. At times I suspect some of the public thinking of industrial designers merely as streamliners who put surface adornment on things and who design "nifty" things to put on objects after they have been produced.

We have a profound relationship to the gentleman on my right. In our attempt to give logical and rational expression to function I think we should borrow the fundamental Asian concept of simplicity and serenity in the design of things.

Senator Kinnear: That is Scandinavian too.

Mr. Parkin: Yes, whereas the North American objective appears to demand a layer upon layer of things of "creative obsolescence" which, in our country at least, we can ill afford.

Senator Kinnear: Are there any examples where good design and design research have established an international market for us?

Mr. Weiss: There is one case we have mentioned in our brief, Madam Senator, that was a direct result of one of the research projects that we supported. This is the case of a Dr. Coburn in the dental profession, and this is an extremely interesting case. There was a consensus among the profession that the whole operational arena for the performance of the dental function was antiquated. There was a tremendous loss of dentists, in terms of mental and physical fatigue, and the patients themselves were not reacting properly to the environment.

The Chairman: I am glad that they suffered too!

Mr. Weiss: As a result, Dr. Coburn, with some support from us, undertook extensive time-motion and human behavioural studies, and evolved new basic criteria and a system for the development of the total environment, including the equipment. This is very recent, because the project itself was only completed about six months or so ago.

Several Canadian manufacturers have taken up the concept and are now producing approximately half a million dollars' worth of new equipment for dental stations, 80 per cent of which is being exported to the United States. This is a very minor example in what might be considered a relatively insignificant field.

Senator Grosart: That case is detailed in your brief. The question that occurs to me is: Has Dr. Coburn a patent?

Senator Haig: He will get it in three years.

Senator Grosart: No. Has he a patent now?

Mr. Weiss: The system...

Senator Grosart: No. Is it patented?

Mr. Parkin: I cannot answer that, but I would like to take an easier example.

Senator Grosart: No. We are dealing with this, and you speak in your brief about the thrust being to be first on the market with a better product. It is rather interesting that nobody knows whether Dr. Coburn has a patent on this because you funded the research.

Mr. Weiss: The research is for public distribution. The manufacturer who takes a concept and develops it into a product, he has the privilege of patenting it; but the basic concept and criterion is public knowledge, so any manufacturer can take the basic research and apply it to a product, but the concept itself is not patentable.

Mr. Parkin: A more ready example is Mr. Bombardier and his Ski-Doo, which established and maintains 50 per cent of the market in North America and is phenomenally successful, as on export item. As a concept, it is a direct consequence of the climatic conditions of this country. We have something that has sprung from ourselves, rather than being imported. At the same time, it is a handsome object. It was not so in the earlier stages of design development, but it has evolved into a very elegant piece of machinery.

Senator Bourget: Did you help in the designing of the Ski-Doo?

Mr. Parkin: They have a pretty sophisticated design staff of their own.

Mr. Weiss: We have promoted the design and brought this to the attention of the public years ago, not only as a well-designed item but as a demonstration, really, to industry and commerce as to what can be done through the proper application of design. It has this two-fold function of promoting the sale of well-designed items and also to bring them forward as a demonstration of what can be done with proper application.

Senator Bourget: Is there a liaison between your council and, let us say, the steel industry in the construction of bridges and things like that? Do you have some contact with them?

Mr. Parkin: Indeed, we do. In fact, we attempt to encourage joint programs where we provide seed money, provided there is an industry input. We have done this with the Canadian Institute of Steel Construction, with the alloy groups, with the Society for the

Plastics Industry of Canada, the wood and timber industries and with the Portland Cement industry. There are perhaps 12 trade associations of a national character with whom we have collaborated. We will not participate unless it is a shared-cost joint venture between the private sector and ourselves. We believe this has to be correlated.

Senator Kinnear: Here are some quotes from your brief:

> Expenditures by Canadian manufacturing establishments on industrial design activity are insignificant in comparison to other leading industrial nations.

That is in the first part of your summary. Then:

> As a result, the general quality of Canadian design does not compare favourably with that of other countries:

That is the second paragraph of the summary.

Then you speak of:

> ...the lack of consideration for human requirements in the design of Canadian products and systems.

That is in recommendation (c).

> ...one of the major deficiencies in the design of Canadian products and systems is the lack of proper consideration for human requirements...

That is paragraph 2.7 on page 3.

But in the brief it says:

> ...the mean expenditure per annum by Canadian manufacturing establishments in industrial design ranges from $100 to $3,700.

That is at page 3, paragraph 2.7. Again, in the brief there is this:

> .. appreciation of design and desire for concerted action does not exist amongst the majority of the decision-makers in Canadian industry and Government...

That is at page 5, paragraph 2.10. This is echoed again in paragraph 4.9.1 on page 11.

I am wondering if it is frustration, or a lack of good designers.

Mr. Parkin: It is rather difficult, Madame Senator, to conjecture, but I assume that the proximity of the New York market, and certain other things such as inertia and "the path of least resistance," has caused certain parts of our economy to be copyists rather than originators. Here I am taking a great risk at over-generalizing.

We are also slightly schizophrenic to the degree that the retailer turns to the manufacturer and says: "No matter how innovative you are, we simply cannot sell that product." Some suggest that good design is the so-called "kiss of death". We have the Canadian Association of Consumers telling us that they want better products, and the elimination of the extraneous. So, we have this terribly difficult problem of bringing along in a kind of parallel way, the distributor, the department stores and the small merchants. We must bring along the manufacturing agencies, the manufacturer and the industrialists. We must bring along the purchasing agents, the municipal officials and the consumer. After all this, we really come back to where we start, in that in our concern—as I put it earlier—for high literary culture we have been somewhat prone to ignore our visual culture.

Mr. Weiss has just reminded me of Place de Ville here, which is the office tower occupied by the Department of Industry, Trade and Commerce in which three extra floors of space were provided by the use of well designed furniture. The members of the Senate are well aware of the vast increase in the cost of accommodation here in the capital over the last five years. Mr. Weiss and his department, because they have developed a new approach together with the Departments of Supply and Public Works in the use of modular furniture, will save the Department of Industry, Trade and Commerce $2.5 million in rent over ten years, because they have evolved furniture which is based upon time and motion and comfort conditions, and which gets away from the conspicuous waste of space, which is so inefficient, while at the same time creating a solution which is usually delightful.

I think the members of your committee, Mr. Chairman, might wish to see that living example of how good design has already been applied.

Senator Grosart: But consumers, on the other hand, tell us that they would rather have less design in the package and more cereal in it.

The Chairman: Yes, that is what he implied.

Senator Kinnear: At page 13 of your brief, in paragraph 5.3, you say:

> Canadian universities or other educational institutes produce few graduates in the field of industrial design—

And in Appendix B under "Profession" it is stated:

> Canadian designers appear to have been trained for the most part in the U.S. and those that were trained in Canada go elsewhere for employment. These facts indicate that Canadian designers... are unsuitable or not required in Canadian industry.

Further on it is stated that within Canadian industry there is "almost an entire absence of professionals in industrial design", and "the professional design societies within Canada appear to have a very complacent attitude towards these conditions and also seem to lack the motivation or incentive to create change within Canadian industry to improve and foster design and design innovation".

However, in Appendix B under "Education" it is stated that we have no statistics on the movement of Canadian design graduates. In Appendix B under "Education" it is stated:

> In comparison to similar institutions in the U.S. and U.K., Canadian institutions come out comparatively poor. An attitude of complacency exists in relation to the degree of content...and placement of designers within industry.

It seems that we do not properly train designers, and that industry does not want them in appreciable numbers anyway.

We have heard repeatedly that research is a handmaiden of education, and on page 24, paragraph 10.8, three university departments are mentioned in which design research is linked to education. Do these schools train designers in the aesthetics and human performance aspect of products as well as in the most modern technology of materials and processes?

Mr. Parkin: Mr. Chairman, we have been gratified by the initiative taken this year by the University of Montreal in a new concept of design education, in the field of environmental studies, whereby design is thought of as a totality involving planning, architecture and industrial design. We should begin to create at a professional level a grade of industrial designers, a cadre of men who will be able to speak to the higher echelons of government and to the private sector, and eventually, one trusts, influence them.

We have been training designers at the technical and technological level to date. We have not been able to reach out to those who make the decisions in this city and other cities across the country.

The University of Waterloo has a very fine emerging professional level course in industrial design. We believe that this is much sounder than training designers at colleges of art. We have nothing against a diletante viewpoint, but we believe that design is a fundamental expression of today's technology tempered by a concern for quality.

Mr. Weiss has just reminded me that of the eleven most recent graduates of the University of Waterloo, ten went to the United States and one stayed in Canada.

The very environment of this nation is in substantial part designed—and I say this with due respect—by those who live in the country to the south of us. In the reality of this, we would ask: What is the purpose of all the good intent of the Canada Council, and of all the other organizations through which we strive to secure a national identity—a sense of being Canadian—when the environment—from the rooms in which we live and the cities in which we act out our lives—is designed from New York, Chicago, or some other place in the United States. Our cities, and the objects in them, must be designed by those who understand this country best, and we believe that they live in Montreal, Quebec City, Toronto, Vancouver, and Winnipeg. They do not live in the country to the south.

Senator Kinnear: It made me wonder whether we should not have an institute of design in Canada. I have so many questions here that I do not think I should proceed, because I am taking up the time of other members of the committee.

It is, however, demonstrated in the brief that Canadian industry does not use industrial designers and does not appreciate their need. You have partly answered this. What, therefore, will the graduates of these schools do? You have answered that by saying that ten out of eleven go to the United States. Are we going to produce, once again, another surplus of highly trained people, like Ph.D's in the pure sciences? Do you wish to elaborate on that, or do you consider it already well answered?

Mr. Weiss: I think the reason some of the graduates in this particular case left for the States was that their education was far too sophisticated for the needs of Canadian industry. This was a post-engineering course, a highly sophisticated industrial design course, and there was not a need for their talents on the Canadian market. I would say with respect to your other question, we are recommending that industrial design training be more closely linked with the needs of Canadian industries.

Senator Kinnear: Would it not be a good idea to put these men into our own industries and paid by Canadians, so that they can help our industries reach a more sophisticated attitude towards their products?

Mr. Parkin: This is where we believe the adoption of incentive programs may be of help, just as the recent incentive programs directed to pure research, applied research, have been so successful. I mentioned Sheridan Park. We believe that studies should be initiated by government to explore the possibility of adopting such incentives to encourage specifically Canadian design.

Senator Kinnear: I hope so, and I hope it is done soon. How many industrial design schools de we have here?

Mr. Parkin: At the university level we now have, I would guess, three.

Senator Kinnear: Is it just the three you mention in the brief?

Mr. Parkin: There is l'École du Meuble and the Ontario College of Art in Toronto, which are diploma courses. In total we might have perhaps five. We believe that this is a university level situation. Technicians and technologists are very much part of it, but we believe that at the top there should be a professional qualification.

Senator Kinnear: I have three pages of questions but I will not ask them right now. However, I should like to comment on the article you quote from the paper about high voltage lines being put underground to transmit power. Will this be done directly from power stations, instead of those very ugly towers they have been using? I know the hydro is ready to put out a new type of tower to carry the lines. Would it be possible to carry all that high power underground?

Mr. Parkin: I suspect whatever would be done, would be the result of a cost effectiveness analysis. When this becomes available as a production item by Union Carbide it will likely first occur in urban areas.

Senator Kinnear: That would not be nearly as high as the big power lines?

Mr. Parkin: The penetration of high voltage transmission lines into the innermost core of our cities is something we can all see, with the consequent erosion of our land inventory. We can regain some of this land for superlative rights of way for commuter lines, expressways, parks and so on.

Senator Kinnear: I know they take up a long line. Those are all the questions I will ask at the moment.

The Chairman: We might come back to you, Senator Kinnear, later on.

Senator Haig: I would like to ask a question of Dr. Jenkins. Where does your association stand on the use of the metric system?

Dr. Jenkins: As a result of a survey we made of industry we came to the conclusion that there are many merits in the metric system, and that we should have to bear in mind two major markets. There are those countries now using the metric system, with whom we want to develop our markets, and yet we must bear in mind that for many of our commodities our major market is the United States. For us the ideal solution would be if the United States went to the metric system, but until such time as the United States does we should try to keep in step here, although our industries have indicated that for special markets they are willing to use the metric system. At present, our wood industry, whose big market has been in the United Kingdom, is continuing to manufacture on the inch system, but is specifying material going to the U.K. in the corresponding metric system. In the survey we made of industry we ran into no opposition to it, and most of those reporting felt that there would be no outstanding technical problems. One, of course, is the question of economics.

Senator Haig: In the conversion?

Dr. Jenkins: In the conversion. They do not want to have to set up two production lines, one manufacturing to the inch and the other manufacturing on the metric system. For that reason we have been much encouraged by the United States Senate setting up this three-year study to be carried out by the U.S. Bureau of Standards.

Senator Haig: I should now like to turn to Mr. Smart and his presentation. Do I understand from reading your brief, Mr. Smart, that you say the Patent Act is not effective because of the slowness of granting a patent?

Mr. Smart: In our opinion the Patent Act is less effective than it should be, because of the slowness in granting a patent. We do not go so far as to say that it is ineffective.

Senator Haig: What does a "patent pending" mean?

Mr. Smart: That is a notice a person who has applied for a patent may put on his product to indicate he has an application pending, and that a patent will probably issue on that product.

Senator Haig: You also said in your presentation that I may apply for a patent for some new inventive process and not get the patent for three to four years, by which time it is out of date. What is the use of a patent if it takes so long to obtain one?

Mr. Smart: Some inventions have a short life. For instance, novelty toy might be very popular for two or three years and then lose its popularity. If the patent on that toy were not to issue for four years it would be an exercise in futility, as you suggest.

Senator Haig: If the patent-granting method were improved, do you think it would increase research and development?

Mr. Smart: I think it would be very difficult to prove by facts and figures that such is the case, but I would very strongly be of the view that if all of the deficiences that we see in the present-day patent system were removed so that patents were more or less instantly granted and could be relied on to mean what they say in terms of enforcibility, investment of money in corporate research and new plants in order to put into practice the results of that research, the incentive would be much greater.

Senator Haig: Do you think, Mr. Smart, that the use of the computer in this system would eliminate the amount of researching that has to be done?

Mr. Smart: According to the best information I have been able to obtain from consulting people, who are in the actual business of computerizing patent information, there are some firms in the United States that have been in that business and one in particular that I mentioned in the brief. The amount of time that a patent examiner would have to spend in relation to the research of the documents and applications would be cut down to 10 per cent of what he has to spend in the manual research.

I have been told by the officials of our patent office that an examiner spends approximately 10 per cent of his time in gathering the documents which he must look at in order to reassess.

Senator Haig: In relation to that patent?

Mr. Smart: Yes.

Senator Haig: You mentioned page 25, 6 and 3. "In relation to proposed legislation affecting patents", what do you mean by that?

Mr. Smart: In the process of initiating legislation it very often happens that legislative ideas will take general form within a particular department and will go from that general form to almost a stage where a department is committed to a particular expression, shall we say, of this idea before there has been any input of reaction from other departments that might be affected. For instance, one might take a hypothetical example and say the Combines Branch might have an idea on some specific feature of legislation which they think would be a good thing, from the point of view of combines investigation. That same idea may be completely repugnant to the—I do not know the name of the department—it used to be the Department of Industry.

The Chairman: Industry, Trade and Commerce.

Mr. Smart: It might have a very serious objection to a particular provision of that kind. My suggestion is that there should be some kind of body which could be convened and which would test the views and the various conflicting areas of government policy before the legislation concerned gets crystallized to a form in which the original sponsors become really obliged to put it forward in a certain form.

Senator Haig: At the deputy minister level.

Mr. Smart: I think it would have to be at least that, senator; preferably at the deputy minister level or certainly at no lower than assistant deputy minister level.

Senator Haig: Thank you, Mr. Smart.

Senator Bourget: Mr. Chairman, I should like to ask Mr. Jenkins about the budget. You said that your budget for administration publications was around $327,000, and in addition to that you say that you have six divisions. What is the total budget then for administration, publications and your six other divisions?

Dr. Jenkins: About $4,750,000.

Senator Bourget: This money comes from where? Is it from members?

Dr. Jenkins: In the preparation of the standards the committees are made up of members who devote their time. Then there are firms which are called sustaining members and they make grants to the CSA for the writing of the standards, the publication of the standards and we aim to make a small profit on that. It is by donations from the sustaining members, industrial firms and profits on the sale of our publications that give us the funds for running the division responsible for standards. In regard to the other divisions responsible for service cases, there is a charge made plus about 4 per cent. This is a charge of the actual cost of carrying out the tests. They have a professional and technical staff, but the board of directors and administrating boards concerned with these divisions all work on a voluntary basis.

Senator Bourget: In your labs what does the staff consist of? Are they engineers, metallurgists or others?

Dr. Jenkins: In the administrative division, concerned with administrating the standards, they are mainly civil engineers.

Mr. F. A. Sweet, Canadian Standards Association: We try to cut across the entire engineering field. At the moment we have a civil engineer, an electrical engineer, a metallurgist, a forestry engineer and a technician in the drafting field.

Senator Bourget: They are Bachelors, Masters or holders of PhD's?

Mr. Sweet: That is right.

Senator Bourget: They are?

Mr. Sweet: They are mainly engineers.

Dr. Jenkins: In the testing laboratories where they have a staff of 75 they are mainly electrical, civil and mechanical engineers. In the welding bureau I believe there are eight professionals. They are mechanical and civil. In the Canadian Lumber Standards Division and the Structural Glued-Laminated Timber Division the staff is very small. There are four from industry, and four of the leading consulting engineers in Canada. It is that administrating board that does assessments.

Senator Bourget: In your laboratories you make only tests of materials; you do not make any research? Am I correct in saying that? You make tests about timber, such as testing its strength, compression, et cetera. You do not make real research?

Dr. Jenkins: The laboratories primary concern is the testing of products to a CSA standard for the development of a new product or a new piece of equipment. It often happens that the standard for that has not yet been written so the staff will have to carry out a certain amount of investigational work to determine the best way of testing the qualities of this product. There is no research, in the exact term, carried out. There is a certain amount of development work.

Senator Bourget: I suppose that as a new product is developed, then the research would be made by the person or the company that will develop this product, and then it will be sent to you for you to analyze and recognize this as a standard?

Dr. Jenkins: One of the interesting things about the writing of standards for a new product or a new technique is, when you get into it, to have a balanced committee, consisting of industrial members, users and government.

When you get into it you find that often there are surprising gaps in the technical data available. Certainly, when I was connected with the laboratories of the federal Government, one of the interests I was so keen on was the committee work on standards, as a lot of our research projects resulted from attempting to write standards.

It was surprising how many gaps you find there are in research knowledge, when you actually start to apply that information in a technical standard. So standard writing does foster research, and it is done not by the CSA itself but all those who work on these committees.

Senator Bourget: Do you at times get the advice of universities? Do you work at some laboratories in universities, or the NRC, or some of the government agencies here?

Dr. Jenkins: When there is an apparent requirement for a new standard, it is investigated; and if there is a need for it, then a committee is set up. In selecting that committee we not only get the industry people but we try to get engineers and university staff who can make their contribution to it.

One of the encouraging things about it is the way in which leaders of the university staff and consulting engineers are willing to devote their time in working.

Those on several of my boards and committees, after a year or two, have said that they have learned a lot from it, too. It is a two-way flow.

Senator Bourget: When you require the services of a university laboratory, do you have to pay for that?

The Chairman: Or a government laboratory?

Senator Bourget: Or a government laboratory?

Dr. Jenkins: If it were actual testing, if there were a standard or code already prepared and if you were a manufacturer, say, who wanted testing done to that standard,—supposing it is electrical equipment, you could go to the CSA testing laboratories and they would test it. Or you could go to a commercial industrial laboratory and they would test it and they would charge.

In the developing of a standard where there is a need for information, we have been lucky, I think, on all of our committees, that the members on it have had access either to government laboratories or possibly their own laboratories, and that work is done without charge.

I think the Government would be surprised to know how much development work and research work they do, as a part of their regular worthwhile program, for the standard development.

Senator Bourget: How much are you getting per year from the Government as grants or subsidies? I understand it is very little. If I remember well, it was around $45,000 or $60,000.

Dr. Jenkins: Originally we got a grant of $30,000 through the National Research Council. When that was first established, it paid not only the international dues but it also left us about $15,000 for work on national standards.

The fees of the two international organizations, ISO and IEC, have gone up so tremendously in recent years that it more than used up our grant from government. We had to go back to government again and in the last two years, pending a decision regarding the Standards Council, they have made us a grant which is for the purpose of paying our international dues. We get the cheque, put it in the bank, buy a bank order, and the same amount of money goes across to Switzerland. So in reality we are not getting a grant for our standard development work.

Senator Bourget: About your publications, are they published both in French and English?

Dr. Jenkins: That is one of the most difficult problems we have been up against, especially in the last two or three years.

Senator Bourget: I have heard that from the NRC.

Dr. Jenkins: First of all there is the problem of translation because, as you know we have to get the exact shade of meaning of the specification. We have been lucky on some of our committees. Not only have they been well balanced committees, from the view of disciplines, but they have been bicultural enough that the committee itself could do the translation. But that is quite an imposition on a committee. Two years ago, we established a special committee, headed by Mr. Gignac of Quebec Hydro, to study this problem; and they have not come up with any solution yet. Another problem we are facing in our publications is that we are working on such a shoestring that we have got to make a profit on our publications. So we try to assess the audience and we find that, with the English edition there is a much bigger public and much bigger sales.

We have published one or two in French, but the number who purchase them is much smaller. If we set a different price it is called discrimination, so we try and set the same price. But to publish it in the same type as the English edition, we lose money on it heavily. It is a very difficult problem. We have been discussing this problem with the Department of Standards in the Province of Quebec and it is one we want to try and solve, but it is very difficult.

Senator Bourget: It is difficult at this time because it is difficult to find good translators, particularly in a technical field. But I was thinking about the Government trying to help in that direction so that your publication could be published without any cost to your organization and subsidized to a fair extent by the federal Government. However, it is up to the committee to make that recommendation. In the circumstances, I think it could help.

Senator Grosart: Mr. Chairman, I wonder if I could ask Dr. Jenkins what enforcement authority there is behind the standards recommended by the Canadian Standards Association, both intramurally, so far as Government is concerned, and extramurally.

Dr. Jenkins: All of our standards are voluntary. The authority results either from a purchaser wanting to use them, or from legislated safety measures. This is especially so in provincial governments who do make certain standards mandatory.

Senator Grosart: In other words, they are not mandatory per se, but...

The Chairman: They could not be, because this is a private organization.

Senator Grosart: Well, there are private organizations whose recommendations are mandatory under our system of government, Mr. Chairman, where they are made so by law. But within the Government, I understand that the procurement policies they do make your standards mandatory in certain cases. Is that so?

Dr. Jenkins: Of course, the Government standards are those prepared by the Canadian Government Specifications Board. There is an agreement between the CGSP and the CSA that, if there is a suitable CSA standard, it will be used.

Senator Grosart: You mean that it will be made mandatory? This is a very important question.

Senator Bourget: Yes, it is.

Dr. Jenkins: It would be made mandatory either by legislation or...

The Chairman: Or by administrative practice.

Senator Grosart: But is there any case where it has been made mandatory by legislation? Is there any case where a CSA standard has been made mandatory?

Dr. Jenkins: In the provinces.

Senator Grosart: No, we are dealing with national science policy here.

Mr. Sweet: I recall that away back in the thirties there was legislation set forth where the Department of Public Works at that time called upon an existing CSA standard as having to be used for procurement purposes.

Senator Grosart: Was that in legislation or in regulations of the department?

Senator Bourget: In specifications, probably.

Mr. Sweet: No, it was in an act, as I recall—an order in Council.

Senator Grosart: That is a different thing. If there are such examples, I would be particularly interested in getting them from you, because this is the nub of the question in standards. It is all very well to say that they will be adopted, but will they be adopted uniformly across the country? For example, your motorcycle helmet standard was adopted by some provinces, but other provinces said that they would use the British standard, and still other provinces said they would use still other standards.

But the principle is that, if they are to be effective, standards must be legally mandatory. That principle, to me, is very important as part of national science policy in this field.

The Chairman: But you are interested not only in the cases where standards are enforced by legislation.

Senator Grosart: That is the first part. My second question is...

The Chairman: Your second question is by order in council.

Senator Grosart: No, there are three ways. The second way is by regulations under the authority of an order in council. Are there any cases where your standards have been adopted by regulation?

Dr. Jenkins: I don't know. So many of our standards deal with safety, especially in the electrical field and in structural design. But now, in the electrical field, say, the Province of Ontario has adopted the electrical code. I don't know to what extent the federal Government has adopted it. I don't know what authority the federal Government would say Ontario has in the electrical light requirements for this building, for example. I don't know whether the Department of Public Works has its own code. I don't think so. But I would think, where safety is required in elevators and electrical equipment, for example, the electric code that is enforced in the particular province would have a bearing.

Senator Grosart: It is true that many of these standards of safety in elevators and highways, and in other areas, are under provincial jurisdiction, and I am aware that there has been a tendency to adopt your standards in that way, but from the point of view of federal Government action and activity in this particular field of science policy, I would be very interested to know of any regulatory action based on your standards.

Now, the third area I come to is procurement. To what extent are your standards written into procurement tenders or procurement specifications?

Dr. Jenkins: The National Building Code, which also provides the building regulations for CMHC under the National Housing Act, comprises 137 of our standards.

Senator Grosart: Yes, you say that in your brief.

Dr. Jenkins: So that 137 of our standards are adopted. To that extent CMHC is using our National Building Code for the National Housing Act.

Senator Grosart: This has been on a selective basis, however. They have not adopted all your recommended standards.

Dr. Jenkins: They have adopted all pertaining to housing and building safety.

Senator Grosart: In all types of construction, both housing and commercial?

Dr. Jenkins: It would cover the lighting, structural design, lumber used in the building, cement, concrete and so on.

Senator Grosart: Again, I suggest, Mr. Chairman, it would be very helpful, if we could just have this detailed. I would like to know where we stand at the moment in terms of the endorsement of not only safety standards but standards all the way through. There are areas in the official government standards having to do with length, weight, and so on; but that is another story. However, in respect of the very good work the CSA has done, I should like very much to know these things, if it is not too much trouble.

Dr. Jenkins: We would very much like to get that information for you, and it is something I should have thought of sooner.

Senator Grosart: On page 17 of your brief you have a quotation from the proposals regarding the Standards Council. Where is that quotation from? What is the document? I am referring to the quotation concerning the proposed structure for a standards organization in Canada designed to leave the responsibility for the development of new and revised standards with existing and future standards-writing bodies, and so on. Where does this quotation come from?

Dr. Jenkins: Three years ago CSA approached the Government for an increase in our grants because of the increased cost of international standards work. We heard nothing for about a year, and then we were told that a proposal was underway which would set up an entirely new standard organization for Canada, and that Cabinet had directed the departments concerned to consult with the Canadian Standards Association. So we set up this joint steering committee under the joint chairmanship of Mr. Reisman and Mr. Warren and on it were representatives from the then Department of Industry, Trade and Commerce, and then we brought in Consumers Affairs. We were told what the Government would like to do and we worked with them to make it more workable and less objectionable.

Senator Grosart: I was mainly interested in the citation. What document does this come from?

Dr. Jenkins: Out of what we came up with what we call a proposal and this a quotation from the draft proposal.

Senator Grosart: Who is "we " in this case?

Dr. Jenkins: This joint steering committee.

Senator Grosart: I am interested in this joint steering committee. We probably have 200 around in government now.

Dr. Jenkins: This joint steering committee of the proposed Standards Council.

Senator Grosart: And this was Treasury Board, Public Works, Consumers Affairs?

The Chairman: I do not think that Treasury Board was represented. Mr. Reisman was Deputy Minister of Industry at that time.

Dr. Jenkins: This was a proposal we prepared jointly knowing what government wanted.

Senator Grosart: This is a task-force document for consideration by government?

Dr. Jenkins: And that went as a draft before the federal-provincial committee a year ago, and certain changes were suggested by the provinces and they have been included in the final proposal from which this is a quotation.

Senator Grosart: I think in your openings remarks you used the phrase referring to the Standards Council "if it stays within its terms of reference"—what are those terms of reference? Has the bill come down yet?

Dr. Jenkins: Not so far.

Senator Grosart: At the moment there are no terms of reference.

Dr. Jenkins: Except those in the proposal, and it is primarily a co-ordinating body. It will consist of a rather large council made up of different organizations interested in standards writing and certification, a secretariat and an executive committee. Its primary role is co-ordination of standards activity and to see what other gaps exist. A major change so far as we are concerned would be that the Council would take over and become the designated national body for the two international organizations, but the technical committees of all these, ISO and IAC would continue to be the standards writing body. But we feel there are gaps in the standards field despite the consumers field where the Council can play a good role. But in some of the publicity given out the impression has been given that it has concentrated on the Standards Council without any reference to other standards organizations and giving the impression to the general public that this Standards Council is going to be the one and only body. But, as I say, its role is a co-ordinating role representing Canada on the central body of the ISO and IAC. But it has the role, and this is not in the proposal, of a standards writing body and as long as that position is kept, I think we can live with it.

The Chairman: Is there not a conflict in objectives between the two councils?

Mr. Parkin: We would not have thought so.

The Chairman: But you are trying to standardize and make a more differentiated product.

Mr. Parkin: I would have thought we are concerned with working as closely as possible with CSA at least in those areas concerned with standards and objectivity. We are concerned in fact with the whole question of design legislation. The need for better design legislation is a matter of utmost concern to us. If I may turn the tables a little, we feel there is certainly an inadequate degree of design legislation. So to answer your question, I see no inherent conflict really.

Senator Haig: What does the symbol on your brief mean?

Mr. Parkin: When we were created by statute in 1961 we tried to arrive at a symbol which would indicate, like any other symbol, something meaningful. This we hope shows motion, thrust, interface and other ideas. We wanted something which, since our initials do not translate purely in both languages, could be identifiable on consumer tags purchased by the design award winners and placed on objects for sale throughout the country. We wanted a symbol which would be useful for packing cases left on the wharves of the nations. We believe that symbolism serves a very useful purpose particularly if it is accompanied by some strong propaganda to create the associative value of its worth.

The Chairman: It seems to me like Union Nationale!

Mr. Parkin: I might say, Mr. Chairman, that I was on the special Expo symbol committee while chairman of the design board at Expo. At one time it looked as if we might lose the symbol we had chosen for Expo. I hope the same will not happen here today.

Senator Grosart: My interpretation of it is that it is input, output, sometimes going up and sometimes coming down, but it never quite goes around in a vicious circle.

Mr. Parkin: We will write that down.

Senator Grosart: One other comment on the standards situation; if we had the minister here, I would ask him if the Canadian Standards Act is at long last going to have some enforcement authority in the standards field, particularly the safety field.

Now, if I may turn to the design brief; the same sort of principle comes up here, the question of enforcement. It would seem that the Government could enforce good design in its own procurement policies and yet your brief seems to indicate they do not do this.

Mr. Parkin: We are starting on such matters as the procurement of office furniture and office components. We seek to make industry more ready to adopt what I might call a kind of value analysis program. We are attempting to do this within the means we have available.

We hope to extend this through the whole spectrum and, certainly, since Mr. Gordon Hunter, the Deputy Minister of Defence Production, is a member of our Council, we have his whole-hearted support and enthusiasm. I suspect that in the passage of time this will filter through to the procurement of many objects. This is an old question, for us. So many of the things we must do must be evaluated on a subjective basis rather than, for example, objective specification of the thickness or gauge of metal or the kinds of criteria you gentlemen can identify so readily. It is not as easy in our field.

Senator Grosart: Except there is a tremendous area of objectivity in design which prompts this question: Why have design and design engineering tended to be regarded as a corollary discipline? A layman would assume it would be inherent in engineering, that it would be inherent in architecture that you would not have to say to an architect, "Now please call in a design consultant."

Mr. Parkin: We believe that design is the simultaneous process of bringing together engineering criteria, technology, visual criteria and, again, the behavioural—and I would stress that—the behavioural criteria, much of which is founded more on intuition and lore than through fact. We have very little research going on in universities or anywhere else in the social sciences and their interface with the products of the environment. I agree with you that this is the way it should happen. Design is so often thought of, not only by designers—perhaps more often than not of the old school—but particularly by some groups of laymen, as an additive process. As a matter of fact, am I not correct in suggesting that our Canadian design legislation, in so far as it protects design, basically protects a design applied, an appliqué to the surface of something, rather than the intrinsic form of the material? So, we have a kind of paradox. That decoration on that tumbler might be capable of protection, but the basic worth of the tumbler is incapable of protection. Perhaps I have used the wrong example here?

Mr. Smart: Mr. Chairman, I might be able to clarify that, because it is one of the fields we are concerned with.

Exactly what our present design legislation covers is something which has not been settled, because the statute itself is what is left of the 1905 Trade Marks and Design Act, when everything but the design provisions was repealed when the new Trade Marks Act came in years and years ago. It is antiquated and very difficult to understand. Practically every decision of the court relating to it has conflicted with previous decisions of the court in relation to it.

We had reached a stage a matter of a few years ago when any lawyer in the field would advise you that you cannot validly protect any feature of shape under our design statute. Then a case came along in which there was a novel design of a sofa, where the shape of the sofa was the thing which was purportedly covered by a design, and our Exchequer Court held that was a valid design registration and gave relief to the design owner.

So, once again we are in a situation where there is a very great need for an overhauled design statute which says what it says in clear terms, in terms which can be understood by a person who is not necessarily a lawyer, because really the person who needs to understand it is the designer.

If we do that, I would think that certainly the members of our institute would agree with the proposition that a good design statute would be a great inducement to the use by Canadian industry of original design.

I think it should be fairly clear that for an industrial concern to spend a substantial amount, rather than the rather meagre amount now spent, but say to spend $50,000 a year on design would be difficult to justify if the design could be copied by the man across the street and plagiarized.

Senator Grosart: You have given us in your brief some pretty clear indication of the changes that would make our Patent Act more effective. I wonder if we might ask the representatives of the Design Council to give us something along the same lines.

Mr. Parkin: We would be pleased to, and in so doing I would like to associate our Council with the views previously expressed.

Senator Grosart: I have read the act, but it is a long time ago, and this is the first time I have heard it described in this connotation of superficiality which I did not realize. We come back to the lumping together of trademark, patents and industrial designs, an obviously stupid piece of classification.

Mr. Parkin: I think it is fair to say it is an almost nineteenth century concept, the act being written at the threshold of this century, when design was basically "after the fact". The ceiling of this chamber is perhaps a useful instance of this kind of additive design practice.

Senator Grosart: On page 18 of your brief you project your federal Government funding from its present level of less than $1 million to about $7½ million in 1973-74. Is this a pious hope or an informed guess?

Mr. Parkin: It is a rather pious hope, sir, under present circumstances.

The Chairman: Before you go on, I think Mr. Smart would like to add another comment on this act.

Mr. Smart: There is one further observation I think I should make about the present act. In it it says, in one section, who may apply for registration of an industrial design, and it says it in another difficult to interpret way, but it has recently been held by our Exchequer Court that an assignee cannot apply. If that decision is correct, then virtually all industrial design registrations in Canada are invalid, because they are almost invariably filed by the assignee, that is, by the person who has purchased the design from the actual designer, and that is perhaps one reason for urgency in the matter of having a new statute.

Senator Grosart: I know you are also an expert on copyright, Mr. Smart, and I think you and I would agree that a lag in the revision of all of these acts in this particular field is, to use Charles II's words "unconscionable."

The Chairman: I want to ask a short question here. When do you think the Economic Council will report?

Senator Grosart: I can give you a very quick answer, Mr. Chairman. They will not tell.

The Chairman: I think the report will be out in the fall.

Mr. Smart: I had the privilege, Mr. Chairman, of spending a day with two gentlemen on the Council, and they indicated to me that they were somewhat perplexed about which aspect they should bring out a preliminary report on first. They seemed to be somewhat dismayed by the amount of material with which they had been presented, and as of the time I spoke to them they seemed to be having difficulty in respect to what their priority should be as to which side they should start with. They just would not predict. All they would say to me, as someone interested very much in when the report would be out, was: "As soon as we can we will bring out a preliminary report".

Senator Grosart: You refer in your brief to the report of the Ilsley Commission. This, I think, was in 1956.

Mr. Smart: The report, I believe, came down in late 1958 or early 1959.

Senator Grosart: They made a good many recommendations in your field...

The Chairman: Before you go on, senator, I should mention that Mr. Parkin wants to be excused because he has another engagement.

Senator Grosart: Then might I ask him a quick question?

On page 22 you give the percentage of funds available to the agency for the support of extramural scientific activities actually expended, and the percentage expended seems rather low. What is the reason?

Mr. Weiss: I wish we had included the figures for 1967-68 because they are practically 98 per cent. The reason for this is that we have been taking a much more critical look at the applications. There was a concern that some of the research was not directly associated with the needs of Canadian industries, so we were much more critical in the allocation of funds. This is the task of the Council. However, in 1967-68 the expenditures were 90 or 95 per cent of the funds available. This year we have applications for funds that are 125 per cent of the funds that we have available for R & D.

Senator Grosart: How did you spend the other half of the money over the years?

Mr. Weiss: It goes back into the Consolidated Revenue Fund.

Senator Grosart: It was returned to the Consolidated Revenue Fund?

Mr. Weiss: Yes. It is a specific budget for funding.

Senator Grosart: The vote in the Estimates specifically covers these extramural grants.

Mr. Weiss: Yes.

Senator Grosart: Was there not a howl from the design researchers, or did they not know that you had sent the money back?

Mr. Parkin: We have some rather interesting applications, and occasionally we have letters of complaint.

Senator Kinnear: I have a rather long question that I would like to put to Mr. Parkin, but I will not ask it now.

The Chairman: Perhaps Mr. Weiss can answer it.

Senator Kinnear: It is on architecture. I do not apologize for my intention to ask it when I read your curriculum vitae.

Mr. Parkin: What is your question? I am rather curious now.

Senator Kinnear: It is on technology and architecture. On page 2, paragraph 2, it is stated that since the war much greater emphasis in professional education has been placed upon the humanities and the behavioural and social sciences, and it is significant that students of architecture favour elective subjects in these fields, and will donate themselves enthusiastically to studies relating to human factors in design.

It is worrisome that the brief is not able to explicitly state an enhanced interest in science and technology. To expand on this point I will quote a leading architectural critic Reyner Banham who thoroughly considered the response of architecture to the first industrial revolution, in his book: "Theory and Design in the First Machine Age". Banham claims that the attempt to fuse the world of the machine to architecture, for example, by the German Bauhaus group, failed due to a lack of technical training, a failure to "grip fundamental problems of building technology", and a failure to understand the nature of technology itself—that is, its dynamic change-making nature. We are, as Banham points out, in the second industrial revolution, and must be concerned about the successful relation between architecture and the new technology.

Banham closes his book as follows:

> It may well be that what we have hitherto understood as architecture, and what we are beginning to understand of technology are incompatible disciplines. The architect who proposes to run with technology knows now that he will be in fast company, and that, in order to keep up, he may have to...discard...the professional garments by which he is recognized as an architect. If...he decides not to do this, he may find that a technological culture has decided to go on without him. It is a choice that the masters of the Twenties failed to observe until they had made it by accident, but it is the kind of accident that architecture may not survive a second time—we may believe that the architects of the First Machine Age were wrong, but we, in the Second Machine Age, have no reason yet to be superior about them.

Will you comment on this? Are we in danger, again, of training architects with aesthetic and social sensibilities but with only a superficial knowledge of building technology and the nature of the new technological age?

Mr. Parkin: I associate myself, Mr. Chairman, with those architects who have chosen to run with technology, although my training, like that of all architects of my age, was essentially in the empirical or intuitive method. I suspect architects have this in common with some industrial designers. The kind of blind application of intuition which seemed to strike earlier generations of architects is today highly suspect. Architects and industrial designers must in their design utilize such concepts as systems design, computer analysis, cost-effectiveness and optimization. Costs are soaring into astronomical figures. At the same time we now understand that the amounts of social capital available within the total economy are very limited.

Should there be student placement positions or hospital accommodation uncreated because of lack of shelter for schools or hospitals merely because of the wanton caprice of the architect or industrial designer playing God with aesthetics as his toy, society will render quick judgment and choose the obvious alternatives. The architect today, unlike his nineteenth century dilettante predecessor, is the servant of society. No designer can in this age continue building monuments when so much must be done. We must, in effect, reshape our aesthetic concepts and notions to fit social availability.

Architecture tends to be the mirror of the age which produces it. If architects produce only for the rich and the dilettante—after all only two per cent of the housing of this nation is designed by architects—then there is something fundamentally wrong. We have got to make ourselves more available.

I look upon all these new concepts and the computer too, as being but handmaidens, rather than something of which to be fearful or frightened. I hope that this answers your question.

Senator Kinnear: Yes. The surprising factor is the two per cent.

Mr. Parkin: It is about two per cent.

Senator Grosart: I think what you are saying is that shoebox architecture may not be nice but it may be necessary.

Mr. Parkin: I think we will simply have to adjust our ideas of what is beauty. Honourable senators may be aware that once mountains were regarded as ugly. At least, Ruskin went through Europe telling us so, and as a result Switzerland was empty.

I think a few architectural shoeboxes are a minor manifestation of the total problem. It seems to me that architecture has moved from the scale of the isolated building to the scale of the whole complex, and we must not judge things architecturally merely because of the isolated building. The richness will come from the larger intermix between buildings rather from the richness of such details as this ceiling. We simply cannot afford a room like this one any more.

Senator Haig: It is going to be changed anyway in a little while.

Senator Grosart: I agree entirely with Mr. Parkin. Last summer I was conducted around Oxford by a professor of architecture. When we visited a very modern building I remarked on what appeared to be its incongruity in the Oxford setting. He replied: "Don't worry about it. A hundred years from now people will be saying, 'Too bad our architecture today is not as beautiful as that'."

Mr. Parkin: Yes, that is very just.

The Chairman: Thank you, Mr. Parkin.

Mr. Parkin: Thank you for the very good questions. I am sorry to have taken up so much time.

Senator Grosart: I should now like to ask Mr. Smart some questions on patents. One of the noticeable things, and one of the reasons why I think there is a good deal of criticism of the patent principle, is that so few patents are registered in the name of the individual creator. Why is that? I know you make very clear in your brief what our act says about that and the difference with the American act, but why is it that so few patents are registered in the name of the individual responsible for the invention?

Mr. Smart: If I understand your question correctly, senator, you mean why are so few inventors patent owners. I want to understand the question correctly.

Senator Grosart: Yes, it is the same thing. Why are so few registered in the name of the patent owner, the patent creator.

Mr. Smart: The reason for that, in my view, as I believe we stated in the brief, is that the importance of patents to the economic system is something upon which a decision to apply money and effort to a particular purpose can be based. In other words, if it is proposed to a company board that money should be spent on building a new plant to manufacture a new product, one of the ingredients in a decision whether or not it would be justified to proceed is the fact that the new product, or the new process, whatever is the object of the decision, is properly protected by patent. In the brief we use the analogy of a patent being nothing more than a piece of paper when it is in the hands of a person who does not have the skill and resources to reduce it to practice.

Senator Grosart: That is my point. It is much more than a piece of paper; it is a property; it may be an intangible property or an intellectual property, but it is property. I think one of the reasons governments are tending today to take a non-proprietary view of the patent principle is just this. I know I need not tell you that it is the very opposite in, for example, copyright, where the whole emphasis is on the original creator, who can assign it, who can do anything he likes with it but still retain the droit d'auteur. This is one of the great strengths of copyright, that the original author or owner is always in the picture. In patents this is not so. Is this bad strategy on the part of industrial concerns and others, that they have not recognized the original creator?

The Chairman: Very often the original creator wants to eliminate himself by selling his rights.

Senator Grosart: This is the point. He can sell them, he can assign them, but history is full of instances in copyright and patents of the man who actually created something that became a very, very valuable product, dying in poverty.

Mr. Smart: As you may know, according to our Patent Act the inventor must be named; his name is on the invention whether or not he has assigned it to a corporation, so he is recognized as long as the patent is available in the search records of the Patent Office; that inventor is not forgotten, shall we say. However, when it comes to exploiting the rights conferred by a patent, I suggest it is not very different from exploiting the rights which attach to a copyright, in that regardless of whether there is a residual right, depending on the nature of the transaction by which the title has been changed from the inventor to the corporation, both the author and the inventor are getting a return, unless of course the return to the inventor is a return he gets because he is employed to invent by an employer.

Senator Grosart: I am not speaking of an employer-employee contract, which is a different thing.

Mr. Smart: An interesting thing that has been called to my attention by my friend Mr. Kirby is that in certain countries there is a compulsory remuneration to inventors. West Germany, for instance, has introduced a system whereby all inventors must be remunerated according to a scale. Perhaps Mr. Kirby is more familiar with how this has worked out.

Senator Grosart: There is a continuing residual right in West German legislation.

Mr. Peter Kirby, Immediate Past-President, Patent and Trademark Institute of Canada: There is a residual right to a remuneration, but no right to control the patent or the manufacture under it. This legislation exists in Sweden, Austria, Germany and to a lesser extent in Denmark and Norway. It cannot be abrogated by contract. It is compulsory remuneration on a very complex scale, and a payment is made to the inventor on the basis of this scale. There is a whole department of the German Patent Office set up to administer appeals in this area.

The Chairman: There must be quite a number of them.

Senator Grosart: Which brings me to the second question. What is the present degree of reciprocity internationally in patents and what is the effect of certain levels of non-reciprocity on Canadian invention? I believe you have just returned from the international—was that BIRPI?

Mr. Kirby: AIPPI is a private organization of professionals in this field. BIRPI is the headquarters that administers the International Convention and this is an international governmental organization.

Senator Grosart: Is there an International Convention on Patents?

Mr. Kirby: Yes, the cornerstone on internationality conventions on patents is what is often referred to as national treatment. In other words, the Canadian will be treated in Germany the same way as the German will be treated in Germany. The German will be treated in Canada the same way as the Canadian. You do not give preference to your own nationality or anybody else's. That is one essential feature.

The other is the priority period of one year. This means that after you have filed an application in one of the convention countries you have a year in which to file it in others, with the full benefit of the original eight, which is very important in patent matters. This gives a period in which to investigate the exploitation possibility of the invention and generally to take the necessary preliminary steps to translate and the many other steps needed in preparation. Those are perhaps two of the most important aspects of the internationality convention. There are many articles dealing with other matters which aim towards harmonizing of laws, although we still suffer from a great lack of harmonization of the laws of the major industrial countries.

Senator Grosart: To what extent are the provisions—I can only call it the antiquated patent system—restricting the development of Canadian inventions abroad? The United States is perhaps a good example. Our laws are very different from theirs in patents. Is this holding back the support of the product of Canadian invention? Are they actually invoking the reciprocity revisions of the international convention?

The Chairman: There is one aspect in which the United States—

Mr. Smart: It could be said to be in breach of the internationality convention in that it has a provision in its domestic patent law which recognizes, as the person entitled to the patent, the one who first invents it in the boundaries of the United States.

Senator Grosart: The one who first invents it or first registers it?

Mr. Smart: The one who first invents it within the United States. That word invention can be taken to mean constructively inventing, for instance by filing a patent application in the United States. A United States resident who has made an invention in the United States may claim priority for his invention as of the day in which he first actually, physically made his invention. Therefore, he can go back in point of time earlier than his filing date, whereas the foreign inventor who makes his invention in some country other than the United States may not claim benefit for anything that he did prior to his United States filing date unless, of course, he can claim the filing date of his patent application in the country that he first filed in, under the convention. In that case, the United States inventor who makes his invention in the United States has an advantage over foreign inventors in relation to their access to the United States patent system.

Senator Grosart: To what extent are the fairly common requirements in the federal funding of R & D restricting patent applications, a hold-back on Canadian R & D?

Mr. Smart: I am not quite sure that I understand your question, senator.

Senator Grosart: I will put it another way. We have evidence here that in many cases where there is funding of R & D in universities and industry there is a requirement in the funding grant or contract that this may not be patented, other than by the Government, or that it must be turned over to Canadian Patents Ltd.

Mr. Smart: I see what you mean. I have not seen any of the recent documentation of transactions of that nature.

A short time ago I had been under the impression that the hold-back of rights or the string, if you like, of the R & D grants, was limited to certain specified reservations on the part of the Government—by either a royalty or an ability to have the invention of anything licensed to the Government agency that might require the use of the technology that was developed.

Senator Grosart: We have been told, for example, in the evidence here that industry at times shows no interest in Government grants, because of the requirement that they must throw them into the public domain.

The Chairman: Under certain programs.

Mr. Smart: That being the condition offered for the R & D grant I should think there would be many industries less interested than if such a string were not attached.

Senator Grosart: That is why I asked a question about Dr. Coburn's invention.

Mr. Smart: It would be very interesting to know, Mr. Chairman, whether that was patentable and, if not, whether Dr. Coburn is going to lose the fruits of his invention. I suspect the latter is so, because from the evidence we have received many firms are jumping in on it.

The Chairman: Senator, I am sure we will have questions to ask, but—

Senator Grosart: May I ask one short one, because I think it is an important question. What is the general nature of the conflicts between Bill C-102 and the Patent Act?

Mr. Smart: What Bill C-102 does, in effect, is to remove, in relation to a whole class of subject matter, whole sectors of industry.

Senator Grosart: This is the drug bill?

Mr. Smart: Yes. The normal incentives of a patent system. If one assumes that these incentives exist and that it is a good thing that such incentives should exist then the removal of them from one sector of industry brings in the kind of difficulties of application of the statute law that we discussed, for instance, in Appendix 4 of the brief, where we were discussing section 41 of the Patent Act.

The philosophy behind Bill C-102 cuts across the basic philosophy of the Patent Act and it brings different parts of the act into conflict with each other.

As actual specific examples will arrive, people will not know precisely what their rights are in many areas.

Senator Grosart: As I recall, Bill C-102 does not say "notwithstanding anything in the Patent Act".

Mr. Smart: Actually, sir, it is an amendment to the Patent Act.

The Chairman: It is part of it.

Mr. Smart: So it will be part of it when it passes. It will be part of the Patent Act.

Senator Grosart: That is right.

Mr. Smart: I was going to answer the first part of the question which you asked me, before Mr. Parkin left, that is, that there has been no amendment to the Patent Act since 1954, which was before the Ilsley Commission.

The first amendment of the act will be Bill C-102 and the second will be Bill C-194, which is merely to be a device for the setting of the fees in the hands of the order in council rather than being fixed by statute.

Senator Grosart: Would you mind detailing for me—I do not want you to go into details now—the recommendation in the Ilsley Report in respect to patents that have been adopted. None have, I understand.

The Chairman: None of them?

Senator Grosart: None, and I think this is important, because it was a royal commission appointed to look at the very subjects we are discussing, and nothing has happened.

The Chairman: Not only in that field but in the field of corporations and trade marks.

Senator Grosart: All royal commissions?

The Chairman: That is not true.

Thank you very much, gentlemen. We are very grateful for your presentation here this morning.

The committee adjourned.

APPENDIX 145

BRIEF

TO THE

SPECIAL COMMITTEE ON SCIENCE POLICY

OF THE

SENATE OF CANADA

Submitted by

CANADIAN STANDARDS ASSOCIATION

77 Spencer Street

Ottawa 3, Ontario

February 1969

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FOREWORD

1. In Canada there exists a recognized neutral medium acting as a co-ordinator of the opinions of producer and consumer interests, for the establishment of national standards for materials, manufactured products, test procedures and codes of practice and of related testing and certification services. Such a medium is the Canadian Standards Association which provides a standardization and certification service to the Canadian producer and consumer, and its facilities are available to industry, government and the citizens of Canada.

2. It is essential for standardization to be developed on a voluntary basis and to be acceptable alike to both producer and consumer interests. Standardization must be practiced on the basis of minimum requirements, consistent with sound industrial practice, and at a level that will permit a broad scope for individualism in the matter of design and for the production of a superior quality if desired or demanded.

3. Standards should promote the expansion of both domestic and international trade and generate public awareness of the advantages of using products complying with such standards.

4. The Canadian Standards Association which in this year 1969 celebrates its first half century of achievement is the only body of its kind in Canada.

5. CSA, industry and government, have before them vast opportunities entailing a great volume of work in seeing that the many benefits of standards, standardization, simplication and certification are extended over the widest possible range of Canadian industry. In CSA we have an organization well fitted to serve the national interests.

SUMMARY

1. First of all - what is CSA? It was incorporated by Letters Patent in 1919 and in 1944 its name was changed to its present form. For almost 50 years therefore CSA has been performing the role of a National Standards Body in Canada, in both national and international fields.

2. Although financially assisted by government, it is a non-profit autonomous organization concerned with the preparation and use of standards - in the interests of quality performance and safety - in the fields of industrial products, basic materials and for codes of safe practice.

3. Originally CSA was concerned only with the preparation, publication and distribution of national standards. Now, although this preparation of standards continues an important and essential responsibility for CSA, its role has broadened necessitating the establishment of an additional five divisions concerned with testing, certification and other activities directly related to the use and application of CSA standards.

4. The six Divisions of CSA are:

1. Standards Division
2. CSA Testing Laboratories
3. Canadian Welding Bureau
4. Canadian Lumber Standards Division
5. Structural Glued-Laminated Timber Division
6. Architectural and Structural Precast Concrete Division

5. Each of these six Divisions is a separate financial entity within the Association.

6. In the preparation of standards, CSA activities are of a voluntary nature, designed to promote the establishment of uniform nation-wide standards for products, processes and procedures. Its standard-writing committees are selected from manufacturers, users, inspection authorities, representatives of scientific and technical societies, universities and government departments.

7. The broad basis of the CSA structure is its more than 2800 individual members of the Association who work on technical committees and the 1900 sustaining members who contribute technically and financially. The latter memberships are held by corporations, engineering and manufacturing companies, public utilities, municipalities and provincial government departments.

8. The more than 1000 CSA Standards in current use, cover a wide range of fields such as Building Materials, Concrete, Electrical Wiring and Equipment, Ferrous and Non-Ferrous Metals, Oil and Gas-Heating Equipment, Protective Packing, Plumbing, Photographic Equipment, Timber, Welding and various Safety Codes.

ACTIVITIES AND ORGANIZATION

1. CSA ORGANIZATION

1.1 The Canadian Standards Association was incorporated in 1919, as the Canadian Engineering Standards Association and in April 1944 its name was changed to its present form of CSA. Extracts from its Letters Patent of 1944 are shown in Appendix A. In its concept of a standards-writing body, it is a national association of technical committees with members representing producer, consumer, scientific and technical societies, inspection interests, government departments, both federal and provincial and educational institutions. Though financially assisted by government, it is a non-profit, non-government autonomous organization concerned with the preparation and use of standards, in the interests of quality, performance and safety, in the fields of industrial products, basic materials and for codes of safe practice.

1.2 Originally CSA was concerned only with the preparation, publication and distribution of national standards. Now, although this preparation of standards continues an important and essential responsibility for CSA, its role has broadened necessitating the establishment of an additional five divisions concerned with testing, certification and other activities directly related to the use and application of CSA standards.

1.3 The Canadian Standards Association consists of individual members, sustaining members and honorary members. The Association includes at the present time six Divisions, namely the Standards Division, Testing Laboratories, Canadian Welding

Bureau, Canadian Lumber Standards Division, Structural Glued-Laminated Timber Division and the Architectural and Structural Precast Concrete Division.

President
and
Board of Directors

- Advisory Committee
- Executive Committee
- Standards
  - Administrative Board
  - General Manager*
  - Technical Council
  - Sectional Committees
  - Specification Committees
  - Canadian National Committees on ISO and IEC
  - Advisory Committees on ISO, IEC & CEE
  - Steering Committee on ABC Standardization
- Testing Laboratories
  - Administrative Board
  - General Manager
  - Advisory Councils on Electrical, Fire Safety and Plumbing
- Canadian Welding Bureau
  - Administrative Board
  - General Manager
  - Advisory Council
- Canadian Lumber Standards
  - Administrative Board
  - Industry Committee
- Structural Glued-Laminated Timber
  - Administrative Board
- Architectural and Structural Precast Concrete
  - Administrative Board
- Future Divisions

*Also Secretary to Board of Directors

1.4 Details of this Organization are as follows:

1.4.1 Standards Division, with headquarters in Ottawa, is responsible for the wide range of administrative matters concerned with the preparation and publication of standards. These include the study and recommendation on the need for new standards, the organization of the necessary technical committees, the circulation of draft standards for ballot and the publication and distribution of approved standards. It undertakes the office work and liaison duties resulting from CSA being the designated national body for international standards activities and acts as the Canadian clearinghouse for the circulation of ISO and IEC documents. It also carries out general administration and co-ordination duties for the Association as a whole.

1.4.2 CSA Testing Laboratories, located in Toronto, with branches in Montreal, Winnipeg and Vancouver, are responsible for testing, examining, reporting upon and certifying electrical appliances, devices and materials, oil and gas-fired equipment, plumbing fixtures, safety hats and caps, plastic pipe, automotive equipment and building products, etc., as they relate to CSA Standards, Codes and Laboratory Requirements.

1.4.3 Canadian Welding Bureau, with headquarters in Toronto, is a service organization devoted to sound and safe practice in welding operations through conformance with CSA codes and standards. The Bureau tests and certifies fabricators and contractors who employ qualified welders, and provides a list of such firms for the guidance of industry or government departments, who may require welding services. In addition to these certification activities, the Bureau conducts nation-wide educational and training programs in the interests of improving welding techniques.

1.4.4 Canadian Lumber Standards Division, with office in Vancouver provides, through CSA, a medium for studying and approving the grade-marking qualifications of lumber manufacturing associations and independent grading agencies operating in Canada, and deals with other problems referred to it in connection with the grade-marking of lumber in Canada, to meet the requirements of the National Building Code and such agencies as Central Mortgage and Housing Corporation, and the United States Federal Housing Administration.

1.4.5 Structural Glued-Laminated Timber Division, with office in Ottawa, is responsible for the qualification of manufacturers of structural glued-laminated timber. It is responsible for the proper application of CSA Qualification Code O177, which contains the requirements in plant, equipment, processes and training of technical personnel for the manufacture of glued-laminated structural beams and arches, to the high standard essential for public safety. Compliance with this Qualification Code is a requirement of the National Building Code and the cities and municipalities using it.

1.4.6 Architectural and Structural Precast Concrete Division, provides a certification service for plants producing architectural and structural precast concrete products.

2. CSA FINANCES

2.1 Each Division is a separate financial entity within the Association.

2.2 The Standards Division is financed mainly by Sustaining Membership subscriptions from private enterprise and provincial and municipal governments. For the fiscal year ended March 31, 1968, this income amounted to $134,000. Other sources of income were $30,000 from a Government Grant and $62,000 from the net sale of CSA publications. During the present fiscal year the Government Grant will be $48,500 to be used solely for payment of Canada's membership fees in international organizations ISO and IEC. The total income for 1967-1968 was $248,500 expended for the preparation of national standards and ISO/IEC national administration. The expenses incurred by Committee members in attending meetings or otherwise assisting the work of committees are not defrayed by the Association.

2.3 The Testing Laboratories are financed by testing and inspection fees, having a total budget of two-and-three quarters million dollars, to expend on testing and certification services and relevant standards activities.

2.4 Canadian Welding Bureau obtains its finances through Sustaining Membership subscriptions from concerned industrial firms, certification and testing fees and fees obtained from educational services. Its budget of $200,000 is expended on certification, testing and educational services of the Bureau in the field of welding.

2.5 Canadian Lumber Standards Division operates on a very small budget, drawing heavily on the services of dedicated volunteers in connection with the certification services on grade-marking of Canadian lumber.

2.6 Structural Glued-Laminated Timber Division also operates on a small budget, expended in qualification and certification services in this field.

2.7 Architectural and Structural Precast Concrete Division also operates on a small budget, expended in qualification and certification services in this field.

3. CSA PROCEDURE IN STANDARDIZATION

3.1 National standardization is carried out through the CSA Standards Division, by means of a system of committees operating under the jurisdiction of the Board of Directors. In all committees, every opportunity is given to all appropriate interests to participate in the work of establishing standards for specific subjects. In this respect, the CSA has close contact, by direct representation, with such interests as Canadian manufacturers, federal, provincial, and municipal governments, public utilities, educational institutions, professional bodies, labour organizations, purchasing departments, etc.

3.2 The Committees responsible for the development of CSA Standards are the Technical Council, the Sectional Committees and the Specification Committees.

3.3 The Technical Council, which is the senior committee within the Association, consists of not less than fifty and not more than one hundred members, nominated by and representing specific groups of interest, including professional organizations, industrial associations, government departments and agencies, public utilities, trade associations, educational institutions, and special members appointed by the Board of Directors.

3.4 Under the Technical Council various Sectional Committees are appointed, representing the various branches of consumer and producer interests and inspection authorities concerned with the standardization practices coming under their jurisdiction. The major sections include Civil Engineering, Mechanical Engineering, Electrical Engineering, Illumination, Ferrous Metals, Non-Ferrous Metals, Automotive Work, Timber, Structures, Welding, Safety Codes, etc.

3.5 Under the authority of Sectional Committees, Specification Committees on specific subjects are appointed. Members of these committees are selected from the interests directly concerned and comprise representatives of manufacturers, users, inspection authorities, etc. with a sufficient number of technical advisers to ensure thorough review of the work undertaken.

3.6 Specification Committees may assign work in whole, or in part, to subcommittees established for the purpose.

3.7 Any member of the Association, or any non-member, may request the CSA to establish a standard on any specific subject, or to revise an existing standard, by formally submitting such a request, in writing, to the Standards Division of CSA.

3.8 The procedure that follows such a request follows well defined lines. Need and practicability are investigated and, if the proposed standard receives a reasonably broad application support, the CSA Board of Directors authorizes the establishment of the proposal as a CSA project. A committee is then organized, comprising representatives of all sections of producers concerned with the item to be standardized, as well as representatives of consumer and general interests. The committee meets at intervals, until agreement is reached on the proposed draft standard. The draft standard is then submitted, in turn, for letter ballot approval to the Specification Committee, the Sectional Committee having jurisdiction, and the Technical Council. The Technical Council is the final authority, within the Association, for the approval of technical provisions of completed proposed specifications, prior to publication and of subsequent revisions thereof.

3.9 CSA procedure is based on the principle that any group having interest in setting up a standard has the right to give its technical knowledge, ideas and experience towards the development of that standard. The CSA acts as a co-ordinating medium, by bringing all interests into cooperating groups. In the preparation of its standards, full use is made of available reports of authorized laboratories, the opinions of reputable technical experts, and the practical experience of widespread groups of producers and consumers. Close contact is maintained with the work of similar organizations in Commonwealth, American and foreign countries. The CSA Standards Division takes no part in determining the technical details of any standard, but it does lend assistance, where necessary, in matters of committee correspondence, and is responsible for final editing and publication.

4. <u>CSA CERTIFICATION SERVICES</u>

4.1 Associated with its national standardization work are the CSA Certification Services. CSA has established the following six voluntary certification services:

4.1.1 General Certification - employing the use of CSA registered marks "CSA STANDARD" and "CSA STD" to signify that the manufacturer, agent or distributor asserts that the product conforms to the applicable CSA Standard.

4.1.2 Certification Under Test by CSA - employing the use of the CSA registered monogram CSA to indicate that the Canadian Standards Association, after test by CSA, certifies that the product conforms to the applicable CSA Standard.

4.1.3 Certification by Canadian Welding Bureau - employing the use of the CSA Mark "CWB" to indicate the testing and certification by the Canadian Welding Bureau of fabricators, contractors and electrodes to CSA Welding Codes and Standards.

4.1.4 Certification by Canadian Lumber Standards Division - approval of Canadian grade-marking associations and agencies.

4.1.5 Certification by Structural Glued-Laminated Timber Division - certification of fabricators and contractors to CSA Qualification Code on Glued-Laminated Timber Construction.

4.1.6 Certification by Architectural and Structural Precast Concrete Division - certification of producers to a CSA Qualification Code now under preparation.

5. INTERNATIONAL STANDARDS

5.1 The application of national and international standards so necessary to the development of trade in goods manufactured by one country and imported by another, is an area of major activity by the Canadian Standards Association. CSA is the member for Canada in the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC).

5.2 CSA Testing Laboratories, acting on behalf of Canada, serves as the Canadian observer on the International Commission on Rules for Approval of Electrical Equipment (CEE) to keep in touch with European requirements for electrical home appliances.

5.3 The CSA, through its appropriate technical committees, has participated in the development of international standards, (such as Commonwealth Standards Conferences and ABC Standardization Conferences (American, British, Canadian).

5.4 To carry out these functions, CSA has established Canadian National Committees on ISO and IEC and a Steering Committee on ABC Standardization.

5.5 In addition to participating in the Commonwealth Conference on Standardization, CSA has an exchange arrangement for national standards with sister standardization organizations of fifty-eight nations. CSA has in its library all these exchange standards and serves as the agent for distribution in Canada.

6. ACHIEVEMENTS

6.1 CSA has had a proud record of achievement recognized and appreciated generally by both government and industry. Brief details are shown in Appendix B.

FUTURE OF CSA

1. CSA is planning for increased activity in the next fifty years of its existence. However it realizes that the proposed Standards Council for Canada is a factor which will have to be taken into account. It is realized that the new national standards organization will necessitate CSA relinquishing or sharing certain of the responsibilities, for which under its Letters Patent, CSA is now solely responsible. However it is anticipated that the new organization will result in greater activity and interest in the whole field of standards - domestic and international. This in turn should benefit CSA in its continuing role in the preparation of national standards and participating in the work of the technical committees active in the international standards field.

2. CSA feels strongly that the future of CSA and the success of the proposed standards organization for Canada is dependent on its two related parts - the Council and the standards-writing agencies - being fully appreciated. In this connection CSA places great importance on the following portion of the Proposal under which the Standards Council for Canada is being established:

"...the proposed structure for standards organization in Canada is designed to leave the responsibility for the development of new and revised standards with existing and future standards-writing bodies, but making their work more effective through the benefits of improved co-ordination through their participation in the Council".

3. CSA believes that it has an important contribution to make in the new organization - by membership on the Council and as a standards-writing agency. However CSA does have some concern regarding the possibility of unnecessary expansion in staff by the Standards Council, which would result in unnecessary encroachment on standardization and certification activities now being satisfactorily carried out by the CSA organization. Such encroachment would be wasteful in money and in qualified technical personnel.

APPENDIX A

EXTRACT OF TERMS OF AMENDED LETTERS PATENT - 1944 OF CANADIAN STANDARDS ASSOCIATION

(a) To provide, originate and furnish Canadian standards of any nature whatsoever which are in the interests of producers and users; to co-ordinate the efforts of producers and users toward the improvement and standardization of materials, processes and related matters; to provide systematic means by which organizations interested in standardization work may cooperate in establishing and promoting Canadian standards to the end that duplication of work and the promulgation of conflicting standards may be avoided;

(b) To serve as a clearinghouse for information on standardization work in Canada, and foreign countries; to further the standardization movement as a means of advancing national economy, and to promote a knowledge of, and the use of, approved Canadian standards both in Canada and foreign countries; to act as an authoritative Canadian channel in international cooperation in standardization work;

(c) To register in the name of the Association, and to hold, own, use and operate any and all trademarks, proof, letter or device and to enforce and protect the use of such marks, proofs, letters or devices and to oppose any proceedings or applications which may seem calculated directly or indirectly to prejudice the interests of the Association;

(d) To enter into any arrangement with any government or authority, supreme, municipal, local, or otherwise, which may seem conducive to the Association's object or any of them;

(e) To procure the Association to be registered or recognized in any foreign country or place;

(f) To appoint in foreign countries, in Great Britain, and in all of the British Dominions, representatives to further the objects of the Association.

APPENDIX B

ACHIEVEMENTS

1 Standardization

B.1.1 Through its Technical Council, 28 Sectional Committees, 300 Specification or standards-writing Committees and a great many supporting preparatory subcommittees, the CSA has established to date approximately 1000 national standards and codes, with many others in various stages of development. CSA Standards may be dimensional, safety, performance or quality, method of test or a code of practice, the scopes of which are illustrated by the classifications shown below.

Civil Engineering	- Building Materials
	- Concrete & Reinforced Concrete
Mechanical Engineering	- Fire Prevention & Protection
	- Gas Burning Appliances and Equipment.
	- Mechanical Work
	- Oil Burning Equipment
	- Plumbing and Heating
	- Screw Threads & Screw Products
Electrical Engineering	- Electrical Work
	- Illumination
	- Radio
	- Canadian Electrical Code, Parts I and II - Safety Standards for Electrical Wiring, Appliances and Equipment
	- Canadian Electrical Code, Part III - Outside Wiring Rules
	- Canadian Electrical Code, Part IV - Radio Interference
	- Canadian Electrical Code, Part V - Electrical Regulations for Mines
Automotive Work	
Railway Work	
Ferrous Metals	
Non-Ferrous Metals	
Timber	
Structures	
Welding	- General
Miscellaneous	- Abbreviations, Definitions & Symbols
	- Photographic Equipment
	- Protective Packing
	- Safety Codes
	- Gas and Oil Pipeline Codes
	- Miscellaneous subjects

B.1.2 All CSA Standards are "Voluntary" and "Advisory" but many become mandatory through adoption by an authority (municipal, provincial, federal, etc.) having jurisdiction. Some of the important ones are the Canadian Electrical Code, Requirements Governing the Construction and Inspection of Boilers and Pressure Vessels, Refrigeration Code, Elevator Code, Code for Identification of Piping Systems, Installation Code for Gas Burning Equipment and another one for Oil Burning Equipment, Head and Eye Protection Codes and various Timber and Welding Qualification Codes - all of which have the force of law by adoption in most of the Provinces of Canada.

B.1.3 The Canadian Electrical Code has been adopted by all the Provinces, thus CSA has made great contributions in safety of the public in creating universal practices in Canada. Recent developments in automobile safety are under active study by CSA Committees, e.g. Automobile Tire Safety Code and Standard on Seat Belts. Broad use of CSA standards has brought the Association into a position where it is generally regarded as a national standards body.

B.1.4 In International standardization, CSA has played a large and active part in the work of both the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC). In addition to being the member body for Canada in these two organizations, CSA holds Participating Status on 70 ISO Committees and Participating Status on 60 IEC Technical Committees and has Observer Status on the International Commission on Rules for the Approval of Electrical

Equipment (CEE). In addition to this, CSA has maintained for many years close liaison with such sister organizations as the British Standards Institution, the United States of America Standards Institute, and the American Society for Testing Materials.

B.2 Certification

B.2.1 CSA, through its various certification mediums, such as the Testing Laboratories, the Canadian Welding Bureau, Canadian Lumber Standards, the Structural Glued-Laminated Timber and the Architectural and Structural Precast Concrete has provided worthwhile certification services in the interests of ensuring safety, quality control and performance of products, so important to the Canadian economy.

B.2.2 The CSA Testing Laboratories

B.2.2.1 The CSA Testing Laboratories have established agencies overseas. These employ the facilities of the British Standards Institution (BSI) and KEMA Laboratories in Arnhem, Holland, to test goods exported from the United Kingdom and Western Europe to Canada. Also the Japan Machinery and Metal Inspection Institute (JMI) has been retained to perform similar factory inspection in Japan. Lately CSA established a reciprocal agreement with BSI under which CSA can test and certify Canadian products to BSI standards. Contacts have been established in other countries for similar purposes. In addition, Branch Offices have been established in Montreal, Winnipeg and Vancouver.

B.2.2.2 The CSA Testing Laboratories certification program which is ever-expanding presently embraces the investigation of equipment and materials on the basis of

CSA Standards and Laboratory Requirements. These services concern not only safety to serve the needs of provincial and municipal authorities but also consumer needs, also such groups as public and private utilities, industrial organizations, purchasing and retail agencies and federal government agencies.

B.2.2.3 The products covered by this certification include electrical equipment, gas and oil-burning equipment, plumbing products, safety equipment, building products, textile products, etc.

B.2.3 The Canadian Welding Bureau

B.2.3.1 The Canadian Welding Bureau's main purpose is to test and certify fabricators and contractors engaged in the welding of bridges, buildings and machinery to the CSA Welding Qualification Code W47.

B.2.3.2 In 1947, fifty-five firms were able to qualify and today nearly 700 are certified. Although fifty-five firms were approved in 1947, many others were unable to do so due to lack of trained personnel. It was at this point in early 1948 that the Administrative Board of the Bureau accepted the view that the Bureau had some obligation to assist firms to meet code conditions and undertook, on behalf of fabricators, a major educational program which has ever since continued and become a principal Bureau activity over the years. Although involving assistance to all educational institutions, correspondence courses constituted the principal media and have proven remarkably successful under the system evolved by the Bureau. These courses have been developed by Bureau engineers ably and willingly assisted by many others and have been eagerly taken by individuals and sponsored by many employers. To date nearly 8,000 have participated creating a body of trained men unequalled certainly in any other industrial country of a comparable size.

B.2.3.3 This certification service has been broadened to include both the welding of steel and aluminum structures as well as the qualification of firms undertaking the welding of reinforced concrete parts and structures and resistance welding. Welding inspection organizations are also now being certified.

B.2.4 Canadian Lumber Standards

B.2.4.1 The Canadian Lumber Standards Division is the agency to which Central Mortgage and Housing Corporation in Canada and the Federal Housing Administration in the USA look for the control of the grade-marking of lumber. It has established a grade-checking service to ensure that the associations and agencies authorized to grade-mark Canadian lumber are maintaining satisfactory standards. CLS has a close working relationship with the F.H.A. in the United States as well as the ALS (American Lumber Standards) and the ICBO (International Conference of Building Officials).

B.2.5 Structural Glued-Laminated Timber Division

B.2.5.1 Fifteen plants representing over 96 per cent of the production capacity of the structural glued-laminated timber industry in Canada have been certified by this Division as being qualified in conformity with the CSA Qualification Code O177. Compliance with this Qualification Code is a requirement of the National Building Code of Canada and the cities and municipalities using this Code.

B.2.6 Architectural and Structural Precast Concrete Division

B.2.6.1 This is a new Division of CSA which is being set up to provide a certification service for the qualification of manufacturers of architectural and structural precast concrete products.

APPENDIX 146

S U B M I S S I O N

to the

SENATE SPECIAL COMMITTEE

on

SCIENCE POLICY

by the

PATENT AND TRADEMARK INSTITUTE OF CANADA

at

Ottawa, Ontario

April, 1969

INDEX

PATENT AND TRADEMARK INSTITUTE OF CANADA
(herein referred to as the Institute)

1. The Institute is a professional body incorporated as a part II company and comprising a membership embracing patent agents, trade mark agents and lawyers having a special interest in patents, trade marks, copyrights and designs. A copy of its Constitution and By-laws will be found in Appendix I and an up-to-date list of its membership will be found in the Proceedings of the 1968 Annual Meeting which is attached as Appendix II. The membership comprises practically all Canadians who are professionally occupied with patents, trade marks, copyrights and industrial designs. It was founded in 1926 and first incorporated in 1935.

2. The Institute is committed to the promotion of effective Canadian laws in relation to patents of invention and the efficient administration of the Canadian patent system. We regard the patent system as a very important element in the development of Canadian industry and urge the Canadian Government to adopt policies calculated to strengthen and make more effective the Canadian patent system as a medium for the advancement of practical science and the strengthening of the Canadian industrial economy both of which in our view are inextricably bound together in this day of rapidly advancing technology.

3. In this brief it is our intention to examine the Canadian patent system, to consider its relationships with other patent systems, to consider its objects and the extent to which these are presently met, and finally to suggest a number of areas of Government policy in which we believe there are opportunities for the adoption of specific policies which would enable the Canadian patent system more nearly to fulfil its intended objects.

The Role of Patents

4. There is much misconception about the way in which a patent system is supposed to operate. There has been a tendency to emphasize general statements of object such as "to encourage the advancement of the useful arts", "to encourage invention" or "to reward inventors" which tends to conceal the practical value of the system and the manner in which it functions. Both in practice today and historically, as will be seen from the brief historical outline to be found in Appendix III, patents are of value primarily in the hands of entrepreneurs. They constitute a means by which enterprising entrepreneurs may be encouraged to assemble the necessary capital, expertise and management to bring into being new industrial undertakings. A patent in the hands of an inventor who lacks the necessary financial resources and entrepreneurial skills to establish the practical exploitation of the invention is no more than a piece of paper. It is a little like a mining claim owned by a prospector who has no financial backing or ability to proceed with development. In one very important respect, however, the patent differs fundamentally from a mining claim. The claim, until it was staked, constituted part of the public domain and the staking of it removed a previously existing piece of property from the public domain and assigned it to the exclusive use and profit of the claim owner. A patent of invention, on the other hand, can only validly be granted so long as it removes <u>nothing</u> from the public domain and secures to its owner for exploitation <u>only</u> that which was previously not in existence. That is because a patent can only be granted for something that is new and any purported claiming of something that is old, or previously known is by definition invalid (see Appendix III).

5. Patents are of importance today primarily because they form an important ingredient in the corporate decision making process by means of which corporate funds and effort are allocated to the production of a particular product or the operation of a particular process. The collective experience of our members is that there is great reluctance on the part of industry in general to embark upon the manufacture of a new product or the employment of a new process unless the product or process is adequately

protected by patent.

6. It is primarily because of the importance of patents in protecting new areas of corporate expansion through use of new processes or marketing of new products that corporate management can justify the expenditure of corporate funds on research and development. The independent private inventor still exists and in many cases produces valuable inventions which if successful are, through the medium of patent assignment or licence, put into practice with due reward to him. However, the assignment records at the Canadian Patent Office show that relatively few of the approximately twenty-five thousand patents granted in Canada each year are granted to individuals operating independently. Thus, the major impact of the encouragement to invention afforded by the patent system must be taken to reside in the justification that patents provide for the allocation of funds to support corporate research and expansion based on the results of such research.

7. Important in any discussion of how the patent system functions is the international aspect of patents. In our view much too much emphasis has been placed from time to time upon the fact that over 90% of Canadian patents are granted to non-residents of Canada. Frequently overlooked is the fact that the Canadian patent owned by a foreign corporation is an ingredient in any corporate decision of that foreign corporation relating to its present or prospective operations in Canada. The existence of the patent justifies the investment of the foreign corporation in a Canadian plant in exactly the same way as it would in the hands of a Canadian corporation, and it is unquestionably the case that much Canadian plant which is owned or controlled by foreign corporations owes its existence to that incentive. The foreign Canadian patent owner is further encouraged to exploit his Canadian patent by manufacture in Canada rather than by importation by reason by Sections 66 to 73 of the Patent Act which oblige a Canadian patentee to practice his invention in Canada within three years of the grant of his patent or run the risk that a compulsory licence will be granted by the Commissioner of Patents to some other person who proposes to practice the invention in Canada.

8. Another important way in which the patent system operates is that it provides a market place for technology. The patent provides a package of technology which can be bought or sold or licensed. The patent publications of the various Patent Offices of the world and the searching facilities available at those Patent Offices effectively publicize the existence and ownership of these various "packages" of technology making it possible for persons who own the "packages" but are not using them in their current operations to sell or licence them to companies requiring such technology for their current operations, thus leading to a greater utilization of existing technology than would be the case in the absence of a patent system.

9. The patent archives of various countries of the world are accessible to and usable by the public thus forming a medium for the dissemination of technical knowledge which is a valuable research tool.

10. What has been said about the operation of Canadian patents in the hands of foreign corporations is equally true in relation to the operation of foreign patents in the hands of Canadian corporations. These serve as a basis for the development of export markets for Canadian products as well as for the establishment of Canadian enterprises in foreign countries based on exploitation of the foreign patents.

11. In the foregoing we have indicated five principal roles of the patent system, namely,

(1) Encouragement of investment in new production facilities and the manufacture of new products;

(2) Encouragement of industrial research and of invention by individuals;

(3) The provision of a market place for new technology;

(4) The provision of a medium for the dissemination of technical knowledge;

(5) The provision of a basis for the development of export markets and expansion of Canadian business into foreign countries.

12. We now intend to examine the present Canadian patent system for purposes of assessing the extent to which the present Canadian patent system

enables the fulfilment of these objectives.

The Canadian Patent System and its Shortcomings

The Patent Act

13. According to the Canadian Patent Act the person entitled to a patent is the inventor of an invention regardless of where or in what country the invention is made [8]. The invention must be a new and useful art, process, machine, manufacture or composition of matter or a new and useful improvement therein [9] and it must not have been the subject of a printed publication printed anywhere in the world more than two years before the application is filed at the Canadian Patent Office nor must it have been in public use or sale in Canada for more than two years prior to the filing of the application. The inventor (or his legal representative) of such an invention is entitled to his patent upon filing his application and "on compliance with all other requirements" of the Patent Act. The principal requirement is that he file a specification with a clear and precise description of his invention including drawings, where necessary, and ending with a series of claims in which the patented embodiments of his invention are precisely defined [10].

14. The Canadian Patent Act is almost unique in providing for the grant of a patent to the first inventor rather than to the inventor who first files a patent application. The United States grants patents to the first inventor in respect of domestic inventions but in respect to inventions made abroad including those made in Canada the earliest date that may be claimed as a date of invention is the filing date of the United States application (or pursuant to the Convention, the date of the first filed foreign application). With the exception of the Philippines all other countries grant a patent to the inventor who first files a patent application.

15. The Canadian Patent Act is also unique in another respect in that it permits an inventor to publish his invention or to publicly use or sell his invention for up to two years prior to the filing of his application.

8. Patent Act s. 28
9. Patent Act s. 2 (d)
10. Patent Act s. 36 (1), (2)

In most other countries except the United States where there is a corresponding period of one year the invention must be new at the time the application is filed and prior publication of it destroys the applicant's right to a patent.

16. The Canadian Patent Act also provides special limitations on the nature of the patent obtainable in the case of inventions relating to substances prepared or produced by chemical processes and intended for food or medicine [11]. In this respect it is very similar to the British Patent Act in force prior to 1949.

17. Section 67 declares that "patents for new inventions are granted not only to encourage invention but to secure that new inventions shall so far as possible be worked on a commercial scale in Canada without undue delay". There are enumerated six general classes of cases where the patent rights will be deemed to have been abused and where the Commissioner of Patents, in accordance with a prescribed procedure, may grant compulsory licences to persons applying for them as well as other remedies up to and including revocation of the patent. In this respect the Canadian Act differs sharply from that in the United States where there is no provision at all for compulsory licences.

11. Section 41 (1) - See App. IV

Problems

(1) Validity

18. It is a feature of the Canadian patent system as it is with those of other Commonwealth countries and the United States that the patent can only be enforced if the patent claim asserted against an infringer is valid in the opinion of the court in accordance with the applicable jurisprudence. While the subject matter of a particular claim may be new and useful and meet all of the expressed statutory requirements, the courts may still find the claim to be invalid as not being inventive. Although there is a great mass of jurisprudence on the subject of what is and what is not an invention which extends back almost to the origin of the concept of patents of invention, no court has as yet been able to define what an invention actually is. Many courts have stated what invention is not. The history of the jurisprudence both in the United States, England and Canada shows that judicial viewpoint swings periodically from periods during which a high standard of invention is required to sustain a patent to periods where a lenient standard prevails. It is also an historical fact that in all periods where cases involving the determination of presence or absence of invention have found their way to the ultimate court of appeal judicial opinion has been divided to the extent that in some cases a majority of all the judges who heard a particular case have held an opinion contrary to the final result in the ultimate court of appeal [12.]. Thus in 1947 after an exhaustive analysis of the results of patent cases which turned on the question of presence or absence of invention Fox was able to conclude "only a small number of the patents issued is litigated and of that small number more than half are held invalid by the courts" [13].

19. In the years since 1947 the uncertainty surrounding validity of patents has continued to grow at an accelerated pace. New grounds of invalidity have been established in our courts and already recognized grounds of invalidity have been given an increasingly broader field of application. This is most apparent in relation to that aspect of "invention" which is referred to as "utility". The Patent Act requires that an invention must

12. Fox Monopolies & Patents 1947 University of Toronto Press, Chapter XIX
13. ibid page 273

be useful and this is interpreted by the courts as meaning that everything lying within the language of the claim must be useful to an extent regarded by the court as imparting to it the attribute of "utility". A claim, any part of which lacks "utility", is invalid. Thus, in addition to the essentially subjective test of "invention" the patent claim must withstand the additional essentially subjective test of "utility", and if a claim for an outstandingly useful invention is so worded as to include within its scope fringe areas which do not meet this subjective test of "utility" then the whole claim falls and the patent owner finds himself with no patent rights. In our view the strictness with which the test of utility is applied is unfair and has an undermining effect on the patent system. The person who infringes the patent does not normally operate in the fringe areas of a patent claim, rather he takes the essentiality of the invention and benefits himself from the established usefulness of that essentiality. Is it fair that having done that he should be able to defend himself against what would appear to be the morally justified complaint of the patentee by saying "I admit I have taken the essentiality of your invention which I admit is very useful but the part of your claim that I am not using has not the required attribute of utility and therefore your claim is bad and you have no right to complain". This, however, is precisely the effect of the present state of the law relating to utility as pronounced by the Courts. [14]

14. Minerals Separation v. Noranda (1947) Ex. C.R. 306 and 69 R.P.C. 81
(1950) S.C.R. 36
Hoechst v. Gilbert (1966) S.C.R. at 189
Rhone Poulenc and Ciba v. Gilbert (1968) 30 Fox Pat. C. 203
Union Carbide v. Trans-Canadian Feeds /1967/ 49 C.P.R. 29

(2) Patent Processing

20. The science explosion of the last thirty years has seriously strained the patent systems of the world. It has become increasingly clear that reform both in procedure and concept are necessary if the patent systems of the world including that of Canada are to be capable of performing their intended purposes. Several European countries notably West Germany, Holland, the Scandinavian countries and France have in fact recently overhauled completely their patent statutes in an effort to meet the challenge presented by the mushrooming expansion of technology. The existence of a problem was recognized in Canada at least fifteen years ago when the Ilsley Commission[15] was appointed but no legislative changes have followed the report of that Commission made just over ten years ago. This may be all to the good since the true nature and magnitude of the problems confronting the patent system could not have been as apparent then as they are today, and the possibilities for constructive action which exist today could not have been apparent before the advent of the computer as a practical tool for the handling and administration of technical data.

21. Today the principal problems have become obvious. Speaking generally the patent systems of the world, including our own are clogging up and choking on an undigested mass of new patent applications which it becomes increasingly out of the power of the patent administration facilities to process on a current basis. Each year the average patent application deals with subject matter which is more complex and thus takes longer for a patent Examiner to understand. Each year adds thousands of new patents to the already massive repository of patents which must be searched by the Patent Examiner each time he has a new application before him. Thus the time of processing for an average application tends to become longer. The longer the period between application and the grant of a patent the more likelihood there is that two or more applications for the same invention will be before the Patent Office at the same time making necessary in the case of our own Patent Office a special proceeding to determine who as between the various applicants is the first inventor [16].

15. Royal Commission on Patents, Copyright and Industrial Designs

16. Patent Act, Section 45

22. Despite serious effort within the existing framework of the system to offset these tendencies by increasing the examining staff of the Patent Office and by streamlining administration and examining procedures, which effort has not been without substantial effect, it becomes increasingly apparent that within the present framework the processing of patents on a current basis with an acceptably short period between the date of application and the date of grant is a virtual impossibility without a vast increase in the personnel of the Patent Office entailing an expenditure which would be unacceptably high.

23. A most disturbing feature of the foregoing situation is that its impact is greatest in those complex fields which form the most important spearhead of today's advancing technology such as electronics and organic chemistry. By way of example, in a case of conflicting patent applications [17] recently before the Supreme Court of Canada involving some of the basic technology of colour television, the patent applications were filed in 1951.

24. The average length of time for an application for patent to be pending in the Canadian Patent Office in the more complex fields such as electronics and organic chemistry where there is no conflict is three to four years.

25. The result of the foregoing situation is that the effectiveness of the Canadian patent system is far from what it should be. The inventor or applicant acquires no rights until the patent is actually granted and with the long delays in processing patent applications which currently exist manufacturers have to make a choice between delaying a new development until the patent issues or proceeding with the development without the benefit of patent protection, taking the risk that the invention will be copied by competitors. This risk is serious because of Section 58 of the present Canadian Patent Act which protects the person who acquires a patented article or machine before a patent is granted from liability to the patentee after the patent is granted. It has even been held that a person who puts a patented process into use before a patent is issued may continue to use the process after a patent has been granted covering the process [18]. One consequence of the prolonged periods now commonly required

17. <u>Radio Corporation of America</u> v. <u>Philco Corporation (Delaware)</u> 1966 S.C.R. 296

18. <u>Libbey-Owens-Ford Glass Company</u> v. <u>Ford Motor Company of Canada, Limited</u> [1969] C.P.R.

for the processing of patent applications is that the monopoly period no longer commences at the same time as the introduction of the invention which it protects. Many important innovations become commonplace and thus come to be treated as though they were public property before the patents covering them are granted. This has the undesirable effect of disrupting those industries which may in good faith have been treating such inventions as public property and of postponing, by the length of time taken for processing of the application, the time when the inventions fall into the public domain by expiry of the patents. Furthermore, many inventions are superceded before the patents covering them are granted. Thus, the prolongation of the patent processing period produces results which are not consistent with the fundamental philosphy of patents of invention of securing to the inventor a limited period of monopoly for the innovation without diminishing the previously existing public domain. As it presently operates our patent system tends to put many innovations into the public domain only to remove them at some later date for a period of seventeen years.

RESEARCH INCENTIVE

26. In formulating the science policy in relation to the conducting of research one has two major possibilities to consider, one being the encouragement of research through subsidies from the government either by fostering research at government administered institutions or at existing institutions such as universities. The second main area where important research can be done is in the laboratories of industrial organizations. Insofar as our Institute is concerned we are primarily interested in the latter and primarily interested in those circumstances which will create a favourable atmosphere for the encouragement of research by industrial organizations. When one is considering research by industry the only justification for conducting research that we are aware of is that it may lead to establishing a market position which will enable the person who has financed the research to gain benefits in the market place and that if such a prospect is not presented a business man has no incentive to finance research at all. Secrecy offers the only alternative to patent protection in the establishment of such a market position, and secrecy can never be satisfactory nor wholly effective.

27. The patent system has at various times and in various places come in for criticism. Many patents are held by large industrial organizations. Many patents are held by non-residents of Canada. Some of the criticism that has been directed against patentees is no doubt justified but the criticism relates not to the reason beneath the patent system but to the way particular businessmen have conducted their affairs taking advantage of whatever resources they have available to them including patents and if one examines the various attacks that have been made against the patent system none strikes at the fundamental need for a system which will give to the entrepreneur a business reason for financing research.

28. It is difficult to establish by direct evidence the reasons why, relatively speaking, corporate research in Canada appears to attract less investment than it does in other countries notably the United States. As with any matter involving corporate decision making, many factors are involved and in any particular situation anyone of these factors may be predominant. We think that the type of consideration which is pertinent in shaping corporate policy in relation to investment in Canadian research activities is best illustrated by the following hypothetical example of a dialogue between a Canadian subsidiary and its parent:-

29. A United States company has an active research program in the United States. It has a Canadian subsidiary which manufactures and sells products developed by its United States parent. The subsidiary has prospered and some of its officers believe that consideration might be given to establishing research facilities in Canada not to duplicate work being done by the parent necessarily but to supplement it by investigating new subject matter or per haps by transferring some research establishment to Canada. The officers of the Canadian company advance the following arguments in favour of doing this:

30. (1) Canada is at the threshhold of good industrial growth. Its population offers a domestic market, is rapidly approaching one half of that of France or Great Britain or Italy or West Germany and is close to that of the combined population of Sweden, Norway, Denmark and Finland. Midway through the Industrial Revolution in 1800 the population of Great Britain was one half that of Canada today. The President of the National Research Council has said that we are in the midst of a comparable technical revolution.

(2) Given equal opportunity most graduates of Canadian universities would prefer to remain in Canada. There is a good supply of technically qualified people and the universities are anxious to expand their graduate schools.

(3) Canada is relatively stable politically and is well served by its civil servants and offers a good business environment.

(4) New development is encouraged in Canada in many ways:-

(i) Financial assistance is available for research in Canada from (a) The Department of Industry for research in industry under The Industrial Research and Development Act and for the establishment of Canadian industrial research institutes in the universities with facilities to do research for industry. (b) The National Research Council may make grants for long term research grants under The Industrial Research Assistance Program. (c) Both the Department of Industry and the Department of Defence may make grants for research relating to defence.

(ii) Under the Area Development Incentive Act the Department of Industry may make financial assistance available for expanding facilities and establishing new facilities in designated geographical areas and similar inducements and assistance are available from local governments.

(iii) The National Research Council and the Ontario Research Foundation may accept specific research assignments.

(iv) The National Science Library provides useful facilities for study of technical literature.

(v) The promotion of new designs and inventions and of new technology will be assisted by Provincial Departments of Trade and Development, by the National Design Council and by the Department of Industry.

31. To the foregoing points the United States parent replies:-

(1) The research that interests us is the research that will improve our competitive position. We cannot support extensive research if our competitors may freely use the results of it. We must, therefore, take great care either to maintain the results of our research in absolute secrecy or to ensure that we can protect it adequately by means of patents. A fact with which we must live is that the United States patent laws, unlike those of any other country, puts the researcher who is working outside the United States at a disadvantage as compared to the researcher who is working in the United States. In a

competition between the two for a United States patent the issue is who was the first to invent in the United States. We cannot risk having our inventors work outside the United States on research projects that may be vital to our business. In Bills now before Congress efforts are being made to delete this discriminating feature of our United States laws and it may be eliminated soon. Perhaps some pressure from Canada in this direction would have weight but unless this provision is removed from our law we would be foolish to put ourselves at a disadvantage in relation to our United States competitors.

(2) We are not much troubled by separatists but we are concerned about the political difficulties that seem to exist in Canada. We are not in the drug business but we understand that certain drug companies were considered, we assume correctly, to be making inordinate profits through a combination of factors including ownership of patents and trade marks. We are accustomed to the principle that someone who abuses his position may be prosecuted by the Government or may be liable for damages at the suit of an injured party or that his abuse may be raised as a defence in any action that he may bring in the courts. We accept that principle but we are troubled by the news that action has been taken in Canada not against individual companies that have been guilty of such abuses but rather has been taken against all owners of patents and trade marks for drugs regardless of how they have conducted themselves. We are informed that much of the difficulty may stem from the problem that the Federal Government cannot legislate in relation to property and civil rights even as they may affect certain aspects of the conduct of business, that it cannot deal directly with such things as drug prices or that it cannot create remedies of the kind that we have under our United States Anti-Trust Law to deal with or curb the activities of those who restrict competition unfairly. It would seem that the Canadian Government has the choice of branding businessmen as criminals through criminal legislation or by taking action in the Patent and trade mark field. This makes us uneasy about committing a high proportion of our research business to Canada, being dependent as we are on patent and trade mark protection to sustain our research activity. Perhaps what is needed is Federal jurisdiction to rigidly enforce business practice so that business men who conduct themselves properly are not pulled down by those who act improperly.

(3) We are interested in the incentives that are offered by various levels of government in Canada to invest in Canada and to do research in Canada. We are not qualified to judge the effectiveness of these schemes. We have heard that they have quite an effect in stimulating research in government establishments and universities but that so far they have borne little fruit in industry. So far as our own attitude is concerned we would not plan to set out on a long range research program in Canada that relied very heavily upon obtaining financial support from governments because such programs have been known to change or to be withdrawn entirely. The employment of researchers in universities or other farming out of research may be useful in relation to specific problems but cannot replace research conducted and directed by our own organization under the eye of our own business management.

32. The foregoing leads to the important conclusion that although the patent system justifies the allocation of corporate funds and effort to research, the situs at which such research will be carried out is largely determined by other factors. The fact that Canada has a patent system encourages research amongst those who intend to do business in Canada but it does not necessarily of itself encourage the people concerned to carry out the research in Canada.

33. The United States patent law encourages United States businesses to do their research in the United States and in this respect discriminates against all foreign based research. But a similar provision in the Canadian patent law would not appear to be any real answer since it would be aimed only at the United States and would have no meaning at all once Canada adopts a first to file system as recommended elsewhere herein.

34. Generally speaking, research will be done wherever it can be done most economically and most effectively. We suggest that it is more important to the Canadian economy that the results of research wherever carried out should be available to Canada than that the research leading to those results should necessarily be carried out in Canada. The patent system is the medium through which Canadian industry can make use of the results of research carried out abroad. There will always be research carried on within Canada either because the Canadian environment is favourable to certain types of research, because certain gifted people happen to be resident in Canada and because certain

organizations which are research oriented happen to be based in Canada. Research which is directed toward national defence and other things which specifically relate to defined areas of the Canadian public interest perhaps must be carried out in Canada under government sponsorship. We doubt, however, that there is any public purpose to be served by attempting to unnaturally expand the Canadian research effort in the general industrial field beyond the limits set by sound business judgment in the ordinary corporate decision making process.

CONCLUSIONS

35. It is apparent from the foregoing that the following factors present in the Canadian patent system are responsible for limiting its effectiveness:-

1) The time between the filing of an application and the grant of a patent is too long;

2) Conflict procedure based upon the determination of first inventorship causes inordinate delays in the processing of patent applications;

3) There is too much uncertainty in the enforcement of patent rights because of the judicially applied tests of "inventiveness" and "utility" which are essentially subjective. This undertainty is aggravated in the field of food and medicine by the imposition (by S. 41 (1) of the Patent Act) of special statutory requirements which in the light of recent judicial interpretation may be extremely difficult if not impossible to meet;

4) The inability of the Federal Government to legislate in relation to undesirable business practices appears to encourage patent legislation which is contradictory in principle (e.g. Bill C102).

36. There are in our view a number of areas in which government policy might be brought to bear in a manner calculated to reduce or minimize the foregoing factors.

37. It is our view that two of the principal difficulties with the present system can largely be met by certain desirable reforms in the substantive and procedural aspects of the Patent Act and by effective use of electronic data processing techniques within the Canadian Patent Office in co-operation with other Patent Offices at the international level.

SUGGESTED CHANGES IN THE PATENT ACT

Filing Date System

38. An amendment to the Patent Act providing that the person entitled to a patent is the first inventor to file a patent application rather than the first person to make the invention would eliminate the need for the special proceedings pursuant to Section 45 of the Patent Act in the case of conflicting patent applications. Such a change would eliminate all the delays now caused by conflict procedure and consequently reduce the work load of the examining staff of the Patent Office. At the same time such a measure would conform to the Ilsley Commission report and would bring Canadian patent law more into line with the patent laws of other countries and would be a step in the direction of an eventual world-wide uniformity of patent law which we consider is a desirable ultimate object of any Patent Cooperation Treaty. The membership of this Institute has indicated that it is almost unanimously in favour of adoption of the filing date system.

2. Validity

39. We think it highly desirable that amendments be made to the Patent Act which would reduce the undertainty surrounding questions of validity.

A major step forward would, in our opinion, be to define the right of action for infringement in such a way that if what has been done by the alleged infringer is within the scope of a claim and possesses the attributes of invention namely, is new, useful and an ingenious departure from the prior art, the court need not enquire further into validity. Such a provision would have the effect of directing the court's attention to the merits of the dispute and would preserve the validity of claims covering meritorious inventions which through inadvertence or failure of the patent agent to express the limitations of the invention accurately might be held according to present jurisprudence to be invalid as being too broad. At the same time it would not necessarily encourage claims of undue breadth since it will still be necessary for the patentee to comply with Section 36 of the Patent Act by claiming his invention explicitly.

40. We also suggest that inventions relating to food or medicine be placed on the same footing as other inventions as regards validity by abolishing Section 41(1) of the Patent Act as recommended by the Ilsley Commission. Our specific reasons for this recommendation were set out in our Brief to the House of Commons Special Committee on Drug Costs and Prices and are reproduced here in Appendix IV.

3. Infringement

41. A further change in the Patent Act that appears desirable is a modification of Section 58 which protects a person who has acquired an invention before the grant of a patent from liability to the patentee. A similar section used to appear in the United States Patent Act but was removed nearly 100 years ago. While there may be some justification for protecting the innocent person who without knowledge that he is acquiring someone else's invention makes an investment in plant or equipment and later finds that it is covered by a subsequently issued patent, we can see no justification for protecting a person who, with knowledge of the fact that what he is acquiring is someone else's invention, proceeds to invest money in plant equipment on the basis that section 58 will protect him against what would otherwise be the legitimate claims of the patentee. The worst features of Section 58 would be eliminated if the Section were amended so that it applied only to those persons who have acquired an invention before the grant of a patent without knowledge of the prospective rights of the subsequent patentee.

COMPUTERIZED PATENT SEARCHING

42. The use of computerized information retrieval techniques is a comparatively recent art. The first electronic digital computer ENIAC was born at the University of Pennsylvania in 1946. The first commercial stored-program computer UNIVAC 1 was delivered to the United States Bureau of Census in 1951. The first electronic machine designed for business data processing, also UNIVAC, was delivered to General Electric Company in Louisville in 1954. By July of 1969 it is estimated that there will be close to forty thousand computers engaged in the electronic data processing industry in the United States alone [19]. These computers are all programmed to perform specific tasks of storing and retrieving information essential to the operation of the particular industries that employ them. The kind of information which can be stored is unlimited and the basis upon which the information can be retrieved almost instantaneously is limited only by the ability of the person controlling the computers to develop the

19. Business and Research Data on Software Development, David Bender, 1968 Proceedings, National Law Center, George Washington University

appropriate program. The amount of information which can be stored is limited only by the capacity of the memory systems in the computer. Present day so-called third generation computers are fully capable of storing and retrieving all of the patent information which exists throughout the world. Several United States companies in the EDP (Electronic Data Processing) industry have already produced limited programs for the searching of patents in specific fields. One such company[20] has programmed all United States chemical and related patents which have been granted in the United States since 1950 and offer their program to commercial clients for a fee. This particular company has been operating for ten years and is therefore in a position to assess approximately the cost of maintaining and extending computerized searching. The Vice-President of the company[21] recently stated to us that the cost of programming all Canadian patents would be something of the order of $70,000.00 per year. The cost of programming all Canadian patents to date on the same basis would be somewhat less per year and would diminish year by year with the lower volume of patents issued in the earlier years. If all Canadian patents were programmed in the manner now employed by the IFI/Plenum Data Corporation it would eliminate the need for a manual search of the patent art by the Examiner and enable the Examiner who is a highly trained technical man to devote almost all of his time to consideration of the relevant documents and the preparation of his report. It is estimated that about one third of an Examiner's time is presently spent in searching. Conservatively, the adoption of a system of the type above outlined would save at least 25% of an Examiner's time. There are approximately 170 Examiners in the Canadian Patent Office who earn approximately $11,000.00 annually, on the average. Thus, computerization of Patent Office searching would appear to be economically sound as well as being technically desirable.

43. In order to achieve the full benefit of electronic data retrieval it is highly desirable that the search records involved should be on a world-wide basis and this means that it would be desirable that similar programming

20. IFI/Plenum Data Corporation, 1000 Connecticut Ave., N.W. Washington, D.C., U.S.A.
21. Mr. Harry Allcock

techniques be employed by all Patent Offices whose own files may be accessible to other Patent Offices by means of data link transmission. This is indeed the ultimate object of international discussions which are currently taking place concerning a proposed Patent Cooperation Treaty It would seem most important that Canada should take a leading part in the development of such a world-wide information retrieval facility to ensure that the ultimate facility meets Canadian standards and to keep the Canadian Patent Office in step with the development so that when the time comes it will be capable of making the maximum use of the facility.

44. From the technical point of view there is no difficulty in expanding the stored information in such a facility to include any desired subject matter. For instance, we understand that users of the IFI/Plenum Data file of chemical and related United States patents include in their own magnetic tapes (on which the information is stored) data from the research notebooks of their employees as well as data from their own technical libraries. Thus, there would appear to be no technical reason which would prevent Canada from utilizing such a facility to produce its own comprehensive bank of scientific information comprehending as well as world-wide patent information a complete record of all scientific journals and compendiums in all fields. It would take time to program all of this material and the cost would be roughly proportional to the total amount of material to be programmed. However, spread over a number of years the overall cost, however large it might be, would be justified by the value of making available to scientific research throughout Canada the ability, on a virtually instantaneous basis, to produce a complete bibliography on a specific scientific subject. The facility in the course of time could become self-supporting with a fee for use of the system and the pace of research in Canada would be speeded up by elimination of the very considerable amount of time that everyone engaged in research must necessarily spend in searching the scientific literature. In our view, the important thing is to make a start on the programming as soon as possible. It is not necessary to await the coming into existence of what might be considered to be the ideal

programming system because programs can be modified and perfected as occasion demands without losing the information already stored. The big task lies in the original coding of the documentary information and this need not await the perfection of the ultimate retrieving program.

45. We strongly advocate a policy of increased participation in the effort to computerize patent data both on an international level and within the Canadian Patent Office.

COORDINATION OF DEPARTMENT POLICIES AFFECTING PATENTS

46. A number of departments of the Federal Government operate in areas where patents are of some concern. The Department of Consumer and Corporate Affairs in addition to being responsible for the Patent Office is responsible for the administration of the Combines Investigation Act, Section 30 of which deals with the abuse of patent rights to unduly restrict trade or commerce. The department also has broad responsibilities in the area of sonsumer affairs which conceivably give rise to considerations in which patents are a factor. The Department of Industry has a concern with the role of the patent system in the development of new industry. The Defence Department is concerned with patents in relation to the sharing of technology with other countries under the NATO commitments. The National Research Council & Canadian Patents and Developments Limited are concerned with patents as a means of dealing with the results of research and recovering through royalties a part of the cost of research. The Department of Health and Welfare has a concern with patents in relation to the supervision of drugs licensed pursuant to the Patent Act, particularly as it will be amended by the final passage of Bill C102. Many other departments of the government have a concern of one sort of another with patents and therefore, presumably, a view upon the question of what, from the point of view of the objects of the programs being administered in such departments, the ideal Canadian Patent Act should provide in furtherance of those programs.

47. We have the impression that there is a need for consultation between these various departments on a departmental rather than political level at a very early stage whenever legislation affecting patents is under consideration in order to reconcile conflicting interests in different

departments before proposed legislation reaches the stage of becoming a definite commitment.

48. A case in point is Bill C102 which when it becomes law, will to all intents and purposes, eliminate in respect to drug patents all of the incentive which the patent system is supposed to provide. It does this in the name of the desirable social object of decreasing drug costs and prices although no one has been able to produce any concrete evidence of what the effect of the provisions of the Bill will be on the eventual level of prices in the drug industry. It is our impression that had the views of the Department of Industry been sought at an early stage during the preparation of the Bill the Government might have been more reluctant to deprive a substantial portion of Canadian industry of the benefits of the patent system. Ways might have been sought to accomplish the worthy objects of Consumer Affairs without penalizing an entire industry as such.

49. We recommend that consideration be given to the establishment of a permanent inter-departmental consultative body at the Deputy Minister or Assistant Deputy Minister level which might from time to time be convened when legislation affecting patents is under consideration in order that, before drafting of new legislation is commenced, the department promoting the legislation may be made aware of the affects of the proposed legislation on the areas of responsibility of the other departments who are concerend so that the legislation when drafted does not conflict with the policy of one department nor derogate from the public policy of another.

CONSTITUTIONAL QUESTIONS

50. It will have been noted in our review of the Canadian patent system that some apprehension has been expressed about the use of the Federal patent legislative power for purposes of attempting to control what may be considered to be abuses in the buying and selling of commodities. Our apprehension is based upon the feeling that such legislation cannot fail to introduce more uncertainty into the patent law than is already there. One cannot forecast what future areas of special public policy might give rise to further patent legislation of this nature and one therefore may be apprehensive of a piece meal abrogation of the patent

system which in time would render it substantially ineffective as an incentive to investment in new industry and research. While such legislation under the existing provisions of the BNA Act may be considered a necessity it is in our view highly desirable that steps should be initiated which in the course of time are calculated to remove this danger. We realize that constitutional reform is politically a very sensitive subject especially at this particular point in our history. Nevertheless, we feel that there may well be non-controversial areas which, if explored, might permit acquisition by parliament of legislative power to the extent necessary to enable Federal legislation in relation to unfair or unconscionable trading practices to be independent of the Federal powers of legislation in respect to patents and criminal law. We suggest that consideration might be given to the initiation of a study aimed at determining what specific legislative authority would be required for a reform of this nature. Such a study might be non-political in concept and draw assistance from personnel from both the public and private sector.

SUMMARY OF RECOMMENDATIONS

51. This Institute considers a strong, effective, and efficiently administered patent system to be of prime importance in the expansion of Canadian industry and industrial research. It recognizes that the effectiveness of the present patent system is not as great as it should and could be and recommends the following measures calculated to improve and to preserve the effectiveness of the system.

(1) The allocation of increased funds and personnel for purposes of designing and adopting electronic data retrieval techniques within the Canadian Patent Office in co-operation with international groups and Patent Office of other countries. Such personnel should include personnel specifically assigned the task of representing Canada in the international sphere.

(2) Amendments to the Canadian Patent Act designed to

(a) constitute the first inventor to file a patent application as the person entitled to a Canadian patent.

(b) reduce the uncertainty in relation to patent enforcement by reducing the field of application of the subjective tests of "invention" and "utility" together with the elimination of Section 41 (1) of the Patent Act.

(c) restriction of the application of Section 58 of the Patent Act so that it protects only those persons who acquire an invention bona fide without notice from subsequent claims by a subsequent patentee.

(3) Provision for inter-departmental consultation in relation to proposed legislation affecting patents.

(4) Initiation of a constitutional study aimed at removing the need for legislative power in respect of patents to be used to control undesirable trade practices.

APPENDIX III

THE PATENT SYSTEM

Historic Outline

52. The concept of patents of invention, that is to say, of granting to an inventor the exclusive right to make, use or sell his invention for a limited period of time has its origin in the common law of England in the day of the guilds. In those days the King, by Royal prerogative, could grant to any subject a monopoly in respect of any trade, but the monopoly was subject to the law courts who, before enforcing it, had the power to determine whether or not the monopoly was lawful. Thus in "The Case of The Monopolies"; Darcy v. Allin [1] counsel for the defendant put the following passage to the court as representing the common law of the time in relation to monopolies:-

> "Now therefore I will shew you how the Judges have heretofore allowed of monopoly patents which is that where any man by his own charge and industry or by his own wit or invention doth bring any new trade into the Realm or any Engine tending to the furtherance of a trade that never was used before and that for the good of the Realm; that in such cases the King may grant to him a monopoly patent for some reasonable time, until the subjects may learn the same, in consideration of the good that he doth bring by his Invention to the Commonwealth; otherwise not."

53. This passage has formed the foundation of our modern theory of patents not only throughout the British Commonwealth and the United States of America but throughout most of the civilized world [2]. It was first codified in the Statute of Monopolies [3]. With embellishments which have been added from time to time with the passing of succeeding patent statutes the fundamental principles of the foregoing passage are expressed in the present Canadian Patent Act [4] notably in Sections 28, 46 and 49 (1).

1. (1602) 11 Co. Rep. 84 b; Moore K.B. 671; Noy 173; W.P.C. 1.
2. Gordon Monopolies by Patents, 219.
3. (1624) 21 Jac. I, c. 3
4. R.S.C. 1952, c. 203 as amended by 1953-54 c. 19 1953-54 c. 40, s. 15

54. The important thing to note is that a valid patent monopoly can exist only for that which was not previously in the public domain. The grant of a patent can foreclose no previously existing area of commercial or industrial activity. The area of the new activity covered by the patent is added to the public domain when the patent expires.

55. As the practice of granting patents of invention was adopted in more and more countries and international trade became an important part of the economy of more and more countries it became evident that some form of international agreement was needed to prevent the pirating of inventions patented in one country by persons trading from other countries. Thus on March 20, 1883 there came into being the Union Convention of Paris which was adhered to by the major trading nations of the world and which in general provided that the inventor who filed a patent application in one of the countries adhering to the Convention would be afforded the right to apply for and obtain a corresponding patent in any of the other Convention countries with the same priority as if the application in the other countries had been filed on the same date as the original application, provided the other applications in the other countries were filed within one year of the filing of the first application. From time to time the original Convention document has been amended and brought up to date and an increasing number of countries have adhered to it, Canada having joined in 1925. Today practically all countries who have patent systems belong to the Convention, a total of 79 countries. Statutory expression is given to the Convention in Canada by s. 29 of the Patent Act.

56. Although most of the patent systems in the various countries of the world relfect the same fundamental concept, the patent statutes of each country express the concept in somewhat different terms and require different procedures for obtaining patents. Much has been done and is being done through such international organizations as AIPPI [5], ICIREPAT [6]

5. Association Internationale Pour La Protection De La Propriete Industrielle
6. Committee for International Cooperation in Information Retrieval Among Examining Patent Offices

BIRPI [7] and others to promote greater effectiveness of patent systems throughout the world, and much activity is being directed towards the formulation and adoption of a Patent Co-Operation Treaty which in our view should provide a central comprehensive computerized searching authority available to applicants of all countries, and should simplify the application procedure.

7. United International Bureaux for the Protection of Intellectual Property

APPENDIX IV
(Extract from submission to Special Committee of
the House of Commons on Drug Costs and Prices)

57. 1. Section 41 (1) reads as follows:-

(1) In the case of inventions relating to substances prepared or produced by chemical processes and intended for food or medicine, the specification shall not include claims for the substance itself, except when prepared or produced by the methods or processes of manufacture particularly described and claimed or by their obvious chemical equivalents.

We do not think that this sub-section of the Patent Act serves the present day public interest of Canada and we shall attempt to explain why we hold this view.

58. 2. There are, we think, two main reasons why Section 41 (1) in part fails to perform anything useful in relation to the present public interest and in part is ineffective, namely:-

(1) The science of chemistry has expanded so enormously since 1923 when the forerunner of the present section, based on an English precedent of 1919, was introduced into Canada that the philosophy behind the section is no longer valid.

(2) The precise meaning of words, especially those having to do with technical subject matter has so changed as the scientific context against which they are applied has changed and expanded that words which in 1923 in the then scientific context may have been reasonably clear and precise have become subject to a variety of plausible interpretations which could not possibly have been foreseeable when the words were first adopted.

59. To illustrate the above two points, this sub-section came up for consideration by the Court in the case of Winthrop .. Commissioner of Patents * in the year 1948 approximately 25 years after the section

* (1948) S.C.R. 46

became law. The case involved a technical point of Patent Office practice. The Commissioner of Patents contended that the sub-section meant that there must be a separate claim with respect to the process by reference to which a separate claim in respect to the product must be limited. The appellant, who had a very large number of accrued patent applications which would have to be amended at considerable expense if the Commissioner's view were right, contended that the wording of the sub-section was met if it had in a single claim a claim to the product when made by a particular process set forth in the same claim. The scope of the patent would have been the same in either case. The President of the Exchequer Court in a detailed judgment** agreed with the appellant, and reversed the Commissioner. The Supreme Court concluded that the Commissioner's view was right and reversed the Exchequer Court. Thus, some 20 years ago the difficulty of construing Section 41 (1) was such that it enabled two courts to come to different conclusions as to the meaning of its language. Fourteen years later in the case of Boehringer v. Bell-Craig *** the Exchequer Court concluded that not only must the process be separately claimed but the product claim which referred to it for purposes of limitation could be valid only if the process claim was itself valid even though the reason for the invalidity of the process claim might have had no bearing whatever on the scope of patent protection included within the language of the product claim. The Supreme Court of Canada **** supported that view and affirmed the Exchequer Court specifically on that point thus establishing an additional ground for the invalidity of patents to which Section 41 (1) applies over and above the usual grounds of invalidity to which claims to subject matter not within Section 41 (1) are subject. In the Exchequer Court a number of additional grounds of invalidity arising solely from the wording of Section 41 (1) were adopted by the Court and since these were not dealt with by the Supreme Court of Canada, they must be taken as representing the present state of the law. As a practical matter in most cases it would be virtually impossible for an applicant for a drug patent to have any confidence that he has avoided all these grounds of invalidity.

** (1947) Ex. C.R. 36
*** (1962) Ex. C.R. 201
**** (1963) S.C.R. 410

60. The reason for this is that the inventor of a new chemical compound which is intended as a drug (usually a chemist) has completed his task as soon as he has made the new compound and had it confirmed in tests that it (and usually a group of chemically related compounds) possesses unusual and potentially valuable properties. Before that compound or any of its related compounds can be accepted as a useful drug there must be extensive biological tests, in vitro first, and then in test animals, and finally extensive clinical testing in humans. This may take several years. The patent system, however, requires the inventor to file his patent application as soon as he has made his invention or run the risk of being forestalled by a rival inventor*. When he files his application he has no basis for predicting confidently which particular one of his group of new compounds will turn out to be the drug of choice, or what the preferred salt, dosage form and method of production will be. However, among the grounds of invalidity adopted by the Exchequer Court in the decision above referred to is failure in the specification to particularly describe these things.

61. Thus not only does the interpretation of Section 41 (1) give difficulty, but the current judicial interpretation of it shows it to be booby-trapped with special requirements for validity which are frequently impossible to meet.

62. Back in 1919 and indeed well into the 30's it was a widely held view that the value of chemical science lay primarily in the devising of new processes by which substances already known or to be found in nature could be synthesized or could be more cheaply produced. It was also a widely held view that chemical compounds per se were intrinsic to nature and that therefore, no chemical compound per se could be held to have that element of novelty necessary to make it a patentable invention. That view has now changed notably in the following respects:-

(a) Synthetic chemistry has expanded beyond anything that was foreseen in those days until we have reached the stage where it is

* In all countries except Canada (and with respect to domestic inventors only, the United States) the person who first files a patent application is the person who is entitled to the patent.

taken for granted that chemical substances not found in nature can be synthesized and chemical research is devoted almost entirely to the preparation and investigation of the properties of chemical compounds which have never before been in existence. These are theoretically as unlimited in number as the stars in the universe.

(b) The fundamental laws of chemistry have been ascertained to the extent where a fundamentally new chemical method is a great rarity. Where a chemist conceives a chemical formula for a previously unknown compound, he is able to predict with reasonable certainty a number of known chemical methods by which such new compound can be prepared, thus putting it out of the power of any subsequent chemist to claim any originality of thought in the mere preparation of such new substance by any of the methods which have already become conventional chemistry. Thus, today we have had it pronounced by the Supreme Court of Canada * that the inventive merit in a case involving an important drug resides in the discovery of the useful properties of the product rather than in any particular method of producing it.

63. This would seem to make it clear that a section such as Section 41 (1) which was designed to restrict the reward to the inventor of a new substance to the aspect of his invention involving what was then (in 1923) regarded as the inventive merit, namely the process, is out of place in a later day and age which regards the discovered intrinsic properties of the product as the seat of inventive merit.

64. Nor is the foregoing the only anomaly to be found in respect to Section 41 (1). If it is intended (as we think it must be presumed to be) to make special provisions in the public interest in respect to food and medicine, then it seems to us to be clear on its face that it falls far short of that objective.

65. As it stands, Section 41 (1) prohibits the patenting of new compounds per se only when such compounds are produced by chemical processes and intended for food or medicine.It does not prevent the patenting per se of foods or medicines which are not produced by chemical processes and it does not prevent the patenting per se of new compounds which are produced

* Hoechst v. Gilbert (1965 S.C.R.)

by chemical processes and later turn out to be useful foods or medicines unless at the time of the filing of the patent application the compounds concerned were intended as food or medicine. Thus the sub-section is not directed generally to all patents having to do with foods or drugs but only to those patents on foods or drugs where the substances concerned are produced by chemical processes and which were known to be sufficiently useful as foods or medicines at the time of the application as to be intended for food or medicine. Thus, a particular new chemical might be intended for medicine but might never pass the clinical testing required by the Food and Drug administration before it could be used as such and so might never actually be a medicine. Yet the sub-section under consideration would clearly apply to it and deprive the inventor of the right to a patent on it even though it might be a very useful compound from points of view other than use in medicine and a most useful contribution to the scientific arts. On the other hand, a patent on a new compound which was not intended as a medicine can create a perfectly valid monopoly on a medicinal substance <u>per se</u> as long as the inventor did not know it was useful as a medicine at the time he filed his patent application. In our submission, this situation is nothing short of ridiculous. In the present state of scientific knowledge and government control of foods and drugs we can see no justification for putting the patentability of substances <u>per se</u> in the food and drug field on any different basis than that of compounds <u>per se</u> in any other field such as dyestuffs, plastics, etc.

66. If Section 41 (1) were to be repealed the position in respect to patents on foods and drugs would then accord with the general philosophy of the public interest in the patent system which is the encouragement of the advancement of the useful arts by giving to inventors and their legal representatives a limited period of exclusive use of this invention in return for a public disclosure. In our submission the force of this philosophy is, if anything, greater in relation to the medical arts than it is in relation to the other useful scientific arts.

67. We agree with the Ilsley Commission Report (pp 93,94) that Section 41 (1) should be repealed both for the reasons there given and

for the reasons outlined above. The corresponding provision in the British Patents Act was in fact repealed in 1949 as recommended by the Swan Report *.

* Report on "Patents and Designs Acts" presented to the Parliament of Great Britain by the President of the Board of Trade - September, 1947

APPENDIX 147

NATIONAL DESIGN COUNCIL

Submission to the Senate of Canada
Special Committee on Science Policy

May 1969

PREFACE

This brief is submitted on behalf of the National Design Council to draw attention to the state of design in Canada and to propose that greater benefits to the Canadian economy will be accrued through the closer integration of design and scientific activity.

Since its inception in 1961, the National Design Council has been directing efforts to the improvement of design in the products of Canadian industry by various means, addressed to five main sectors of the economy: manufacturers, distributors, consumers, the design professions and government.

To date, the largest percentage of its efforts and expenditures have been devoted to attitude promotion - creating a greater awareness of the importance of good design through promotional media. In this connection, its most extensive activity has been the 'Design Canada' Centre Programme which consists of the operation of two permanent design centres in Toronto and Montreal and 'on the road' activities which extend to other key locations across Canada. This programme comprises exhibits, seminars, audio/visual presentations and associated promotion.

A limited technical assistance service has been offered by the maintenance of a design reference library which makes available information on publications pertaining to design, including design research, processes and criteria. Part of this service is the Product Index which contains a record of products which have been evaluated for their design qualities. Constructive critiques are forwarded to the manufacturers concerned following evaluation. On a selective basis, a technical design advisory service has been rendered to assist influential decision makers in the application of design technology, examples of which are described in this brief.

Promotional incentives have been offered to encourage the application and acceptance of good design on the part of manufacturers, distributors and consumers. One notable example was 'Canada Design 67' which by the issuance of awards, labelling privileges, catalogues and through promotion provided Canadian designers, manufacturers and businessmen opportunities to design, produce and promote products and systems required to construct and equip the numerous Centennial building projects and Expo '67, as well as giftware for the visitors to Canada during 1967. A number of design award programs have been successfully implemented on an industry/government co-operative basis with industry associations such as the Structural Steel Association, Canadian Wood Council, Portland Cement Association, and the Canadian Appliance Manufacturers Association.

Expenditures on financial incentives have been relatively modest, concentrated in the area of scholarships and grants in support of advanced training in the field of design, design research and design promotion as described in detail in the body of this brief.

In summation, for the most part, the Council's efforts and expenditures have been directed to the promotion of good design by persuasive means, which in the Council's view is required. However, it is becoming increasingly evident that such means alone will not be sufficient to advance the state of design in Canada and to encourage and assist Canadian industry in increasing its design activity to the degree necessary to compete favourably in many important sectors of the domestic and export markets.

Since, industrial design is an important function in the innovative process, it is the view of the Council that it should be considered as an integral component in the formulation of Canada's Science Policy with respect to research, development and innovation.

In the content of this brief, particular emphasis is placed on ways by which the federal and other levels of government could and should exploit their positions in support of good design in areas which fall under their jurisdiction.

The need for comprehensive joint programs with industry also is stressed and should it be confirmed that financial assistance is required to enable Canadian manufacturers to undertake greater design activity; to support related research and development; and to develop appropriate Canadian design capability; provision should be made for such assistance. In anticipation that such support is necessary, the Council has suggested that provision be made for increased funding for this purpose in its projected estimates for 1970-74 as detailed in the brief under section 8 dealing with "Expenditures Associated with Scientific Activities".

SUMMARY OF MAIN CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

The lack of design innovation in Canadian industry is diminishing the competitive position of Canadian products both in domestic and export markets. Expenditures by Canadian manufacturing establishments on industrial design activity are insignificant in comparison to other leading industrial nations.

Most of the industrial design activity which is carried out by Canadian manufacturers originates from engineering departments and company owners or officials with no specific design responsibility. The industrial design profession is not recognized by the majority of Canadian manufacturers, consequently a very small percentage of the industrial design is professionally executed. As a result, the general quality of Canadian design does not compare favourably with that of other countries.

One of the major deficiencies in the design of Canadian products and systems is the lack of proper consideration for human requirements which is a primary factor in good industrial design. Canadian basic and applied research dealing with the relationship of man to machine, systems and environments is fragmented and it is not orientated for application to industry.

Although considerable support has been given to the promotion of improved industrial design by the Federal Government and some of the provincial governments, it has not been given sufficient support within the immediate areas of governmental jurisdiction. For example, it is just beginning to be given consideration in the formulation and development of standards, procurement and public works policies and activities; in industrial and trade development programs; and incentive programs for the advancement of science, technology, industrial research, development and innovation.

RECOMMENDATIONS

a) In order to improve the competitive position of Canadian manufacturers both in domestic and export markets, comprehensive joint programs should be initiated by the Federal Government with manufacturer associations and provincial governments to encourage increased design innovation and the application of industrial design.

b) Stronger support should be given to the development of a Canadian industrial design capability at the various levels of education orientated to the requirements of Canadian industry.

c) Greater emphasis should be placed on basic and applied research dealing with the relationship of man to machines, systems and environments in order to overcome the lack of consideration for human requirements in the design of Canadian products and systems.

d) Good industrial design practice should be made mandatory in the formulation and development of governmental standards, procurement and public works policies and activities.

e) Industrial design should be given greater emphasis and more fully exploited as a means of achieving governmental industrial and trade development goals.

f) More positive provision should be made in support of industrial design in governmental incentive programs for the advancement of science, technology, industrial research, development and innovation.

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1. HISTORICAL BACKGROUND

1.1 The National Design Council (NDC) was established by Act of Parliament in June 1961 (Appendix A) with the general intent of achieving design improvement in the products of Canadian industry. The Act designated that the Council be under the direction of the Minister of Trade and Commerce.

1.2 With the formation of the Department of Industry (DOI) in July 1963, authority for the administration of the NDC Act was transferred to the Minister of Industry.

1.3 The merger of the Departments of Industry, Trade and Commerce (ITC) in March of 1969 resulted in the transfer of authority of the NDC Act to the Minister of that Department.

1.4 Since its establishment, the administration of the Council's program has been provided by essentially the same administrative office, initially identified as the National Design Branch under T&C and DOI and currently known as the Office of Design Adviser (ODA) under ITC.

1.5 In addition to its administrative responsibilities to the Council, the ODA continues to have the prime responsibility for the formulation and integration of design projects relevant to the Departmental activities of ITC.

1.6 As the NDC is the declared national design authority, the ODA on behalf of the Council and the Department participates on Federal Government committees of Treasury Board and Privy Council and other agencies on matters pertaining to design.

2. ROLE AND OBJECTIVES

2.1 The object of the National Design Council is to "promote and expedite improvement of design in the products of Canadian industry".

2.2 The aspect of design which is of particular concern to the NDC is that which pertains to the relation of products and systems to those who use them. This is a primary factor in industrial design.

2.3 The main role of the NDC is to stimulate Canadian industry and to provide it with the assistance necessary in order to achieve advancement of industrial design in Canada.

2.4 The major hindrance to achieving this objective is the fact that there is a lack of awareness of the value of good industrial design on the part of Canadian industry and the other sectors in the economy. Design extends into all fields of human endeavour; there are no facets of the economy or society to which design is not relevant; nothing devised can be physically realized without design; and yet in Canada it is given a low priority in terms of activity and expenditure.

2.5 The economic and social success of a nation, to a considerable extent, is measured by the design quality of its communities, architectural and engineering achievements and particularly by the products which it contributes to the world. It can be clearly demonstrated that well-designed living and working environments are more conducive to social well-being and greater productivity and that products of superior design are more competitive in the domestic and world markets. To an appreciable degree, the economic success of the USA, Scandinavian countries and the post-war economic resurgence of western European countries and Japan can be attributed to good industrial design.

2.6 The value of good design to an economy and society can be demonstrated; conversely so can the negative effect of poor design. The most undesireable implication of poor design is that it can contribute to economic and social stagnation. Poor design also can be detrimental to the basic maintenance of the economy and society. For example, poorly designed urban developments, including housing, educational and hospital facilities and transportation services, not only result in adverse social conditions but lead communities into financial crisis. Poorly designed systems and products have created almost insoluble problems such as air and water pollution, traffic congestion and urban blight which divert valuable human and financial resources from more constructive applications. Therefore, not only is it important to appreciate the value of good design but to recognize the detrimental implications of mediocre and poor design.

2.7 The studies and analyses conducted by the NDC since its inception clearly indicate that one of the major deficiencies in the design of Canadian products and systems is the lack of proper consideration for human requirements which is a primary factor in good industrial design. A study completed by Price Waterhouse Associates in April 1969 (Summary of the Study of Design in Canada - Appendix B) revealed that the mean expenditure per annum by Canadian manufacturing establishments on industrial design ranges from $100 to $3700. This includes all sources - in-house, purchased or gratuitous. Approximately 63% originates from engineering departments or from the imagination, ingenuity and skill of the owners or officials with no specific design responsibility. Approximately 30% is provided by in-house craftsmen, staff designers, engineering departments or consultant industrial designers with specific responsibilities. The remaining 7% is obtained from foreign parents and other sources. Although overall statistics from other countries are not available for comparison, the expenditures on industrial design by a number of successful corporations in the USA have been obtained which emphasizes the insignificance of expenditures on industrial design on the part of Canadian industry (Appendix C).

2.8 The lack of design innovation in Canadian industry is diminishing the competitive position of Canadian products both at home and abroad. The emphasis on greater industrial productivity is valid; however, without greater industrial design activity, this will not be sufficient to satisfy important markets for Canadian manufactured products. Evidence of a positive design approach can be demonstrated by again citing the Japanese example.

2.9 The rapid development of industrial design in Japan which has contributed remarkably to increasing trade both at home and abroad is partly due to the friendly aid extended by industrially advanced western nations and partly to the enterprising and independent spirit of the Japanese people.

Through such preliminary techniques as foreign fact-finding missions and participation in international design organizations, Japan has progressed rapidly since 1958 in advancing the design of its industrial products. Knowing the importance of good product design, the government, educational foundations, business organizations and design associations adopted an extensive program for harnessing the nation's traditional and cultural beauty and the appreciation of beautiful things to comply with the world demand for well-designed products. This nation wide design program includes basic research and guidance, promotion of design for specific business needs and the education of both consumers and manufacturers.

As for design administration, the Japanese government in 1958 established the design section in the Ministry of International Trade and Industry. This section co-ordinates the promotion of good design and offers guidance and encouragement in creative and original design. The government maintains large design research and development laboratories staffed by both scientific and design experts. Each of these 150 design research centers, maintained by the national and local governments and located throughout Japan, is equipped to handle specific problems of materials, merchandise requirements and design tradition that exist in a given region. They are similar to research and development departments found in large enterprises in the United States. They are also geared to give design guidance to small manufacturers who cannot afford their own design staff.

These and other allied efforts by governmental and private groups are oriented towards Japan's ultimate goal in this field - to make continued efforts in producing unique 'hybrid' designs which incorporate the best of East and West, and thus significantly and increasingly expand her export markets.

2.10 Unfortunately, such appreciation of design and desire for concerted action does not exist amongst the majority of the decision makers in Canadian industry and government to the same extent that it does in Japan and other countries. Although there are a number of outstanding exceptions, the lack of good design application is very evident in our environments and products.

2.11 Nevertheless, it must be acknowledged that industry and government, and not the public, have the prime responsibility for the application of design, with government playing an increasingly important role.

As to the role of the Canadian governments, the 1967 Fourth Annual Review of the Economic Council of Canada has revealed that 40% of Canada's products and services are directly purchased by governments. This major 'customer' position of public authorities demands much more sophisticated design planning and decision making on the part of government agencies responsible for design and the procurement of services and products.

Therefore, in order that the Canadian economy and society can gain full value from good design both domestically and abroad, comprehensive joint programs should be undertaken between industry and government, including provincial governments, with the Federal Government providing the initiative.

2.12 In this regard, the NDC has implemented a number of projects,through the departments with which it has been associated, in co-operation with manufacturer associations and current plans are for greater concentration on joint programs with industry.

2.13 In respect to government standards and procurement, agencies of the Federal Government with responsibilities for these functions have become increasingly receptive to good design primarily as the result of cost benefit demonstrations implemented in connection with government office accommodation.

2.14 To date, industrial design has not been sufficiently exploited by federal government agencies charged with responsibilities for industrial and trade development or adequately recognized in programs created to foster industrial research, development and innovation. However, this condition is expected to improve within the framework of the new Department of Industry, Trade and Commerce.

2.15 The majority of the federal government industrial research and development incentive programs are orientated to the engineering aspects of scientific activity. Research and development in the natural and social sciences as they relate to industrial products and systems are not given sufficient attention.

In evolving new or improved products and systems which are user orientated, it is necessary to reconcile the engineering and human requirements. The physiological and psychological needs of the user are given full consideration by the industrial design process in addition to advancing the "state of the art" for the respective technologies.

The full product cycle requires constant interplay of all the disciplines that are involved from the concept stage to the final stages of production and marketing. Therefore, industrial design should be clearly identified as an eligible current expense in the regulations of governmental R&D programs both in terms of basic and applied research as well as development and innovation.

3. ORGANIZATION

3.1 National Design Council Organization

3.1.1 The organization chart presented (Appendix D) shows the current organization of the NDC including its administrative arm, the Office of the Design Adviser (ODA), Department of Industry, Trade and Commerce.

3.1.2 The NDC is composed of seventeen members appointed by the Governor in Council for terms of three years. A list of current members of the NDC is attached (Appendix E).

3.1.3 The ODA comprises a General Director, design consultants and administrative support for the formulation, development and implementation of the NDC program.

3.2 Channels of Communication

3.2.1 The NDC reports to the Minister of Industry, Trade and Commerce through its Chairman. An annual report of the operations of the Council is submitted by the Chairman within three months after the termination of each fiscal year.

3.2.2 The NDC recommends programs for the consideration of the Minister.

3.2.3 The Minister in turn may refer proposals for the consideration of the NDC.

3.2.4 The budget for the NDC program is provided through the Department of Industry, Trade and Commerce and is allotted at the discretion of its Minister. The NDC does not have direct control of funds.

3.2.5 The General Director acts as operational liaison between the NDC and ITC.

3.3 Units Responsible for Scientific Activity

3.3.1 The NDC does not undertake intramural research and development or industrial design activities as such. It initiates programs to stimulate such activities and on a limited basis offers financial assistance for selected activities.

3.3.2 Internally, the ODA carries out technical and economic studies which provide the base for policy recommendations and the formulation of the NDC program. Complex studies are contracted out to professional consultants.

3.3.3 The stimulation of design activity is primarily achieved through promotional means such as exhibits, publications, seminars, awards, demonstrations and through an advisory service to industry, business, educational institutes, the professions, governments and others concerned with design. A technical design reference library is maintained for this purpose.

3.3.4 Financial assistance is offered in the form of scholarships for advanced training in industrial design; grants for design research of a non-proprietary nature; grants in support of groups qualified to assist the NDC in the achievement of its objects (Appendix F).

4. ORGANIZATIONAL FUNCTIONS

4.1 Statutory Responsibilities and Functions

4.1.1 The statutory functions and powers of the NDC regarding scientific activity are not limited as long as they are within the framework of the objects of the NDC as specified in Section 10 of the NDC Act (Appendix A). The extent to which the functions and powers are expedited are at the discretion of the Minister of Industry, Trade and Commerce.

4.2 Functions and Responsibilities in Relation to other Federal Agencies

4.2.1 The NDC may recommend to the Minister policies and programs for adoption and implementation in any areas of governmental jurisdiction. Specifically, through the ODA it provides an advisory service to ITC, Treasury Board, Privy Council and other departments and agencies wishing its assistance on matters pertaining to design.

4.3 Functions and Responsibilities in Relation to Industry

4.3.1 It is the responsibility of the NDC to advise the Minister on the state of design in Canadian industry; to recommend programs for stimulating and assisting Canadian industry in achieving design improvement; to give direction to ODA in the implementation of such programs and to evaluate and report on their effectiveness.

4.4. Functions and Responsibilities in Relation to Educational Institutes

4.4.1 The NDC may and does offer advice and financial support to educational institutes for the advancement of industrial design education, design research and design promotion; specifically through its annual scholarships and grants program (Appendix F).

4.5 Functions and Responsibilities in Relation to International Scientific Activities

The Council is a member of the International Council of Societies of Industrial Design and participates at its assemblies, congresses and support committees concerned with the advancement of industrial design.

4.6 Review of Operational Effectiveness, Duties and Goals

4.6.1 All program activities are evaluated annually for purposes of long range planning and for annual budgeting. Although many of the NDC activities are promotional and difficult to measure in terms of cost benefits, criteria other than cost are used as a basis for judgement. Where feasible, projects are evaluated on the basis of their contribution to industrial and trade development and other Canadian economic and social objectives.

4.7 Outside Studies of Operating Procedures

4.7.1 Several studies were commissioned to advise on the effectiveness of the 'Design Canada' Centre Program and to recommend improvement measures.

4.8 Relationship Between Responsibilities and Powers and Activities

4.8.1 The NDC has the prerogative of recommending to the Minister any proposals which it feels will best achieve the objects of the Act. The extent to which such proposals are accepted is at the discretion of the Minister and subject to prevailing economic constraints.

4.9 Major Hindrances

4.9.1 The lack of awareness of the value of industrial design not only on the part of Canadian industry but on the part of governmental departments and agencies which should be concerned about design.

4.9.2 The hesitancy to accept industrial design as a significant consideration in governmental programs for the advancement of science and technology, industrial research, development and innovation.

4.9.3 The lack of commercial intelligence and statistical information necessary as a base for the formulation of programs and the determination of priorities.

4.9.4 Foreign ownership of Canadian industry which tends to minimize the opportunities for encouraging design innovation in Canada.

4.10 Changes in Organization Functions

4.10.1 On the assumption that major hindrances can be overcome and that stronger support to industrial design will be forthcoming, it is probable and desireable that the scope of the NDC will broaden and will become more policy and less operational in orientation. The ideal condition would be for the NDC to provide the "umbrella" under which the following will transpire

4.10.2 Industrial design activities in the Federal Government will become integral functions of departments and agencies.

4.10.3 Manufacturer associations will establish committees to conduct programs for advancement of industrial design.

4.10.4 Provincial governments will establish agencies to foster industrial design at the regional level.

4.10.5 Educational institutes will establish facilities for industrial design training.

4.10.6 Public and private institutions will undertake greater research and development related to industrial design.

5. PERSONNEL POLICIES

5.1 The personnel policies of the NDC pertain only to its administrative arm, the ODA of ITC.

5.2 Since the bulk of the NDC activities are implemented extramurally, the primary need is for personnel knowledgeable in the field of industrial design with an appreciation of economic and other factors which influence design, production and marketing. All such personnel are identified as consultants and their function is to study and analyse existing conditions, formulate proposals for projects to improve conditions, and develop the formats and specifications by which such projects can be implemented either by intramural or extramural resources.

5.3 Canadian universities or other educational institutes produce few graduates in the field of industrial design, particularly in the disciplines of design research and design management. Consequently, qualified personnel are difficult to obtain from within Canada. The majority of the design consultants received their education abroad or developed their capabilities through practice. The greater percentage of the consultants are originally from the USA or Great Britain.

5.4 The criteria for identifying those who will be creative and effective researchers is built into the formats for R&D projects. The ability to structure R&D projects that will bring forward the desired intelligence is the main criteria.

5.5. Personnel capable of preparing criteria and specifications for the development and implementation of research activities are selected for research administration.

5.6 Since extramural research activities predominate, a higher value is placed on administrators of research in terms of promotion and salaries.

5.7 Personnel showing the greatest potential are permitted to attend conferences, seminars and short courses which will contribute to their personal development. Such permission is limited due to manpower constraints.

6. DISTRIBUTION OF ACTIVITIES

6.1 Although it is the object to extend activities to all regions of Canada, in practice, in addition to Ottawa, intramural activities are carried out in Toronto and Montreal. Extramural activities are implemented regionally in the following general pattern - Ontario, Quebec, Manitoba, British Columbia, Alberta, Saskatchewan and the Atlantic Provinces.

6.2 Ontario and Quebec are most receptive to activity related to industrial design.

6.3 Investigations are conducted on a regional basis to determine the extent of industrial design activity in industry and academic institutes including design education.

6.4 The NDC works closely with provincial government sponsored agencies concerned with the advancement of industrial design specifically Ontario, Manitoba and British Columbia. Modest financial support has been extended to such agencies.

6.5 There is no doubt that if regional governments would undertake activities for the advancement of design, cost benefits could be achieved if the scope of the program was extended and sufficient funding was made available. For example, co-operative projects with regional governments have been carried out on a basis of cost and/or administrative sharing.

7. PERSONNEL ASSOCIATED WITH SCIENTIFIC ACTIVITIES

7.1 The current personnel establishment of the ODA is forty-seven with a total manpower allocation of forty-five. This establishment is augmented by two office service positions and a financial analyst seconded from service branches of the Department. Categories of personnel are as follows:

Professionals	18
Other supporting personnel	29

7.2 Number of professional staff with administrative duties - six (6).

7.3 Degree staff only - (Bachelor level)

	Canada	USA
(i) Country of birth.		3
(ii) Country in which secondary education taken.		x
(iii) Country in which university degree taken.		x
(iv) Number of working years since graduation (average).		17
(v) Number of years employed in present organization (average).		2
(vi) Average age.		42
(vii) Percentage able to operate effectively in Canada's two official languages.		0

The balance of professional staff listed under 7.1 i.e. fifteen (15) possess diplomas in arts or design. Until recently, there were no universities in Canada granting degrees in industrial design.

7.4 Total number of professional staff in each degree category for:

1962	nil
1963	nil
1964	2
1965	2
1966	2
1967	4
1968	3
1969(est.)	4
1970-73(est.)	4

7.5 Percentage of turnover in degree staff

1962-1967 incl.	nil

7.6 Percentage of current degree staff formerly employed by industry - 100%

Percentage of current degree staff formerly on staff of universities - nil

Percentage of current degree staff formerly with provincial departments or agencies - nil

Percentage of current degree staff formerly with other federal government agencies - nil

7.7 Number of staff on education leave - nil

7.8 Number of university students given employment in the field of scientific studies:

1962	nil
1963	nil
1964	3
1965	3
1966	5
1967	5

8. EXPENDITURES ASSOCIATED WITH SCIENTIFIC ACTIVITIES

8.1 Funds for the design program of the NDC have been allotted on the basis of standard objects of expenditure and a breakdown within specific categories is not available. The allotment of these funds, however, covers intramural R&D, data collection, R&D in universities and support of education in the industrial design field. Total funds allotted, exclusive of salaries, are as follows:

Allotted	1962-63	$ 127,650
"	1963-64	188,200
"	1964-65	348,650
"	1965-66	505,700
"	1966-67	537,247
"	1967-68	843,600
"	1968-69	899,080
"	1969-70	935,000
Projected	1970-71	935,000
"	1971-72	1,221,000
"	1972-73	5,115,000
"	1973-74	7,525,000

The most direct funds allotted under the NDC program are for scholarships and grants for the study of industrial design and for design research. Expenditures from 1962-63 to 1968-69 are as follows:

	Scholarships	Grants
1962-63	$1,500	$11,900
1963-64	$8,000	$7,000
1964-65	$10,000	$16,100
1965-66	$10,500	$6,300

	Scholarships	Grants
1966-67	$4,250	$18,880
1967-68	$24,500	$33,575
1968-69	$25,550	$114,147

8.2 Operating and capital funds allotted are included in the total budget allotment listed under 8.1.

9. RESEARCH POLICIES

9.1 Units Concerned With Intramural Activities

9.1.1 Programs and projects are selected by two basic means:

a) on the basis of economic and technical studies initiated by NDC.

b) by identification of industrial and trade development programs and projects to which a contribution would be made by the advancement of industrial design.

The Department of Industry, Trade & Commerce is the source for the latter. The programs and projects of Treasury Board, Privy Council and other departments and agencies with which the NDC is involved influence selection.

9.1.2 Program Planning and Budgeting (PPB) is the primary means for establishing priorities. Benefit to the economy, society and the objects of the NDC are considered in the process.

9.1.3 Versions of CPN or PERT are used for complex programs. A system of Project Briefs and Activity Sheets are most commonly employed for the development and implementation of projects.

9.1.4 Complex projects in support of intramural programs have been contracted out, specifically with respect to research related to the environments of home, work and play. The most extensive projects have been concerned with office environment to establish factors which must be considered in office planning and the design of furniture, furnishings and equipment.

9.1.5 Funding of extramural research programs in the universities is provided through the NDC scholarships and grants program. Industry is eligible for such funding if they are prepared to release the results for general use. Preference is given to extramural research which relates to intramural programs, however, sufficient allowance is made for unrelated projects which have potential application beyond immediate intramural concerns.

9.1.6 The research activity of the NDC is short term, therefore, there has been no need to shift research resources to meet changes in the technical environment.

9.1.7 Since the sources for research associated with industrial design are limited, there are few occasions when transfers would prove beneficial.

9.2 Units Exclusively Concerned with Extramural Research Activities

9.2.1 The only regular funding for extramural activities is provided through the NDC scholarships and grants program. Applications are invited annually for financial assistance under this program. Applications are considered by the Professional Relations Committee and recommended for the approval of the NDC. Generally, the factors for acceptance are considered in the following order:

i) Policies of granting agency.

ii) Nature of proposed project.

iii) Previous record of achievement of unit or individual requesting funds.

9.2.2 Priorities are established on the basis of significance to the economy and the advancement of industrial design.

9.2.3 Major projects are monitored by the ODA at critical stages. The results of most projects are applied further to NDC funding at which time meaningful evaluation can be carried out.

9.2.3 The funding for the scholarship and grant program is limited and the demands exceed the supply. Resources are allocated commensurate with their significance to the economy and the advancement of industrial design and the magnitude of the project. Total dependency on NDC funds is also a consideration.

9.2.4 Recipients of grants for major projects are requested to present plans and employ methods such as CPN and PERT in the development and implementation of their projects.

9.2.5 Projects under the scholarship and grants program are supported by an outright grant which is not subject to transfer.

9.2.6 Percentage of funds available to the agency for the support of extramural scientific activities actually expended:

1962-63	52%
1963-64	60%
1964-65	60%
1965-66	31%
1966-67	46%

10. RESEARCH OUTPUT

10.1 To date, the results of research activities, in their original form, have been recorded in the technical design reference library which is maintained in Ottawa and also made available through the two design centres in Toronto and Montreal. The results are referred to for the development of NDC programs and are used externally mainly by professionals, educators, students and technical writers.

10.2 The type of research activities sponsored by NDC normally do not lead directly to patents or licences.

10.3 Technical writers have extracted information from research projects for incorporation in publications and other audio/visual forms such as filmstrips and exhibits in connection with NDC projects for stimulating design advancement.

10.4 No reports have been issued in their original form but extracts have been incorporated in support of proposals for specific projects.

10.5 Seminars and conferences are held on a regular basis at the design centres in Toronto and Montreal on the basis of the results of research.

10.6 The technical design reference library includes data and sources of data from countries outside Canada.

10.7 The design consultants who have had the opportunity to train themselves in specialized fields are still on strength.

10.8 The following research capabilities have arisen through the direct and indirect support of the NDC.

a) Industrial Design Department, University of Waterloo

b) Systems Engineering Associates Limited, Toronto

c) Design Group, Department of Mechanical Engineering, McMaster University.

d) Department of Industrial Design, University of Montreal.

10.9 All of the above mentioned have developed new processes for design determination particularly the interface between human and engineering factors.

10.10 Because most of the research output is of recent origin full impact of the results is yet to be realized. Notable exceptions are described under "Projects".

11. PROJECTS

11.1 Intramural Projects

1962/63/64	Nil
1965	Optimal specifications for Government Office Furniture to establish criteria and scientific systems for determining the design of office environments, furniture and equipment.
1966	Design at Home - Work - Play - to establish the economic, social, technological and human factors which influence the design of environments and their products.
1967	Study of office organization and planning to develop for publication scientific methods as a guide for office planning and design of office furniture, furnishings and equipment.

11.2 Extramural Projects - sponsored under scholarships and grants program.

1962-63	Professor R.H. Grooms - Study of basic design research in Japan.
"	The Toy Testing Council - Development of criteria for safe and effective toys.
1965-66	Donald Huffman - Research on European lighting systems.
1967-68	Dr. Donald Coburn - Research on available dental equipment and time-motion studies of ten selected groups.
"	Charles Hahn - Development of electronic instruction console.
"	Anthony Mann - Study and report on consumer education in the field of design.
"	Dudas, Kuypers & Rowan - Research on the design functions in industry.
"	Professor George Soulis - Research on the interaction of the designer and the computer.

1968-69 Peter Briggs & Professor Sramek - Development of a curriculum for instruction in design principles for industrial arts teachers at secondary school level.

" Pierre Tremblay - Research on modular components for farm buildings.

" Warren/Gatrill - Design specifications for products that can be produced by handicapped people.

" Richard Inglis - Research on the use of plastics in European furniture.

" Richard Jasper - Research and development of design criteria for a computer/programmer work station.

11.3 Case Histories

11.3.1 Case History - Intramural Project
"applied research and development"

The results of the intramural research projects dealing with the office environment conducted in 1965 and 1967 are being applied in the establishment of Federal Government accommodation and construction standards by committees under the direction of the Treasury Board.

The Board has recognized that the application of the results of the research projects will reduce the cost of Federal Government accommodation and construction by an estimated 15%. In addition, greater productivity is anticipated on the part of personnel due to improvements in operational conditions.

The pilot project to which the research was first applied was Tower B in the Place de Ville complex, Ottawa. As a result, a $2.5 million dollar saving will be realized over a ten year period in the case of this building alone.

The research projects on office environments are related to a major program of the Council titled, "Better Products for Modern Living". This program was initiated to take full advantage of the extensive building activity planned for Canada in the immediate future as a vehicle for stimulating design innovation.

New concepts are being developed for accommodation requirements such as, schools, hospitals and dwellings for which new and improved products and systems will be in demand. Through applied research and development, it is the intention to identify the design requirements for new products and systems and to initiate projects which provide incentives for Canadian manufacturers to design and produce for this extensive market.

Since the federal and other levels of governments are major customers of such products, initial emphasis is being given to the governmental sector. By doing so, not only will immediate benefits be realized, but the governments will provide the leadership so necessary to stimulate design innovation in Canada.

11.3.2 Case Histories - Extramural Projects

Three examples of where research sponsored under the NDC scholarships and grants program has contributed specific advantages to:

a) A specific sector of Canadian industry.

b) Design education at secondary school level.

c) The development of a new design management policy for Canadian secondary industry.

---

a) Dr. Donald Coburn - Research on available dental equipment and time-motion studies of ten selected groups. The time-motion studies of ten dental practitioners, using different types of equipment to perform the same operation, was conceived and organized by Dr. Coburn to determine their relative merits, with the view to producing reliable data for the development of better equipment. As far as can be ascertained, this has never been done before in Canada, the U.S.A., or anywhere else. Only two manufacturers of dental equipment in Canada have been located but the findings are to be distributed to dental training institutions and clinics all across the country.

Many dentists have been dissatisfied with their working posture of endless standing and straining over their patients. Dr. Coburn decided to do something about it and his argument was sufficiently convincing to obtain a research grant. The conclusions drawn in the savings in effort and time to be obtained from a new approach to dental equipment was equally convincing to one of the two Canadian manufacturers referred to above, and their prototype equipment also convinced some leading American dental practitioners.

The said manufacturer which had previously been collaborating with Dr. Coburn on developing some new pieces of dental equipment had sufficient insight to go through two financial re-organizations within a year and to develop a network of 56 outlets in Canada and the U.S.A. in expectation of being first on the market with a better product. Their output has already reached half-a-million dollars with 80% being exported to the U.S.A. They have great expectations for the future and readily ascribe the new developments to the initial NDC research grant.

b) Peter Briggs & Professor Sramek - Development of a curriculm for instruction in design principles for industrial arts teachers at secondary school level. Since there is a lack of design capability in Canada, it is necessary to develop a means of informing secondary school students of the potential opportunities in the application of design in industry. Therefore, two independent researchers at the College of Education in Toronto were given grants to develop and introduce the subject of design at secondary school level so as to better train the growing generation to understand the principles of good design. Their studies have taken them to various universities in the U.S.A. - Cranbrook Academy, Wayne State University, Rhode Island School, Pratt Institute, etc., as well as the Loughborough, Hornsey, Shoreditch and Cardiff centres in the United Kingdom. They are also working with the Association of Professional Industrial Designers of Ontario and with others involved in the development of industrial design training courses sponsored by the National Design Council.

This co-operation with other organizations is making the work they do increasingly useful, since it adds an orderly step in the progression of students with potential interests in this field. The progressive steps being the technical college or art school, design education at university degree level and finally, post graduation studies.

c) Dudas, Kuypers & Rowan - Research on design functions in industry. One of the major hindrances to the advancement of industrial design is the lack of awareness of the role of design on the part of Canadian industry. Contributing to this lack of awareness is the fact that there is no published information on the on the interaction of design with the industrial and commercial process. Therefore, a firm of industrial design consultants was given a grant to research and develop the methodology of communicating the design process to industry and business.

This has been achieved by demonstrating the design function under different types of product cycles, for example: invention of a new concept; innovation based on an existing concept; modifications and/or improvements to existing products.

The methodology also includes principles of design management in terms of policy, finance and administration.

The results of this research will be produced in various visual forms and directed to the industrial business and academic community.

APPENDIX A

9-10 ELIZABETH II.

CHAP. 24

An Act for the Establishment of a National Design Council.

[*Assented to 1st June, 1961.*]

HER Majesty, by and with the advice and consent of the Senate and House of Commons of Canada, enacts as follows:

SHORT TITLE.

1. This Act may be cited as the *National Design Council Act*. Short title.

INTERPRETATION.

2. In this Act, Definitions.

(*a*) "Council" means the National Design Council; and "Council."

(*b*) "Minister" means the Minister of Trade and Commerce. "Minister."

NATIONAL DESIGN COUNCIL.

3. There shall be, under the direction of the Minister, a National Design Council consisting of seventeen members, including Establishment of Council

(*a*) five members who shall be chosen from the fields of industry, commerce, and organized labour,

(*b*) two members who shall be chosen from the field of the distribution of goods,

(*c*) four members who shall be chosen from any of the fields of architecture, design and engineering,

(*d*) four members who are officers or employees of Her Majesty employed in departments or agencies of the government of Canada that have a specialized interest in industrial design, and

(*e*) two members of the general public,

to be appointed by the Governor in Council as provided in section 4.

Appointment of members of Council. **4.** (1) Each of the members of the Council shall be appointed to hold office for a term of three years, except that of the seventeen first appointed eight shall be appointed for a term not exceeding two years.

Chairman of Council. (2) One member shall be appointed to be Chairman of the Council for such term, not exceeding three years, as is fixed by the Governor in Council.

Reappointment (3) A retiring Chairman or other member is eligible for reappointment to the Council in the same or another capacity.

Eligibility (4) A person in order to be eligible to be appointed as a member of the Council described in paragraph (*a*), (*b*), (*c*) or (*d*) of section 3 shall have knowledge of the field he is to represent, or of technical aspects of design.

Remuneration and expenses. **5.** Members of the Council shall serve without remuneration but are entitled to be paid reasonable travelling and living expenses while absent from their ordinary place of residence in the course of their duties.

Quorum. **6.** A majority of the members constitute a quorum of the Council, and a vacancy in the membership of the Council does not impair the right of the remaining members to act.

Election of Vice Chairman. **7.** (1) The Council shall elect one of its members to be Vice-Chairman for a term not exceeding three years.

Absence of Chairman. (2) In the event of the absence or incapacity of the Chairman, or if the office of Chairman is vacant, the Vice-Chairman shall act as Chairman.

Meetings

8. The Council shall meet at least three times a year on such days as are fixed by the Council.

Procedure

9. The Council may make rules for regulating its proceedings and the performance of its functions and may provide therein for the delegation of any of its duties to any special or standing committees of its members.

Objects

10. The objects of the Council are to promote and expedite improvement of design in the products of Canadian industry, and, without limiting the generality of the foregoing, the Council may, in furtherance of its objects,

(*a*) plan and implement programmes to create an awareness by industry and the general public of the need for good design;

(*b*) develop methods of achieving improved design;

(*c*) assist industry in developing and applying good design techniques;

(*d*) organize and assist committees and other groups in the implementation on a national, regional or industry basis of programmes to foster good design;

(*e*) recommend to the Minister the awarding through appropriate organizations and otherwise of grants or scholarships

(i) to individuals in Canada for study or research in design in Canada or elsewhere, and

(ii) to institutions in Canada to encourage study or research in design in Canada;

(*f*) grant or issue certificates, citations or awards of merit in respect of Canadian products of outstanding design; and

(*g*) arrange for and sponsor the exhibition of displays of good design in Canada and abroad.

11. (1) The Minister may refer to the Council for its consideration and advice such matters relating to the promotion and expedition of the improvement of design in Canada or otherwise relating to the operation of this Act as he thinks fit. Reference to Council.

(2) The Council shall investigate and report on all matters referred to it pursuant to subsection (1) and shall make such recommendations to the Minister in respect thereof as it deems appropriate. Council to investigate and report.

GENERAL.

12. (1) In order to carry out its objects the Council shall utilize the services of such officers and employees employed in the Department of Trade and Commerce as the Minister may designate for the purpose. Staff.

(2) Subject to subsection (1), the Minister may provide the Council with such professional or technical assistance for temporary periods or for specific work as the Council may request, but no such assistance shall be provided otherwise than from the public service of Canada except with the approval of the Treasury Board. Advisors.

13. The Council is not an agent of Her Majesty and the members of the Council as such are not part of the public service of Canada. Not agent of Her Majesty.

Financial

14. Expenditures for the purposes of this Act shall be paid out of moneys appropriated by Parliament to defray the charges and expenses of the public service of Canada within the Department of Trade and Commerce.

Report

15. The Chairman of the Council shall, within three months after the termination of each fiscal year, submit to the Minister a report of the operations of the Council for that fiscal year.

APPENDIX "B"

SUMMARY OF THE STUDY OF DESIGN IN CANADA

TABLE OF CONTENTS

INTRODUCTION

The practice and vigour of industrial design in Canada have been subjects of concern for some time to the National Design Council and the Department of Industry, Trade and Commerce. The Office of the Design Adviser in the Department, has sought to evaluate the prevailing state in order to fashion sound stimulation policies and programs.

This study of Design in Canada is intended to reveal the extent of design awareness, activity, source, expenditure, relationships of education, profession and quality of products in well-defined sectors of Canadian industry which, collectively, constitute the population. This population comprised industries whose "products assessed as of design significance" represented $10 million or more "value added" annually.

INDUSTRY

The following broad conclusions are couched in global format and are primarily the results of the Price-Waterhouse study of Design in Canadian Industry.

The results of the study point out that approximately half of the "population" (industry) is 'design-aware' and product manifestation of design, as represented by the sales revenue associated with design activity may be ranked as follows:

Instigation of Design	Percentage of Total Annual Product Sales Revenue of Design-Aware Establishments
Establishment, with distinguishable cost	40%
Establishment, with no distinguishable cost	16
Foreign parent, etc. with no distinguishable cost	15
Customers	9
Others	9
Foreign parent, etc. with distinguishable cost	7
Canadian parent, etc. with distinguishable cost	2
Canadian parent, etc. without distinguishable cost	2
	100%

THE COST OF DESIGN MAY BE RANKED IN TERMS OF THE FOLLOWING SOURCE CATEGORIES

Source of Design	Percentage of Total Annual Design Cost of Design-Aware Establishment	Mean Cost per Annum per Design-Aware Establishment
Engineering department, with no specific design responsibility	32%	$ 3,700
Imagination, ingenuity and skill of owners or officials	31	3,600
In-house craftsmen	13	1,500
Creative staff designers	11	1,300
Foreign parent, etc. with distinguishable cost	6	700
Engineering department, with specific design responsibility	3	300
Consultants, industrial designers, etc.	3	300
Others	1	100
	100%	

THE MEANS OF IN-HOUSE DESIGN MAY BE EXPRESSED IN THE FOLLOWING MANNER:

Means of In-House Design	Percentage of Design-Aware Establishments Possessing a Specific Means	Percentage of Design-Aware Establishment Possessing one or more Means
Gratuitous	31.4%	44.6%
Creative thinking	31.3	44.5
Evolution	31.3	44.5
None	4.6	6.6
Other	1.4	2.0
	100.0%	142.2%

In summary, 78% of industrial design activity, in terms of associated product sales, seems to be instigated by the subject manufacturing establishments (56%) and by their foreign parents (22%). Furthermore, 63% of design expenditure in Canada has its source in company engineering departments not having segregated design responsibility (32%), and in the imagination, ingenuity and skill of individual proprietors (31%). The average annual outlay for design by these major sources is in the neighbourhood of $3,650.00, whereas the average outlay of all sources of design is about $2,700.00. Finally, in-house design activity appears equally divided among gratuitous, creative, and evolutionary means.

The state of design in Canada, with a few notable exceptions can not be described as vigorous.

Product

The quality of products produced in Canada in terms of function, construction, human factors and aesthetics, varies from industry to industry. The most pronounced influence on the design of Canadian products stems from the U.S.A. and in varying degrees by other foreign countries.

Those industries which are owned and dominated by U.S.A. usually have their products designed in the U.S.A. and/or produced to a set of specifications generated by the parent company. With a few notable exceptions such as the Communication industry, the overall quality of products produced in Canada by U.S.A. firms is not high. The areas of design weaknesses in these products are in human factors and aesthetics. Design innovation seems to be considerably lacking in products produced in Canada by both U.S.A. and Canadian owned industries. It is interesting to note, that in certain industries where there is an abundance of designers such as the furniture and clothing industries; the degree of design innovation is low.

There is a definite lack of Canadian design innovation and activity within industry across Canada. In most cases, products produced and designed in Canada are copies, facsimiles or derivations of U.S. and European designs. The most notable example being the furniture industry. The overall quality of the products produced in the furniture industry again is low with the greatest weaknesses in design occurring in human factors and aesthetics.

In summation, the observations are couched in a global format and indicate that there is not a great demand in Canadian industry for design innovation, research and development. This condition is paramount in the industrial design, environmental design, and graphic design considerations of product design.

In conclusion, the concern for producing and developing well designed products within Canadian industry is not paramount. A greater concern for producing and developing well designed products appears to be more prevalent in the highly technical industries such as electronics, and communications.

Profession

In North America there is an adequate supply of professional designers to meet the demands of Canadian industry, however, due to the large proportion of Canadian industry being foreign owned the number of Canadian designers available and used within industry is very limited. U.S. designers are used almost exclusively by U.S. owned Canadian industry.

In some industries such as, the jewellery industry, designers are imported from U.K., Belgium, and Japan in order to meet the demands of the industry. Within other industries as fashion, furniture and graphics/typography there is a large number of Canadian designers within the industries, however the degree to which they are permitted to innovate is questioned as these industries products appear to be copies, and/or facsimiles of U.S. and other foreign designs.

Canadian designers appear to have been trained for the most part in the U.S. and those that were trained in Canada go elsewhere for employment. These facts indicate that Canadian designers have qualifications and credentials that for the most part, are unsuitable/ or not required in Canadian industry.

The results of numerous horizontal studies indicate that there is an over abundance of professionals in the engineering disciplines present within Canadian industry and almost an entire absence of professionals in industrial design, environmental design and graphic design. This is an interesting phenomenon in some industries namely, the aircraft industry, which compares favorably in all aspects of design with foreign competition; but there is a total absence of professionals in the industrial and environmental design fields in this industry.

In conclusion, there seems to be a consensus of opinion between professional designers, evaluators, educators, and consultants that there is a definite lack of competent professional designers within Canada, however, industry appears not to care because of the abundant supply available from the U.S. and other foreign countries. The economic opportunities for the professional designers is somewhat limited in Canada and this condition has a tendency to drive Canadian designers to the U.S. for employment and other career opportunities.

The professional design societies within Canada appear to have a very complacent attitude towards these conditions and also seems to lack the motivation or incentive to create change within Canadian industry in order to, improve and foster design and design innovation.

Education

The various educational institutions within Canada are not training people in the design disciplines for specific industry-market areas but rather the education in design is only of a general nature, however, Canadian schools are training designers for some specific industries as fashion, interiors, furniture, graphics and some theatre design. This is further exemplified by the fact that design curriculums are established within an educational institution in relation to the economic structure of the given institution rather than in relation to the demands of industry. With the exception of Graphic Design the criteria for establishing design curriculums being; the economic structure of the institution, leads to unsatisfactory curriculums in relation to the demands of Canadian industry. These conditions have reduced the overall effectiveness of the educational institutions in teaching design. In comparison to similar institutions in the U.S. and U.K., Canadian institutions come out comparatively poor. An attitude of complacency exists in relation to the degree of content, time involved to complete design courses, and placement of designers within industry. These facts are substantiated by the number of design courses being offered within educational institutions in relation to the number of courses in other disciplines such as, engineering, that are being offered to students. Design courses are being offered as options or fill-ins within the various curricula.

In conclusion, most graduates have to leave the country; others go into teaching industrial arts, while still others are employed by local designers -- and there is not a valid way of establishing to what extent.

On querying the colleges, they say "...Oh yes! Our students trained in industrial design find employment in Canadian industry;" but upon request for substantiation of this and requests to see records in black and white of this being the case, they are very reluctant to do so, for in actuality, they do not have documents to prove that this is the case.

GENERAL CONCLUSIONS

To analyze the problems and opportunities relevant to design, a continuing study of Design in Canada was initiated to identify the specific industry sectors that need attention. The program is structured to respond to situations which arise not only in respect to industry but to the government, manufacturers, distributors, consumers and professionals. If it is the intent of the Department of Industry, Trade and Commerce and the National Design Council to encourage industry and trade development, and carry out the National Design Council Act in order to improve and foster design; the following conditions are set out for due consideration:

Industry

The extent to which Canadian design activity and innovation is carried out within the various industry sectors is affected by the fact that Canadian industry is 60 to 70% foreign owned. There appears to be an adequate supply of professional designers in North America to meet the demands of Canadian industry, however, Canadian industries that require design talent tend to import rather than encourage internal development. Canadian education appears not to relate specifically to industry and Canadian designers go elsewhere for employment. The majority of products manufactured in Canada have their design origination in the U.S.A. or other foreign countries. The strongest influence on design of products in Canadian industry are those designs obtained by licencing, consultants, and copying designs not protected by Design Patents and Copyrights.

The following is an appraisal of design in the major industry sectors:

DOMESTIC ENGINEERING

(Motor vehicles, household radio & T.V., small electrical appliances, major appliances, boatbuilding and sporting goods.)

The majority of these industries are U.S. and/or European owned and the products produced in Canada are mostly designed in these countries. The overall quality of the products produced in this industry sector is fair. The quality of construction is fair, the functional aspects are fair, their suitability to human use is fair and the aesthetic qualities are fair. There is an adequate supply of design talent to meet the demands of the industries, however, being foreign dominated there is a lack of Canadian design innovation and activity within these industries. Demand for design education specifically for these industries is not present in Canada due to the fact that design origination stems from the U.S. and/or other foreign sources.

INDUSTRIAL ENGINEERING

(Communications equipment, electrical industrial equipment, office and store machinery, instruments, heating and plumbing, aircraft, agricultural implements, truck bodies and trailers, shipbuilding, architectural products, and tools, hardware and cultery.)

The products of these industries are for the most part designed outside Canada with little or no design innovation steming from the Canadian industry. This condition is partly due to the fact that, a large portion of these industries are U.S. and European owned. Quality of the products produced in these industries in terms of construction are fair, the functional qualities are good, the products suitability to human use are fair and in terms of aesthetics the products are fair. The two weakest areas of design in these products are human factors and aesthetics. Again, the design education opportunities related specifically to these industries are limited within Canada due to the demands and number of industries that are foreign owned coupled with the degree of design origination steming from outside Canada.

FURNITURE

(Special furniture, household, office, sash, door and planing mills, and musical products.)

There is a lack of design innovation in these industries. Most of the furniture design is copied from U.S. and European furniture designs.

There is an abundance of design talent available to these industries however, the overall quality of the products manufactured in Canada is only fair. In terms of construction and suitability for human use the quality is good, however, in function and aesthetics the quality if fair. The weakest areas of design innovation and quality are in aesthetics and function. These industries appear to be followers in design innovation rather than leaders in spite of the abundance of design talent available to meet the demands of the industry.

TEXTILES

(Synthetic, cotton, wool, lino and coated fabrics, carpets.)

These industries appear to lack design innovation, as most of the products are copies from U.S. and European industries, however, the overall quality of the products produced by these industries is good. Most of the skilled design personnel are trained within the industries via apprenticeships and very little demand for formally trained design talent exists within the industry. This condition affects the demand for educational facilities and opportunities related specifically to these industries and therefore they exist in a very limited degree in Canada.

CLOTHING

(Men's, women's, children's, shoes, knitting, hosiery, foundation, footwear, fur, hats, and buttons, buckles, and fasteners.)

These industries are well supplied with fashion designers and are employed to a great degree within the various industries. The products compare favourably with foreign countries, however, most of the styles and fashions are copies from European countries and the U.S. There is a lack of design innovation within the industry and there is indication that suitable educational and training facilities exist to a limited degree in Canada. The quality of the products produced in these industries appears to be good with the major deficiency existing in aesthetics.

CRAFT

(Jewellery and silverware, glass and glass products, opthalmic goods, leather products.)

These industries appear to produce a high quality product in the high cost or precious goods categories. Design talent related specifically to these industries seems to be imported from such countries as Belgium, U.K. and the U.S. Apart from the fact that The George Brown College in Toronto is the only place where courses on jewellery arts and silverware are given; there is a demand for more graduates in this field.

GRAPHICS & TYPO

(Printing and publishing (magazines), publishing (book), signs and displays, and packaging.)

There is an abundance of these industries in Canada, however, the degree of design activity and innovation is minimal. There is an abundance of semi-trained personnel within the industry and a limited number of fully qualified designers within Canada. The industries tend to train personnel from within their structure rather than encourage training by an educational institution in Canada. The quality of the products produced by these industries is fair, with major areas of design deficiencies in construction and aesthetics.

MISCELLANEOUS - SMALL

(Brooms, brushes, mops, toys and games.)

These industries show a lack of design awareness and innovation. They seem to be dependent on U.S.A. for design input and rely heavily on copying designs from foreign countries. Educational facilities related specifically to these industries are minimal in Canada, apparently due to the lack of demand from the industry.

After review of the findings in the total study of design in Canada it is evident from the various inputs of Price Waterhouse, Professional designers, educators, professional journalists and individuals with a wide degree of experiences in all facets of design; that there is a definite correlation and substantion of facts and information that permits substantial validation and confidence in the total findings.

APPENDIX C

DESIGN EXPENDITURES OF U.S. COMPANIES

Design expenditures of U.S. companies vary depending upon the type of product and technology involved.

In highly technical industries such as the computer industry, design activity is great and companies are extremely design aware. Due to the tremendous costs involved in technical developments and research, the design expenditures appear minimal in relation to expenditures on research and development, however, this is not a true reflection, for the amounts spent on design by such companies as IBM and Honeywell are considerable.

In the consumer product oriented companies where technical innovation and advancement is minimal, the design expenditures appear to be greater in relation to expenditures on research and development.

The following is a breakdown of design expenditures by U.S. companies:

IBM CORPORATION

Industrial design/human factors engineering represents, on average, 6% of hardware development costs for new units and systems - about 2½% for re-hash or modified designs.

Small I/O Units	% of Development Costs
New Design	10%
Re-hash	4%
Medium Computers	
New Design	5%
Re-hash	2%
Large Computers	
New Design	3%
Re-hash	1%

(Software development costs is not included as it is unique to computers and represents a very large cost factor.)

HONEYWELL E.D.P.

Industrial design/human factors engineering represents, on average, 8-10% of hardware development costs for new units and systems - about 2½% for re-hash or modified systems.

Small I/O Units	% of Development Costs
New Designs	10%
Re-hash	4%
Medium Computers	
New Designs	5-8%
Re-hash	2%
Large Computers	
New Designs	3-4%
Re-hash	1%

APPENDIX C Cont'd

Industrial designers represent 1% of the professionals in engineering (for every 100 professionals there is 1 industrial design professional).

WESTINGHOUSE CORPORATION
MAJOR APPLIANCE DIVISION

Major Appliances	% of Engineering Costs
Washers, refrigerators, dryers, freezers	On the average, design expenditures represent about 1/5 of the total engineering costs or approximately 20%. The amount of design expenditures varies between re-hash and new product innovation as much as 8%.

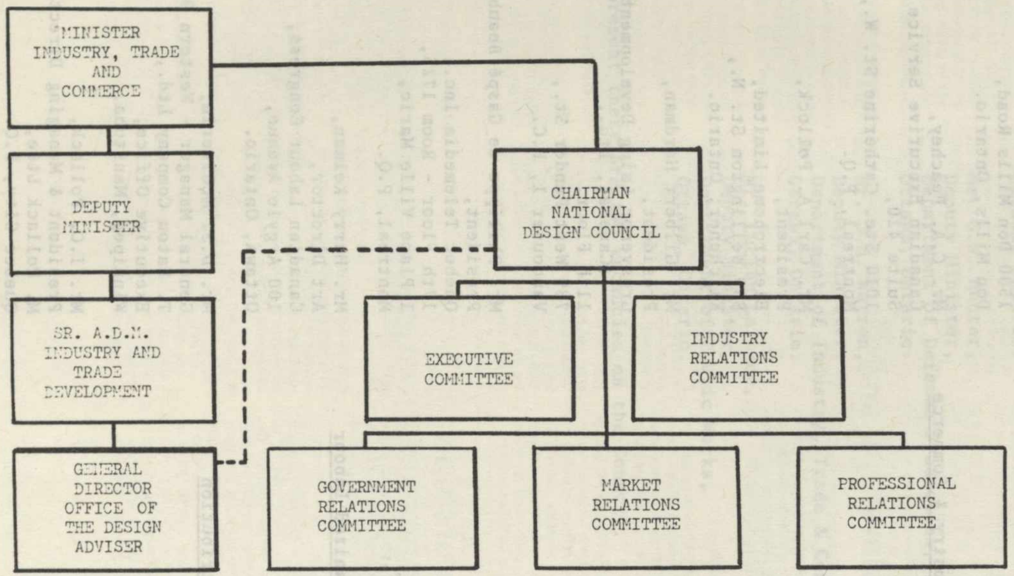
POLAROID CORPORATION

On the average, hardware design development averages 20-25% of engineering budget.

Product Design	% of Engineering Costs
Cameras and accessory equipment	20-25% of engineering budget. 85-95% is new product design innovation. (primarily consultants) Presently converting to in-house design staff.
Graphics	
Brochures, literature, film and camera packaging, advertising	10-15% of public relations and advertising budget - primarily done in-house.

APPENDIX "D"

ORGANIZATION CHART - NATIONAL DESIGN COUNCIL



APPENDIX E

NATIONAL DESIGN COUNCIL MEMBERS

Chairman	Mr. John C. Parkin, John B. Parkin Associates, 1500 Don Mills Road, Don Mills, Ontario.
Industry & Commerce	Mr. C.A. Peachey, Canadian Executive Service Overseas, Suite 420, 1010 Ste. Catherine St. W., Montreal, P.Q.
	Mr. Carl A. Pollock, President, Electrohome Limited, 809 Wellington St. N., Kitchener, Ontario.
	Mr. Gilbert Hardman, President, Grosvenor Laing Developments (Canada), Ltd., 11th Floor, 789 West Pender St., Vancouver 1, B.C.
	Mr. Philippe de Gaspé Beaubien, President, Quebec Telemedia Inc., 17th Floor - Room 1725, 1 Place Ville Marie, Montreal, P.Q.
Organized Labour	Mr. Harry Kelman, Art Director, Canadian Labour Congress, 100 Argyle Avenue, Ottawa, Ontario.
Distribution	Mr. D.S. McGiverin, General Manager - Western Division, T. Eaton Company Ltd., Executive Office, Winnipeg, Manitoba.
	Mr. I.C. Pollack, President & Managing Director, M. Pollack Ltée, Quebec City, P.Q.
Engineering & Design	Mr. Clair Stewart, President, Stewart & MOrrison Ltd., 42 Charles Street East, Toronto, Ontario.
	Mr. Marcel Girard, Girard, Bruce, Garabedian & Associates, 1808 Sherbrooke St. W., Montreal 25, Quebec.

General Public	Mrs. T. Bata, Bata International Centre, 59 Wynford Drive, Don Mills, Ontario.
Government	Mr. S.S. Reisman, Secretary to the Treasury Board, Ottawa, Ontario.
	Mr. G.W. Hunter, Deputy Minister, Department of Defence Production, Ottawa, Ontario.
	Mr. J.H. Warren, Deputy Minister, Department of Industry, Trade & Commerce, Ottawa, Ontario.
	Mr. Lucien Lalonde, Deputy Minister, Department of Public Works, Ottawa, Ontario.

Note: At present there are two vacancies on the Council.

APPENDIX F

Scholarships and Grants Program

The National Design Council and the federal Department of Industry offer a program of scholarships and grants to encourage advanced training; research and to support the promotion of industrial design in Canada.

The program offers:

1. SCHOLARSHIPS—to persons engaged in industrial design and to students of design for advanced study in Canada and abroad in the field of industrial design.
2. GRANTS, RESEARCH PROJECTS — to provide financial assistance to persons qualified to engage in research projects directly related to industrial design in areas which could be of importance to Canadian industry.
3. GRANTS, DESIGN PROMOTION — to institutes and organizations qualified to sponsor and carry out activities promoting industrial design in Canada.

Definition of Industrial Design: that activity directed at determining the materials, mechanisms, shapes, colours, surface finishes and decorations of objects which are to be reproduced in quantity by industrial processes.

Excluded from this program are activities which are exclusively identified with the fields of fine art, handicraft and architecture, except when these activities relate directly to the field of industrial design — e.g. fields such as packaging, craft based industry, manufactured architectural components and structural systems.

Activities solely concerned with the design of materials, mechanisms, and production processes which are exclusively associated with the field of engineering are not admissable.

All communications regarding scholarships and grants should be addressed to:

Registrar,
DESIGN CANADA
Scholarships and Grants Program
Department of Industry
Ottawa 4, Ontario

Scholarships

Scholarships are available to persons engaged in industrial design and to students of design for advanced study in Canada and abroad in the field of industrial design.

■ CONDITIONS

Scholarships are awarded on merit. Awards will be given only if, in the judgment of the National Design Council, the program of study planned by the applicant has been well chosen in relation to the applicant's previous training and experience. Preference will be given to courses of study which could be applied to important areas of Canadian industry.

■ CITIZENSHIP AND RESIDENCE

All scholarship applicants must have resided in Canada for at least one year and must intend to continue in the field of industrial design in Canada upon completion of their studies.

■ ACADEMIC QUALIFICATIONS

(a) Scholarships will normally be awarded to applicants with proven ability in design who are employed in the field of industrial design and hold an acceptable degree or diploma in industrial design or related fields.

(b) Scholarships may be awarded to outstanding design students who have completed at least two years of an industrial design course in a recognized institute and wish to continue and amplify their design studies.

■ APPLICATIONS

Applications for scholarships must be made on the approved form and must be filed not later than April 1 of any given year. No guarantee will be given that late applications will be considered.

Applications must be accompanied by supporting documents collated in the following order:

(a) evidence of academic qualifications, or academic records in the case of students.

(b) three letters of recommendation (forwarded directly to the National Design Council) by qualified persons with a knowledge of the qualifications and ability of the applicant and the nature of the applicant's planned course of study.

(c) illustrations of achievements in industrial design or related fields, including any papers or publications originated by the applicant.

(d) full details of planned course of study, name of institute, duration of course, and intended commencement date.

(e) a brief, describing what the applicant believes the planned course of study will do towards improving his industrial design capabilities and how this could be applied to Canadian industry.

(f) amount of award required and information concerning known and anticipated expenses, including those for tuition, materials, travel and living.

(g) a letter of acceptance from the institute to which the applicant has applied, including one from the head of the department agreeing to supervise and report on the applicant's study and training. If this letter is not available, the applicant may forward the other documents in order to meet the April 1 deadline. However, undue delay will disqualify the applicant from consideration.

■ TENURE OF SCHOLARSHIPS

Scholarships are for one academic year and the successful applicant may commence tenure anytime after the award but in no case later than March 31 in the following year.

After a scholarship is awarded, the National Design Council may permit a change in the course of studies or in the institution of tenure. Requests for such changes made reasonably in advance, will be considered only in exceptional circumstances and must be accompanied by a statement from the department head of the institute concerned.

■ RENEWALS

Scholarships may be renewed at the discretion of the National Design Council. An applicant for a renewal must complete a new application form together with a written report on progress to date. A statement from the head of department of the institute the applicant plans to attend must support an application for renewal.

Applications for renewal must be received before April 1 of any given year to ensure consideration for assistance for the year following this date.

■ DEMONSTRATING AND INSTRUCTING

A scholarship holder is permitted to demonstrate or instruct for a maximum of three hours per week, provided the department head of the institute considers it desirable, and on condition that it does not hinder the progress of his studies. A scholarship holder may accept remuneration for such work at the usual rate paid by the institution concerned.

■ REPORTS

On completion of the studies for which their awards were received, recipients of scholarships must submit a report to the National Design Council by June 1st of the year following the award.

■ PAYMENTS

Scholarship payments are made directly to the applicant in amounts determined by his commitments to the institute he will be attending. A portion of the payments will be withheld until the applicant's report has been submitted.

Grants Research Projects

Grants are available to persons qualified to engage in research projects directly related to industrial design, in areas which could be of importance to Canadian industry.

■ CONDITIONS

Individuals applying for grants for research projects must have resided in Canada for at least one year. In the event of a group applying, one member who will be active in the project must so qualify.

■ ACADEMIC QUALIFICATIONS

All individuals or members of groups must have proven ability to carry out the intended research project and must hold an acceptable degree or diploma in a course related to the type of work to be undertaken.

■ APPLICATIONS

Applications for grants must be made on the approved form and must be filed no later than April 1 of any year, if the grant is required for the year following this date. No guarantee will be given that late applications will be considered.

Applications must be forwarded, complete with supporting documents, collated in the following order:

(a) evidence of academic qualifications of the individual or members of group who will be involved in the design research project.

(b) three letters of recommendation (forwarded directly to the National Design Council) from qualified persons with a knowledge of the qualifications and ability of the applicant(s) and the planned research project.

(c) the results of previous design research projects undertaken by the applicant(s).

(d) full details of planned research project, names of those who will be involved, facilities to be used, organizational plan and program of activities.

(e) a brief, describing how the applicant or applicants believe the results of the project could benefit Canadian industry.

(f) amount of grant required, including details of known and anticipated expenditures to be incurred.

(g) in the event that the project is to be conducted by individuals or groups as part of an educational or other institute, a letter of commitment must be provided by the head of the institute.

■ TENURE OF GRANTS

Grants are for one full year and successful applicant(s) may commence tenure anytime after the awarding of the grant but no later than one year after April 1 of the year in which the grant was awarded. After a grant has been awarded, the National Design Council may permit a change in the program or in the tenure provided it can be justified and financed within the regulations governing the grants program.

■ RENEWAL

No commitment can be given for assistance beyond the original grant. However, grants may be renewed at the discretion of the National Design Council. Applications for renewal must be completed on new application forms together with a written report on progress to date.

■ REPORTS

Recipients of grants must submit interim progress reports at intervals to be established by the National Design Council on the basis of the project program. All reports and subsequent publication of the results of the project will become the property of the National Design Council for public distribution.

■ PAYMENTS

Grant payments are made directly to individual applicants or to an appointed agent of a group of applicants at predetermined intervals during the execution of the project subject to the acceptance of the interim progress reports. The first payment will be sufficient to commence the project.

Grants Design Promotion

Grants are available to institutes and organizations qualified to sponsor and carry out activities promoting industrial design in Canada.

■ CONDITIONS

■ RESIDENCE

Institutes and organizations applying for grants must be located in and intend to sponsor and carry out the program in Canada.

■ SPONSOR QUALIFICATIONS

(a) Grants will normally be awarded only to sponsoring institutes and organizations with a recognized status within the community.

(b) Grants may be awarded sponsoring groups which do not have such recognition provided they have the support of an authoritative body.

■ APPLICATIONS

Application for grants by sponsors must be made in the approved form and must be filed no later than April 1 of any year, if the grant is required for the year following this date. No guarantee will be given that late applications will be considered.

Applications must be forwarded, complete with supporting documents, collated in the following order:

(a) evidence that sponsor has recognized status in the community, or has the support of an authoritative body.

(b) evidence of ability to sponsor the type of program proposed.

(c) the results of any previous programs conducted by the sponsor relative to the proposed program.

(d) full details of proposed program, names of organizers, facilities to be used, and organizational plans and program of activities.

(e) a brief, describing what the sponsor intends to achieve with the program towards the promotion of industrial design.

(f) amount of grant required, including details of known and anticipated expenditures to be incurred.

■ TENURE OF GRANTS

Grants are for one full year and successful applicant(s) may commence tenure anytime after the awarding of the grant but no later than one year after April 1 of the year in which the grant was awarded. After a grant has been awarded, the National Design Council may permit a change in the program or in the tenure provided it can be justified and financed within the regulations governing the grants program.

■ RENEWAL

No commitment can be given for assistance beyond the original grant. However, grants may be renewed at the discretion of the National Design Council. Applications for renewal must be completed on new application forms together with a written report on progress to date.

■ REPORTS

Recipients of grants must submit interim progress reports at intervals to be established by the National Design Council on the basis of the project program. All reports and subsequent publication of the results of the project will become the property of the National Design Council for public distribution.

■ PAYMENTS

Grant payments are made directly to individual applicants or to an appointed agent of a group of applicants at predetermined intervals during the execution of the project, subject to the acceptance of the interim progress reports. The first payment will be sufficient to commence the project.

The Queen's Printer, Ottawa, 1969

First Session—Twenty-eighth Parliament

1968-69

THE SENATE OF CANADA

PROCEEDINGS

OF THE

SPECIAL COMMITTEE

ON

SCIENCE POLICY

The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*
The Honourable DONALD CAMERON, *Vice-Chairman*

No. 65

TUESDAY, JUNE 17th, 1969

WITNESSES:

Du Pont of Canada Ltd.: Mr. F. S. Capon, Vice-President, Dr. H. F. Hoerig, Vice-President, Research and Development; Canadian Industries Limited: Mr. L. Hynes, President; Dunlop Research Centre: Dr. Norman S. Grace, General Manager, Mr. S. B. Kerr, Vice-President, Finance & Corporate Planning; Shawinigan Chemicals Division: Mr. V. N. Hurd, Vice-President; O. H. Johns Glass Company Limited: Mr. J. P. Richards, Director; Uniroyal Ltd. Research Laboratories: Mr. J. C. R. Warren, Co-ordinator, Research and Development.

APPENDICES:

148—Brief submitted by Du Pont of Canada Limited
149—Brief submitted by Canadian Industries Limited
150—Brief submitted by Dunlop Canada Limited
151—Brief submitted by Gulf Oil Canada Limited and its subsidiary Shawinigan Chemicals Division
152—Brief submitted by O. H. Johns Glass Company Limited
153—Brief submitted by Uniroyal Ltd. Research Laboratories

20654—1

MEMBERS OF THE SPECIAL COMMITTEE
ON
SCIENCE POLICY

The Honourable Maurice Lamontagne, *Chairman*

The Honourable Donald Cameron, *Vice-Chairman*

The Honourable Senators:

Aird	Grosart	Nichol
Belisle	Haig	O'Leary (*Carleton*)
Blois	Hays	Phillips (*Prince*)
Bourget	Kinnear	Robichaud
Cameron	Lamontagne	Sullivan
Carter	Lang	Thompson
Desruisseaux	Leonard	Yuzyk
Giguère	McGrand	

Patrick J. Savoie,
Clerk of the Committee.

ORDERS OF REFERENCE

Extract from the Minutes of the Proceedings of the Senate, Tuesday, September 17th, 1968:

"The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That a Special Committee of the Senate be appointed to consider and report on the science policy of the Federal Government with the object of appraising its priorities, its budget and its efficiency in the light of the experience of other industrialized countres and of the requirements of the new scientific age and, without restricting the generality of the foregoing, to inquire into and report upon the following:

(*a*) recent trends in research and development expenditures in Canada as compared with those in other industrialized countries;

(*b*) research and development activities carried out by the Federal Government in the fields of physical, life and human sciences;

(*c*) federal assistance to research and development activities carried out by individuals, universities, industry and other groups in the three scientific fields mentioned above; and

(*d*) the broad principles, the long-term financial requirements and the structural organization of a dynamic and efficient science policy for Canada.

That the Committee have power to engage the services of such counsel, staff and technical advisers as may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to examine witnesses, to report from time to time, to print such papers and evidence from day to day as may be ordered by the Committee, to sit during sittings and adjournments of the Senate, and to adjourn from place to place;

That the papers and evidence received and taken on the subject in the preceding session be referred to the Committee; and

That the Committee be composed of the Honourable Senators Aird, Argue, Bélisle, Bourget, Cameron, Desruisseaux, Grosart, Hays, Kinnear, Lamontagne, Lang, Leonard, MacKenzie, O'Leary (*Carleton*), Phillips (*Prince*), Sullivan, Thompson and Yuzyk.

After debate, and—

The question being put on the motion, it was—

Resolved in the affirmative."

Extract from the Minutes of the Proceedings of the Senate, Thursday, September 19th, 1968:

"With leave of the Senate,

The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

20654—1½

That the name of the Honourable Senator Robichaud be substituted for that of the Honourable Senator Argue on the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—
Resolved in the affirmative."

Extract from the Minutes of the Proceedings of the Senate, Wednesday, February 5th, 1969:

With leave of the Senate,

The Honourable Senator McDonald moved, seconded by the Honourable Senator Macdonald (*Cape Breton*):

That the names of the Honourable Senators Blois, Carter, Giguère, Haig, McGrand and Nichol be added to the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—
Resolved in the affirmative.

ROBERT FORTIER,
Clerk of the Senate.

MINUTES OF PROCEEDINGS

TUESDAY, June 17, 1969.

Pursuant to adjournment and notice the Special Committee on Science Policy met this day at 3.30 p.m.

Present: The Honourable Senators Lamontagne (*Chairman*), Belisle, Blois, Bourget, Cameron, Carter, Haig, Kinnear, Leonard and Robichaud—10.

In attendance: Philip J. Pocock, Director of Research (*Physical Science*); Gilles Paquet, Director of Research (*Human Science*).

The following witnesses were heard:

DU PONT OF CANADA LTD.
Mr. F. S. Capon, Vice-President
Dr. H. F. Hoerig, Vice-President
Research and Development

CANADIAN INDUSTRIES LIMITED
Mr. L. Hynes, President

DUNLOP RESEARCH CENTRE
Dr. Norman S. Grace, General Manager
Mr. S. B. Kerr, Vice-President
Finance & Corporate Planning

SHAWINIGAN CHEMICALS DIVISION
Mr. V. N. Hurd, Vice-President

O. H. JOHNS GLASS COMPANY LIMITED
Mr. J. P. Richards, Director

UNIROYAL LTD. RESEARCH LABORATORIES
Mr. J. C. R. Warren
Co-ordinator, Research and Development

(*A curriculum vitae of each witness follows these Minutes*)

The following are printed as Appendices:

No. 148—Brief submitted by Du Pont of Canada Limited
No. 149—Brief submitted by Canadian Industries Limited
No. 150—Brief submitted by Dunlop Canada Limited
No. 151—Brief submitted by Gulf Oil Canada Limited and its subsidiary Shawinigan Chemicals Division
No. 152—Brief submitted by O. H. Johns Glass Company Limited
No. 153—Brief submitted by Uniroyal Ltd. Research Laboratories

At 6.03 p.m. the Committee adjourned to the call of the Chairman.

ATTEST:

Patrick J. Savoie,
Clerk of the Committee.

CURRICULUM VITAE

Capon, Frank S., C.A.: a director and vice-president of Du Pont of Canada Limited, was born in Romford, England. He received his education in Britain and came to Canada in 1930, where he qualified as a Chartered Accountant. Mr. Capon is a Canadian citizen. After several years with the Montreal accountancy firm of Riddell, Stead, Graham and Hutchison, he joined Canadian Industries Limited in 1938 as a clerk in the secretarial department. In 1946 he was appointed assistant treasurer, became treasurer in 1949 and when that company was divided in 1954, he was appointed secretary and treasurer of Du Pont of Canada. He was elected to the board of directors in 1957 and was named vice-president in September, 1960. He was named a member of the company's Management Committee formed January 1, 1962. He is a director of Dennison Manufacturing Company of Canada Limited and of Loomis-Sayles Canadian and International Fund Limited. He is a member of the Board of Overseers of the Amos Tuck School of Business Administration, Dartmouth College, Hanover, N.H., and Honorary Treasurer of the Montreal General Hospital. He became first President of the Montreal Chapter of Financial Executives Institute (then known as Controllers Institute of America) in 1948, subsequently serving in various capacities in Institute affairs. In 1960, he was elected as President of the Institute, the first Canadian to hold this position, and served as Chairman of the Board in the following year.

Grace, Norman S.: Born: Naini Tal, India, August 15th, 1906. Technical Training: B.Sc. (gold medal) & M.Sc. Chemistry, University of Saskatchewan 1927 and 1929; Ph.D. London 1931. Post Doctoral Fellow University of California, Berkeley 1931-33. Physics Department, University of Toronto, 1933-35. Professional Career: Research Chemist, Gutta Percha & Rubber Co., Toronto, 1935-37; Research Chemist under Dr. G. S. Whitby, National Research Council, Ottawa, 1939. With Dunlop since 1939 starting in laboratory and plant process control; Chief Chemist 1940 on leave majority of time 1942-44 to Canadian Government Synthetic Rubber program, nine months Washington representative; remainder Manager, Technical Service Division, Polymer Corporation, Technical Superintendent, Dunlop Canada Limited, 1945-54. Present position since June 1954. Activities: Chairman Ontario Rubber Group 1940-41, 1941-42; Chairman Toronto Section CIC 43-44, Chairman Exhibits Committee Chemical Conference 1944; CIC Councillor "A" 1945-48, CIC Councillor "B" 1954-57, First Chairman Division of Rubber Chemistry, CIC, 1945-46. Member, National Research Council Committee on Synthetic Rubber Research 1945-52. Founding member and Past Chairman, Canadian Research Management Association; Company representative Industrial Research Institute, New York. Chairman, Ontario Research Community Organizing Committee 1960-61. Director and Past President, Sheridan Park Association, Director, Sheridan Park Corporation. Chairman, Chemical Engineering Sub-Committee, Queen's University Engineering Advisory Council. Past Chairman, Division of Rubber Chemistry, ACS; first Canadian to hold this position. Participated in first seminar on "Managament of Industrial Research" sponsored by IRI at Harvard

Business School in 1959. Life member Ontario Rubber Group. President, Chemical Institute of Canada. Member, Board of Governors, York University, Toronto. Member, Research & Development Committee, Canadian Chamber of Commerce. Extra Activities: President, Oneida Country Club, Port Credit, Ontario. Founding Director Toronto Striders Track Club. Past Warden, Church Redeemer, Toronto. Honours: Fellow, American Association for the Advancement of Science. Fellow, Chemical Institute of Canada. Fellow, Institution of the Rubber Industry of Great Britain. Family: Two sons, one daughter. Interests: Fishing, hunting, golf, tennis, hockey.

Hoerig, Dr. Herman F.: A vice-president and member of the Management Committee of Du Pont of Canada Limited, is a Canadian citizen born in Milwaukee, Wisconsin, and a graduate of the University of Wisconsin where he obtained his Ph.D. in 1942. After research work with Goodyear Tire and Rubber Company in the United States, he became an instructor in chemical engineering at the University of Wisconsin. He joined E. I. du Pont de Nemours and Company in 1942 as a research engineer at the Yerkes Research Laboratory at Buffalo, N.Y. In 1950, he was named director of the laboratory. Dr. Hoerig later moved to the technical division of Du Pont's Foreign Relations Department and then, in 1954, to Du Pont of Canada where he became manager of the Research and Development Department in Montreal. He was named a vice-president in September 1960. Dr. Hoerig is a member of many professional and business groups, including the Chemical Institute of Canada, the Society of Chemical Industry and the Corporation of Professional Chemists of Quebec. He is past Chairman of the Executive Council of the Canadian Chamber of Commerce.

Hurd, Vincent Norman: Place of Birth: Lock Haven, Pennsylvania, U.S.A. Title: Vice-President, Gulf Oil Canada Limited. Education: Pennsylvania State University, 1941, B.S. ChE. Employment: 1942, Joined Gulf Oil Corporation, Pittsburgh, Pa. Research Department; 1961, Manager, Gulf Eastern Company, London, England; 1965, Appointed Executive Vice President, Shawinigan Chemicals Limited, Montreal, P.Q.; 1966, Elected Director, President and Chief Executive Officer, Shawinigan Chemicals Limited, Montreal, P.Q.; 1969, Elected Vice-President, Gulf Oil Canada Limited. Memberships: American Chemical Society, American Institute of Chemical Engineers, Canadian Chemical Producers' Association (Director 1967-68), Canadian Manufacturers' Association, Chemical Institute of Canada, Manufacturing Chemists' Association, Inc., Montreal Board of Trade, National Industrial Conference Board.

Hynes, Leonard: Date of Birth: 3rd July 1911, Toronto, Ontario. Marital Status: Married, two sons, two daughters. Education: St. Michael's College, Toronto; University of Toronto, B.A. 1932 (Honours Chemistry and Mineralogy); University of Toronto, M.A. 1933 (Chemistry). Employment: Canadian Industries Limited, 1933 to date; Vice President and Director, 1954; President since 1962. Director: Bank of Montreal; Pilkington Brothers Canada Limited, Canadian Chemical Producers' Association, Manufacturing Chemists' Association (U.S.). Memberships: American Management Association; Canadian Chamber of Commerce, (Chairman of Executive Council, 1960-61), (Chairman of Joint Committee of Canadian and U.S. Chambers of Commerce, 1964); Canadian Institute of Mining and Metallurgy; Chemical Institute of Canada (F.C.I.C.); International Chamber of Commerce, (President, Canadian Council, 1968-70); Montreal Board of Trade; National Industrial Conference Board, Canadian

Council, 1968-69; Science Council of Canada, 1968-71; Society of Chemical Industry (Gold Medallist, 1967); President, St. Mary's Hospital, Montreal, 1960-62; Governor, St. Francis Xavier University, 1963-65. Recreation: Sailing.

Kerr, Stanley B.: Technical Training: Obtained B.Comm. degree at Edinburgh University in 1948. Qualified for Associate Membership of the A.C.C.A. in 1955. Professional Career: Joined the Dunlop staff in 1948 and worked in various financial positions at Birmingham and London, England. He was transfered to Dunlop Canada Limited as Chief Accountant in 1955. In 1961 he became Secretary-Treasurer of Dunlop Canada Limited, and in 1965 Secretary and Vice-President of Finance. He was appointed to his present position of Vice-President of Finance & Corporate Planning in 1967.

Richards, J. Paul: Graduated Industrial Engineering 1956 B.A.Sc., University of Toronto. Sales representative and Technical Product Supervisor, Fiberglass Canada 1956-60. Sales Manager: Plastic Bottle Division, Owens-Illinois of Canada Ltd. 1960-1961. Post Graduate, Business Administration: Universtiy of Toronto M.B.A. 1961-1962. Department of Trade and Commerce, Trade Commissioner Service 1962-1966. Assistant Trade Commissioner and Acting Trade Commissioner: Rio de Janeiro, Brazil, 1963-1968. O. H. Johns Scientific and O. H. Johns Glass Company Ltd., 1968-1969.

Warren, J. C. Russell: 1939, B.A. Honours Chemistry, McMaster University. 1940-41, Graduate Student, University of Michigan. 1939-40, Metallurgical Department, Steel Co. of Canada, Hamilton. 1941-42, Chemist & Supervisor, Welland Chemical Works, Niagara Falls. 1942-43, Chief Chemist, Canadian General Rubber Co., Galt. 1943-45, Research Fellow, Ontario Research Foundation, Toronto. 1945-53, Process Development, Chemical Division, UniRoyal, Elmira. 1953-59, Market Research & Planning, Chemical Division, UniRoyal, Elmira. 1959-, Co-ordinator, Research and Development, UniRoyal Ltd. Fellow, C.I.C. Member, CRMA, ACS, CMRA, AMA. Patents, 19.

THE SENATE

SPECIAL COMMITTEE ON SCIENCE POLICY

EVIDENCE

Ottawa, Tuesday, June 17, 1969

The Special Committee on Science Policy met this day at 3.30 p.m.

Senator M. Bourget (Acting Chairman) in the Chair.

The Acting Chairman: Gentlemen, I would like on behalf of the committee to apologize for the delay this afternoon. The delay is due to the fact that our chairman, Senator Lamontagne, had a bill to sponsor respecting the Boy Scouts. Even the Senate, you can see, is interested in the Boy Scouts.

I shall now call upon Mr. Capon, the vice-president of Du Pont Canada Limited, to give us a resumé of the brief they have presented to the members of the committee.

Mr. F. S. Capon, Vice-President, Du Pont of Canada Limited: Thank you, Mr. Acting Chairman. Du Pont of Canada welcomes this opportunity to present to your committee its views on the nation's science policy needs.

We have been most impressed with the way in which the committee is handling its task. We feel that it is a privilege to be with you.

The company which is Du Pont of Canada, and was originally both CIL and Du Pont of Canada, traces its history hack over a hundred years in this country.

Since 1954 Du Pont of Canada has been a subsidiary of E. I. Du Pont de Nemours in the United States which own 75 per cent of our common stock. On size, our sales last year were about $208 million; we employed about 6,500 Canadians at the end of the year. Our sales are comprised entirely of technologically oriented products and, in common with other technologically oriented companies, our future success depends upon the ability of such Canadian products to compete in both domestic and foreign markets.

We have three main research laboratories. We spend about $7 million a year in research and development, which in relation to sales is about half as intensive as the effort of our parent company in the United States, which spends about $180 million a year.

In our brief to the committee we made a number of points regarding the structure and administration of the government's various science incentive programs, but our main concern was to emphasize that the economic environment in which Canadian companies must operate will have a much greater impact on Canadian scientific research and technical development that will all the other factors combined. It is the economic environment which determines the opportunities and therefore the validity of research objectives.

For a nation to have policies it has to have objectives. I assume for purposes of discussion that Canada's primary objectives are freedom, independence and high living standards for all our people. Today none of these objectives can be obtained by societies which lack a strong technical base.

High living standards for Canadians depend upon the success in Canada of the most productive industries, those which use the most modern, the most sophisticated, technology. The whole purpose of technology is to develop new products and new processes which increase our wealth generation through the most effective use of resources. That is to increase the value of output per unit of input.

Since the late thirties, and spurred on by the need for new scientific knowledge to win the last war, there has been a fantastic increase in scientific research in the world. Therefore a sharp rise in per capita generation of wealth in those countries employing the newest technology has occurred. Their living standards have shot up. The technology change continues to accelerate and now poses a very real problem in Canada and other smaller powers.

To use just one example, in our industry advancing technology calls for ever greater manufacturing units and often for plants with an individual capacity equal to or greater than our total market for those products.

Our combines laws and many government regulations and policies pertaining to industry remain, however, oriented substantially to pre-1940 technology.

To achieve affluence we must employ technology to the fullest. To employ technology we must have a large and up to date research capability. This can be justified only if the products resulting from the research effort will be produced in large volume in Canada. That in turn will be realized only if Canadian plants can produce at costs competitive with those in other nations, with government policies designed to ensure that the most productive uses are in fact made of Canadian resources.

Unfortunately, following a period of great success after the war, we are now experiencing a hesitancy, a serious hesitancy, in Canada's most productive industries.

An analysis of the present trends in the chemical industry, which by any measure is one of the nation's most productive, shows clearly that the disadvantages of small-scale Canadian plants, combined with a heavier tax burden, place Canadian producers at a significant disadvantage, averaging over 20 per cent opposite our neighbours in the greater countries. Our particular relationship is not new; traditionally a 25 per cent lower wage scale, combined with reasonable tariff protection, enabled us to compete.

The drive by labour for wage parity and then the effect of the Kennedy round tariff changes, has resulted in a sharp falling off in the forecast of expansion by the chemical industry, also in the rate of expansion of Canada's research effort.

In the final analysis capital and research funds will be invested wherever they can earn the best return, whether the owners be Canadian or foreign.

The unit production costs in the very large scale new plants of technical industries represent such great reductions from costs possible in smaller plants that huge plants will be built and will take their growing share of the market.

Canada has the raw materials and she has the human skills. She either has or can acquire the needed technology to build such new plants. They will be built here only if they are reasonably assured of the Canadian market. Their output must penetrate other world markets at selling prices which result in an adequate return on investment. If the return on investment of such a plant built in the U.S., Europe or Africa, to supply the Canadian and other markets, would be higher than the return of such a plant built in Canada then we have to assume that the plant would not be built in Canada, even though it might be built with Canadian capital.

The technologically based industries are virtually all composed of international corporations of great size, and this is no accident. The large research budgets needed to support the huge technical effort on which our future depends, combined with the very great capital investment now needed in each new plant, make it inevitable that only very large corporate entities can succeed in the most productive, the most highly technical new processes.

As more of the world's business is carried on by international companies, so more and more of the decisions on the building of new plants will be based on comparative analyses of the costs, profits and political factors in the various countries in which these world corporations operate or are prepared to operate.

Canada must compete with the world in operating costs, wage rates, costs of capital, taxation, governmental controls or restrictions of freedom to operate and all the other factors which bear on our business system.

Canada probably feels the effects of international corporations more than any other country, because so high a percentage of ownership of all our most technical industries is in the hands of foreign and international corporations. The investment decisions, the expansion plans for Canadian subsidiaries inevitably take into account the comparative advantages or disadvantages of building in Canada or elsewhere. Certainly Canadian subsidiary managements fight for the Canadian expansion, but it is difficult to overcome an argument from the owner of capital against his investing in the same plant elsewhere at a much higher return.

This country has a great future, a future of affluence, if it will make effective use of its tremendous resources. Because it can do this only by exploiting the most up to date technology it must have a full scale, modern scientific capability. This in turn can be justified only if the results of scientific work in terms of new products and processes are in fact exploitable in Canada. Government could extend its grant and subsidy policies to the extent that the Canadian taxpayer would bear the full cost of all technical effort in this country. Such a course would ensure that we have more research work done here. That would be a waste of money unless the results of that work could be employed to raise Canadian living standards as a whole.

In the final analysis we can succeed in Canada only if we are competitive in the world, competitive in all aspects of life. This includes business efficiency, education, skills, wage costs, government expenditures, monetary stability, political reliability and all the other factors that make up an affluent world.

The true incentive for research is the opportunity for profitable growth to result from research effort. Canadians have tended to assume that all research is desirable and justified. They have therefore placed great emphasis on how to finance the cost of a growing research effort. We believe that a full scale scientific effort will develop automatically from an expansion of the opportunity for technologically based industry to succeed in Canada.

Our emphasis should therefore be shifted from worrying about the cost of research towards ensuring that there is enough opportunity to warrant a sound and growing program.

It is therefore our hope that your committee will place major emphasis on the broad environmental factors governing the use of technology in Canada in presenting its findings to government.

A system of incentives or grants has its place and will be essential to support technological effort in competition with such systems developed in other countries. The economical fiscal policies determining the success of technologically based industries necessarily have an effect on scientific effort far greater than any direct incentive or grant programs up to now.

We feel that government has not always taken into account all the inter-related business and scientific factors when formulating taxation, tariff and trade policies.

The main purpose of our brief, therefore, is to urge that there be a thorough understanding of these inter-relationships, that government recognize the need to ensure success for technologically based industry in Canada with its related research support and with broad recognition of the competitive needs of such industries when government formulates national and international fiscal, trade and economic policies.

The Acting Chairman: Thank you, Mr. Capon.

Before we call on Mr. Hynes from CIL, I see that our chairman is now back with his bill passed on second reading. I suppose he will be from now on an honorary boy scout. I will ask him to take over.

Senator Maurice Lamontagne (*Chairman*) in the Chair.

The Chairman: Thank you, Senator Bourget.

Mr. Hynes, you are very well known as president of Canadian Industries Limited.

Mr. L. Hynes (President, Canadian Industries Limited): Thank you very much, Mr. Chairman. Honourable senators, we in CIL were very pleased to receive your invitation to attend this meeting of the committee and to express our views. I am supported today by my colleagues, Dr. J. H. Shipley, our Vice-president, and Dr. Gordon Segall, our research manager, who are in the audience. Dr. Shipley was here on Friday with the Canadian Chemical Producers Association. He told me that there were some questions asked at that time he thought were not answered. There was one question in regard to how much of the Canadian chemical production is exported.

In the Canadian Chemical Association's brief on page 27 the figure is given that of the annual gross value of shipments of $2\frac{1}{4}$ billion, the exports were $400 million, or 18 per cent.

I think Senator Robichaud also asked can examples be given of products innovated in Canada and exported? In our CIL annual report for last year we said, and I would quote, the sale of technology has begun to provide a significant source of income. The company's continuous TNT process was licensed to the United States government. In addition design and engineering services were provided for a fee. A new caustic flaking process has been licensed and the licencee has built several plants.

A plastic film packaging machinery development has been licensed to four United States companies. This work was done under Dr. Segall's direction in our labs outside Montreal.

Polyethylene blend patents were licensed in Japan and options on the new CIL rigid plastic foam process have also been licensed to

Japan. In addition we have been licensing some paint technology to companies both in the United States and Japan for several years.

While these are not all our innovated products, it does indicate that a new technology development in Canada is a highly marketable product outside our country. I am sure that other companies export technology in a similar manner.

Coming to CIL, we are basically a chemical products manufacturing company. We are owned to the extent of 73 per cent by Imperial Chemical Industries of the United Kingdom. 25 per cent of our shares are held largely in Canada by somewhat over 8,000 Canadian shareholders. Many of these, of course, are investment institutions or life insurance companies who are holding them on behalf of many other people as well. We manufacture industrial chemicals, fertilizers, explosives, sporting ammunition, paints, plastics, synthetic fibres at about 30 locations across Canada.

Our sales last year were over $300 million. Approximately 12 per cent of the value of our manufactures were exported from Canada. We currently employ about 10,500 people. On balance we represent something in the order of 10 per cent of the Canadian chemical industry measured in terms of sales value, the number of people employed and so on.

CIL is a member of the Canadian Chemical Producers Association and supports the brief that was presented by that association to the committee last Friday. On our own part we have chosen to confine ourselves in our brief to emphasizing that development of a science policy and a greatly expanded government financing of research and development cannot and I would repeat that, cannot stand alone. In this respect I would support Mr. Capon very much.

The desired benefits could still be largely frustrated by other government actions. In order to increase the probability of successful research and development programs we stress the need for greater co-ordination of a wide range of government actions with science policy. These include the areas of patents, tariffs, combines, taxation and so forth.

In the Science Council's first annual report, repeated in their fourth annual report, they stated we must be sure that enough of our R & D effort is successfully directed towards profitable projects to ensure the continuity of the production which supports all our research. Again, they say if our industry becomes unprofitable there will be no money for any kind of research.

I spent some time with Dr. Solandt this morning. I asked him if he realized this was stated in these terms about 20 years ago. I would like to read this to you:

> If we know nothing about production, if we cannot restore and develop production as speedily as possible and achieve solid successes so that the livelihood of the workers first of all and the people in general is improved, we shall be unable to maintain our political power. We shall be unable to stand on our feet and we shall fail.

That, Mr. Chairman, is a quote from Mao Tse Tsung's address to the central committee of the Chinese Communist Party.

The Chairman: I thought it was coming from CIL.

Mr. Hynes: No, it is a measure of the kind of opposition we are up against. If we are going to be dealing with China, we have got to recognize that they are born winners and we will have to be very good. Mao Tse Tsung knows what it takes. You have got to be profitable. We subscribe to this view and we repeat that there must be greater co-ordination of a wide range of government actions.

The Chairman: That does not mean that you will follow his cultural revolution?

Mr. Hynes: Not necessarily, but if we are going to win ours we will have to operate profitable business or his culture will prevail. He intends to have it prevail, and he knows what will make it prevail. If we are going to prevail we will have to be able to utilize the results of R & D. Thereby we will grow more rapidly in size in our productivity and possibilities. Only in this way can the results of science and technology contribute to the attainment of Canada's national goals.

We have given some examples in our brief to illustrate where co-ordination of policies of government is necessary between science policy and action on such things as patents, combines, tariffs and taxation. We have pointed out in our brief that a high level of research and development work in itself will not produce the desired economic benefits to the nation.

We have cited the example of the United Kingdom, which has a relatively high research and development expenditure but a low rate of economic growth. We have cited that in Japan there has been a high rate of economic growth with a relatively modest expenditure on research and development. For the growth of productive industries it is essential to have not just a high level of research and development expenditures. There must also be the application of the results of science and technology within a framework of co-ordinated government actions.

We recognize that various bodies such as the Economic Council and the Science Council and many others have reviewed and studied and made recommendations on objectives, on science policy and so on, over the past few years. We really need now an agreed set of national, social, cultural and economic goals or objectives. Against these we could relate a science policy which would help us to achieve these goals.

We must have co-ordination of all government policies so that we do achieve these objectives.

From the industrial standpoint, assuming that various levels of government in collaboration with industry have agreed on the proper areas for industrial expansion, on development and on specialization to meet the nation's goals, we suggest the provision of incentives to support industrial research in these areas.

We would include support right through to the application of the research results. There is no point in stopping halfway down the line. As somebody said, what is the point in getting 20 per cent of the way to the moon, or halfway across the Atlantic ocean? We seem to be trying to get halfway across the Atlantic ocean too often.

The Chairman: If you were to put this in terms of the Pacific ocean perhaps there may be some better objectives.

Mr. Hynes: The Japanese and the Russians are fishing within three miles of Canada, but we are not fishing within three miles of either Russia or Japan.

Such support should not be administratively cumbersome. It should not be unrealistically nationalistic, nor should it be confined to just an increase in research effort.

We need effective incentives for a sustained high level of industrial research and development activity. There must be the application of this technology from all possible sources into the areas important to achieving our national goals. We need this all within a framework of co-ordinated government policies and actions.

The thing that strikes me in looking at this across the world in the last few days—I am just back from being in Asia and Europe for the last four weeks—is that Canada's basic personal attitude is not dedicated to wanting to win. There are a lot of other people who do want to win.

We seem to have a dedication to the fear that somebody will get ahead. Therefore we are moving at a dedication to the average, or the convoy system. As a result of this, by definition, we are losers. If we make grants on the one hand to something as an incentive you will find some other area to take it away again.

We need rather a dedication to excellence, instead of a dedication to the average. The dedication to excellence in a small country like this means we have got to pick and choose and do those things in which we have some advantages and get very good at it. Then the world will come to us. There are very few unemployed experts. The Canadiens do not fire Jean Belliveau.

I will be glad to answer questions.

The Chairman: Thank you very much, Mr. Hynes. Now, I am sure that the members of the committee all recognize Dr. Grace, who was before us some days ago in his other capacity as the new president of the Chemical Institute of Canada. This afternoon he makes his second appearance before us in his other capacity as general manager of the Dunlop Research Centre at Sheridan Park.

Dr. Norman S. Grace, General Manager, Dunlop Research Centre: Thank you very much, Mr. Chairman. It is a pleasure to be with you again. I have with me a representative of Dunlop of Canada's top management, Mr. S. B. Kerr, who is vice-president of finance and corporate planning.

In order to give you the benefit of our points of view, each of us has prepared some very brief remarks. The reason I mention this is because Mr. Kerr's are written in the first person, and he has asked me to present them to you. I shall shift to the more general in just a moment.

This is Mr. Kerr's comment; it is interesting to get comment from a man who is an accountant by education and who has a financial point of view. I think Mr. Kerr and I would both subscribe a hundred per cent to what has been said before. I am afraid there is a little overlapping, but it is not a one hundred per cent overlapping. This is Mr. Kerr speaking:

I appreciate the opportunity of appearing before you to describe something of the attitude of my company to the theme of industrial research and development and to the role that we feel government can most usefully play in fostering this significant activity.

Initially I would like to say a few words about Dunlop. We are a long-standing Canadian company and believe that we have contributed to Canada's growth and development in a spirit of good corporate citizenship.

At the same time we are part of a group that is truly international in character and accordingly we stand at the point of interaction of the Canadian and international scene in our industry. In no area can this be said with greater truth than in the field of research. As I know you are aware, the form and character of a company is the result of a number of forces, social, governmental, financial and legal, to name a few.

In the case of our research activities we have evolved a situation that contributes to Canada's interests, both social and economic. Dunlop's research in Canada was undertaken without benefit of support from government agencies. However, when this was forthcoming I participated in a number of discussions to determine whether we were able to qualify so that Dunlop could expand its research operations to its continuing well being and that of Canada.

My reactions may interest you. In one case on a visit to the National Research Council I found an attitude that was typical of the best thinking, helpful, sympathetic, unselfish, a minimum of regulations.

On the other hand, on reviewing with the appropriate officials the application of the IRDIA legislation, I found that while the undoubted aim of the legislation was well intentioned its form was restrictive, beset with regulations, detailed reports, etcetera. This, frankly, did not accord with what I sincerely believe to be the objective of the government in assuring consistent research and development in this country involving, as it must do, the creation of a working environment suited to the scientists and technologists.

From a practical business standpoint I offer these suggestions for your consideration: One, express a federal government attitude or philosophy towards research that is essentially unselfish and in tune with the spirit of research itself. Two, give expression to this attitude by the creation of a separate ministry to foster the growth of research, development and innovation in Canada. Three, permit a good deal of scope for the exercise of discretion and a minimum of rules and administrative procedures. Four, in the staffing of such a ministry give weight in the appointment of senior officials to those who have served in government, universities and industry in research capacities. This would be in accord with the attitude expressed by the Prime Minister when he called for business people to spend at least part of their career in the government service.

Finally, under the proposed new ministry, bring together the separate programs that now exist for government assistance to research efforts and, in this way, eliminate the duplications that must inevitably exist in the present situation.

Here are my own comments, which are closely related:

Most recent studies point to industrial development and its follow through via technological innovation as the weakest part of our scientific activity, yet it is the way in which science must be used in order to expand the national economy.

The pressing question is therefore what are the best ways of correcting this weakness? It is clear: First, that most approaches must involve both industry and government acting in cooperation. Second, that the present incentive schemes, with their limitations and restrictions, have not been effective and will not result in a rapid change in the desired direction. Third, that the whole area of incentive schemes and other approaches must be critically reappraised. Objectives, this has been mentioned already, with time scales must be clearly established and simple flexible realistic programs established with continuing dialogue between industry and government.

General incentives for development should be across the board and most of the IRDIA restrictions eliminated.

Special incentives should not only support development but also the whole innovative process. This has been mentioned already. They should be evolved with sufficient flexibility to meet the needs of every deserving case. For example, for the large well defined development a simplified updated revision of the PAINT scheme may be the answer.

For general improvement across a product range a revision of the National Research Council industrial research and assistance program might prove most effective. It would make additional manpower available for development.

For areas important to the civilian sector, pollution, transportation, urban development, for example, some form of government contract with industry should be investigated. Of course, this is already being used in connection with the communications satellite.

Finally, and I think perhaps this is the most important representation, the case of the inventor, the individual innovator, the entrepreneur, needs careful consideration on how to encourage them to stay in Canada and first commercialize here.

I am going to put in for the record a little report from the New Scientist of a speech by a man by the name of Dr. Charpie, who is the new president of Bell and Howell, in which he states that:

> In the United States more than 80 per cent of the research and development dollars are spent in 200 large companies. Yet more than two-thirds of the basic discoveries which resulted in important innovations came from independent inventors or small firms.

So I think we have been a little light in Canada on this side.

Finally, if schemes such as those already outlined are not adequate, then we must evolve programs that are.

The vital importance of our economic climate for innovation in Canada is now so clearly recognized that it needs no further elaboration from me at this time.

Thank you, gentlemen.

The Chairman: Thank you very much, Dr. Grace. Who is going to speak on behalf of Shawinigan Chemicals?

Mr. V.N. Hurd, Vice-President, Shawinigan Chemicals Division: Mr. Chairman, thank you very much for the opportunity to be here.

I have just a very few remarks to make. First, I would like to say that Shawinigan Chemicals did participate in the preparation of the CCPA brief which was presented here last week. We fully support the views in the CCPA brief. Also, our brief is presented in concert with the brief of Gulf Oil Canada Limited, of which we are now a division.

Shawinigan Chemicals Division of Gulf Oil Canada Limited, through its predecessor, Shawinigan Chemicals Limited, has been engaged in research activities for the past 54 years.

Although the research is small by present North American standards the output has been high by any standard.

The earning potential of chemical companies in the Canadian economic environment is quite limited today. This has a bearing on the company's ability to mount really extensive new research programs. Under these conditions a very substantial amount of the research expenditure is devoted to supporting and improving existing operations and products, while lesser amounts are spent on exploring and developing new products and processes.

Our company is dependent to a great extent on its ability to purchase new technology. At the same time the company must maintain a cadre of highly skilled scientists to make use of this technology.

The scientific aspects of the company are thus tied up with people and the ability of the people to communicate, not only with their associates, but also with the scientific world. In recruiting scientific personnel for its research laboratories the company attempts to hire individuals of an intellectual capacity which would allow them to proceed to the Ph.D. level, if they had not already done so and with a versatility which would allow them to work on diverse problems within their broad range of scientific training. People of this kind are not easy to find today. Our graduate schools tend to place the student into a narrower and narrower area. When the student emerges and wants to do his specialty he finds that his specialty is not being done in Canada. He leaves for the ten-fold larger economy to the south, where his specialty may be done. Failing that, he may return to the universities to teach and train others to do the same specialty.

Legislation will not change this, but it is possible that a government stimulated university-industry co-operative research program might channel some of the training effort into projects which have some relevance to the Canadian economy.

Our company feels that the best way to encourage industry to increase its research effort is to attempt to create an economic climate which will allow viable companies to earn reasonable profits.

In this we certainly support the DuPont-CIL representation.

If this environment cannot be maintained we must recognize that scientific research will fall more and more into the government domain. The ability of industry to mount substantial research programs will be more and more dependent on stimulation by government in the form of research and development grants and tax incentives.

Thank you very much.

The Chairman: Thank you. I call on Mr. Richards, who is a director of the O.H. Johns Glass Company Limited.

Mr. J. P. Richards, Director, O. H. Johns Glass Company Limited: Senator Lamontagne and Honourable members of the committee: I would first like to express the appreciation of our company for this opportunity to appear before the committee to give our recommendations and suggestions regarding science policy as it affects our organization in Canada.

I would first like to very briefly review the type of thing that we are doing, since our name is not really the household word that the names of so many of the other companies here this afternoon are.

We manufacture scientific glassware and apparatus in Toronto and Montreal. To my knowledge, we are the only company in Canada with its primary objective as manufacturing scientific apparatus for laboratory use in this country.

The Chairman: An artificial monopoly.

Mr. Richards: An artificial monopoly, that is quite right. I will have more to say on that a little later.

We are a private company, Canadian-owned and have been manufacturing in Canada since 1928. It is our contention that under the present tariff regulations and government incentives it is very difficult to justify the establishment or maintenance of such a scientific apparatus manufacturing industry in Canada. I will have to qualify what I mean by scientific apparatus:

I mean the glassware, the equipment, the instruments that are used in laboratory research, primarily for government research institutions, hospitals and universities.

In other words, some industrial research is being done in Canada, as these gentlemen pointed out, but it is just a fraction of the research that is being done in the United States and in other countries. The character of the research is quite different, so that the demand for laboratory apparatus in industry is quite small in Canada.

In our facility in Toronto we manufacture scientific glassware of all kinds. In Montreal we are manufacturing ampoules and serum vials for the pharmaceutical industry.

For many years in Canada all the Canadian government research institutions had duty-free entry of all scientific apparatus and supplies under the tariff items 69605-1 and 47605-1. There has been an amendment in the last two weeks to these rulings under the new budget. We have not received full clarification, but to the best of our knowledge at the present time it does not affect our brief that has been previously submitted.

I would like to read very briefly from the 50th anniversary publication of the Scientific Apparatus Makers Association in the United States with regard to their approach to the scientific apparatus industry.

While the manufacturers of instruments in America date back to the earliest period of our history, the greatest portion of scientific instruments, apparatus and equipment in this country prior to World War I was imported, principally from Germany and Great Britain.

With the outbreak of World War I they were shut off from their source of supply and it was necessary to develop their industry.

After the war ended in 1918 there was the nucleus of an industry in the United States, but it was not until the 1920's that an organization were successful in obtaining protection. I would like to read you again their comments on that:

> *Protection Encourages Growth*—The historical policies of other nations in regard to the establishment and maintenance of their scientific apparatus manufacturing capabilities are highly indica-

tive of the basis and essential importance of this industry to the national defence and public health and welfare.

Then it goes on to review the problems that Great Britain had at the outbreak of World War I because they were so completely dependent on optical instruments from Germany. They had to develop their own industry in near panic conditions.

So too did the early members of SAMA launch a program to obtain government action to protect and strengthen this country's capabilities to manufacture scientific instruments and apparatus. This association effort was successfully culminated in the enactment of the Tariff Act of 1922 which removed the products of this infant industry from the duty free list and established duty rates comparable to those already in existence to encourage the growth of other young US industries.

From this, senator, it would appear that we are anxious to establish duty protection for the goods that we are manufacturing. While this is true in part, I would like to emphasize that there are three other features which are discouraging our expansion and making it very difficult for any new industry to even consider manufacturing in Canada.

If we were to import components to manufacture scientific apparatus in Canada, these are dutiable. We are being penalized under the existing regulations for manufacturing in Canada.

If we were to import the packaging materials or components to put them together in Canada we would pay duty on the components, but we can bring in the finished goods duty free. I am sure that this was not the intent of the original regulations, but this has been the result.

I feel that this is the primary reason why there has not been any development of this industry in Canada. The other reason is that there is no duty protection and there is a very high tariff barrier in other countries. For example, on glassware we are faced with a 39 per cent tariff going into the United States, regardless of the end user and they have some pretty duty free access to this market.

It makes very little sense to establish, or even consider a facility in this country. Indeed, we would be very much better off to shut down our complete operation and move to Buffalo, where we would have the advantages of both markets.

The Chairman: This is unilateral free trade.

Mr. Richards: That is right. Under the Kennedy round recommendations this tariff rate will drop down to I believe 21 per cent, but this is still completely prohibitive in the glassware manufacturing industry.

Another small point which deserves some recognition is that the Canadian government research institutions have not been giving any preference for goods manufactured in Canada, or any preference that we are aware of.

In some areas there does seem to be some allowance for some preference for goods manufactured in Canada, but from what we can understand at the present time there is no fixed policy in this regard.

That covers most of the points that I want to review with the committee this afternoon.

I should also mention that the imports in 1966 under these two regulations that I mentioned were in excess of $100 million, so this is becoming a very major industry. Our exports were so small that they have not even been listed separately in the DBS figures, so it is completely a one-way industry at the present time.

Thank you very much, sir.

The Chairman: It seems to me that this afternoon we have had a kind of intellectual parallelism. Fortunately this is not a form of collusion or combination which is criminal. That is why I call it parallelism.

There are several members of the committee who want to ask questions this afternoon. First, however, we have another opening statement to be made by Mr. Russell Warren from Uniroyal research labs.

Mr. J. C. R. Warren, Uniroyal Ltd. Research Labs: Thank you, Mr. Chairman. Honourable senators, we appreciate this opportunity you have extended to us to give some of our thoughts on a science policy for Canada. Uniroyal was founded under the Dominion rubber name or even an earlier name possibly, back in 1844, so we have been here for a long time. Now we are part of the Uniroyal worldwide organization and are wholly owned by Uniroyal based in the United States.

We do have our own central research facility in Canada and divisional development laboratories. Our research division was founded about 26 years ago in Guelph, Ontario. It was a small laboratory for a number of years until the government program of assisting R and D commenced. From the time when it commenced until now we have grown at the research centre at Guelph from 18 people to 115. We are now being accused of using this program for the purpose for which it was put. We have tried to comply with the intent of the program.

Our thoughts on this subject are much the same as what you have heard but possibly put in a slightly different way and with slightly different emphasis. Our thoughts are for Canada and not for Uniroyal.

To make Canadian industry more viable, to improve the economy and to provide greater opportunities for Canadians, increased applied research and development is required in Canada. In addition an even greater increase in innovation associated with research and development is needed. Although these matters should be the concern of everyone in Canada and more effort must be made to bring the situation to the attention of the public, our Government can exert the most influence in providing the climate, incentives and controls required to accomplish these ends.

While the federal government has recently encouraged the short-term expansion of industrial research and development by providing certain financial support with some measure of success, at the present time further increases in support should be considered. Support over a much longer period is required and, in particular, provisions must be made for adequately carrying out those steps required between development and full-scale production in order to provide the long-term benefits which we are seeking.

The market to which most Canadian manufacturers have free access is less than one-fifth that available to manufacturers in other technically advanced nations. This usually results in smaller-volume Canadian production units, higher unit costs and a resultant lower ability to compete even in domestic or unprotected export markets. Foreign producers with higher volume production units can now compete in Canada with most Canadian producers in spite of some tariff barriers.

As the Canadian tariffs are lowered, Canadian industry will become less competitive and the trend toward "rationalization" and specialization will accelerate. Since foreign industry already possesses larger scale production units, pressures will encourage importation rather than Canadian production.

Canada will then have to depend for her future growth on distinctive new products which will only result from more intensive research and development. To span the gap until the time when a sufficient volume of new products, produced in Canada, is established in international markets, massive support will be needed for research and development and innovation. The time required may be ten to twenty years.

At the present time there exists an improper balance between the types of research done in Canada. There is far more basic research, undertaken mostly at our Universities and NRC, than there is applied and industrial research. While basic research is required to create a strong science front in Canada, it doesn't lead to innovation as rapidly as does applied research. Applied and industrial research can be based no fundamental research done in other countries as well as Canada. These countries may be better able to afford such basic research. It is generally believed that basic research is not mission oriented. On the contrary, it is, but the mission very often is a personal one rather than the more practical or beneficial one which is characteristic of applied and industrial research. Our goals in research should be oriented more toward the benefit of the Canadian people. To create the proper balance in research and to get a better return to the nation for the efforts expended, applied and industrial research should receive a higher priority than basic research. This can be done by government through incentives of many kinds for applied research in the three sectors: industry, federal government and universities.

While Canadians have had to display a substantial capacity for inventiveness and innovation in order to develop this country to its present state in spite of all obstacles, this capacity has seldom been directed to new products. Inventions and innovations are usually made under the stress of need or opportunity. The national needs and goals of Canada are not sufficiently defined that a good research program or even a national science policy can be developed based on them.

There is need for increased activity in the following areas, which may be brought about through the use of incentives by the federal government. We feel that the government should provide, at least in broad terms, national needs and national goals. It could also be extremely helpful in providing information on needs of other countries.

Industry should develop, to a much greater extent, the ability to pin-point and define needs, which it is capable of supplying, in both national and international markets.

International market intelligence is required for the establishment of sufficiently large-volume production units to be competitive.

We feel that in the research and development area applied research in universities and at the National Research Council must be increased and related to industry. The amount of research conducted in industrial laboratories relative to universities and government must be increased substantially.

(a) Research grants to universities could be designated for applied research.

(b) Research grants for joint industry-university and industry-NRC projects could be made.

(c) Greater use could be made of university and National Research Council staff as consultants to industry.

(d) Industrial post-doctoral fellowships could be provided.

(e) Industrial sabbaticals for university staff could be arranged.

(f) Committees responsible for policy decisions in government and University research could have a strong representation from industry.

(g) Current research and development incentive programs should be revised and expanded to support projects on a more permanent rather than expansion basis.

(h) Ways must be sought to encourage and reward good research and yet not necessarily force continued or premature expansion of any particular research group.

(i) Wherever possible, research, in which a government agency is interested, should be contracted to an industrial laboratory rather than conducted in house.

(j) Industrial scientists should be encouraged to keep "on top" through international meetings.

(k) Industrial scientists should be supported in giving lectures in universities and to the public.

(l) Awards with national recognition might be increased for industrial scientists.

(m) Initiate a program to make science students aware of the more practical goals of science.

(n) In any program for the rationalization of industry there should be some provision for similar rationalization of research and development so that a fair share is done in Canada.

Getting along to the innovation area, the gap between research and full-scale production must be supported sufficiently that the full benefits of research are realized in Canada.

(a) Specific inducements for the commercialization of new products in Canada should be arranged.

(b) Incentives to encourage the export of new products should be available.

(c) Adequate patent protection, worldwide, for Canadian inventions should be ensured and incentives may be a useful tool.

(d) When research and innovation supported by Canadian funds is successful, means must be found to ensure that adequate returns to Canada are made from any commercialization.

(e) A tariff policy must be developed which is compatible with our national policy and our science policy.

A science policy must not concern itself only with science. It must consider how this science—involved in research, development, innovation, production and marketing—impinges on the national life of our people. It has some relation to markets and growth or loss of markets, to the size of these markets and the effect this has on the cost of producing a product in Canada. We could have the best science policy in the world but if foreign producers can ship freely into Canada the production from lower cost, large-volume plants, they will sell such production at prices lower than we can meet. This has nothing to do with the quality of science but with the size of the producing units which in turn depends on the size of the market available.

Where several firms in Canada have plants providing a product for Canadian consumption one plant might turn out enough to supply the whole market and do so at the lowest price possible. Our laws prevent any such arrangement which could be to the national benefit. The multiplicity of foreign subsidiaries may compound the problem. But our laws do not prevent a foreign supplier from underselling the Canadian producers and putting them, one at a time, out of business. Some parts of our national policy seem to be designed to destroy what other parts of our national policy are trying to foster.

The Chairman: Thank you very much, Mr. Warren. Senator Belisle, do you have some questions?

Senator Belisle: Thank you, Mr. Chairman. In reading these briefs I have prepared many questions.

The Chairman: We have about an hour.

Senator Belisle: With your permission, Mr. Chairman, if I may, I would like to ask about three questions directed to three groups, the first being the Johns Glass Company, the second the Dunlop Company and the third the DuPont Company.

My first question arises from the Johns Glass Company brief which says that the company would like to set up glassware companies but the tariff situation makes it difficult. I will quote from the brief:

> We are trying to expand our manufacturing in Canada and to export but the tariff barrier entering the United States is 39 per cent. This means that we are completely blocked from competing in the United States but the United States has complete and free access to this market—

Mr. Richards: The market I have defined is the laboratories, the hospitals, universities, and government research institutions.

Senator Belisle: My question is: Is the Canadian market not large enough to support a growing company? And what price differential is there in the Canadian market between the products of this firm and those imported from the USA? I am aware that you made some comments a while ago, but could you elaborate further?

Mr. Richards: Yes, I would be very pleased to do that. There is no price difference, and there cannot be a price difference. This is not a new arrangement or a new tariff system. We have grown up under it, and we can compete with the American prices in most instances on a duty-free basis. However, you again reach this economic factor of level of production. We do not have access to the American market; it is completely closed. They have very much larger runs. They can produce cheaper than we can in many instances. From over-runs they can supply most of the Canadian market. We would far rather have access to the American market than have protection for our own. This would be our first choice because our workers and our technology in most instances are as good as theirs.

The Chairman: Would this allow you to specialize more than you are doing now?

Mr. Richard: Oh, yes, very definitely.

Senator Leonard: Could I ask a supplementary question? Why do you not move to Buffalo?

Mr. Richards: I spent five years with the Department of Trade and Commerce and I am so thoroughly Canadian that that is why I am here, to try to prevent that.

Senator Leonard: That is a good answer.

Mr. Richards: Perhaps it is pride. I think it can be done in this country.

Senator Belisle: My second question is directed to the Dunlop Company. The brief discusses the experience of the research centre at Sheridan Park and of Dunlop Canada Limited with federal R & D assistance programs. I am referring to paragraphs 4(a) and (b) on pages 4 and 5. The programs are all found wanting. The summation is to be found in the summary at the top of page 6 of the brief, from which I would now like to read:

> Despite Dunlop's efforts in the scientific community, despite the necessity for Dunlop Canada to innovate in order to stay alive, despite Dunlop establishing a research centre with 35 to 40 people, the company receives very little encouragement to maintain, much less expand, the research and development activities in Canada under the present incentive programs.

May I ask the witness to expand on these problems? What are the main problems?

Mr. Grace: I will answer first, if I may, and perhaps Mr. Kerr will expand on it also. It is a matter of the way in which, for instance, the so-called general incentive program IRDIA is written, and I touched on it earlier in my comments. It is so beset with restrictions that our research budget is not eligible. It is funded as a group budget.

I know from personal experience that at least one American company, with a Canadian subsidiary, for that very reason failed two years ago to establish a laboratory here in Canada. So there is quite a serious restriction. Perhaps Mr. Kerr would like to comment further.

Mr. S. B. Kerr, Vice-President, Finance and Corporate Planning, Dunlop Canada Limited: Only in conjunction with something you have already said, Dr. Grace. I think we have found in Dunlop that we do those things in the research field that are designed to be done within the Canadian confines, but the particular form of our corporate structure and the means of financing our total operations in Canada simply did not permit us to qualify under what we felt were the rather restrictive ground rules implicit in the IRDIA legislation.

Mr. Hynes: Senator Lamontagne and I had dinner with Dr. Hornig last fall sometime. The following day I spent some time with Dr. Hornig, who was then scientific adviser to the president of the United States, and the representative of the Department of Industry explained these incentive programs. I think Dr. Hornig's attitude was, "Well, it is nice to be able to publicize that you are in favour of research but you are taking so much away with all the rules and regulations that it really has no effect." I think that is really what Dr. Grace is trying to say.

Dr. Grace: Yes.

Mr. Hynes: This is a hypocritical statement. It is a statement that you are encouraging research, but you make sure that the Department of National Revenue people do not get it.

Senator Belisle: On page 2 a statement is made of the need for greater aid and incentive for Canadian industry in doing research and development. However, it is also pointed out that research and development is one step in technological innovation. In order to increase innovation in Canada perhaps the government should encourage more R & D but develop encouragement regarding other ingredients of the innovation. My question is: How does this firm stand regarding innovation? How big is their R & D effort? What has been their record of innovation? How do they view the innovation prospects of the future? I could go on in this regard but I think I am limited as to time.

Dr. Grace: Let me deal with this specifically. A few years ago, in 1957, soon after we started research activity in Canada, we developed a new family of synthetic rubber for which we hold the basic patents around the world. They have been licensed in the United States, they are manufactured in the United States and imported into Canada and we produce rubber goods made from this synthetic rubber. It has also been licensed in Canada but, because of the size of the market, it has not been innovated. Neither our company, nor in fact any of the rubber manufacturing companies, produce their own synthetic rubber in Canada. The market is just not big enough.

So there is something I think we Canadians can take pride in, a world first of very substantial magnitude that, however, we have been unable to have innovated, carried to the production stage in Canada.

Senator Belisle: I have a question that is directed to DuPont. This brief contains a pessimistic view of the exporting potential of the Canadian chemical industry. It is similar to the views heard when the national association of producers appeared before the committee. In an industrialized country the chemical industry in general has been growing faster than the rest of industry as a whole. From 1958 to 1966 the United States chemical industry had an average annual growth rate of 8.5 per cent. The comparable figure for European countries, excluding Finland, was 10 per cent, and for Japan it was 16 per cent. The brief states on page 7, paragraph 11:

> In recent years the chemical industry in Canada has not progressed as fast as in other countries. The rate of increase in chemical production since 1958 has fallen well below that in other industrially advanced nations. Indeed, the rate of increase in Canada's index of chemical production has been three-quarters of that in the United States, one-half of that in Europe, and one-third of that in Japan. This has not been due to slower growth in Canadian markets. Domestic consumption of chemicals has grown more rapidly than in the United States, although not as rapidly as in continental Europe.

As pointed out in paragraph 12, this is due to continuing expansion of imports and, presumably, if this continues unabated, we will at some future time have no industry left. Are there any comments from the witnesses on that?

Mr. Capon: Senator Belisle, we thought that the words that we had put down there were largely self-explanatory. The Canadian chemical industry has been growing at a slower rate than the chemical industry in these other countries because costs of production have been rising relatively more rapidly. Our wage costs have been rising more rapidly. Our duty rates in Canada are less than half the duty rates in the United States. Now I am quoting the average duty on all chemical exports, and I only have figures back to 1963; we do not have world figures since. The Canadian rates are much lower than those of the United States, Japan and all the European countries except Germany. As a result the Canadian products are becoming less competitive in world markets, assuming a selling price that will yield a comparable return on investment. What we are saying is that the profitability of the Canadian chemical industry has been falling badly and, as a result, its rate of growth has also fallen. That is borne out by the published figures in the chemical companies' reports.

Senator Belisle: My last question is regarding federal research incentives referred to in this same brief. The brief, sir, on page 8, paragraph 15, and on page 9, paragraph 17, states that a nationalistic approach to research incentives is impractical and speaks of unduly nationalistic regulations. Could you expand on that?

Mr. Capon: Yes, this has to do with the regulations on what research expenditures will be eligible for grants. It particularly ties down the research expenditure to that involved in an effort which will be exploited in Canada or for which the Canadian company claiming the expense will have the right to export its products throughout the world; there will be no limitation by foreign parent companies on exports throughout the world.

In my opening comments I made some references to international companies and the implications for Canada because we in Canada in the chemical industry are composed very largely of subsidiaries of foreign parents and in almost all cases our relationship is a reciprocal relationship with our foreign parents' technology. We have access to the very major foreign technology but in turn we give the foreign parent company access to the technology which we develop in Canada. We have the right to exploit in Canada the technology which we acquire from abroad. Part of the cost of that is giving to the foreign parent company the right to exploit abroad the technology which we develop in Canada. It is a two-way reciprocal thing.

So when government comes along with a regulation which says, "We will give research grants to aid in the development of research but you cannot have it if your foreign rights are going to your parent company", they are really preventing us from expanding a very important research activity.

As I say, it is a reciprocal thing for international companies. The Canadian company is only part of a total world scene and it is quite proper and equitable that the foreign rights to Canadian technology should be traded for Canadian rights to foreign technology, always assuming equal values, and we do put values on the two-way trade when we determine the amount that we will pay or we may receive from our foreign parent company. We may receive funds because what we have done has more value in the world than what they have provided. The point is that it is a reciprocal arrangement, and it is quite proper that it should be, because we are part of a total world entity which operates as a world entity.

The Chairman: Are you really asking for a kind of reciprocal free trade arrangement with respect to research and development work?

Mr. Capon: Senator, when we say a reciprocal free trade arrangement, I have to make one qualification, that I am convinced that a free trade arrangement in the end has to result in economic unity and then political unity, and I am not sure that I am in favour of that.

The Chairman: I am not speaking of free trade in general.

Mr. Capon: Free movement. Well, perhaps it is not a free movement; it is an unfettered movement of technology in both directions but which results in a payment which may be a net payment in either direction, depending on the flow of value. I am not in favour of free trade.

Senator Kinnear: I have a question, Mr. Chairman, that I would like to ask. I noticed in the June issue of the *Monetary Times*, and you have referred to it in two or three ways in your brief, it says that in 1968 DuPont of Canada had sales up 14 per cent and net income of $12.6 million, up 20 per cent, but the company earns only 4.3 per cent on invested capital. Down a sentence or two further it says that Canada's deficit in chemical trade could run from about $350 million in 1968 to about $1 billion in 1975. It then sort of tapers off a bit and says that with more aggressive marketing, new products, plastic types of packaging material and so on, DuPont of Canada under Blackwell is likely to show further recovery through 1969. Do you feel your figure is true if you are hoping to have a better marketing condition?

Mr. Capon: Our share of the billion dollar deficit in 1975, do you mean?

Senator Kinnear: Yes.

Mr. Capon: Yes, we are very much afraid of that in Canada. We are very much afraid it is true, or that it can be true. Incidentally, the article in the *Monetary Times* article is theirs rather than ours.

Senator Kinnear: Yes, I realize that.

The Chairman: I wondered if you were being correctly quoted.

Mr. Capon: We were not being quoted at all. They are talking there, for example, about plastic packs. Our Canadian company went to Finland for technology in plastic packs, not to the United States, because we were into a product in which our United States parent company is not interested. They are not in that field. This is a product new to Canada and the biggest installations we have made so far have actually been in the Caribbean, or, at least, some of the very biggest ones have been in the Caribbean area.

This is an aggressive piece of marketing and is moving into technology which is Canadian and which has a world application. However, we remain a part of DuPont in the world sense, and if it becomes apparent that the best method—the most effective financial method if you like—of exploiting that kind of technology in the world happens to be putting plants in Europe or the United States to sell to the world, then that is the decision that worldwide DuPont ought to make because they are a worldwide corporation. So we in the Canadian company will do our best to increase our results but we may well lose out.

The Chairman: But then if you are too successful it may be taken from you.

Mr. Capon: It can, and I could not argue it would not be right if this were done. It would not be that it would be taken from us; we would be paid for the technology. However, the exploitation of that technology may be more logically done in other countries simply because the amount of capital that has to be invested to exploit it will earn a higher return elsewhere than in Canada. That is why we are putting so much emphasis in our brief and in our remarks on the need to ensure that investment in Canada can earn a competitive return.

Senator Kinnear: Was that one of the reasons why two or three years ago you shut off a great deal of the research in nylon? Was it sent elsewhere?

Mr. Capon: I will ask Dr. Hoerig who is here to answer that.

Dr. H. F. Hoerig, Vice-President, Research and Development, DuPont of Canada Limited: There is an important point here which I hope is not misunderstood. The chairman pointed out that if we were too successful this may be taken away from us. I think it must be worded in another way, that the end result would really be no different than if we had an arm's length competitor. The only way in which our development might be taken away from us, which would mean we might lose production, is if we become inefficient or too high-cost because of the total environment in which we work. In other words, the end result is really no different, I think, whether it is an international corporation or two competing corporations in different countries. The corporation which finally manufactures a product for any given market place is the one which will do it more efficiently.

To answer your question, senator, with regard to nylon research, I do not know where that impression might have been reached because nylon is one of our most important products. It is one that is produced worldwide and we have an excellent record of maintaining the efficiency in the productivity of this operation on a world competitive basis because it happens to be one of the products which is on a sufficiently large scale. We have a good record of success in improving the productivity through research. And I can assure you that in this area there has been no diminution of effort on the part of our company.

Senator Kinnear: I just knew about many researchers being laid off about two and a half years ago.

Dr. Hoerig: I could not be with us. It just could not be our company because that has not happened.

Senator Kinnear: I am sure it was.

Dr. Hoerig: I do not have the budget here, but our budget on nylon research...

Senator Kinnear: Not on nylon thread but at your nylon plant in Kingston.

Dr. Hoerig: This was not a reduction of force as far as technical people are concerned.

This perhaps shows how things can be misunderstood. I believe that two years ago—correct me, Mr. Capon, on this if I am wrong about it—two years ago there was a recession, if you will, in the fibres market. This was a recession which I think none of us really anticipated.

We have a program of hiring summer students, many of whom are used in the technical work during the summertime. We did have a situation several years ago where, with this recession in activity and with the problem we would have had with laying off, let us say, some of the workers, and some of these people were going into payroll jobs in the plant, we did not want to be confronted with a situation where we laid off payroll workers and brought in summer employees. So that we were confronted with a very embarrassing situation at that time of having to notify a group of university students that the job offers which we had made could not be honoured.

What we did then was to very carefully put our employee relations department to work on this matter, and I am glad to be able to report that every one of the young people who had been applying for jobs with us was hired in some other activity by other companies or by our own company in other areas. That is the only instance of unemployment, if you will, which we have faced in the nylon business.

Senator Kinnear: Thank you.

The Chairman: Senator Blois?

Senator Blois: Mr. Chairman, I think Senator Belisle and I should put our heads together because we have been working pretty much on the same questions.

The Chairman: It is again a case of intellectual parallelism.

Senator Blois: I was interested in the remarks the speaker made that the duty on the glass products they are making going into the United States was 39 per cent, or approximately that. Does the United States give preferential treatment to any countries shipping glass in there, or is it wide open?

Mr. Richards: There is no preference, to my knowledge.

Senator Blois: I understood you to say that if you had a free market going into the United States you could compete down there with the products that you are making?

Mr. Richards: Yes.

Senator Blois: That being the case, why do you not get all the Canadian business? How can they come in here, even if it is a free market; is their price lower than yours?

Mr. Richards: The size of run has a great deal to do with it.

Senator Blois: They can undersell you to a certain extent?

Mr. Richards: Yes, and they can be far more flexible because of the size of run.

Senator Blois: Would there be sufficient business in Canada, if you had all the business, that could keep a company such as yours busy making this equipment for science.

Mr. Richards: There is well over $6 million of scientific glassware being imported. In scientific apparatus, if you broaden the term, as I mentioned, just for the one field which comes in duty free, it is over $100 million. That was in 1966 and there has been a very sharp expansion since that time. So I would think we are probably talking about a market of $130 million or $140 million for scientific apparatus which goes into the laboratories in government research, hospitals and universities.

Senator Blois: Perhaps you do not care to answer, but approximately how many people do you employ at the present time?

Mr. Richards: In manufacturing glassware we would have 60 or 70.

Senator Blois: It is quite a little industry, in other words?

Mr. Richards: Oh, yes.

Senator Blois: I think it was CIL which mentioned the fact that it had licensed some of its processes to the United States and Japan. For a certain reason I am asking this question: Are any of the products manufactured by those processes coming back into Canada at a lower price than you can make them?

Mr. Hynes: They could but, you see, I think one makes a great mistake in relating selling prices and costs. Selling prices are determined in the market place, depending on whether someone wants something. Cost is determined by how efficiently you did the job. We have no way of stopping somebody shipping caustic soda into Canada. Other members get the business from the Canadian customer before he does. That is what we try to do. At the same time we have developed a process which at the time made better caustic soda than was being made in the United States, in terms of the form, and there were people who like to work with that quality of material. So we were able to license them to make that quality of material but we did not limit them as to where they might ship it. However, they would have tried to get our business in Canada. They have been trying to get our business in Canada all along.

Senator Blois: So you get something out of licensing?

Mr. Hynes: We endeavour to hold everything we have, and we hope to get hold of something more in order to help us do more research in Canada.

Senator Blois: One reason for my asking the question was that I happened to think of people in the United States who have found that some of the licences they have sold have resulted in products coming back into United States and underselling them in a few instances.

Mr. Hynes: I have a case about which Mr. Basford is worrying of somewhat the same order, where we did sell some material which is now coming back into Canada. And it is our own material. However, I was also interested in the same point being made by the member from Saskatoon about Canada selling wheat to China, I think, at what Mr. Caouette said was a dumped price but which somebody else said was a market price. It seems to me that neither of these things has anything to do with cost. It is what somebody will pay you for something.

There was one thing that was on my mind in connection with some of the earlier questions. You were talking about the basic disadvantages in Canada. I think it is in this area of scale. There has been a great deal of work done in the Department of Industry and we are still working with them in the Department of Industry on what we are going to do about this. Because of the increasing recognition of the disadvantage of scale, together with the Kennedy Round having established a new level of production, a new level of tariffs, and the traditional pattern of making products in Canada for the Canadian market which in total is now less than the economic unit, a great deal of the Canadian plant has become "garbage" in Mr. McLuhan's word.

The effect of the budget, which came in within the last few weeks while I was out of the country, was merely to make some of the plants which were going to be garbage two years from now garbage to-day, which is probably a good thing because it makes us recognize that it is garbage and perhaps take a hopeful view of it.

However, we must recognize that when we have turned our plants into garbage, Mao hasn't. I think this is something about which we should all do some hard thinking.

Senator Cameron: Who hasn't?

Mr. Hynes: Mao of China. If you are going to have your ideology you are going to have to win on the production line. We have now turned our production equipment in many cases into garbage.

Senator Blois: Mr. Chairman, I have noticed, while listening to all of the gentlemen who have been speaking to-day, that they have said that there must be closer co-operation with government—and in that case I suppose it was intended to be all forms of government—in what is being done in research, tariffs, and other sorts of things such as co-operation with industry, large and small. I wonder if anybody has come up with how this can be done? I think it has been a matter facing government for quite a number of years, and yet we do not seem to be getting much closer to a solution.

We have listened to some able scientists, and we have heard their programs, and there is a pretty general feeling that they must have help. However, Mr. Chairman, I for one have not got down to just what we can give them by way of the help they require. Some say it is money, but others say, "It is not money, we need more co-operation".

I wondered if any of the gentlemen present have some suggestions as to a committee that might work more closely with the scientists. In that way perhaps eventually something will come out of this science policy committee. Apparently—and I say this in all fairness—every government needs help and support from industry.

Mr. Hynes: Mr. Chairman, I have here the statement of conclusions that was adopted at the meeting of the International Chamber of Commerce at Istanbul on the 7th of June. This arose out of a study made in the United States and which was debated by 48 nations. I was the chairman of the committee which drew the final conclusions, and put them through the plenary conference.

This statement may be of some assistance to you. There are some preliminaries, and then the conclusions of the special committee on trans-national corporations, and conclusion No. 4 is:

> International corporations are naturally concerned about the investment climate and potential earnings.

This is what Mr. Capon has said, and I think what the rest have said.

> Host countries that adopt measures affecting the operations of companies subject to their jurisdiction should appreciate that these measures invariably affect the investment climate of their countries, either adversely or favourably, and thus influence the rate of economic growth. The achievement of rising living standards will be facilitated by liberal laws, regulations and policies that affect business operations of foreign or national companies alike.

I think what we are concerned about here is that we have a tremendous number of restrictive laws that may have been appropriate to another time.

The Chairman: You are not interested in "conservative laws"?

Mr. Hynes: I do not think we are because we are living in a liberal economy. We are living without regard to the big "C's" and "L's". We must go forward by getting more people into the game. This is not a conservative tradition. You have to have a greater sense of participation by all the people in this. Canada is a conservative country with liberal ambitions.

That particular conclusion was advocated and spoken to very strongly by Peter Quinn, the head of Levers in the Hague. He was looking at it from the point of view of his experience over the years in all sorts of countries, and Lever's are looking to invest in areas in which this type of thing is developing.

I do not suggest what the anti-combines situation ought to be, but the one we have is certainly appropriate to achieving economies of scale. For instance, if Mr. Capon and I were to merge you would have us in court to-morrow.

Senator Belisle: Rightly or wrongly.

Mr. Hynes: Because you think bigness is badness.

The Chairman: Or if you speak on the telephone.

Mr. Capon: We do that.

Mr. Hynes: Canada is trying to play in a game, which is international competition, using the rules created by its competitors. If Canada is going to win it has to have some rules of its own.

The Chairman: Do not forget that if you have been separated it is not because of Canadian laws.

Mr. Hynes: Yes, that is right. To-day you have examples coming out in the Watkins Report. It was mentioned quite often at Istanbul that Canada is defeating itself by, for example, allowing itself 17 refrigerator companies whereas the country's requirements could all be produced in two efficient plants; that is two efficient plants could produce all the refrigerator requirements of Canada.

Going back to my pet peeve, Canada had the greatest demand of any country in the world for transportation after the 1914-18 war. We took over as a nation the Canadian National Railways.

The Chairman: We had to.

Mr. Hynes: Right. And we ran it on as cheap a basis as possible.

The Chairman: Of course it was a Conservative administration which did it.

Mr. Hynes: That is right. We put no research and development into transportation. We had great opportunities to test transportation under all sorts of climatic conditions and under many different ups and downs. We could have learned more about how to transport goods than anywhere else in the world. We could have sold our technology to the world. But we instructed the CNR to make sure that anybody who supplied the CNR did not make any money. We made sure that the railway equipment business went broke. And that is the Canadian mental attitude.

Senator Blois: That we cannot make money.

Mr. Hynes: Until you create the attitude of wanting to be successful instead of wanting to be a failure, you will go on being a failure.

Senator Kinnear: Mr. Chairman, that upsets me a bit. I do not think we are all that bad, being about the second richest country in the world. Something must have happened along the line in our development which allowed us to achieve that success. As I recall from my reading about business over quite a few years, CIL and DuPont are probably among the foremost successes in Canada.

Mr. Hynes: Our return on investments over the past 20 years—and this would even go back to before we were broken up—has not been anything like good enough. We have, unfortunately maybe, talked people into putting money into the company but they should have put it somewhere else. For the future it is even worse. The last investment we made of any consequence was in Sarnia a few years ago. It is losing money at the moment. We are not planning to spend any money now, and I think it is fair to say that the chemical industry is not disposed to spend any money right now. There is no incentive to spend any money.

Senator Carter: Do you not think you have brought a lot of these things on yourself? You complain now of our anti-combines laws and all the other restrictions there are, but do you not think you are partly to blame for it?

Mr. Hynes: In which way, sir?

Senator Carter: In many ways. I come from the Maritimes. We start in with a small enterprise down in the Maritimes somewhere. It employs probably 100 or 150 people, and it is profitable. Immediately it gets profitable down comes some big firm in the same line from Toronto, and buys it up and shuts it down.

Mr. Hynes: Have you some examples?

Senator Carter: And who wins? You see, the place where this little plant was situated does not win. The people who are laid off don't win. And the price of the product goes up.

Mr. Hynes: Well, what is happening now on an international basis is that Canada has become the Maritimes.

The Chairman: Senator Cameron has been wanting to ask a question for some time. I am afraid, Senator Carter, you will not get an answer here.

Senator Carter: I think there is another part of this story that should go on the record.

Mr. Hynes: I am sorry if you do not believe me. I think the problem we have had with the Maritimes right along has been again one of markets for a plant.

Senator Carter: No, there was no problem in the case of this little plant. It had its market, and it was employing its people, and it was making a profit for the people concerned. However, a larger plant in the same industry—and it could be canning apples or almost anything—comes down, sees this little profitable enterprise which is probably hurting them a bit, and buys it up. And immediately it is bought up it is shut down. You spoke earlier about price being related to scale. This economy of scale you are talking about does not come into play in this situation because the price of that product does not go down with the larger production up in Toronto or somewhere else. In fact, the price goes up. Everybody is worse off, to my mind.

Mr. Hynes: This is quite possible if you are going to consider the Maritimes versus Quebec as being the problem. If your larger market in Quebec justifies the plant, then it would be cheaper to put the Maritimes volume through the Quebec plant, and you would be able to compete with the man who is shipping the glassware in against Mr. Johns, for example. What you want to do is chase the American out of the Maritimes before he chases you out. And the only way you are going to do that is to get your costs down.

Your Maritimes plants in many cases are among the 17 that Professor Watkins, Dr. Deutsch and others have pointed out as being one of the Canadian problems of lack of productivity. Somebody is going to compete for the market. This is the price that is prevailing in that market. The question is who is going to get the business.

Senator Carter: What do you mean when you say it is lack of productivity? These people were competing. They were competing with Toronto. Their productivity must have been good.

Mr. Hynes: Let me put it the other way, if the plant had not been bought out it would have been put out of business by somebody else shipping in there and knocking it out that way. That is exactly what happened to Mr. Johns. The 100 million products of glass coming into Canada from the United States do not come in because Mr. Johns brings them in; they come in because he cannot sell to keep them out.

Senator Blois: Not all Maritime firms have been forced out, of course.

Mr. Hynes: That is right. We are running a plant in Halifax ourselves.

Senator Cameron: This session this afternoon is typical of the dilemma in which the Science Policy committee finds itself. Here we have Mr. Hynes and all the others submitting a number of excellent briefs—, and they are brief too, and I compliment the business people here on their brief briefs. However, in the briefs I have read there is a great deal of agreement. Mr. Capon, Mr. Hynes, Dr. Grace, and many others are all agreed that we should seek to achieve excellence. Everybody is for that. Everybody is also agreed that we should do only those things that we can do best.

Here we have a glass company, and I assume it is an excellent one. Yet it cannot compete. There is $100 million worth of glassware coming in. So here is a dilemma that our committee and Canadian industry are in. If we accept the principle that we should concentrate on doing the things we do best, then somebody has to say, 'All right, Johns Glass Company, you cannot compete, so you go out of business", or to Joe Doaks over here who making something else, "You cannot compete, so you go out of business."

Consider the rubber people. I have listened to the boys up at Kitchener, trying to stop the Chinese footwear coming in from Hong Kong, saying they cannot compete. We have had the electrical industry which says that 85 per cent of the components of our radios and so on are imported, and we are not giving employment to Canadians. This seems to be the Canadian dilemma. It is also a dilemma that the Science Policy committee is in.

Are we to say in a recommendation to the government of Canada that some body which the government will set up—some minister possibly—is going to have to say, "All right, out you go"? You cannot do that in a democracy.

Not one of you gentlemen—and I have the greatest respect for all of you—has suggested how we can rationalize this policy without being ruthless dictators. None of you has suggested how we do it. That is what we are supposed to find out.

Mr. Richards: We have said that we are quite willing to compete anywhere if we have the same access to other markets that they have to ours.

Senator Cameron: But you cannot, because they will not give it to you.

Mr. Richards: You are right.

Senator Cameron: So, being realistic, practical businessmen, what do you do?

Mr. Hynes: I agree that this in one of our great problems. About 10 years ago I asked Mr. E. P. Taylor to come down and speak to the annual meeting of the Canadian Chamber of Commerce in Halifax. He spent about six months researching what he was going to say, and then came to the conclusion he was not coming. Maybe that is why he is living in Nassau.

The Chairman: After having closed quite a number of beer outlets in Ontario.

Mr. Hynes: I have been thinking about that more and more recently because the more I contemplate some of the information coming to us now the more I get, shall I say, unduly pessimistic. At the same time I feel sure that a lot of us are here for the reasons that have already been given, because we do not want to move to Buffalo. However, we have a strong feeling that Canadian governmental efforts are endeavouring to make us move to Buffalo.

At the meeting of the International Chamber of Commerce last week there was a great deal of discussion on money and the need for a better means of international settlements, and what has to be done to control inflation. If it can be summed up, I think it would be on the basis that pretty well every country except Germany has been living beyond its means domestically and has been exporting its domestic lack of balance in its budget by trying to borrow to pay this deficit, and everybody borrowing leads to an inflationary situation because you start governments making what becomes virtually mythical money.

Back in the days when Mr. Diefenbaker was the Prime Minister, if I may say so, I went to Germany and visited with the Canadian ambassador and his staff there, and I came back with a certain book which I have brought along with me to-day. The foreword to that book is rather interesting. It was written in 1961 by Mr. Adenauer. It points out the great problems that Germany had in 1945 and what they did about it.

Senator Cameron: This is not Dr. Schatz' book?

Mr. Hynes: No, it is an official government book. He is here talking about property-owning policy which he says is the distinctive thing about the private enterprise system, being dedicated to that as opposed to the sort of controls you are talking about or government dictation.

> The federal government in its declaration of policy of October, 1957, allotted the wide dispersal of property the foremost place in its program setting forth social policy. Many measures have been taken which facilitate and make possible the formation of private assets to above all those persons with a small or moderate income. Emphasis was placed, on the one hand, on the capacity of those with small incomes to save and, on the other hand, incentives to save to cover the direct subsidizing of the saving capacity of the individual saver. They reduced the income and wage taxes so that it was possible to increase the net incomes and thereby stimulate the capacity to save.

They went on to enable one to put against his income tax payments the amount paid to acquire a house, if he were setting up a family, and to acquire his furniture. We, on the other hand, gave a $500 grant to the contractor who built the house, or something of that sort. They gave special tax relief. They had an act as early as 1948 whereby savings accounts were encouraged by relief from taxation, so if you increased your savings in the bank you got relief from taxation. This tax relief ended with effect in December, 1958, and on May 5th, 1959, a savings premium act entered into force as a new form of encouraging savings. This gave the small savers particularly incentives to accumulate assets.

They then recognized that they had to watch their union problems, so they encourage the employee to buy shares, but so that he would not buy just into his own company they formed mutual funds which had to own shares in twenty companies. He paid his income tax by buying into the industry of Germany.

It is interesting to think now that in 1969 the one thing that everybody is trying to do to get out of their problems is to make the one man who has managed their domestic affairs stop doing it because he is too damned good. He has the only hard currency in the world. And why? Because there has been encouraged this broad ownership of the country by the people.

What is the situation with us? We are taking the money away from the corporations. If we are successful in one of these industrial operations the government takes 52 per cent, and the corporation gets 48 per cent. In the case of my personal income I get less than half of it. There is no incentive for me to produce very much for this country.

The Chairman: And still you work very hard.

Mr. Hynes: That is right. I'm crazy.

The Chairman: You are not the only one.

Mr. Hynes: This needs a lot of deep thought.

Senator Cameron: You fellows should suggest something.

Mr. Hynes: I have. I wrote to Senator McCutcheon and sent him that book when he was Minister of Trade and Commerce but he would not even read it.

Senator Cameron: I think he did.

Mr. Hynes: No, he didn't. I will show you the correspondence. If I could get this book in the Canadian Embassy in Bonn I am sure you can get it in the Department of Finance.

The Chairman: I am sure that some of our committee members will read it now after what you have said.

Mr. Hynes: There is probably a new edition out. However, this is a pretty strong book.

Senator Carter: Where did you get Chairman Mao's book? I thought his thoughts were in little red books.

Mr. Hynes: They are. One of the great things industry must know is what is the competition up to.

Mr. Capon: Mr. Chairman, I think there is something we should say in reply to the very legitimate complaint of some of the senators who say, "You come here with a dilemma and you give us no answer." That is quite right. We do have a dilemma. We in the chemical industry have been working for some time now with the government through the Department of Industry, Trade and Commerce on an agreement first of all, on what the dilemma is. Up to now all that industry has said is, "All we need is higher tariffs and lower taxes, and we can go to town", and all that Government has said is, "We have other priorities and problems and what you are going to get is higher taxes and lower tariffs". So we have been pulled apart up to now. However, at this point in the history of Canadian development we all recognize, in both government and industry, that we do have a dilemma and if we are going to move forward it can only be on the basis of successful technologically based industry.

What will make that succeed? The first thing we recognize is that in the past we did succeed, our industries developed very well, partly because our cost structure was helped by a 25 per cent differential in wage rates. And wage rates are most of our cost. So, as I say, we did have a 25 per cent differential in wage rates and we did have a high rate of duty.

In addition to that, and this is what Mr. Hynes, I believe, has been trying to say, Canada raised its living standard very rapidly after the war by selling off its resources, by living on its capital, by selling its corporations to foreign shareholders and then complaining that we had too much foreign ownership of Canadian business. We raised our living standards by living off our seed corn. But you can only do that for so long.

The Chairman: You mean taking the windfall.

Mr. Capon: Taking the windfall, yes. Now we face this dilemma. We cannot come to you with pat answers because if there were pat answers they would be in front of you.

We have a problem of scale. In our industry, for example, we believe we do the best job in the world in making nylon. We may be swell-headed about it but that is the way we think. Nevertheless with full efficiency and with all the technology available on nylon, we have unit costs that indicate that our costs per pound of nylon are considerably higher than the costs in any other country because we cannot run one type of nylon day in and day out on one machine and keep taking that machine down and changing the type. These things are real and they do affect the costs. The scale is a big factor.

We say, "Well, we can overcome the problem of scale if we have one nylon plant, so we will get together." Then you say, "Well, the combines laws will not allow you to get together." The Canadian government might say, "We will change the combines laws," but then we will have to turn around and say, "That is really not going to help because it is the United States anti-combines laws that do not permit us to get together."

There are very real problems. We realize there are problems. I wish we had the answers. It is only our hope that we will in fact succeed in a new effort in working with government. In our industry we are doing this now. It is a new kind of endeavour. We have joint committees that are functioning. We believe that out of these joint committees and free discussions, will come constructive suggestions for solutions. We have to have these solutions, or this country is going to be in a mess.

The Chairman: In the matter of government incentive programs, and we have a whole series of them, apparently very few of them are effective or attractive to industry. Would you favour some kind of co-ordinating agency being in charge of all those programs so that you would be in a position to deal with only one agency, and be in a position also to make better representations to that agency so as to improve the programs?

Mr. Capon: I think only, Mr. Chairman, if the creation of such an agency results in the elimination of a greater volume of other agencies. We are in favour of greater co-ordination. We think it is absolutely essential.

Mr. Hynes: I have been worrying about this since joining the Science Council because there was quite a discussion on the relative merits of having a department of science. The OECD experience does not appear to have been a good idea. However, having visited the Atomic Energy labs, the University of Manitoba, and the fisheries labs out in British Columbia, I find that we seem to have people locked into very watertight compartments in our scientific endeavours.

The Chairman: Are you not doing that in industry too?

Mr. Hynes: What I am trying to point out is that we run something like 35 separate businesses. In fact, we have been trying to create more of them where we can, because we really feel that running a plastics business in Winnipeg has not much relationship to running a plastics business in Halifax or Vancouver. They are local in their own way. Whereas we used not to do it that way, we are trying to do it that way now.

No matter how you do this you have need for very high technical competence, and in "technical competence" I include accountants, tax experts, lawyers, chemists, and physicists.

This is equally true of the Canadian Government. You have the department of fisheries, the department of agriculture, the department of mines and resources, and so on. You have people who are spending their whole careers in these areas. However, there is no place to which you can go and say, "Who is the top engineer in Canada?", or, "Who is the top physicist in Canada?". Nor do these top men necessarily have anything to do with the quality of engineering, or physics, or anything else in the whole Canadian economy.

The efficiency with which the taxpayer's dollar is spent in the area of technology, I think, is a great question, certainly in my mind. I am beginning to wonder whether it would not be a case for a minister of technology who, as Peter Drucker says, would have on his staff some experts with a long queue at the door. There should be very few, but with a long queue at the door. They should be seriously concerned that Canada is doing its chemistry as well as the Russians, the Chinese or the Japanese, whether it is in the lab in Halifax or out in Nanaimo. They should be seriously concerned that we are aware of what is going on before it becomes a situation of its being done for us. We should have this person as a very senior cabinet minister, I think, because he should participate very closely in the program of planning the nation's objectives.

Your difficulty, as I understand it, from a political point of view, is that this man must have a small staff but of very high quality. He would not have a very big budget. Therefore, while his contribution in terms of brain power might be large, his responsibility for spending the taxpayers's money might be very small, and therefore this would not be regarded as an important assignment. We do not honour the brain in this country; we honour the manpower. I think that is something we should really worry about. It is bothering me more than anything.

Senator Cameron: Would you be in favour of a minister of technology?

Mr. Hynes: I think so.

Senator Cameron: Or a minister of science?

Mr. Hynes: I am beginning to think that that would be the thing to do. He would not take over the scientific work of everybody, but would be like the Auditor-General on the spending of money. He would be the critic on behalf of the people, saying whether they are getting their money's worth in the science-oriented departments.

The Chairman: You are really thinking about a minister who would be in charge of what we call science and technological affairs or policy?

Mr. Hynes: I would call it technology rather than science. Science to me is an approach. In other words, science is looking for facts, checking that they are facts, and facing the facts. Technology is a body of facts which can be applied in various ways.

The Chairman: I think we have another comment from Dr. Hoerig.

Dr. Hoerig: I support the views that Mr. Hynes has expressed. I think what we have to face up to in this dilemma we have been talking about is that this country is undergoing, and is in the midst of, a very serious transition which is brought about by technological change. It is really fantastic when you look at it from a scientific point of view that, for example, the tariff policy of this country originated back in a day when we were an agricultural country primarily. Therefore when you look at the modern day products you find that these people in government are beginning to negotiate from a base which has no sense of reality at all with regard to modern technical products opposite countries whose tariff duties have been based on a long history of industrialization.

It seems to me that one of the needs for a science co-ordinator is to bring about in government a recognition that some of the old principles that we have adhered to for so many years are no longer viable and really do not have anything to do with the 20th century. In other words, we have to be willing to scrap some concepts that have been very good for this country over a period of many years and recognize that the whole material science, production and industrial development of the 21st century we are going to be entering is a different cup of tea.

For example, we have historically had a great interest, let us say, in the paper industry. I can tell you right now, if you look at it from a scientific point of view and if you consider the fact that paper is only a collection of carbon atoms, that the cost of carbon atoms from cellulose is to-morrow going to be a lot higher than the cost of carbon atoms from oil. Our company, for example, has worked very intensively on developing products that are based on synthesis from oil, and which are replacing paper.

If we have an outlook in this country that we are going to think in terms of rear-view driving in connection with the industries we have to-day and not set up our structures in terms of the requirements of to-morrow, we are just going to find that this dilemma is not going to be solved.

The Chairman: I wish Mr. Fowler were still with us.

Dr. Hoerig: I wish he were too.

The Chairman: He was with us last Friday. My last question is one that we have put to our professional associations. I am sure that Dr. Grace will recall this, and I am glad that he has already taken action to try to fill this vacuum. I wish him success in this new endeavour. However, we put the question last Friday to a number of people representing industries, saying:

You have not consulted with each other before coming into this committee but there has been a great area of agreement in your representations before the committee. Would it not be something new and something quite desirable if within the industrial sector there were some kind of umbrella which would enable the industrial community interested in research and development to be able to meet together, to try to reach a consensus, and, once a consensus has been reached, to meet with the proper government authorities, to make the necessary representations more effective?

We were told last Friday—and it was surprising to me—that this would probably be quite impossible.

Mr. Hynes: It is not impossible because arising out of the discussions we had here in 1961 or 1962 on productivity you will remember that for some time an endeavour was made to find out who was going to speak for management. Dr. Hoerig, Mr. Capon and I have been involved in this for quite some time, and we have now succeeded in establishing in the province of Quebec the CPQ under the chairmanship of Charles Perreault, and this is an association of associations to do just exactly what you have described. So that it is possible. What we have to do is now work with it and hope that it rolls, that it will be a meaningful way of bringing about a co-ordination of effort and comparable discussions with government.

In an effort to be helpful, the last paragraph from this Istanbul statement is very much along that line.

The Chairman: We should have been there.

Mr. Hynes: It says:

> International corporations and governments both have legitimate preoccupations which must be reconciled. The International Chamber of Commerce believes that mutual understanding and agreement on specific issues affecting the relationship between international corporations and governments provides the best basis for economic collaboration. It intends to give continuing consideration to possible formulation of agreed principles governing the conduct of both international corporations and governments.

I might say, as part of the Canadian content in this, that you will remember that Mr. Winters made a statement of the ways in which an international corporation might operate. We picked these up in the Canadian Chamber of Commerce, and we worked with them in the United States Chamber of Commerce. We got an agreement with the United States Chamber of Commerce. These have been filed with the International Chamber of Commerce, and they were reasonably well accepted.

So I think one of the first things we must recognize is that we are all going to have to work much closer together than we did in the past. It is not a case of industry and government being against each other. We have to get together. This is essential.

The Chairman: And the universities.

Mr. Hynes: I quite agree that the universities have to be there too. When Dr. Hoerig stood up I was reminded of something. We were downstairs here when Dr. Hoerig was the spokesman for the chamber of commerce and Mr. Gordon was the minister of finance, and we were complaining about the application of the 11 per cent sales tax on construction materials for plants. It already cost more to build a plant in Edmonton than it cost to build it in Houston, Texas, and the same raw materials were being used to produce the same product. And then to add 11 per cent more to it was not a very sensible thing.

Mr. Gordon's justification for doing it was that he had to balance the budget and this was the next best place to get it. This is why you never balance the budget. You have killed the goose. We came and talked to him but that is no answer. The answer is to look at the expenditures the government is making today, and chop off some that have been there since 1900 and are no longer valid.

The Chairman: Dr. Grace?

Dr. Grace: I would like to review some of these things. First of all, about six years ago we did start the Canadian Research Management Association. It was started with predominant membership from industry. Because there was this gap in communication with research managers in universities and in government we organized the Canadian Research Management Association with about 60 per cent from industry, and a sampling from universities, with substantial graduate schools, and a sampling from government. That has been a very useful nonlobby organization. The research managers across Canada, and several of them are here today, have got to know each other.

The problem we started to run into a little more than a year ago was that we felt the need to try to speak with one voice. But we recognized that the Canadian Research Management Association had this mixed membership, and so last November we had a meeting for the first time of research managers from across Canada at Sheridan Park. We had representatives from Ottawa who presented, on the first morning, various points of view from the Science Council, the Science Secretariat, the Department of Industry and the National Research Council, and out of all that we have continued an informal organization.

We are not quite sure how we are going to rationalize it with the Canadian Research Management Association. We do not want to fragment, but we do feel the need to continue.

We have had dialogues on several occasions with representative study committees from the Department of Industry and Commerce, with representatives from the Treasury Board, and from the National Research Council. I think we had some airing of views. And we put our views about the incentive schemes forward pretty clearly. I cannot tell you that they have been accepted, which is a sad thing.

That leads me again to this point of more communication and more movement. I think that some of us during the war, for instance, were loaned for various periods. We occupied two or more jobs, one of them perhaps in industry and one in government, and we knew what was going on. I think more planned movement of people from the civil service to industry and vice versa, including the universities, would go a long way to help each group realize that the other group is not—well, there is a lady present so I am not able ot use the word that usually applies.

Senator Kinnear: I won't listen.

Dr. Grace: Well, each group would realize that the other is not an oddball, and we should not be going around saying things about each other. So I would strongly recommend a deliberate plan, a deliberate attempt, to appoint task forces, make temporary appointments...

The Chairman: Greater mobility.

Dr. Grace: Greater mobility without anarchy.

Mr. Hynes: This is a responsibility I would give to your minister of technology in this whole area.

Senator Cameron: I think, Mr. Chairman, that Dr. Grace has put his finger on the nub of this whole problem. We recognize the increased productivity occurring in the United States as opposed to ours. If you examine their situation, you see that one of the characteristics of the American scheme is the greater movement between industry and government, back and forth, like Bob McNamara's going from Ford into the government. There are dozens of other examples. As a result, there is a closer understanding, and a closer communication. It is the same with universities.

In these briefs there is the suggestion that there should be more of an interchange between universities and industries. I have been repeating that now for 20 years. Until recently, however, university salaries were not set to attract top people. It is not quite so bad today. If a university went to CIL, or some other group, and said, "Look, we want John Smith, who is one of your top scientists, for two years. Would you second him to us?" and there is a salary differential, that industry might be well repaid by setting up a fund to bridge that gap. Such an investment could be the best that industry made.

The Chairman: There would have to be pension arrangements too.

Senator Cameron: Yes.

Mr. Hynes: There is a point here about which I have already had some discussions. Senator Leonard knows about this. We have been approached, as has Du Pont and others, by all universities across the country for money for some time. And we have given it, and given it in substantial amounts. Recently, I have been increasingly coming to the view that we have been acting like the parent who gives a teenager money but does not get involved in his activities. Therefore I have tried to decide that we will not give to bricks and mortar in universities, but that we would rather like to get into the action with them, in much the same way as you are describing.

We have a very good lab run by Dr. Segall outside of Montreal. I have suggested to Roger Gaudry that he might appoint Dr. Segall as an associate professor at the University of Montreal, and they might give some of their graduate students credit for working at our lab. I am quite sure that at our lab they will get a better education than they will at his. They will get a different kind. We have a regular League of Nations there. So far the universities have not come around to this.

The last one was the University of Windsor. They were in to see me about this. The same is true of the University of Alberta. I was told that Dr. Johns was reasonably receptive to the idea. My statement to them was, "I will get involved with you on a project but I will not give you any money." I said the same thing when I was approached by the University of Windsor. The Province of Ontario requires the University of Windsor to raise 10 per cent from me. My refusal to contribute the 10 per cent stops them getting involved in this.

If you want to make a recommendation I think you had better get into that area. This is where government, by its own regulations, is preventing involvement between universities and industry. I have not been able to get one university to pick me up on this thing.

Senator Belisle: May I take note of that?

Mr. Hynes: I have given money to all of them, and I now give no more money but I will be glad to exchange professors or send people to them or give lectures. We have qualified accountants, engineers, chemists, and so on. We will take people in and let them work with us.

Dr. Hoerig: Mr. Chairman, your committee might be interested in an initiative our company has taken to try to improve the relationship between the scientists operating in government and those in our company in that we appointed several years ago Mr. Raeder, who is sitting here, as director of technical services to government. His function is to be here in Ottawa. This is not a lobby operation. He maintains a very close contact with the various agencies of the government who maintain technical services and tries to determine, by maintaining this contact on a full-time assignment, areas in which our people may have a common interest with government people.

As a consequence of these relationships we bring together scientific people, who are working in areas of interest with us, with government people who are working in similar areas. This, we hope, with perhaps enlightened selfishness will result in our working in the right direction to help to meet some of the needs of government. At the same time it produces that personal contact between scientists, something that I think is essential. I am not talking about the global top level; it is the working level. This is working out extremely successfully now.

I think we need the initiative now from government on the other side. For example, we wanted to use a consultant from the National Research Council. We learned this past May that a National Research Council scientist is not permitted to do a consulting job with outside industry. I think the NRC is trying to work this out. I think the way they are going to do it is that he is going to go on leave of absence for one day, and consult with us. I think that is very ingenious.

The Chairman: Or he might even do it during a weekend.

Dr. Hoerig: The thing that impresses me is that in this field the government has really set up some very strong barriers, just as they have with these grant programs. The grants, as Mr. Hynes pointed out, are given and taken back. It is that sort of deal.

While I would not want to give too much credit for the way things are done down in the United States, they, at least from the standpoint of their grants to industry, do not tie them up with a lot of restrictions. What they do, however, is to make sure that industry utilizes the results of research work, let us say, for foreign purposes, and the income tax people take a look at it and make sure that that company has received a just and due reward.

It seems to me that that kind of *modus operandi* is the sort of thing we are looking for in the grants program of this country. They ought to give the freedom to research that research has to have, and then the income tax department may be allowed to look at it to determine that the rules of the game are being obeyed from the standpoint of Canada's getting fair value, if this is licensed or given away.

The Chairman: It is already past 6.00 o'clock. We could go on, of course, during the evening, but the members of the committee have to come back at 8.00 o'clock for a sitting of the Senate.

Gentlemen, before we adjourn this afternoon I want to thank you very much indeed for being with us. We hope that our conversations will be a continuing thing. This has been our first frank discussion. We hope it will not be the last one.

Mr. Hynes: Thank you very much for the opportunity of being here. I made a speech to the Association of Canadian Advertisers last month on the impact of our changing society on business, which has been printed.

The Chairman: Is that something you would like to distribute now?

Mr. Hynes: Yes.

The committee adjourned.

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BRIEF TO THE SENATE SPECIAL COMMITTEE ON

SCIENCE POLICY

SUBMITTED BY

DU PONT OF CANADA LIMITED

MONTREAL, QUEBEC.

18TH MARCH, 1969

DU PONT OF CANADA LIMITED

BRIEF TO THE SENATE SPECIAL COMMITTEE ON SCIENCE POLICY

SUMMARY

(a) The application of advanced technology to economic and social goals is essential to achieving higher living standards, and the link between science and the generation of wealth is industrial productivity.

(b) Foreign ownership of itself does not limit the development of indigenous science and innovation. Canada's highest productivity industries not only have access to massive foreign research programs but also engage large numbers of highly qualified scientists and technically trained people in Canada in order to use and develop technology.

(c) The scale of industrial research programs in Canada is directly related to market opportunities and the general industrial climate. The Canadian chemical industry faces disadvantages of scale, rapidly rising wage rates, taxes and other costs, and reduced tariff protection. The paramount contribution to be made by government is the provision of a framework of fiscal, monetary and trade policies which will enable the most productive manufacturing industries to prosper.

(d) Incentive programs for industrial research are essential if our industry is to succeed in the face of competitive disadvantages. These programs should contemplate the free flow of technical information across our borders in all directions, under normal commercial conditions. Tax law and administration may be used effectively to ensure that "arms-length" consideration is obtained for transfers of knowledge.

(e) The capital grants provided by the I.R.D.I.A. have been effective, but the formula for grants for operating expenditures should be revised to make these incentives of much greater value to those parts of industry which are already research intensive.

(f) It should be an important aim to reduce to a minimum the administrative and book-keeping requirements associated with incentive programs. Elaborate requirements diffuse the effort of highly trained people into non-productive paper work. In addition, flexibility of assignment of people to programs is a necessity if research programs are truly to be related to changing needs.

(g) Tax free initial periods of operation are a powerful tool. Extension of this incentive to Canada's most productive industries would undoubtedly accelerate industrial growth.

(h) We regard the Science Council's proposals for major "mission-oriented" programs related to national goals as constructive. We would welcome an attempt by government to involve Canada's industrial research organizations in these programs on a contractual or other basis.

(i) The healthy growth of highly productive industry does not depend solely on science policy, which is one of several means to the end of national prosperity. Trade, taxation and monetary policies are at least as important in generating the climate which is required.

BRIEF

1. Du Pont of Canada welcomes the opportunity to place before your committee its views on certain aspects of science policy. These views, as you are aware, are those of a Canadian company engaged in the chemical industry, an industry which is heavily "science-based". In common with many other firms in this industry, we are a subsidiary of a United States parent company. Heavy reliance on science and technology is not unique to the chemical industry, but the industry does exhibit certain features which must, we believe, be considered in determining optimal policies to foster innovation.

2. If a nation is to retain its independence and achieve satisfactory living standards for its people, it must control its economy and exploit its resources so as to generate the greatest possible amount of new wealth. The phenomenal rate of technology development in the world makes possible the creation of new wealth much faster than ever before, but only if the nation has access to the newest technology and also has the capability to employ it. Those nations which lack either the educational capability or financial capacity to employ this technology are rapidly falling behind in the drive for prosperity, while those which can keep up to date are achieving new records each year in national incomes. Thus technology, whether developed domestically or imported, is the key to the nation's material welfare.

3. It is gratifying to note the growing volume of public discussion of the place and importance of science and technology in achieving national goals. The work of the Science Council of Canada, in particular, has made a major contribution to more complete understanding of the complex phenomena of research, development and innovation, and the inter-relationships of these in contributing to economic and social progress. The Science

Council has identified a series of national goals, both social and economic. The first of these, "national prosperity", is primarily economic, and provides a highly relevant framework for presentation of our views as a part of Canadian manufacturing industry. "National prosperity" is an abbreviation for the series of goals postulated by the Economic Council of Canada in its First Annual Review as:

- a high rate of economic growth
- full employment
- a reasonable stability of prices
- a viable balance of payments, and
- an equitable distribution of rising incomes

4. The first goal, rapid economic growth, is probably the most important, because it creates a climate conducive to optimum employment of resources. Economic growth in turn, depends to a large degree on the success of high-productivity industries and again, as the Science Council points out, the particular contribution of science to achievement of national goals is through increased industrial productivity.

5. Canada's high-productivity industries tend to be capital intensive, technology-oriented, and they require and generate considerable research effort. If Canadian industries are ranked according to their outlays for scientific activities, the top three - electrical products, aircraft and parts, and chemicals and chemical products, account for nearly 60% of research and development expenditures in the manufacturing sector. If expenditures by manufacturers of paper and petroleum products are also included, this proportion rises to 75%. These industries are among the fastest growing and most dynamic. They account for a growing volume of exports and they employ large numbers of scientifically and technically trained people.

It has often been pointed out that Canada has many subsidiaries of foreign companies which, like Du Pont of Canada, have been able to import a great amount of technology. It is interesting to note that in the high productivity industries the proportion of foreign ownership is generally high. It is not correct to regard foreign ownership as a factor which limits or restrains the development of indigenous science and innovation. For example, Du Pont of Canada has access to its parent Company's technology and to the results of the parent's research programs which are conducted at an expenditure level of approximately $180 million a year. The nature of technological industry, however, is such that the results of research done by others can only be used to advantage if the using company itself engages in comprehensive programs of its own. This is so because technology can be employed effectively only by technically-qualified people. To put scientists to work to re-invent what has already been invented elsewhere is a waste of time and money, since it is always cheaper to purchase what already exists. But once acquired, it must be effectively employed and constantly improved. Technology continues to change; processes must not only be kept up to date but we must do all in our power to achieve innovations which will give us competitive advantages. Thus Du Pont of Canada maintains substantial research facilities staffed with highly trained scientists even though we rely extensively upon acquiring technology from our U.S. parent company.

7. Earlier in your hearings on Canadian science policy, Dr. Schneider of the National Research Council and Senator Lang of your Committee discussed this question of externally acquired research. Senator Lang asked whether or not it was true that the purchase of information by a firm or country could play a more important part in technological advance than the firm's or country's own research and development. Dr. Schneider rightly pointed out that industrial strength requires a strong indigenous science, and

that an advanced country cannot depend only on imported technology. Both these observations are correct, but should in our view be carried one step further. Professor Raymond Vernon in his review of the O.E.C.D. report on technological gaps (O.E.C.D. Observer - April 1968) remarks that "the industrial effectiveness of nations depends much more upon their capacity to draw upon the existing body of basic scientific knowledge, wherever it may have been generated, than upon their capacity to contribute to that body of knowledge". The point is that the capacity to draw upon existing knowledge demands that an industrial organization maintain competent research activities. It is not a question of either imported technology or indigenous effort, but of the desirability of both. In spite of the vast technological efforts of its parent, to which it has access, Du Pont of Canada has found it necessary to operate three major research laboratories, in addition to smaller laboratories located at its plants, expending approximately 4.2% of sales on research and development activities.

8. A second important point made by Professor Vernon, based on the O.E.C.D. studies, is that industrial innovation depends critically on the innovator's perception of his market opportunities. The magnitude of this Company's research and development programs is a direct reflection of the commercial opportunities which we can uncover within the framework of Canada's cost and market environment and opportunities for export business. While incentive programs have a part to play, no incentive can compare with the existence of a large and accessible market. In the long run Canada can only support a significant technological effort if its products are competitive.

9. The costs of research in the Canadian chemical industry must be weighed against possible future earnings in a limited domestic market, and must take account of periods extending up to five or seven years between the date an innovation reaches a commercial state and the time when it becomes a profitable operation.

Limitations of scale in Canada result in relatively higher costs of manufacture than, for example, in the U.S.A.

10. What, then of the possibilities for export? World tariff rates for chemicals and chemical derivatives are generally higher than Canadian rates. Chemical products are manufactured in many parts of the world. Patent positions frequently restrict market access for Canadian exports. In addition, the global chemical industry consists mainly of major chemical companies with subsidiaries in many countries. Canadian subsidiaries, from a practical and economic point of view, can expect to supply only those foreign markets which are economically accessible or those for which the Canadian manufacturer has unique competitive advantages. These are environmental facts of life which must be recognized in the development of programs to encourage chemical industry research in this country.

11. In recent years the chemical industry in Canada has not progressed as fast as in other countries. The rate of increase in chemical production since 1958 has fallen well below that in other industrially advanced nations. Indeed, the rate of increase in Canada's index of chemical production has been three-quarters of that in the United States, one-half of that in Europe, and one-third of that in Japan. This has not been due to slower growth in Canadian markets. Domestic consumption of chemicals has grown more rapidly than in the United States, although not as rapidly as in continental Europe.

12. The main reason for the failure of the Canadian chemical industry to keep pace with growing domestic demand is the combination of disadvantages of scale, rapidly-rising wage rates, taxes and other costs, and reduced tariff protection. The result is a continuing expansion of imports and, in 1968, domestic manufacture supplied 75% of Canadian consumption, while 25% was met by imports. This deficit trade balance in chemicals, which was approximately

$286 million in 1968, could well reach $1.5 billion in 1975, given the increased access provided foreign producers to Canadian markets by the Kennedy Round negotiations.

13. We have dwelt on these broader aspects at some length because we believe that government programs to encourage fruitful research and development in Canadian industry cannot be considered in isolation from the total industrial climate. The first and foremost contribution to be made by government is the provision of the essential framework of fiscal, monetary and commercial policies which will enable the most productive manufacturing industries to prosper.

14. Canada borders the largest and most sophisticated market in the world - the U.S.A. Because of our proximity to that country our people inevitably develop tastes for U.S. products and U.S. living standards, and they are at the same time constantly aware of U.S. prices and incomes. The best of foreign technology must be used to produce what our people want and therefore technical information must flow easily across our borders in both directions. Since Canada must import much of the scientific and technical information which will be used here, research and development activity in this country must therefore be supported so as to place Canada in a favorable bargaining position in the world-wide information market.

15. Because of the parent-subsidiary relationships which are very common among the most technologically advanced of Canadian manufacturing companies and in particular, because of the realities of the world chemical industry structure of patents and licensing arrangements, a nationalistic approach to research incentives is impractical. This should not be surprising to governments which in the recent past have devoted tremendous effort to opening up the channels of international trade by reducing the barriers to movement of goods. Neither, indeed, does it imply that the results

of research undertaken in Canada need be "given away", without consideration, to other countries where larger markets, higher tariffs, lower wage rates or other factors make production more economic.

16. The incentives provided by the Industrial Research and Development Incentives Act are conditional upon the work involved being considered by the Minister likely to benefit Canada. It is essential that the government interpret as broadly as possible the "benefits" flowing from research undertaken in this country, without necessarily restricting these grants to innovations ultimately manufactured and marketed in Canada.

17. Research results are a highly marketable commodity in world trade, and the broadest view of "benefit to Canada" would reflect this fact. In Canada research grants are made chiefly under I.R.D.I.A. and the Program for the Advancement of Industrial Technology (P.A.I.T.), which limit the manner in which results can be exploited because of unduly nationalistic regulations. A much less restrictive approach would result from reliance on the provisions of the Income Tax Act to ensure that a Canadian taxpayer obtains maximum value from exploitation of research results in world markets. The administration of United States research incentives provides industry with considerable flexibility, because it relies on tax law and administration to protect national interests, and leaves industry free to exploit, on a world-wide basis, the results of all research, including that conducted under government auspices. We suggest that general incentive programs should create an environment in which fruitful work will be done, and provide maximum flexibility for total exploitation of research by industry, leaving to taxation authorities the determination of whether or not a fair price has been paid by the recipient to the originator.

18. The grants for capital expenditures provided by the I.R.D.I.A., with the associated tax relief on such expenditures, have been a constructive factor resulting in decisions to expand this Company's research investment base. We believe this provision should continue.

19. The grants provided for current or operating research expenditures, however, are based on incremental growth, and are of limited incentive value for companies already established in the research field. We continue to be at a cost disadvantage in relation to foreign corporations which can absorb research costs in larger scale operations than those in Canada, and which, in many instances outside North America, operate with lower professional, labour, material and tax costs. We estimate that a grant level of approximately 15% as a percentage of total current research expenditure is the minimum required to provide an improved research cost/opportunity relationship under Canadian conditions. Such a level would materially stimulate Du Pont of Canada research and we would recommend consideration be given to adopting this approach in place of the present 25% grant based on incremental growth. This modification in approach would have the further value of providing research planners in industry with a known grant value to be considered in the development of specific programs. In a large research organization where many programs are underway during any period, programs which may take years to complete, this is not now possible because of the incremental and "moving base" provisions of the present grant schedule.

20. We believe it would be a retrograde step if modification of the Act results in any further complication of administration thereby placing increasing burden on both government and industry in discharging audit requirements. Because of the nature of the information demanded to support claims or to audit them, highly-trained scientists are required to devote absurd amounts of time developing information for government forms. Such activities are

a terrible waste for a country whose cost structures are already excessively high, and whose most productive people should devote their total energies to those tasks for which they have been painstakingly trained. Much less rigidity in defining scope and assignment of personnel is also desirable in agreements under the Program for the Advancement of Industrial Technology to permit greater flexibility and freedom of action by industry operating under these agreements.

21. Because of the country's open tariff policy combined with small domestic markets, new ventures resulting from chemical research in Canada are generally subject to large earnings losses for a period of five to seven years following commercial introduction. Certain industries have succeeded in convincing government that they should be encouraged to expand through the incentive of tax-free initial periods of operation. It seems obvious that if such an incentive is in fact effective, it should be extended to all productive industries. In fact the recommendations of the Carter Commission, which would have the effect of virtually eliminating the corporation income tax, would probably do more to foster rapid industrial growth in Canada than would any other incentive.

22. This Company, in common with other members of the chemical industry, has been unable to negotiate P.A.I.T. agreements with the government because of the restrictive provisions concerning the disposition of technical information and patent rights if the work is not brought to commercial completion. In general, new chemical research utilizes technology which is inter-related with existing technology and which, in many instances, is of a highly confidential proprietary nature. Thus, under circumstances of abandonment, the requirement to dispose of the total information applying to a new venture to a possible competitor is onerous and unacceptable. We are in accord with the views expressed by the Canadian Chemical Producers Association in their brief submitted

to you and dated November, 1968 recommending that the regulations of P.A.I.T. be reviewed to conform with those applying to the Industrial Research and Development Incentives Act, modified as suggested in this paper.

23. We note the absence of arbitrary restrictive provisions in the Industrial Research Assistance Program of the National Research Council, in contrast to the I.R.D.I.A. and P.A.I.T. legislation. The permissive application of judgment by the Industrial Research Assistance Committee of National Research Council in evaluating grant applications appears to permit more realistic administration of the program with regard to commercial objectives of importance to Canada than is possible under the more rigid framework of I.R.D.I.A. or P.A.I.T. The scale of this program of course seriously limits its impact on the nation's industrial research environment. Du Pont of Canada has thus far made no application to the Industrial Research Assistance Committee for this type of grant. However, we expect during the current year to submit several proposals relative to longer term objectives which would otherwise not be undertaken because of the cost/opportunity relationships of the projects. In our opinion, consideration should be given to increasing the scope of this grant program, and also to providing in the legislation some greater latitude for research management to re-assign and change personnel to meet the changing needs which inevitably develop in research programs as they progress.

24. In its Report No. 4, the Science Council laid out broad fields of interest for Canadian science and technology in relation to national goals, identifying prototype major programs which could be set in motion now, areas for immediate planning, and other areas for continuing consideration. We endorse this "mission-oriented" approach to setting priorities in relation to overall objectives, because only in this way will the maximum contribution be obtained from the country's total scientific and technological resources.

We believe also that this approach should lead naturally to the involvement of industry, on a contractual or other basis, in important segments of these programs. For example, this Company would welcome the opportunity to discuss possible participation in a major program involving water resource management and development. Government-sponsored research, conducted by industrial organizations, provides other industrially-advanced nations with additional strength in their total scientific capability. It would be a progressive step on the part of the Canadian government to greatly increase the scope for industrial involvement of this kind.

25. Finally we cannot over-emphasize that the provision of grants by government to reduce the cost of research to industry is an attack on only one aspect of the overall objective of harnessing technology to achieve the healthy growth of highly productive industry. Of primary importance is the development of trade, monetary and fiscal policies which will increase commercial opportunities for applying technology in this country vis-à-vis the external environment. We hope there will be increasing involvement in the development and evaluation of such legislation by the agencies of government which are concerned with formulating national science policy.

26. If the objective is to develop more sophisticated technically intensive industry in this country, then surely a policy of low import duties, high corporate taxes, excessive interest rates, and high material of construction taxes is not the route to encouraging such investment nor the technical programs which must precede it.

APPENDIX 149

BRIEF SUBMITTED TO

THE SENATE SPECIAL COMMITTEE ON

SCIENCE POLICY

BY

CANADIAN INDUSTRIES LIMITED

A Submission by Canadian Industries Limited to the
Senate Special Committee on Science Policy

We should like to note at the outset how much we welcome an opportunity to submit a brief to the Senate Special Committee on Science Policy, and it is hoped that our comments will prove helpful. As the Committee is fully aware, the number of subjects that could be dealt with under science policy is legion. The Committee itself in its letter of invitation exposed a large number of questions on which it was seeking answers. This brief does not answer those questions; and, in fact it starts by adding a few pertinent questions of its own, in order to indicate the important matters that will not be covered at this time.

Despite a growing interest in science in this country in recent years - and throughout the world - a number of basic questions remain unanswered, and cannot be answered adequately without considerable research. For example:

1. To what extent is labour productivity and economic growth in this country related to Canadian research and development expenditure?

2. What constitutes a proper balance between domestic efforts and the importation of foreign technology?

3. How much of an improvement in innovation might be expected to accrue from a substantial increase in Canadian research and development outlays?

4. Is the real need for improved management of research results?

5. Will an overall science policy devised today be outdated quickly unless it is flexible enough to deal effectively with such things as changes in world trade and the growing importance of multinational corporations?

Answers to questions of this type are of fundamental significance in the formulation of a sound science policy. Nevertheless, because of time and space limitations, this brief will be confined to a much narrower sphere -- narrow, but of great importance in putting scientific efforts into perspective. Simply stated, even if spending by the federal government on the encouragement of research and development were greatly expanded, desired benefits could still be largely frustrated by other government actions. This is possible because of the tendency to view direct efforts to promote science as enough to compensate for inappropriate policies in other areas. In part the blame for this attitude can be ascribed to scientifically-oriented personnel in industry, government and the universities. These people often have a good case for extolling the benefits of research and development, but they are sometimes over-enthusiastic to the point where in the eyes of some decision makers direct assistance in the field of science comes to be seen as something that could stand alone and bring optimum results. Research and development has gone beyond the stage when this was enough. In the decade following World War II, emphasis was indeed placed on doing enough research as a percentage of sales, this was followed by a period during which attention focussed on the subject matter of the research. More recently, emphasis has come to be placed on how the results of the research can be successfully applied to complete the final stages of the innovation process.

Research intensive industries have had high growth rates which lead to still greater chance for incorporating new technology into expanded facilities. Moreover, specialization in areas of high technology has been seen as related to high standards of living in countries such as Sweden and Switzerland. Nevertheless, it is also clear that a high level of research and development work will not of itself produce the desired economic benefits to the nation. A prime example of this is the U.K., where the rate of growth of the economy has been low in spite of a relatively high level of research and development over a long period. Another example is afforded by Japan which has enjoyed a high rate of economic growth with modest commitments to research and development. The truth appears to be that more than dollar expenditure is required to promote scientific effort, and that science must have a great deal more "going for it" if it is to be successful. In particular, once national objectives have been established, and a science policy arrived at in conformity with these broader objectives, it behooves legislators to be alert concerning the degree to which government actions in pursuit of other policies (e.g. in the field of patents, tariffs, anti-combines, taxation, etc.) may unwittingly thwart the aims of the science policy.

Once the nation's objectives have been established the challenge to administration is to arrange public affairs so that they are approached in a scientific manner and that the available technology is appropriately applied. A scientific approach would be to seek facts, check their validity, and face them. Is this always done when legislators introduce laws applying to patents, tariffs, combines, mergers, to say nothing of taxes of all kinds? Why do other countries notably the U.S., Japan, and to some extent Germany, apply technology to provide employment in new and sophisticated industries so rapidly that they ship to Canada high technical content products, even ones Canadians have invented such as one form of the electron microscope? Is the real need greater public awareness and support of Canadian technology?

The mere proliferation of research groups is no assurance of success, and irrational promotion of research and development in Canada could do more harm than good. For example, for this country to adopt a parochial attitude of self-reliance in science would be extremely short-sighted, a fact that the Economic Council's studies in this field emphasize. Much technology must of necessity be imported; even the more technologically advanced nations, such as the U.S. and Germany, must engage in considerable trading of technology.

Technological development is tied closely to economic development; i.e. research and development follow growth as well as lead it. The experience of other countries demonstrates that it is impossible to achieve a significant research-development base without adequate final markets for the end-products of that research. In the U.S., size of the commercial markets and the extensive government-sponsored space and national defense programs are important elements contributing to that country's technological pre-eminence.

In setting long-term science policies one must necessarily form a judgment, to the best of his ability, concerning conditions that will obtain even a few years hence. This is a difficult task at best - one that involves hard decisions regarding a wide range of matters, including the important one of compatibility with broad social goals. Fortunately, there are some guidelines, and again it is useful to think in terms of the markets that will be available for the end-products that come from allocating more of the country's resources into scientific programs. For example, there will be improved opportunities for Canadian research and development if Canadian governments are able to get other countries to open up their markets for Canadian products.

Another important consideration in the setting of future science policy based on market availability is the growing importance of multinational companies. A greater appreciation of this phenomenon, of the ways in which Canada can benefit from it and of the manner in which research efforts might be distributed geographically in the future because of it, is required before sound decisions can be made on science policy. Some events will be largely outside the control of a relatively small country such as Canada, but there will always remain a fairly large area for discretionary action.

Many of the important factors influencing science-based innovation will still be strongly determined or affected by a wide range of government policies. Therefore, in order to increase the probability of successful research and development programs, we stress the need for greater coordination of a wide range of government actions. Here, we return to the theme that an otherwise well-considered science policy will founder if it comes to be seen as something that can stand by itself and requires little in the way of coordination with other policies. Some of the areas where coordination is necessary are illustrated by, but not limited to, the following:

Patent Policy

The limited monopoly given to an inventor in a patent is provided in order to stimulate innovation by aiding the inventor to recover the costs of innovation. Any policy which erodes the protection of a patent will discourage innovation. For example, the idea that reducing the value of drug patents is a good way to secure lower consumer drug prices should be examined most carefully. Whether it is effective in this way or not is open to doubt. The point is that such actions have adverse effects on the incentive to do research and development in Canada by both domestic and foreign corporations, and legislators should weigh this cost along with other alternatives when arriving at a decision.

Combines Policy

A particular disadvantage of Canadian secondary industry in international competition is one of scale. Often the entire Canadian market is insufficient to support one plant of optimum size. Yet on many occasions the Criminal Code and the Combines Investigation Act, or business concern over the way in which they would be applied, add to the difficulty in uniting small producers. Granted, it is not an easy task to devise policies which will protect the public interest while permitting combinations capable of producing and distributing economically, and the need for more work in this area is being increasingly recognized. To the extent that competitiveness of Canadian producers can be raised through improved production and distribution scale, possibilities are opened up for expanded research and development undertakings in this country. Nevertheless, an active government policy deliberately encouraging collaboration between international corporations in Canada may be needed, rather than the reverse, as well as an international initiative designed to secure freedom in Canada from the unnecessary overflow of U.S. anti-combines legislation.

Tariffs

It has been argued that combines could be permitted if competition were maintained on an international level by free trade. In some cases, free trade will be appropriate, but in others the impact of such factors as higher Canadian effective tax rates, higher capital costs, and higher construction costs would not be offset simply by reaching a more appropriate scale of manufacture.

It is not our intention here to suggest that tariffs are always the best way of achieving a country's objectives. Sometimes they work in the opposite direction. However, the field of tariffs and trade is one in which policy conflicts are likely to be highlighted. An illustration of the dichotomy that can result if tariff policies are not coordinated with science policies can be seen in the following case:

Not long ago the Tariff Board, based on its own considerations, recommended to the Minister of Finance that certain products not manufactured in Canada enter duty free. This would, however, have been a powerful disincentive to conduct research and development in this country because the Tariff Board's proposal meant that it would be extremely difficult to get even moderate tariff assistance in time to assist in the development of certain new products in this country. Ironically, at the same time another branch of government was providing incentives to industry to carry out research and development which was expected to lead to manufacture of new products in Canada. In this case strong representations were made by industry and the Tariff Board's proposal was dropped by the Minister of Finance in favour of a system more consistent with the aims of government policy with respect to the encouragement of research and development.

Tax Policy

This subject is capable of extensive treatment, as evidenced by the voluminous output of the Carter Commission, but we will confine our comments to one observation. Recent research work in and out of government indicates that business in Canada faces a real tax disadvantage opposite U.S. The impact of this is to decrease the ability of Canadian producers to compete for markets and this reduces the case for research and development outlays to develop markets.

Other examples could be cited, such as the untoward indirect effect on research and development of taxes on building materials, the cost of capital in this country, federal/provincial relations affecting nation-wide business planning, or measures that directly or indirectly encourage scientific personnel to leave this country. The main case being made in this brief is simply that a science policy once initiated can only yield the desired benefits if it is coordinated with other government policies.

In this short brief we cannot add much to that part of the current debate which centres on how to formulate and prosecute science policies within government and which touches upon the desirability or otherwise of a minister for science or a minister for science policy with or without appropriate departmental responsibility. Our concern here is not with the administration and coordination of more or less scientific affairs such as the formulation of programs and missions and the allocation of funds and other resources to them, important though these matters are. We are concerned with developing and maintaining a concerted approach to the implementation of science policy on the part of large and powerful government departments ostensibly concerned with other important matters outside the area of science but who have it in their power unwittingly to frustrate science policy. It seems doubtful that this coordination task can be accomplished by a minister of science or science policy unless he is attached in some way to an obvious power centre such as the Office of the Prime Minister or the Privy Council. A Standing Committee on Science Policy could also interest itself from time to time in the working efficacy of the coordination arrangements we have in mind and so help to strengthen them. In some areas (e.g. taxes and anti-combines) extensive reviews are already under way by various arms of government and important decisions will be made in the months ahead. It is hoped that it will be possible to give due consideration to their potential impact on scientific activity.

6th May, 1969

APPENDIX 150

BRIEF SUBMITTED TO

THE SENATE SPECIAL COMMITTEE ON

SCIENCE POLICY

BY

DUNLOP CANADA LIMITED

BRIEF

For Special Committee on Science Policy

Influence of Federal R & D Incentive Plans on a Mature Industry

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Influence of Federal R & D Incentive Plans on a Mature Industry

1. Summary:

This Brief considers the case of a company operating as a non-American Subsidiary in a mature industry.

Since the Canadian market resembles the U. S. market much more than it resembles markets elsewhere, Canadian subsidiaries of U.S. parents do not need to do much development work to prepare products for the Canadian market. They usually can adopt products developed by the U.S. parent.

The same is not the case for the Canadian company with a European parent. Such a company has to absorb more development costs than its American-owned competitors in order to stay alive in the Canadian market.

Dunlop Canada Limited is an example of such a company. It would welcome both general and special incentives from the Federal Government to make it easier to do product and process development in Canada, yet the IRDIA terms are such that no attempt has been made to obtain grants, primarily because of the large amount of administrative effort and costs involved in making and substantiating claims. It has taken one PAIT project but will request no more, because of the large administrative cost and high interest rates involved.

Dunlop operates a research centre in Sheridan Park, which is financed from the British parent. Because of this, it does not qualify under IRDIA. It does have one IRAP grant, but because of the condition to retain the additional staff acquired on the project after its conclusion, there is little incentive to request further IRAP support.

Thus, although Dunlop has established a research centre in Canada and continues to increase its research and development activities within Canada, which is the action that the Canadian Government wishes to encourage, it

has received little support under the present incentive plan.

Suggestions are made on governing principles under which both general and specific incentive plans could be re-organized to provide greater aid and incentive for Canadian industry in doing research and development.

* * * * *

Technological innovation, if it increases productivity, output, employment, investment and produces new markets will result in an increase to Canada's economy. Research and development is one step in technological innovation. The various incentive schemes introduced by the Federal Government are meant to increase the research and development programs in Canada.

It is the contention of this brief that the present incentive schemes, particularly PAIT and IRDIA, are not structured to operate across all industrial segments where it would be useful to increase research and development.

If Canada wants a technologically stronger and more innovative industry, particularly secondary industry, to improve the economy and also to provide muscle in difficult periods such as war or increasing world industrial competition, then this should apply to all industrial segments.

As an example that this is not the current situation, the brief will consider the case of a Canadian Company operating as a non-American subsidiary in the rubber industry, which is a mature industry.

2. Canadian Rubber Industry

It is:

1. Technologically intensive.
2. Labour intensive.
3. Capital intensive.
4. Material intensive.
5. Highly diverse.

6. Subject to a very high rate of change.
7. The changes are paced by those in the U.S., particularly in consumer products.
8. The principal companies are subsidiaries of parents outside Canada.
9. The industry is highly competitive and is sensitive to dumping and importation.

1) Technology:

Most technology is imported, usually from the U.S.A. since changes in Canada are largely paced by changes in the U.S.A. and since most of the major companies in Canada are subsidiaries of U.S. parents.

2) Labour:

The industry uses considerable Canadian labour in making products such as tires, and also makes indirect use of Canadian labour by its large purchases of Canadian-made raw materials.

3) Capital:

The equipment is heavy and costly. The trend is to increase capital involvement in order to improve productivity.

4) Material:

For many products such as tires, material costs are often half factory costs. Most materials used are produced in Canada, including synthetic rubbers, synthetic fibres, reinforcing fillers, chemicals and the like.

5) Diversity:

Even in a field such as tires, it is necessary to produce a wide range of products in order to remain competitive. The same applies to all other rubber goods' fields.

6) Even mundane products like tires are subject to style and fashion changes as well as being subject to design and engineering changes. For example, the consumer has a choice of conventionally-designed tires, radial ply tires, belted bias tires, wide oval tires, a choice of rayon, nylon and polyester tire cord and so forth.

7) Origin of Changes:

Many product changes in the industry follow those made in the U.S. markets. Over half of the rubber consumed in Canada enters automotive products (tires and non-tires). Hence, many of the changes experienced by Canadian rubber industry are controlled by Detroit.

8) Foreign Ownership:

With one exception, the principal Canadian rubber companies are subsidiaries of American parents, the exception being Dunlop Canada Limited which is a subsidiary of a British company.

3. Dunlop Canada Limited

Dunlop Canada Limited is incorporated in Canada with head offices in Whitby, Ontario, and is a wholly-owned subsidiary of the Dunlop Company Limited, London, England. Dunlop Canada Limited operates four manufacturing plants; it also has connections with other parts of the Dunlop Group which operate in Canada, including International Sports Company Limited, George Angus (Canada) Limited, and Dunlop Research Centre at Sheridan Park.

By means of a technical aid agreement, Dunlop Canada receives technological information from other parts of the Dunlop Group.

Funds for Dunlop Research Centre are charged to The Dunlop Company Limited in England. These funds are mainly spent in Canada. It should be noted that Dunlop Research Centre was first established in 1953, long before any of the current Federal incentive plans came into being.

4. Dunlop Experience with Canadian Government R & D Incentives

a) Research Centre:

(i) Industrial Research Assistance Program, National Research Council:

One medium size project has been in effect for approximately three years, and is expected to continue for the full five permitted under IRAP.

Experience with this project has been generally favourable, although there is a disconcerting indication that administrative requirements, which up to now have been at a low level, may tend to be increased. The condition to retain the additional staff acquired on this project after its conclusion was accepted, but it discourages application for further IRAP projects.

The project is administered by Dunlop Canada while the research work is carried out in the Sheridan Park Research Centre.

(ii) IRDIA - Department of Industry, Trade & Commerce

Although Research Centre operating expenses have been increasing, so that there would be a sum of money above the five-year moving average, the IRDIA requirement that funds spent must be reduced by those received from outside the country has prevented us from making such a claim.

Since the capital facilities are held in the name of the parent company, The Dunlop Company Limited (under a Provice of Ontario licence), these do not appear eligible for IRDIA capital grants. The tax incentive was not applicable for the building of the new laboratory in Sheridan Park because the parent company which owns the facilities has no revenue in its own right in Canada agains which tax incentives can be applied.

In other words, although Dunlop took the type of action that the Canadian Government wishes to encourage, it has not been eligible to receive any aid under the tax incentive or IRDIA.

(iii) No other Government incentive programs have been applied for on behalf of the Research Centre.

b) Dunlop Canada Development Activities:

(i) IRDIA - While there are operating and capital development expenses they are inter-woven with technical and control costs. No attempt has been made to obtain grants under IRDIA, primarily because of the large amount of administrative effort and costs involved in making and substantiating claims.

(ii) PAIT, Department of Industry, Trade & Commerce.

One project has been obtained but no further project under this scheme will be requested because of the large administrative costs and high interest rate involved if the project is successful.

Summary:

Dunlop has played a substantial part in Canada's scientific community. Dunlop employees have taken a leading role in the creation of Sheridan Park Research Community and the Canadian Research Management Association.

Despite Dunlop's effort in the scientific community, despite the necessity for Dunlop Canada to innovate in order to stay alive, despite Dunlop establishing a research centre with thirty-five to forty people, the Company receives very little encouragement to maintain, much less expand, the research and development activities in Canada under the present incentive programs.

5. General Incentives

The General Incentives Program should have clearly understood objectives. Presumably, these are to:

(a) Increase research and development capability in Canada including laboratories, equipment and personnel, and

(b) Extend the R & D activity through to marketing a new product or establishing a new factory process.

Like IRAP, it should be:

(i) Very simple to apply for;

(ii) Very simple to grant;

(iii) Very simple to administer;

(iv) Clearly apply to the current year.

There should be a minimum of restrictions in the General Incentives Program. Specifically, we should eliminate such concepts as:

(i) Benefit to Canada;

(ii) Funding in Canada;

(iii) Freedom to fully exploit outside of Canada; and

(iv) Restriction of information to Canada (particularly applies to PAIT)

Bearing in mind the above primary objectives, it is quite impossible to say at the applied research and early development stages whether or not a specific piece of work will be first applied in Canada.

General Incentives should be across the board, that is, designed to make it less expensive to do research and development in Canada than in the United States (hopefully even than in Europe). The moving average concept should probably be eliminated.

Incentives must also apply to capital items.

6. A Practical Suggestion

Permit a current (monthly) credit of

(a) X% of salaries of all people employed in industry on research and development work (in line with the above thinking), bearing in mind that in a research centre the handyman is essential to keep research equipment operating, the librarian essential to keep the up-to-date flow of information moving, the secretaries necessary to type reports and maintain communication and the management essential for direction, etc., plus

(b) Y% of the cost of equipment above a certain amount (say $200).

These credits could be handled in a variety of ways. One of the simplest might be to have them charged against the monthly remittance of income tax payments.

Expenses for major capital items such as new laboratories and additions to laboratories must also be given simple current incentives.

7. Special Incentives

The objective here must be to get new technology used and into the market place, to improve Canadian industry's competitiveness and create more jobs (particularly in secondary industry).

Special incentive schemes are required to stimulate and support the whole innovative process. Some of the features of PAIT may be adaptable to this end. However, they should be modified to bear in mind the above guidelines. Support must go right into the market place and perhaps continued to the break-even point.

This must have "Benefit to Canada" restrictions.

B R I E F

Submitted to

THE SENATE SPECIAL COMMITTEE ON SCIENCE POLICY

by

GULF OIL CANADA LIMITED

800 Bay Street

Toronto, Ontario

and its subsidiary

SHAWINIGAN CHEMICALS LIMITED

1, Place Ville-Marie

Montreal, Quebec

1. SUMMARY

1.1 The development of new scientific knowledge in Canada is of national interest only if it can be exploited in the country in the foreseeable future.

1.2 The commercial exploitation of new knowledge is largely dependent on the economic environment of the country, which is in turn related to geography, international trade relations, social policy, taxation, etc.

1.3 The most important force in the development of new knowledge is the existence of a body of highly-skilled scientists.

1.4 The communication between scientists, either by the written word, or by cooperative labour, will enhance their abilities to develop new knowledge.

2. RECOMMENDATIONS

2.1 That the government's internal research expenditures be coordinated to avoid duplication and to provide a more cohesive research effort within the framework of the Government.

2.2 That the government's external research expenditures be coordinated and periodically reviewed to assess their usefulness.

2.3 That government research grants, limited as to dollars but unrestricted in scope, be awarded university teachers, in aid of avoiding obsolescence.

2.4 That the Government Research Information Services (probably through The National Research Council) be greatly expanded to make scientific information readily available to working scientists.

2.5 That the Government consider the contracting out of research projects of national importance to collective groups from universities, government agencies and industry, according to their abilities, thereby evolving diversified teams to better solve the nation's scientific problems.

2.6 That the Government consider the effect of the country's economic environment on the exploitation of new knowledge and where possible take steps to improve this environment.

3. The Company

3.1 Gulf Oil Canada Limited is the new name adopted on January 1st 1969 by the British American Oil Company Limited. It is currently being amalgamated with Royalite Oil Limited and Shawinigan Chemicals Limited. The company is fully integrated with operations ranging from the exploration for oil to the marketing of refined petroleum products and the manufacture and marketing of chemicals and plastics, most of which are derived from petroleum. Its operations are definitely science-based.

3.2 Capital invested by the company is in excess of $700 million and annual gross sales are of the same order. The company ranks second in size among the integrated oil companies in Canada. During 1968, income tax in excess of $23 million was paid. Sixty-nine per cent of the shares of the company are owned by Gulf Oil Corporation of Pittsburgh, U.S.A., and there are more than 27,000 other shareholders, mostly Canadian.

3.3 There are 11,000 employees in the company, 780 of whom are technically-trained. The company maintains two major research laboratories and also carries out a certain amount of supporting research at various plant locations. There are approximately 300 people engaged in research, of whom 140 are university-trained.

3.4 In addition to the expertise developed within its own orbit, the company has access to a larger source of know-how from the Gulf Oil Corporation, and also avails itself of the opportunity of purchasing foreign techonology when economically preferable.

4. Research Within The Company

The company operates two major research facilities, one located in Ontario and the other in Quebec.

4.1 Sheridan Park, Ontario. This is the larger of the two laboratories and was established in 1964 as a consolidation of the company's geographically-scattered research effort in the petroleum field. The research effort is largely directed to supporting the manufacturing and marketing functions of the company, although research is also done on such diversified subjects as helium, sulphur and heavy water -- all related to petroleum products. There are 149 people engaged in this effort, 73 of whom are technically-trained.

4.2 Ste-Anne de Bellevue, Quebec. This laboratory was established in 1966, replacing a previous laboratory in Shawinigan, Que., operated by Shawinigan Chemicals Limited. Shawinigan has been engaged in active research since 1915 and has been a pioneer in the fields of electrochemistry, organic chemicals, synthetic resins and plastics. The company's innovation record has been good. During the past fifty-four years the company has brought from laboratory bench to commercial production some fourteen major projects. Likewise at least four major novel process equipment developments have been brought to commercial fruition. All of these have received global recognition and several have been used in different parts of the world. In addition to these, a large number of less important processes and products have been developed, and over the years some 246 Canadian patents alone have been issued to this branch of the company. There are currently 102 persons engaged in this effort, 46 of whom are technically-trained.

4.3 At various locations, notably Montreal East, Varennes, Que., and Shawinigan, Que., a limited amount of research supporting the local manufacturing operations is carried out.

4.4 The company has benefitted from certain Federal tax measures relating to research and has received certain grants under the Industrial Research and Development Incentives Act, which permitted the carrying out of certain research projects at a time earlier than would have been normally economically feasible.

5. The Company's Approach To Research

5.1 As a science-based industry, the company is very conscious of the need for continual innovation in its operations. The company believes that its research effort should be directed to fulfill one or more of the following functions:

5.1.1 It should pave the way to the production of a new marketable product.

5.1.2 It should lead to the development of a new or improved process.

5.1.3 It should upgrade existing processes and products.

5.1.4 It should be a mechanism for upgrading and maintaining a high level of technical competence among its employees.

5.2 The company is unlikely to support a substantial amount of fundamental research in its own laboratories unless this research in itself is in support of an existing mission-oriented project.

5.3 The company recognizes that no one research laboratory can be all things to all people, and it is constantly searching for new technology from sources within or without its corporate connections. The company is prepared to purchase outside technology when its own technology is not available or when the outside technology appears superior to that developed locally. The company is also prepared to sell, license or trade its own technology in cases where it is commercially advantageous and where the company will suffer no economic harm.

6. <u>Objectives of a National Science Policy</u>

6.1 Should a National Science Policy be established for Canada an attempt should be made to attain certain broad objectives; e.g.

6.1.1 The improvement of the national economy.

6.1.2 The establishement of national goals in the field of science.

6.1.3 The coordination of internal government expenditures in the field of science.

6.1.4 The coordination of external government expenditures and incentive plans in the field of science.

6.1.5 The encouragement of the commercial exploitation of science-oriented expertise.

6.1.6 The encouragement of the development and maintenance of a high level of scientific and technical competence among the people.

6.2 In order to accomplish these and other related objectives, it will be necessary to consider the policy in the light of national security, national income, international trade relations and the social objectives of the country. It will also require some exceedingly wise men to come to grips with this problem.

7. Development of a National Science Policy

7.1 In considering the development of a National Science Policy, there appear to be three inter-related areas of prime importance; namely,

7.1.1 The development of new knowledge.

7.1.2 The exploitation of new and existing knowledge.

7.1.3 The maintenance of a highly technically competent group of people.

7.1.4 New knowledge has little or no value unless it is exploited; and knowledge can neither be developed nor exploited without the proper people. The "proper people" thus becomes one of the key-stones in any meaningful science policy.

7.2 The People

The corps of technically-competent people is found in four main areas of activity -- educational institutions; Government; mission-oriented research institutes; and private industry. It is important that the responsibilities of each group and the order of priority within the group be clearly understood, not only by the policy makers but also by the members of the group. The following are some suggested responsibilities and priorities:

Group	Priority	Responsibility
Educational Institutions		
	1	To teach (and in the case of students to learn)
	2	To develop new knowledge
Government		
	1	To disseminate new and existing knowledge into channels which may augment the national economy
	2	To develop new knowledge
	3	To train people
	4	To exploit new knowledge when it is in the national interest to do so
	5	To coordinate its own and related research activities so as to minimize duplication of effort and concentrate on suitable national goals
Mission-Oriented Research Institutes		
	1	To adapt existing knowledge
	2	To develop new knowledge
	3	To train people
Private Industry		
	1	To exploit existing knowledge and divert it into economic channels
	2	To develop new knowledge
	3	To train people

In framing a National Science Policy, due consideration and proper weight should be given to the group responsibilities and priorities within the groups.

7.2.1 The maintenance of a continuing flow of technically-competent people into our society is largely dependent on our universities and technical institutions. The importance of high quality up-to-date teaching cannot be overemphasized. In order to avoid obsolescence, a limited amount of unrestricted research within our universities is desirable. This will undoubtedly require public support, a fact which brings into focus the problem of Federal-Provincial relations -- a problem which must be resolved before any meaningful science policy respecting our universities can be effectively implemented.

7.2.2 In order to provide some incentive for people to engage in scientific research within the country, it is necessary that the opportunity be provided for people to work in their chosen or assigned disciplines. This will be affected largely by the level of economic activity, but more particularly by the economic, social and political climate, which needs to be conducive to the profitable commercial exploitation of new knowledge.

7.3 Communication of Scientific Information

7.3.1. Every scientist is dependent on the knowledge developed by others, past and present. With the great proliferation of scientific information during the past quarter century, no one institution appears to be capable of collating and making readily available this information to the working scientists. This is a national problem and could well fall into the orbit of the National Research Council or similar government agency. The problem is an enormous one, but one which might well be one of the cornerstones of a National Science Policy.

7.3.2 The written word is by no means the only method of scientific communication. Personal contact between scientists of the same or related disciplines is equally important and in some cases more effective. A National Science Policy might envisage the contracting out by Government of large research projects which were in the national interest. Each project could be broken down, so that the work would be carried out by the universities, the government agencies, private industry and other research institutions, according to their skills and capabilities. With teams such as these working on single large projects, communication among scientists would be vastly improved and the scientific effort of the country undoubtedly enhanced. Such government contracts to the universities, superimposed on the previously suggested limited grants for unrestricted research, would further upgrade the teaching potential of these institutions.

7.4 Economic Environment

The "development of new knowledge" must have as its corollary the "exploitation of new knowledge", if it is to be effective in improving the national economy. In Canada, this is difficult to accomplish successfully. The company's experience in this regard is probably typical of the experience of other process industries. Of the fourteen major projects which Shawinigan brought from laboratory bench to commercial production, eight could be considered successful in Canada. Of these eight, four were also exploited by the company in the United States and one of these four in the United Kingdom. Two were licensed to others outside the country, and one of these exploited in the U.S.A. by others when the Shawinigan patent expired. Of the six which were not successful in Canada, three were exploited by the company successfully in the United States and one was licensed to outside interests abroad. The inability to exploit successfully these scientific and technical achievements within Canada can be attributed to the economic environment in which Canada finds itself and the economic climate which Canada creates for itself. These involve questions of geography, international trade relations, social policy, taxation and a host of other problems, all of which affect our ability to engage in large scale and/or low cost operations.

It is obvious that the process of exploiting scientific achievement is a highly-selective one. A change in the climate for doing business in Canada could have a far-reaching influence on the effectiveness of any National Science Policy which might be developed.

7.5 Incentives

There has been a long history of government-inspired research incentives in Canada, extending through the broad spectrum of post-graduate scholarships, post-doctoral fellowships, grants-in-aid to teachers in graduate schools, grants to industry and tax abatement for research expenditure in industry. Generally speaking, these have been effective in varying degrees. There would appear to be room for co-ordination and periodic re-assessment of the objectives.

7.5.1 It is suggested that a quantitative re-appraisal of the post-doctoral fellowships programme might be undertaken in order to equate the demand for the product with the potential supply. Massive grants, finding their way into the graduate schools of the universities, might be profitably replaced by contracts for research projects of a national interest.

7.5.2 On the industrial side, the IRDIA grants provide an incentive to speed up long-term projects. The PAIT grants, which provide a means of exploitation of scientific projects, could be made more attractive to industry by allowing the assignment of know-how from unsuccessful projects to the industry. Government research contracts, in cooperation with universities and other agencies, could give industry an incentive to increase its research tempo. The benefits of government research contracts, in addition to fostering the national interest, are often found in the "scientific fall-out" accompanying the work. It is noteworthy that, of the fourteen major scientific developments of commercial importance originating in the Shawinigan laboratories, two were "scientific by-products" of other research projects.

7.6 Research in the National Interest

As a substantial taxpayer, the company would urge that government-supported research should be meaningful and that mission-oriented projects should take precedence over those of a more frivolous nature. If scientific endeavour is to be supported by the Canadian treasury, it should qualify under one of two categories.

7.6.1 Its objective should be to train people and maintain in them a high level of scientific and technical competence.

7.6.2 Its objective should be mission-oriented in the national interest and of a larger scope than could be normally supported by an existing institution.

7.6.3 The first objective is easy to define but requires stern discipline lest one fall into the impractical trap of considering that all scientific endeavour fulfills this function.

7.6.4 The second objective is less easy to define and requires the deliberations of very astute men to set the practical limits of this interest.

7.6.5 The following are suggested without limitation as falling within a reasonable definition of scientific projects in the national interest.

- Those projects which are likely to increase the Gross National Product of the country.
- Those projects which relate to the unique geography of Canada.
- Those projects which relate to the unique climate of Canada.
- Those projects which relate to Canada's principal natural resources.
- Those projects which relate to national security.

Specific projects could be:

- Long-distance communication - satellites
- Plastics adaptable to low-temperature usage
- Long-range weather forecasting
- Non-corrosive anti-icing agents
- New fast-growing grains
- Artificial live-stock feeds
- Low-temperature lubricants
- Perma-frost studies - construction techniques
- Soil-stability studies - muskeg
- Marine farms
- Atomic power
- Arctic transportation - land, sea, air

These are only a few examples of the vast number of projects which could be supported. Some of them are already receiving support. The number, however, far outweighs the resources available to tackle the problems, making necessary a very careful selection of the projects which might warrant support.

8. Conclusion

Scientific progress cannot be assured by legislation. It can only be achieved by the interaction of the minds of men working in an atmosphere which provides not only freedom of thought but also the opportunity to exploit new ideas. Government policy can go a long way towards creating such an atmosphere.

APPENDIX 152

BRIEF SUBMITTED TO

THE SENATE SPECIAL COMMITTEE ON

SCIENCE POLICY

BY

THE O.H.JOHNS GLASS COMPANY LIMITED

THE O.H. JOHNS GLASS COMPANY LIMITED

219 Broadview Avenue

Toronto 8, Ontario

SUBMISSION TO SCIENCE COMMITTEE

CONCLUSIONS AND RECOMMENDATIONS

A. We believe that the establishment of a scientific apparatus manufacturing industry in Canada nearly equals in importance the encouragement of institutional resarch in this country. A scientific apparatus industry should contribute and share in the development and prosperity of a scientific community in Canada and would expand the opportunities for employment and the commercial exploitation of new techniques that are developed in Canada.

2. The two hundred and twenty-five member companies of the Scientific Apparatus Makers Association in the U.S.employ 132,000 people and spend in excess of $59,000,000 in annual research and development.

3. B. We believe that, under the existing Canadian Government tariff regulations,any commercial organization would be very foolish to make any effort to develop and manufacture any type of scientific apparatus in Canada.

4. C. We would strongly recommend that tariff protection be provided for goods of a class or kind manufactured in Canada to encourage growth in the scientific manufacturing industry in Canada and that other forms of recognition should be made to encourage the growth of this industry in Canada.

5. INTRODUCTION

The O.H.Johns Glass Co.Ltd. is the largest and perhaps the only Company in Canada manufacturing scientific glass apparatus and one of the few Companies in Canada making any effort to manufacture scientific equipment. We have manufacturing facilities in Toronto and Montreal and we have forwarded with this submission a copy of our catalogue. All of the items in the section "Glassware Canada", pages 161 to 218, are manufactured completely in Canada by our Company.

6. For many years in Canada, all Canadian Government research institutions, universities and hospitals have been entitled to the duty free entry of all scientific glassware, equipment and supplies. This is allowed under tariff items 69605-1 and 47605-1.

7. These rulings would appear to encourage research in Canada but, in fact,they have virtually eliminated the possibility of a scientific apparatus industry in this country and they have done nothing to encourage or atimulate industrial research. To use our own case as an example, the entire Canadian institutional market may import scientific glassware from the U.S.duty free. We are trying to expand our manufacturing in Canada and to export but the tariff barrier entering the U.S. is 39%. This means that we are completely blocked from competing in the U.S. but the U.S. has complete and free access to this market which is true, not only in glassware, but in virtually all of the other scientific equipment and supplies that could possibly be made in Canada. The result of this policy is obvious, and to my knowledge (except Atomic Energy) there is not a single manufacturer of sophisticated scientific equipment in Canada and there will not be until we either have access to the U.S.market or have some degree of protection to justify manufacturing in this country. A great deal of the industrial research in the U.S. is in the development of new scientific equipment and new techniques and this simply will not be done in Canada until the terms of trade are improved.

8. Last Spring, I attended the Federation of Biological Sciences show in Atlantic City, which is the largest show of its kind in North America. There were hundreds of exhibitors and thousands and thousands of scientific glassware and equipment items and, to my knowledge, there was not one single component from Canada. Practically every other nation in the world was represented in some way or other. This is a disgrace to our national goals and I doubt there is any other industry in which our shortcomings are so evident.

9 "PROTECTION ENCOURAGES GROWTH" -- this heading was taken from page 3 of the 50th anniversary brochure of the "Scientific Apparatus Makers Association" in the U.S.A.

SAMA, the "Scientific Apparatus Makers Association " recently published a booklet to review the accomplishments of their Association. There is no similar organization in Canada and Canadian owned companies are not eligible for membership in this American organization. From this brochure, we learned that, in early Spring and Summer of 1918, the Association of Scientific Apparatus Makers of the United States of America was formed,comprised, at that time, of twenty-one companies. Since that time, the Association has grown to two hundred and fifteen member firms engaged in the manufacture and distribution of scientific and industrial instruments, apparatus, equipment and supplies. Their annual sales to government agencies alone are in excess of $59,000,000 and 67% of the two hundred and twenty-five companies qualify as "small businesses".

10. On page three of "In League with Tomorrow's Science and Technology"--SAMA's 50th anniversary brochure -- we find the following presentation of the origin of the scientific manufacturing industry in the United States:

PROTECTION ENCOURAGES GROWTH

11. "The historical policies of other nations in regard to the establishment and maintenance of their scientific apparatus manufacturing capabilities are highly indicative of the basis and essential importance of this industry to the national defence and public health and welfare.

12. Great Britain, at the outbreak of World War I, found herself so heavily dependent on Germany for scientific instruments and apparatus of all kinds that it was necessary to enact the "Safe Guarding of Industries Act", which established restrictive procedures amounting to virtual embargoes on imported scientific and optical instruments and apparatus in order to permit her to build and strengthen her domestic manufacturers.

13. Since the time of Bismarck at the conclusion of the Franco-Prussian war of 1870, Germany recognized the strategic importance of her domestic scientific instrument industry and embraced government policies designed to preserve and

strength her historical position as a major producer of precision scientific, optical instruments and mechanisms.

14. So too did the early members of SAMA launch a program to obtain government action to protect and strengthen this country's capabilities to manufacture scientific instruments and apparatus. This association effort was successfully culminated in the enactment of the Tariff Act of 1922 which removed the products of this infant industry from the duty free list and established duty rates comparable to those already in existence to encourage the growth of other young U.S.industries."

15. Some of Canada's imports of scientific apparatus equipment and supplies for the years 1965 and 1966 are as follows:

Import Class		In millions of dollars 1965	1966	Major Source
70325	Thermometers	1.5	1.5	U.S.
70613	Medical and Surgical Ins-ruments Equipment and Parts	15.4	18.1	U.S.
70645	Hospital Equipment,Utensils, Accessories and Parts	7.8	10.5	U.S.
70952	Lab.Glassware,Ceramic Ware and Parts,n.e.s.	5.1	5.3	U.S.
70954	Spectrometer,Spectrophotometers and Parts	4.6	7.4	U.S.
70989	Scales and Balances and Parts n.e.s.	4.3	5.5	U.S.
70999	Lab.Scientific Instruments,Apparatus and Parts,n.e.s.	22.9	28.9	U.S.

16. Canada's exports of scientific apparatus are so small that they are not categorized individually in our own DBS figures and the United States import statistics do not identify any scientific glass apparatus from Canada.

17. We would welcome the opportunity to discuss the conditions for the encouragement of a scientific apparatus industry in Canada and would be prepared to discuss specific examples on the shortcomings of the present policy.

THE O.H.JOHNS GLASS COMPANY LTD.

J.Paul Richards.

APPENDIX 153

BRIEF SUBMITTED TO

THE SENATE SPECIAL COMMITTEE ON

SCIENCE POLICY

BY

UNIROYAL LTD

UNIROYAL LTD.

JUNE 17, 1969.

SOME THOUGHTS ON SCIENCE POLICY

FOR THE SENATE SPECIAL COMMITTEE ON SCIENCE POLICY

To make Canadian industry more viable, to improve the economy and to provide greater opportunities for Canadians, increased applied research and development is required in Canada. In addition an even greater increase in innovation associated with research and development is needed. Although these matters should be the concern of everyone in Canada and more effort must be made to bring the situation to the attention of the public, our Government can exert the most influence in providing the climate, incentives and controls required to accomplish these ends.

While the federal government has recently encouraged the short-term expansion of industrial research and development by providing certain financial support with some measure of success, at the present time further increases in support should be considered. Support over a much longer period is required and, in particular, provisions must be made for adequately carrying out those steps required between development and full-scale production in order to provide the long-term benefits which we are seeking.

The market to which most Canadian manufacturers have free access, is less than one-fifth that available to manufacturers in other technically advanced nations. This usually results in smaller-volume Canadian production units, higher unit costs and a resultant lower ability to compete even in domestic or unprotected export markets. Foreign producers with higher volume production units can now compete in Canada with most Canadian producers in spite of some tariff barriers.

As the Canadian tariffs are lowered, Canadian industry will become less competitive and the trend toward "rationalization" and specialization will accelerate. Since foreign industry already possesses larger scale production units, pressures will encourage importation rather than Canadian production.

Canada will then have to depend for her future growth on distinctive new products which will only result from more intensive research and development. To span the gap until the time when a sufficient volume of new products, produced in Canada, is established in international markets, massive support will be needed for research and development and innovation. The time required may be ten to twenty years.

At the present time there exists an improper balance between the types of research done in Canada. There is far more basic research, undertaken mostly at our Universities and NRC than there is applied and industrial research. While basic research is required to create a strong science front in Canada, it doesn't lead to innovation as rapidly as does applied research. Applied and industrial research can be based on fundamental research done in other countries as well as Canada. These countries may be better able to afford such basic research. It is generally believed that basic research is not mission oriented. On the contrary, it is, but the mission very often is a personal one rather than the more practical or beneficial one which is characteristic of applied and industrial research. Our goals in research should be oriented more toward the benefit of the Canadian people. To create the proper balance in research and to get a better return to the nation for the efforts expended, applied and industrial research should receive a higher priority than basic research. This can be done by government through incentives of many kinds for applied research in the three sectors: industry, federal government and universities.

While Canadians have had to display a substantial capacity for inventiveness and innovation in order to develop this country to its present state in spite of all obstacles, this capacity has seldom been directed to new products. Inventions and innovations are usually made under the stress of need or opportunity. The national needs and goals of Canada are not sufficiently defined that a good research program or even a national science policy can be developed based on them.

There is need for increased activity in the following areas, which may be brought about through the use of incentives by the federal government.

1. NEEDS AND OPPORTUNITIES

The government should provide, at least in broad terms, national needs and national goals. It could also be extremely helpful in providing information on needs of other countries.

Industry should develop, to a much greater extent, the ability to pin-point and define needs, which it is capable of supplying, in both national and international markets.

International market intelligence is required for the establishment of sufficiently large-volume production units to be competitive.

II. RESEARCH AND DEVELOPMENT

Applied research in the Universities and National Research Council must be increased and related to industry. The amount of research conducted in industrial laboratories relative to universities and government must be increased substantially.

(a) Research grants to Universities could be designated for applied research.

(b) Research grants for joint industry-University and industry-NRC projects could be made.

(c) Greater use could be made of University and National Research Council staff as consultants to industry.

(d) Industrial post-doctoral fellowships could be provided.

(e) Industrial sabbaticals for university staff could be arranged.

(f) Committees responsible for policy decisions in government and University research could have a strong representation from industry.

(g) Current research and development incentive programs should be revised and expanded to support projects on a more permanent rather than expansion basis.

(h) Ways must be sought to encourage and reward good research and yet not necessarily force continued or premature expansion of any particular research group.

(i) Wherever possible, research, in which a government agency is interested, should be contracted to an industrial laboratory rather than conducted in house.

(j) Industrial scientists should be encouraged to keep "on top" through international meetings.

(k) Industrial scientists should be supported in giving lectures in universities and to the public.

(l) Awards with national recognition might be increased for industrial scientists.

(m) Initiate a program to make science students aware of the more practical goals of science.

(n) In any program for the rationalization of industry there should be some provision for similar rationalization of research and development so that a fair share is done in Canada.

III. INNOVATION

The gap between research and full-scale production must be supported sufficiently that the full benefits of research are realized in Canada.

(a) Specific inducements for the commercialization of new products in Canada should be arranged.

(b) Incentives to encourage the export of new products should be available.

(c) Adequate patent protection, world-wide, for Canadian inventions should be ensured and incentives may be a useful tool.

(d) When research and innovation supported by Canadian funds is successful, means must be found to ensure that adequate returns to Canada are made from any commercialization.

(e) A tariff policy must be developed which is compatible with our national policy and our science policy.

A science policy must not concern itself only with science. It must consider how this science - involved in research, development, innovation, production and marketing - impinges on the national life of our people. It has some relation to markets and growth or loss of markets, to the size of these markets and the effect this has on the cost of producing a product in Canada. We could have the best science policy in the world but if foreign producers can ship freely into Canada the production from lower cost, large-volume plants, they will sell such production at prices lower than we can meet. This has nothing to do with the quality of science but with the size of the producing units which in turn depends on the size of the market available.

Where several firms in Canada have plants providing a product for Canadian consumption one plant might turn out enough to supply the whole market and do so at the lowest price possible. Our laws prevent any such arrangement which could be to the national benefit. The multiplicity of foreign subsidiaries may compound the problem. But our laws do not prevent a foreign supplier from underselling the Canadian producers and putting them, one at a time, out of business. Some parts of our national policy seem to be designed to destroy what other parts of our national policy are trying to foster.

The Queen's Printer, Ottawa, 1969

A science policy must not concern itself only with science. It must consider how this science - involved in research, development, innovation, production and marketing - impinges on the national life of our people. It has some relation to markets and growth or loss of markets, to the size of these markets and the effect this has on the cost of producing a product in Canada. We could have the best science policy in the world but if foreign producers can ship freely into Canada the production from lower cost, large-volume plants, they will sell such production at prices lower than we can meet. This has nothing to do with the quality of science but with the size of the producing units which in turn depends on the size of the market available.

Where several firms in Canada have plants providing a product for Canadian consumption one plant might turn out enough to supply the whole market and do so at the lowest price possible. Our laws prevent any such arrangement which could be to the national benefit. The multiplicity of foreign subsidiaries may compound the problem. But our laws do not prevent a foreign supplier from underselling the Canadian producers and putting them, one at a time, out of business. Some parts of our national policy seem to be designed to destroy what other parts of our national policy are trying to foster.

First Session—Twenty-eighth Parliament

1968-69

THE SENATE OF CANADA

PROCEEDINGS

OF THE

SPECIAL COMMITTEE

ON

SCIENCE POLICY

The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*
The Honourable DONALD CAMERON, *Vice-Chairman*

No. 56

WEDNESDAY, JUNE 18th, 1969

WITNESSES:

Merck Frosst Laboratories: Mr. Ronald S. Stuart, Director of Research; Dr. Jacques Leger, Director of the Basic Research Clinic; Dr. Max Tishler, First Vice-President (Research); Canadian Breweries Limited: Dr. O. O. Schaus, Director, Research & Quality Control.

APPENDICES:

154—Brief submitted by Merck Frosst Laboratories
155—Brief submitted by Canadian Breweries Limited

29633—1

First Session—Twenty-eighth Parliament

1968-69

THE SENATE OF CANADA

PROCEEDINGS
OF THE
SPECIAL COMMITTEE
ON
SCIENCE POLICY

The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*
The Honourable DONALD CAMERON, *Vice-Chairman*

No. 66

WEDNESDAY, JUNE 18th, 1969

WITNESSES:

Merck Frosst Laboratories: Mr. Ronald S. Stuart, Director of Research; Dr. Jacques Leger, Director of the Basic Research Clinic; Dr. Max Tishler, First Vice-President (Research); Canadian Breweries Limited: Dr. O. O. Schaus, Director, Research & Quality Control.

APPENDICES:

154—Brief submitted by Merck Frosst Laboratories
155—Brief submitted by Canadian Breweries Limited

20656—1

MEMBERS OF THE SPECIAL COMMITTEE

ON

SCIENCE POLICY

The Honourable Maurice Lamontagne, *Chairman*

The Honourable Donald Cameron, *Vice-Chairman*

The Honourable Senators:

Aird	Grosart	Nichol,
Belisle	Haig	O'Leary (*Carleton*)
Blois	Hays	Phillips (*Prince*)
Bourget	Kinnear	Robichaud
Cameron	Lamontagne	Sullivan
Carter	Lang	Thompson
Desruisseaux	Leonard	Yuzyk
Giguère	McGrand	

Patrick J. Savoie,
Clerk of the Committee.

ORDERS OF REFERENCE

Extract from the Minutes of the Proceedings of the Senate, Tuesday, September 17th, 1968:

"The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That a Special Committee of the Senate be appointed to consider and report on the science policy of the Federal Government with the object of appraising its priorities, its budget and its efficiency in the light of the experience of other industrialized countries and of the requirements of the new scientific age and, without restricting the generality of the foregoing, to inquire into and report upon the following:

(*a*) recent trends in research and development expenditures in Canada as compared with those in other industrialized countries;

(*b*) research and development activities carried out by the Federal Government in the fields of physical, life and human sciences;

(*c*) federal assistance to research and development activities carried out by individuals, universities, industry and other groups in the three scientific fields mentioned above; and

(*d*) the broad principles, the long-term financial requirements and the structural organization of a dynamic and efficient science policy for Canada.

That the Committee have power to engage the services of such counsel, staff and technical advisers as may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to examine witnesses, to report from time to time, to print such papers and evidence from day to day as may be ordered by the Committee, to sit during sittings and adjournments of the Senate, and to adjourn from place to place;

That the papers and evidence received and taken on the subject in the preceding session be referred to the Committee; and

That the Committee be composed of the Honourable Senators Aird, Argue, Bélisle, Bourget, Cameron, Desruisseaux, Grosart, Hays, Kinnear, Lamontagne, Lang, Leonard, MacKenzie, O'Leary (*Carleton*), Phillips (*Prince*), Sullivan, Thompson and Yuzyk.

After debate, and—
The question being put on the motion, it was—
Resolved in the affirmative."

Extract from the Minutes of the Proceedings of the Senate, Thursday, September 19th, 1968:

"With leave of the Senate,
The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

20656—1½

That the name of the Honourable Senator Robichaud be substituted for that of the Honourable Senator Argue on the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—
Resolved in the affirmative."

Extract from the Minutes of the Proceedings of the Senate, Wednesday, February 5th, 1969:

With leave of the Senate,
The Honourable Senator McDonald moved, seconded by the Honourable Senator Macdonald (*Cape Breton*):

That the names of the Honourable Senators Blois, Carter, Giguère, Haig, McGrand and Nichol be added to the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—
Resolved in the affirmative.

ROBERT FORTIER,
Clerk of the Senate.

MINUTES OF PROCEEDINGS

WEDNESDAY, June 18, 1969

Pursuant to adjournment and notice the Special Committee on Science Policy met this day at 10.00 a.m.

Present: The Honourable Senators Lamontagne (*Chairman*), Blois, Bourget, Cameron, Grosart, Haig, Kinnear, McGrand, Robichaud and Yuzyk—10.

In attendance: Philip J. Pocock, Director of Research (*Physical Science*).

The following witnesses were heard:

MERCK FROSST LABORATORIES

Mr. Ronald S. Stuart
Director of Research

Dr. Jacques Leger
Director of the Basic Research Clinic

Dr. Max Tishler, First Vice-President, (Research)

CANADIAN BREWERIES LIMITED

Dr. O. O. Schaus,
Director, Research & Quality Control

(*A curriculum vitae of each witness follows these Minutes*)

The following are printed as Appendices:

No. 154—Brief submitted by Merck Frosst Laboratories
No. 155—Brief submitted by Canadian Breweries Limited

At 12.40 p.m. the Committee adjourned to the call of the Chairman.

ATTEST:

Patrick J. Savoie,
Clerk of the Committee.

CURRICULUM VITAE

Léger, Jacques, Ph.D. M.D.: Born September 11, 1916, Montreal, Que.; married, 6 children. B.A., 1936, University of Montreal; M.D., 1942, University of Montreal; Ph.D. (Experimental Surgery and Medicine), 1947, University of Montreal; Fellowship, National Research Council (1945-6; 1946-7); Senior Assistant, Department of Medicine, Notre Dame Hospital, Montreal; Associate Professor, School of Medicine, University of Montreal. Merck & Co., Inc.: 1968, Director, Basic Clinical Research, Charles E. Frosst & Co. Associations: Fellow, Canadian Academy of Allergy; Fellow, American Academy of Allergy; Correspondent Member, "Société Française d'Allergie"; Chairman of "Congrès International des Médecins de Langue Française", Montreal 1967; Consultative Member, Association of Medical Boards of Hospitals of the Province of Quebec, Inc.; Member of the Canadian Medical Association; Member, "Association des Médecins de Langue Française du Canada"; Member of the Council, University of Montreal. Awards: Medal of the Order of Canada.

Schaus, O. O.: Born at Hanover, Ontario January 10th, 1924. 1942-1946, R.C.A.F. navigator. 1946-1953, McGill University, Montreal—B.Eng., M.Eng.-Chemical Engineering, Ph.D. Physical Chemistry. 1953-1954, Lecturer in Chem. Eng. McGill Univ. 1954-1960, Cyanamid of Canada, Niagara Falls, Ont.—Senior scientist, Group Leader, Director of Research, Technical Manager. 1960-1962, Audio Devices, Stanford, Conn.—Director of Research & Engineering. 1962, Present, Canadian Breweries Limited, Toronto, Ont. Technical Director and Director of Research & Quality Control.

Stuart, Ronald S., Ph.D.: Born March 26, 1919, Tingley, N.B.; married, 4 children. B.A., 1940, University of New Brunswick; M.A., 1941, University of Toronto; 1942-3, National Research Council Scholar; Ph.D. (Organic Chemistry), 1944, University of Toronto; 1940-42, University of Toronto—Demonstrator, Department of Chemistry; 1943-45, National Research Council—Research Associate; 1945-48, Dominion Tar & Chemical—Assistant Director of Research. Merck & Co., Inc.: 1948-53, Manager Chemical & Biological Control—Merck & Co. Limited; 1953-60, Scientific Development—Merk & Co. Limited; 1960-63, Manager, Technical & Production Operations—Merck & Co. Limited; 1963-65, Director of Research, Merck Sharp & Dohme Canada Limited; 1965, Director of Research, Merck Frosst Laboratories. Associations: American Association for the Advancement of Sciences, American Chemical Society, New York Academy of Sciences, Chemical Institute of Canada, Canadian Research Management Association, Chemical Society of London, Society of Chemical Industries. Research Activities: Dr. Stuart recommends all projects for Merck Frosst Laboratories and directs all the research pertaining to them. He participates in Merck Sharp & Dohme Laboratories research planning and coordinates research contacts with Canadian universities and Government laboratories.

Tishler, Max, Ph.D.: Born October 30, 1906, Boston, Massachusetts; married, 2 sons; B.Sc., 1928, Tufts College (Magna cum laude); M.A., 1933, Harvard

University; Ph.D. (Organic Chemistry), 1934, Harvard University; 1934-36, Harvard, Research Associate; 1936-37, Harvard, Instructor in Chemistry. Merck & Co., Inc.: 1937, Joined Company as Research Chemist; 1941, Section Head in charge of Process Development; 1944, Director of Developmental Research; 1953, Director of Process Research & Development, Chemical Division; 1954, Vice President for Scientific Activities, Chemical Division; 1956, Vice President and Executive Director, Merck Sharp & Dohme Research Laboratories Division; 1957, Elected President, Merck Sharp & Dohme Research Laboratories Division; 1962, Elected to Board of Directors, Merck & Co., Inc.; 1963, Elected Trustee, Merck Company Foundation; 1969, Elected Senior Vice President, Research and Development, Merck & Co., Inc. Fellowships: American Academy of Arts and Sciences, American Association for the Advancement of Science, American Institute of Chemists, Chemical Society (London), New York Academy of Sciences. Honours: Member of the National Academy of Arts and Sciences; Receiver of the Chemical Industry Medal, 1963, awarded by the Industrial Section of the Society of Chemical Industry. Memberships & Affiliations: University of Pennsylvania, Associate Trustee (Science); Tufts University, Life Trustee; Union College, Trustee; Columbia University, Member, Scientific Advisory Committee, Int'l., Institute for the Study of Human Reproduction; Hampshire College, Member, National Advisory Council. Research Activities: At Merck & Co., Inc., Dr. Tishler coordinates all research and development activities both in the United States and abroad. Responsibilities include the Merck Sharp & Dohme Research Laboratories Division of approximately 1,800 people, which under his leadership from 1956 through 1968 discovered and developed new drugs for the treatment of heart disease, hypertension, rheumatoid arthritis and other inflammatory diseases, mental depression, and animal health products for control of economically significant diseases of poultry and livestock. As a medicinal organic chemist, made significant contributions in the field of vitamins, steroids, antibiotics and sulfa drugs.

University; Ph.D. (Organic Chemistry), 1934, Harvard University; 1934-36, Harvard, Research Associate; 1936-37, Harvard, Instructor in Chemistry. Merck & Co., Inc.: 1937, Joined Company as Research Chemist; 1941, Section Head in charge of Process Development; 1944, Director of Developmental Research; 1953, Director of Process Research & Development, Chemical Division; 1954, Vice President for Scientific Activities, Chemical Division; 1956, Vice President and Executive Director, Merck Sharp & Dohme Research Laboratories Division; 1957, Elected President, Merck Sharp & Dohme Research Laboratories Division; 1962, Elected to Board of Directors, Merck & Co., Inc.; 1963, Elected Trustee, Merck Company Foundation; 1969, Elected Senior Vice President, Research and Development, Merck & Co., Inc. Fellowships: American Academy of Arts and Sciences, American Association for the Advancement of Science, American Institute of Chemists, Chemical Society (London), New York Academy of Sciences. Honours: Member of the National Academy of Arts and Sciences; Receiver of the Chemical Industry Medal, 1963, awarded by the Industrial Section of the Society of Chemical Industry. Memberships & Affiliations: University of Pennsylvania, Associate Trustee (Science); Tufts University, Life Trustee; Union College, Trustee; Columbia University, Member, Scientific Advisory Committee, Int'l., Institute for the Study of Human Reproduction; Hampshire College, Member, National Advisory Council. Research Activities: At Merck & Co., Inc., Dr. Tishler coordinates all research and development activities both in the United States and abroad. Responsibilities include the Merck Sharp & Dohme Research Laboratories Division of approximately 4,800 people, which under his leadership from 1956 through 1963 discovered and developed new drugs for the treatment of heart disease, hypertension, rheumatoid arthritis and other inflammatory diseases, mental depression, and animal health products for control of economically significant diseases of poultry and livestock. As a medicinal organic chemist, made significant contributions in the field of vitamins, steroids, antibiotics, and sulfa drugs.

THE SENATE

SPECIAL COMMITTEE ON SCIENCE POLICY

EVIDENCE

Ottawa, Wednesday, June 18, 1969.

The Special Senate Committee on Science Policy met this day at 10.00 a.m.

Senator Maurice Lamontagne (*Chairman*) in the Chair.

The Chairman: Honourable senators, I understand that John Labatt Limited is not available this morning so we have only two groups before us. I would ask Dr. Stuart and his two associates from Merck Frosst Laboratories to come forward and sit at this table, and then Dr. Schaus from Canadian Breweries Limited to come forward.

Gentlemen, you are most welcome here this morning. Without any further introduction I will ask Dr. Stuart to make his opening statement. I understand that after a brief dissertation he will ask his two associates to make equally brief introductions.

Dr. Ronald S. Stuart, Director of Research, Merck Frosst Laboratories: Thank you, Mr. Chairman. Honourable senators, the main thought we have tried to express in our brief is that science in Canada can only lead to new production, new industries and generally help to put Canada in a competitive international trading position if that science is founded on a basis sufficiently broad to permit fulfilment of near-term, interim and long-term needs. In this way there can be a continuum of new ideas, new products and new discoveries which will keep Canada's present industries competitive as well as allow Canada to expand and grow in a competitive way.

We believe that there has been some confusion between science policy and the end results of such a policy. Statements by many people who have written on this subject and by some who have appeared before this committee support this. It seems to us that a clear distinction has to be made between policy and the hoped for results of having a policy. For example, the Science Council has already suggested at least part of a policy when it suggested that Canada should do mission-orientated research. One purpose of our brief has been to suggest ideas which may help fill this gap. We have tried to show ways in which government, industry and university might work together to build a solidly-based research community. In so doing, we would like to emphasize that we have not necessarily said that much more money needs to be spent if this is not possible; but rather that the amount spent could be concentrated in directions which will permit a long-term research base without which we believe an industrial country cannot remain successful and competitive. We have also made the point, often overlooked by both government and industry, that science is international and that to achieve maximum results for our research investment in Canada, companies have to integrate their efforts with subsidiaries, affiliates or parents abroad.

Only rarely is it possible for a company to do research which is specifically Canadian. In fact, unless a company carves out a notch for itself in the total programme of its group, it runs the risk of wasting money or building research on an unsound basis.

We believe that our suggestions represent important considerations in the development of a science policy. There are two important groups who do not appear to be making sufficient input on Canadian science policy. One of these is the group of French scientists in industry and university—a group who are probably in the most active state of scientific evolution of our country, and who represent more than 30 per cent of the population. Another is a group which has not been listened to effectively—the in-college and just-graduated-from-college group. While some of the ideas that these two groups have may be radical and different, they are going to have a lot to say about what happens to science in Canada, and what the science policy might do for Canada in the next ten years.

We are certain that your committee will succeed in molding all of these ideas into an effective policy which will achieve much for all of Canada.

I would now like to ask my colleague, Dr. Jacques Leger, to make a few remarks.

[*Translation*]

Dr. Jacques Leger, Director of the Basic Research Clinic: Mr. Chairman, Honourable Senators, Gentlemen, a great many memoranda have been submitted; it is conceivable that all aspects of research in Canada have been envisaged.

The document submitted to you by the Merck Frosst laboratories is intended to emphasize the necessity of cooperation between the government, the industrial and the academic sectors of research. We venture to believe that a conclusion will clearly result from this brief: Canadian society must count on concerted research that totally meets the needs of this country, so that Canadians and Canada may derive every possible advantage, so that the standard of living—both material and intellectual—may be maintained and improved.

It is agreed by all that we cannot be satisfied with a system of partitioning, and I take the liberty of expressing, of formulating, a medical point of view regarding the medical discipline, in the chapter on biological research, including research work done by the pharmaceutical industry.

From the ensemble of the memorandum that we have the honour of submitting to you, I would like to stress the role of the medical team; from the analysis of Table F at the end of the memorandum, entitled "Interaction and Results", it becomes clear that the medical team has to contribute actively in determining needs in the field of health, taking into account existing pathologies (of their gravity and frequence, obviously) and, also, taking into account the population of patients or sick persons. A satisfactory knowledge of the etiology, or of the cause of affections as well as of the mechanisms for action within the organism, is also an essential contribution to the choice of programme for chemical, bacteriological, pharmaceutical and pharmaceutical work accomplished for the purpose of ensuring efficient means to control sickness.

Medicine is, then, a part of a complex, of a totality, within which are to be found many disciplines.

It is, however, at the clinical research stage that it plays its most important role; indeed, it is after the completion of proof and experimental tests made on animals, that a substance will finally be administered to humans and will be recognized as a medicament.

The substance must be assessed for efficacity, for innocuity (of safeness), for guide-lines and counterindications, as well as for side effects. Such assessments are made in various pharmacological and therapeutic stages or phases.

In the very initial phase, that is, the pharmacological stage, often known as Phase I, under the American terminology, when the medicament is proposed for the initial clinical test for a first administering to patients, the responsibility is great; the number of persons submitted to the experiment is very limited, perhaps only one or two persons in the whole world. Very small doses of the medication in question will be administered, and the patient will be minutely observed from the pharmacological and metabolic points of view, as well as from the point of view of toxicity.

In the therapeutic phases research consists of an initial therapeutic trial, on a limited number of patients; this is known as Phase II.

Next, the clinical study is further widened and the duration of treatment is prolonged. Dosage and the formula, take form; this is Phase III.

Finally numerous clinicians will make clinical trials; the list of patients grows longer; it is only a question of time until the product is commercialized; we have reached Phase IV.

It is stated on Page 9 of our memorandum that rarely can we engage the capabilities in the preliminary phases (I OR II), which are, in fact, pharmacological phases—rarely, I say, can we overcome difficulties in using the competency of our Canadian specialists and the excellence of their installations. These same specialists, for obvious reasons, are then deprived of valuable research matter. We do not at all object to having our Canadian public protected perfectly, and we pay homage to the quality and extent of the work of the Food and Drugs Act administration. We moreover wish that the changes in the control of new drugs regulations could be applied as soon as possible, in the form in which such changes were submitted to us a few months ago by the personnel of the Food and Drugs Act administration. We are well aware that this department is overburdened by the magnitude of is task and that it would be desirable to have an increased budget that would permit expediting the assessment of experimental data; such evaluation is sometimes a long process, so that the Canadian results are definitely late, arriving after the results from elsewhere. Our own pre-clinical experimentation, as well as the interpretation of it, could also be expedited, if it were possible, thanks to government subsidies, at that stage to call upon academic circles. Such initiatives would greatly favour the kind of cooperation that we consider to be desirable, and which was described by Dr. Stuart, between government, academic and industrial research. Thank you, Mr. Chairman.

The Chairman: Thank you, Dr. Leger.

[*Text*]

Dr. Stuart: I would now like to ask Dr. Tishler to speak for a few moments. I might say that Dr. Tishler is one of the pioneers in industrial pharmaceutical research.

Dr. Max Tishler, First Vice-President, Research, Merck Frosst Laboratories: Thank you very much for the high privilege of allowing me to be with you today as you deliberate the broad and important question of government's role as a patron of science. No knowledgeable person would deny government a major role. The question is: What role?

The same fundamental question must be asked of the two other pillars of modern science, the university and industry. What is the rightful function of each? How can they be caused to interrelate to best complement or supplement each other?

Past examples and the unknowns implicit in research warn us against being too dogmatic in our answers. Inevitably, some science policy decisions will prove wrong. But knowing that mistakes will be made should not yield to a laissez faire attitude. The imposing social consequences of modern research and the great expense that research can entail are fit subjects for public concern and demand a serious effort to establish a rational policy.

If science policy must on occasion impose restraints, it should always foster opportunity. A policy encouraging scientific opportunity must receive the highest priority in Canada, as in every other scientifically sophisticated nation.

In approaching questions of science policy, it may be useful to remind ourselves that science itself is not divisible into such convenient categories as government science, university science, or industry science. Science is one even though it may have many sponsors. The first requisite of a science policy must be that it serve science first, relegating to the background the political interests of government, the prestige interests of the universities, and the financial interests, of industry.

This may sound like mild heresy for a scientist from industry, but it is not. That science has one set of standards is demonstrated by the ease with which scientists move back and forth between private and public research institutions. Moreover, the best interests of science almost always correspond with the long-term best interests of all three major sponsors of research. So the question of overriding the interests of a particular group seldom arises. I say this without hesitation from first-hand observation because over the years I have had the opportunity of serving on a number of governmental and academic advisory boards. Their deliberations are remarkably like the discussions within our own laboratories as we hammer out our research programs.

I need not elaborate upon the obvious and describe how scientific research has increased in scope and complexity in recent years. Simultaneously, it has become considerably more international. While science has never been bound by political borders, the capacity of scientists to work together effectively while based on different countries has always been handicapped by the limitations of transportation and communications.

Now, of course, it is both possible and practicable to coordinate a scientific effort at intercontinental distances as the International Geophysical Year, a few years ago, demonstrated so resoundingly. In my own field, pharmaceutical research, current practice is to search out good scientific talent wherever it is available. This is especially true in the area of clinical testing, since no country has a monopoly on good clinicians. New therapeutic agents under development by Merck currently are being studied in hospitals and medical schools around the world.

Merck, like many other research-oriented companies in the U.S.A., has contributed to the so-called "brain drain". This was because we sought the finest scientific talent we could find to work with us on important problems.

These scientists, in turn, wanted to work where the promise of scientific achievement was greatest. In this sense, the "brain drain" probably will continue. But it does so to everyone's advantage because the result is faster scientific progress, a world-wide asset, and quicker availability of better medicines for all people on earth.

Currently, however, the trend within research-oriented international companies is to extend its laboratories to several countries with proven research capacities. This is Merck's philosophy. For example, our Canadian research is an integral part of our total research effort, coordinated into our overall plan but directed and staffed locally. Our Canadian colleagues participate with us in our company-wide planning and are responsible for important functions in our research strategy.

There is in research a kind of momentum that builds upon its own accomplishment, and we know that our Canadian associates share this spirit. A partial, and only partial, recitation of the contributions of the Merck Sharp and Dohme Research Laboratories to medicine would include several vitamins, including B_{12}; the development of streptomycin; the initial synthesis of cortisone, the discovery of chlorotiazide. More recently the laboratories have discovered or developed important drugs widely used in the treatment of heart disease, high blood pressure and mental depression as well as several highly important vaccines. In the purely scientific field, our work with interferon and the first synthesis of an enzyme—the latter achieved simultaneously and independently by a team at Rockefeller University—are milestone achievements.

Over the years, Merck has worked closely with universities and with the federal Government as an equal partner. We hope that we shall be able to continue to do this, and to do this in Canada, in spite of some of the political currents in my own country which could make such collaboration much more difficult.

A popular misconception exists that the government does most—if not all—of the basic research of any consequence, and that those who develop useful applications of basic knowledge are parasites, or worse. The first premise is false; the second is outrageous nonsense.

The public and even many academic and government scientists do not understand the complexity and the expense associated with the development phase of R & D in the pharmaceutical industry. The industry's unique capacity to translate a concept or a laboratory discovery into a useful therapeutic agent sets it apart from either the universities or government. This invaluable scientific capability must not be undermined.

For its part, the pharmaceutical industry can also take steps to help guarantee further fruitful collaboration among the elements of research. I listed several such opportunities last March in a talk at the Plenary Session of the National Research Council and National Academy of Sciences. With your permission, I would like to repeat these since they seem just as applicable in Ottawa as in Washington.

I said the industry's scientific component should seek ways to broaden its support of university science, directly and indirectly. The industry's scientific component can work toward a broader and more representative involvement in policy-making councils of government. It can explore better ways to facilitate scientific exchange and to foster scientific collaboration. It can design research and development policies so that it is clear to everyone that the pharmaceutical industry undertakes its share of a nationally conceived research and development effort that clearly is in the public interest.

The two vital elements in any effective scientific collaboration or of any viable national research policy are both unwritten; good will and mutual respect. When these are present, they can be sensed in the air, as I sense them within our company in our relationship with our Canadian research associates.

There is no question in my mind but that our Merck Frosst Research Laboratories is an integral part of our total research and is on its way to making solid contributions to science and medicine for Canada and the world. At the same time, this research laboratory is contributing to the health and income of Canada and helping to build the nation's scientific competence and prestige. It provides an exciting focus in Canada for Canadian scientists. But as its projects gain momentum, I would expect to see scientists from numerous nations working side by side with them at the new Kirkland laboratories in Montreal now under construction.

A national science policy, as I know you realize, must similarly encourage good will and mutual respect. When these are present, enormous problems have a way of becoming technical details. When they are absent, technical details inevitably become enormous problems.

Thank you again for letting me be with you today.

The Chairman: Thank you very much.

Dr. Tishler: Mr. Chairman, if I may interrupt for a moment, last night for the first time I had an opportunity to read your talk of June 2nd. I found it very enlightening and very clear.

The Chairman: I do not remember which it was.

Dr. Tishler: This was the one on management at the plenary conference on June 2nd of this year. The only reason I mention it is because you raised a lot of points there which gave me a pretty clear picture as to your thinking. I am not sure that what I have to say today answers many of the questions you raised in that talk. I thought about it coming up here and made a number of notes of what I think might be essential to encourage research, and to which I have not yet addressed myself. I hope that some time this morning I will have another five minutes to just go through this.

The Chairman: We will certainly have some time later, especially if you have answers to our questions. We might even give you half an hour.

Dr. Tishler: I have 14 points which I think are essential for research.

The Chairman: I will now call on Dr. Schaus from Canadian Breweries Limited.

Dr. O. O. Schaus, Director of Research & Quality Control, Canadian Breweries Limited: Mr. Chairman and honourable senators, it is a pleasure to be with you this morning and to be able to participate in discussions of science policy in Canada. Appearing at this late stage of the hearings makes it difficult not to repeat much of what has been said before, but we feel there are possibly a few items which are peculiar to our situation and experience which might be helpful to the committee. In addition our thoughts and opinions, even though similar or opposed to other groups, are based on the experience gained in operating a medium-sized industrial research and development function which has included all phases of the innovation process from ideas to operating plant and which, for that reason, may have some merit.

We at Canadian Breweries have pioneered many technical innovations in our industry such as continuous brewing, continuous malting, the Conbrew process, all of which processes were the first to be developed and operated in the world. These processes have been technically successful but have not been adopted to any great extent by the industry in this country. These processes offer distinct economic and processing advantages over existing methods but are not widely used because of the high risks involved in pioneering new ideas, particularly on a very large scale. This is particularly important when one already has invested many millions of dollars in existing equipment which does a satisfactory job even though it is not as efficient as it could be.

The Chairman: Before you go on, could you tell us whether these discoveries have been applied elsewhere? They have not been applied in Canada, as I understand it.

Dr. Schaus: They have been applied elsewhere. More and more are being built. Some are operating in the United States, some in Spain, some in the United Kingdom, and some in Portugal as well as Malaysia. There are not a large number that have been built yet. As to continuous malting plants, I would say there might be five or six, continuous breweries there are parhaps three or four and, using the Conbrew process, there are two or three operating in the world.

These are all recent discoveries that have been developed since 1963. We have done the work on them before that but this is the first time they became a commercial entity.

In many cases, one cannot justify replacing very expensive equipment with better equipment unless the margin of improvement is great enough to overcome the large loss incurred in scrapping the existing plant. The larger the amount of capital that is invested in a plant, the more difficult it thus becomes to replace this plant with a new and better process. Examples of this problem are readily apparent in the steel industry, the heavy chemical industry, and our own industry where the average brewery today would cost in the area of $30 million.

On the other hand, if we do not move into newly developed and improved processes in this country, industry in other countries will and thus be able to be more competitive in our own markets and exports markets as well. With these thoughts in mind, this appears to be an area where some form of assistance would encourage industry to adopt new and more efficient processes even if they must scrap workable and undepreciated assets. This discussion may appear removed from science policy—and in some ways it is—but there is very little point in doing research and development on a process unless the avenue is open for employing the process, if it proves succesful. With this in mind, we would suggest that this assistance could be in the form of a tax holiday for a period of time after new and more modern processes have been introduced.

The government programs designed to encourage research, such as IRDIA, IRAP and PAIT, have been thoroughly worked over in presentations to this committee and to the Department of Industry. We can merely add that, while they were of some assistance in stimulating additional research and development, they do not appear to have accomplished their long-range objective of stimulating continually increasing amounts of research and development.

We would like to suggest the adoption of the IRDIA type program previously in force—by that I mean section 72A of the Income Tax Act, which I think was introduced in 1962—which would permit 150 per cent of all research and development capital and operating expenses to be charged against taxable income without a deductible base. This is similar to the IRDIA program, and the IRDIA program would be easily acceptable if the base were removed. I think it amounts to almost the same thing; perhaps a 1 per cent or 2 per cent difference. We preferred the program under section 72A of the Income Tax Act. I think it was a little less cumbersome in the administrative details. For that reason we have suggested it here. The current IRDIA program would produce about the same net financial assistance.

There are many fine universities in Canada and each one of them offers courses ranging from home economics to nuclear physics, with only minor differences in entrance requirements and academic standards. Experience in other countries would indicate that science in those countries is greatly stimulated by having a university with very high standards for admission and achievement and which is devoted solely to the teaching of science and technology.

Our discussions of the National Research Council grants, under the student assistance plan, and the National Research Council staff are relatively straightforward and are explained in the brief.

In summary, the following suggestions are made for your consideration as possible means of increasing the amount and effectiveness of the whole innovative process as applicable to the peculiar Canadian scene:

Assistance to Canadian industry to make the large expenditures necessary to adopt new and more modern processes, such as a tax holiday for a period of time after these new facilities have been introduced.

Allow 150 per cent of all research and development and operating expenses to be chargeable against taxable income without a deductible base.

Consider the establishment of a "super" technical university in Canada devoted solely to science and technology and its application.

Orient National Research Council grants from primarily basic, fundamental research types to primarily applied research and development types. I am speaking of the university grants.

Gradually build up National Research Council staff with applications scientists to supplement the current basic, fundamental scientific staff.

The Chairman: Thank you. I will now call on Senator Bourget.

Senator Bourget: Dr. Stuart, on page 1 you say that there has been very little coordination of research effort between government, industry and the university. That has been said often, I think, before this committee. I would like to know what kind of mechanism you would like to see set up so that there would be better collaboration between these three groups, and also what has been your experience in your contacts with the universities and government agencies regarding research?

Dr. Stuart: I think we have answered part of that in one of our recommendations. As I view it, the way to get this collaboration is to have the policy committee composed of members from the three groups, and also composed of working scientists who are more active in science than in administration.

The Chairman: But is that not so at the present time? We have a lot of these committees around. We have counted about 100 advisory boards and committees and subcommittees composed of people from government, industry and universities.

Dr. Stuart: I meant there are plenty of committees now but the result is that this exchange or collaboration has not been achieved. That is a fact which Senator Bourget has pointed out as well as many other people.

Senator Grosart: How do you make it work?

Dr. Stuart: I think you have to get the right people involved in it. Perhaps, instead of having 100 committees, there could be fewer committees, composed of people who are willing to dedicate themselves to this work, with industry, government and universities willing to send their best people to sit on the committees. I think this is the only way it can be done. It is not an easy way to make it work but I think it has to be done. I see no other way to get the kind of collaboration that I feel we must have in order to get all of us working together towards the objectives in which we are all interested.

To answer the second part of your question, I have had contacts over the years with several government departments, as well as the National Research Council. I refer to the section of our brief that deals with the collaborative effort we have on isotopic chemistry with the Research Council. This is an idea that they had, and we and they have developed it together. It has been a very successful collaboration. Unfortunately, there are not enough examples of that type of thing. I might say that we have looked at certain things with the Department of Agriculture. So far we have found nothing that we have been able to make into something useful.

I think part of the reason may be that governments scientists and university scientists, and perhaps we in industry as well, are not in sufficient contact, that we do not know each other's interests and needs as well as we should. I think we must get to know at the planning stage each other's needs so that when we have a piece of work to do it is going to make a real contribution.

Senator Haig: By reason of this lack of coordination and cooperation, is there duplication of effort in research among the three groups?

Dr. Stuart: I would not describe it as duplication. There may be some effort that is wasted in the sense that it is going off in different directions. I do not have a sense that there is a great deal of duplication. There is a lot of scattered effort.

Senator Haig: It should be harnessed to go towards a specific objective.

Dr. Stuart: It is my impression that a lot more of it should be harnessed in that direction, if we are to find a way to achieve the collaboration we stress as our theme throughout the course of the brief.

Senator Bourget: Do you often meet with government agencies or the universities? Do you have many contacts, or is it just once in a while? How close are your associations?

Dr. Stuart: We have a very close, working connection particularly with two government agencies, the National Research Council and the Food and Drug laboratories. We meet with the Food and Drug laboratories very frequently. Dr. Leger could elaborate on that because he is one of our people who meets frequently with them.

As to the universities, we meet with them quite regularly on the medical side. So that to some extent we are doing our part, although undoubtedly it is not all that it should be. However, we are trying to be aware of what is going on in these areas as much as possible.

Senator Bourget: Dr. Leger, as to the question just raised, are you satisfied with the relationship you have with universities and government agencies?

[*Translation*]

Dr. Leger: Honourable Senator, we are very satisfied with the relations we have had with the administration of the Foods and Drugs Act; when we ask questions it is not the result of any difficulty with their regulations. We are in perfect agreement that the regulations of the Canadian Food and Drugs administration are more strict that those of other countries, and we are perfectly satisfied with that situation. We think it is one of the best organizations of its kind in the world. We have no comment in this regard, and our cooperation with that organization is excellent. We very much hope that their internal administration can arrange matters so that their verdicts and their replies to the submissions we make to them can be achieved more rapidly.

We further hope that their control will be widened, so as to permit clinicians of international competency, and who are Canadians, to do some very original work along with similar work being done elsewhere, and this to the end that Canadian research prestige may be recognized and increased so far as the medical clinic is concerned.

So, our relations with the government agency are excellent.

As for our relations with the universities—well perhaps I am committing a heresy, but I feel that it is to some extent in the direction of collaboration, by the Government with the academic world. The situation is that our relations—the relations of industry, with the university world, are carried out to some extent as distributors of funds. We distribute, as does also the Government, large sums of money. Now, when we speak of cooperation, we do not refer to cooperation in the financial field.

If committees, as Dr. Stuart has suggested, were made up of representatives of three groups—governmental, university and industrial—the university scientists could call upon such committees in such a way that the university expert, who generally does thesis work, who does basic work that finds little application in practice, work that is very interesting for the obtaining of a diploma—which is obviously very necessary work—could help. If the academic world were aware of the work being done in the industrial world, then certain basic work that could be done jointly with what the industrial world undertakes, could proceed, with a view to improving the health of Canadian citizens by putting onto the market new products. We should be very glad to entrust a part of our work to the academic world. Of course, we could not subsidize all academic research; perhaps we have here a part of the answer to your question.

Mechanism for greater cooperation between us and the academic world could be vast, without revealing important secrets. We could give part of the pharmacological, toxicological and other kinds of work—physiological, for example—to people in the university world; they could benefit from partial subsidies from us; but they could also benefit by doing work, not *for* us, but *with* us; and they could also benefit from Government subsidies. I think that in this regard Dr. Stuart describes in a somewhat more intimate way the mechanism that could exist and represent cooperation between the three sectors of research.

Senator Bourget: That was exactly the object of my question. From the reply that you have just given us, it appears that there is a lack of contact, a lack of dialogue, between industry and the universities.

The Chairman: If you will allow me—unfortunately this morning we have no simultaneous interpretation service. If you have no objection to continuing, sometimes in "bilingual language" instead of in the language of confidence, I think that more members of the committee will be able to follow you and understand you.

[*Text*]

Dr. Leger: I would be delighted, Mr. Chairman, if you would like me to summarize in a few words what I have just said.

Senator Bourget: I think it would be a good idea because it is a very important point. It goes to the question of coordination and collaboration which was stressed previously by Dr. Stuart.

Dr. Leger: Very well. This will not be just a translation; it will be in a sense an addition. I cannot repeat exactly what I have just said.

I trust Canada and Canadians. I do not believe we are a small country. We are a big country in many senses. I do not believe that we should opt out of the international research race. We have three sectors which are very active in research, the governmental, academic and industrial sectors. As I said before, we have an extremely good relationship with the government agency, the Food and Drug Directorate. We have nothing to say against the rigidity of their rules and regulations. We believe this is one of the most rigid agencies in the whole world but we believe that this is all for the good of the Canadian citizen. There is nothing too severe or too rigid in regulations implemented for the protection of the public when we are dealing with new drugs and the administration of various medications. As I say, we are on very good terms. We would just hope that they could be provided with material facilities to answer more rapidly our questions or, in other words, our pre-clinical submissions.

Senator Bourget: What is the reason for that delay?

Dr. Leger: A pre-clinical submission for a new drug consists of a whole study of the substance in all its aspects, including chemistry, pharmacology, physiology and metabolism. It is a huge responsibility and it takes a long time before, out of a few thousand substances or compounds, we come up with one which is going to be considered as a potential drug. It takes years and we do not object to the fact that it is being looked at very carefully and thoroughly by the food and drug directorate. However, if it takes months and months our pre-clinical submission will get an answer only perhaps after other people in other countries, with whom we have extremely good relationships, get an answer, and, as a result, they will be ahead of us. In that manner we are a little late in the race; it is late before we provide our clinicians with the material they can use for clinical studies.

Senator Bourget: But what is the reason for the delay? Have we not enough people?

Dr. Leger: I believe we have not enough people. This is why I have suggested in my first comment at the start that probably this is one of the sectors of the government's activities which should not be subjected to a decrease in budget. Perhaps we should improve or increase its financial capability. On the other hand, we are in a difficult or handicapped situation concerning what I have called the pharmacological phase, or phase 1. It is not that we are not permitted to initiate phase 1 with our competent people in this country, but, in order to get permission to submit to those people a new drug which has never been given to any human being, the conditions are a little more rigid than they are, for instance, in the United States. This is why, although we have the competence, we cannot—and we find this is very unfortunate—give really new material to topnotch individuals who would be in a position to give an answer just as well as anybody else in any other country.

As to the last part of the question, Mr. Chairman, we, of course, have an extremely good relationship with the academic community but it is in a way the same relationship which exists between the government and the academic community. It is a matter of distributing funds. We do not believe that this is the only way to cooperate. We believe if there were a committee such as Dr. Stuart has suggested, this would be a place where the academic people could apply in order to obtain knowledge of what is going on in industry. Up until now, all those people writing theses and working in university laboratories have been doing an extremely good job but very often much more could be done to give their work some real application. We believe that we could be of great help to them while doing their teaching and studies, so that they could deal with real stuff which would have application to the Canadian citizen.

Of course we do not object to subsidies to some extent. However, in this context we also believe that this is not our exclusive responsibility and that this is where a joint action could be considered between government distributing some funds, industry doing its share, and the academic field working in a closer way with the other two sectors.

Senator Robichaud: Mr. Chairman, in view of the statement which has just been made, and in order not to duplicate our questioning, this might be the time to get the views of the Canadian Breweries on this subject because their brief seemed to indicate very clearly that the universities are too much removed from industry. Could we get at this time the views of Canadian Breweries, and also could the witness tell us if his firm, for example, has attempted to establish collaboration with university staffs, and what has been their experience?

Dr. Schaus: Certainly we have worked with the government agencies, to get back to your original question. We have worked with the government agencies of the National Research Council, the Department of Agriculture, particularly as it relates to barley and malt, and with the food and drug directorate since we are involved in food products. Our relations with food and drug have been similar to Dr. Leger's in that it takes quite a long time to get down to the approvals that have been requested, even the approval of lists of additives, which I think in one instance we have been working on for four years now. It is not their fault, they are first-class people and they cooperate 100 per cent. As Dr. Leger says, it just takes a long time to get all the data they need and to do all the testing to be sure this list is suitable for approval. We do not disagree with that at all.

We work with the NCR on different occasions; I would not say on a large number of occasions, but on a number of occasions. I have worked with them previously when I was employed by another company. They certainly have been 100 per cent cooperative. However, with the NCR we have found in general that they tend to be more on the basic fundamental research side and less on the applied side. Since we are more oriented to the application rather than the fundamental—

The Chairman: You want to remain close to the consumer.

Dr. Schaus: We have to in our business. We have to keep our friends.

Senator Robichaud: What about the university side?

Dr. Schaus: We have attempted to cooperate with universities and work with them.

The Chairman: When I was a university teacher I always noticed that most of my colleagues were good beer drinkers.

Dr. Schaus: They are some of our best customers. We have worked with them on different types of programs such as taking in students to work in our laboratories and finish their final year theses, and we have supported programs in universities. I would say, generally speaking, the returns have been very small. I could not recommend a good system of making a satisfactory cooperative program with them. When you talk to them about a specific program you immediately step on the toes of academic freedom. The sensitivity varies with the person, of course. Therefore, you do not make many yards. Even in attempts to farm out work to universities, which we do periodically in some areas in which we are not competent, we have not really found the results to be truly satisfactory.

When we get assistance from the National Research Council on a special problem where we do not have the necessary specialized equipment, we save had nothing but first-class cooperation and first-class results. However, as I say, I must admit, as far as the academic side of the university goes, we have attempted many times to do it and the results have not been what I would consider successful. I cannot recommend the solution that would be successful because I do not know one.

Senator Yuzyk: Is this the reason why you recommend this "super" technical university in Canada? Do you think it would be easier then to work out a definite program?

Dr. Schaus: Partially that, but that is only a very small part of it. My thinking is that we need an institution of excellence. I would not say that our universities are not excellent, because they are, but they naturally have to cater to a spectrum of people. I think that is perhaps one of the reasons why we do not get the maximum technical achievements out of them that we could if the degree of excellence were a little higher.

Dr. Leger: You have just mentioned academic freedom and independence. I believe that that is the counterpart of the wish for secrecy on the part of industry. These are two of the major problems that could be solved by closer cooperation.

Senator Bourget: Dr. Schaus, you have made quite a serious statement in your brief, if I understand it correctly, when you say there is little possibility that, under present methods of organization and operation, the university can contribute much research which will aid the industrialization of this country. What would you suggest? Do you think the universities are doing too much research or that they do not listen to industry? What is your complaint there?

Dr. Schaus: I believe they are doing too much research.

Senator Bourget: Too much basic research?

Dr. Schaus: Too much basic research. I believe too large an amount of our research dollar in this country is being spent at the universities on what I call random research, which is research without a specific objective. That was the purpose of my statement.

The Chairman: That is a new concept.

Senator Bourget: Yes. I thought it was a very serious one because so far I do not think we have heard that before our committee. That is the reason I asked if you had a special reason in mentioning that. I think to a certain extent you say the same thing about the National Research Council.

Dr. Schaus: That is correct. My feeling on this is that Canada is a relatively small country with approximately 21 million people, and to try to do research in every field of world science is perhaps trying to spread all our facilities a little too thinly both in manpower and financially. For that reason I believe that permitting people to do random research in any field they care is perhaps getting out of contact with the size of our country. It is like the fellow who borrowed from the finance company all the time. Eventually it caught up with him; in other words he did not have enough income to support his borrowing. I think perhaps in research we are doing much the same. We really do not have enough income to support all the random research that is being done.

Senator Bourget: But some basic research has to be done, and I think the universities is where basic research must be done because you must in industry use that basic research to develop or to innovate.

Dr. Schaus: I agree absolutely; there is no question about that. The point is that this basic research is available from all parts of the world. It is published all the time. I feel that for a country the size of Canada our basic research should be in several specific fields so that we can concentrate it strongly enough that it will produce something positive, and not just get a little piece of this and a little piece of that and another piece of something over here that we can never put all together.

Senator Bourget: Coming back to Senator Yuzyk's question, he spoke about the creation of the "super" university.

The Chairman: A Canadian MIT.

Senator Bourget: And CalTech also. Do you think we should establish only one in Canada? Or do you think there should be research institutes created on the campuses of universities?

Dr. Schaus: I do not specifically say there should be just one. I may have used that expression in the statement but my feeling is that we should have possibly several institutions of this nature where the requirements and the expected achievements were above normal. I would not confine it to one necessarily.

Senator Haig: A standard of excellence, you mean.

Dr. Schaus: That is what I am really talking about.

Senator Haig: Others have said "centres of excellence".

Dr. Schaus: Yes, it is about the same thing.

Senator Bourget: Would it be under the government or under universities?

Dr. Schaus: Under universities. I think perhaps it should be part of the science policy of Canada to recommend that they be established or possibly to assist in the establishment of them in some way.

Senator Grosart: Or to establish them?

Dr. Schaus: Yes.

Dr. Stuart: May I make one comment just to elaborate a little bit on the collaboration aspect?

Senator Bourget: Certainly.

Dr. Stuart: The one thing that is different between the Food and Drug Directorate and most other government agencies that we have had anything to do with it is when they are proposing regulations or rules—the sort of things that Dr. Leger was talking about—to govern the conditions of working on a drug, they will talk to us and consult with us before they make the rules and regulations. Perhaps if we could have more of this kind of consultative thing going on before regulations were a fait accompli we could have some of the kind of collaboration that I am thinking of. It is certainly evident, from the conference of industrial research directors I attended at Sheridan Park in Ontario, that many people in industry feel this way, that there is not the kind of collaboration, when the government is talking about research or the support of research, that there ought to be.

Senator Grosart: Is there collaboration initiated the other way? In other words, we hear constant complaints from various performance sectors of lack of coordination, lack of consultation, lack of cooperation on the part of government. Is industry doing anything to initiate cooperation and consultation with the government?

Dr. Stuart: In that respect I cannot answer for the rest of industry because I do not know what other people's experiences are, and that sort of thing did not come out at this conference, but certainly we have made real efforts to collaborate and cooperate with the National Research Council.

The Chairman: You were referring to Agriculture a few moments ago. What was your experience there? What did you achieve? Did you not succeed in making any achievement?

Dr. Stuart: Our dealings with Agriculture have been in two senses. One, of course, is that they regulate certain products we sell in the animal health field or, at least, regulate them along with the food and drug directorate. In that case our experience has been good, not at the same high level as the food and drug directorate, but it has been good. Our other connection with them has been when we have attempted to use results of their research, and on the particular problem involved we got all sorts of information we needed, but it was clearly evident that if they had some industrial thinking at the front end then the results might have been different and more useful.

The Chairman: This, I think, is very important. This is a strategic phase where the results of research could be transformed into technology and innovation. Could you elaborate on that? Did they not want to give you the information?

Dr. Stuart: Oh, no. They did not object to giving us the information that they had but in the conception of the problem they were working on, if they had had industrial help, then I think they would have come up with a more useful result or at least they would have had a much greater chance.

Senator Cameron: In other words, it was too academic?

Dr. Stuart: I would not use the word "academic". It was not well-conceived. I do not know whether that is academic or not.

Senator Grosart: Mr. Chairman, I would like to ask something supplementary on that specific point. It might be difficult to come back to it later on.

The Chairman: Very well; we have plenty of time this morning.

Senator Grosart: I was going to ask specifically what attempts you have made to achieve what you call very aptly front-end consultation on science policy, regulations, or broader science policy in your own business? I am thinking now again of the front end.

Dr. Stuart: We have worked very closely with the national research council, for example, on the possibility of screening chemicals that are synthesized in Canada for possible drug use, and this would be what I would call some front-end thinking.

Senator Grosart: I was thinking of regulations more specifically.

Dr. Stuart: Apart from the Food and Drug Directorate no other body has invited us, and we do not know how to get at the people who make the regulations.

Senator Grosart: Have you ever asked them? Have you ever said, "Please do not bring in regulations without consulting us"?

Dr. Stuart: I do not know whether we have asked that question at the right level, and perhaps we have not. We probably have asked it of the people we have worked with.

Senator Yuzyk: How much collaboration is there in research within the drug industry? I will direct the same question to the brewing industry.

Dr. Stuart: I think Dr. Tishler should answer that question because he is more experienced in that aspect of the drug industry than I am.

Dr. Tishler: On occasion you will get collaboration on a specific project but beyond a specific project there is very little collaboration because you run into legal problems.

The Chairman: They would not only be legal; they would be financial too.

Dr. Tishler: They would be financial as well, that is quite right. But we do face specific problems where they have made a discovery and we have made a discovery and there is good reason why we should work together.

Senator Yuzyk: Do you meet to discuss these regulations?

Dr. Tishler: You are talking about the regulations?

Senator Yuzyk: Yes.

Dr. Stuart: Oh, yes, there we work together. There is no question about that. When we are talking about regulations, it is not Merck talking about the Food and Drug Directorate *per se;* it is the whole industry.

Senator Yuzyk: And you make representations?

Dr. Stuart: Yes.

Senator Yuzyk: What about the brewing industry?

Dr. Schaus: There are only three major brewers in Canada. That makes it very simple. We normally meet the Food and Drug people as a group. There is the odd occasion where one company might have a specific item that concerns it but normally all our meetings are done as a group.

Senator Yuzyk: Is there any collaborative research within your industry?

Dr. Schaus: There is no collaborative research within our industry but we do have collaborative research internationally. We collaborate with groups in the United Kingdom, South Africa and the United States.

Senator Robichaud: Some of the questions I had in mind have already been asked and answered. I would like to take this occasion to compliment the Merck Frosst Laboratories for their brief, and I refer particularly to pages 15 and 18 where they have made a valuable attempt to define the role of a science policy for Canada. I think it is worthwhile to bring attention to this part of their brief, and also to their conclusions and recommendations on pages 19 and 23. They have made their recommendations in detail and they are clearly set forth and easy to understand.

I noticed in Dr. Stuart's remarks this morning he stated that they were not really insisting on more money being spent on research. This is quite different from many, many of the briefs which have been presented to us so far.

My first question, Mr. Chairman, could be answered by both the representatives of the Merck Laboratories and the Canadian Breweries Limited. If we refer to page 14 of the brief of the Merck Laboratories it states as follows:

> In the last three years our growth has been slowed by the fact that we have been having difficulty in finding the best of highly skilled personnel. This same situation may exist in the coming years...

I think the brief from the Canadian Breweries indicated a similar situation.

My question is: In view of the fact that we have been told many times by many witnesses who have appeared before us that we have already a surplus of Ph.D's in the pure science field, is industry really looking for those scientists, and what efforts is it making to obtain their services?

Dr. Stuart: I think that what you have said is a true paradox, that in the midst of plenty we do not have what we need. For example, this year there are many organic chemistry Ph.D's coming out of universities, some of whom may have difficulty finding employment. At the same time we seek pharmacologically trained people, and chemically trained people with a biological orientation, and we cannot find them. That is what we meant.

I will give you an actual experience that occurred last year. We were looking for two Ph.D organic chemists. We advertised widely and we let our friends at the universities know. We interviewed some 20 candidates for those positions and in the course of doing so we interviewed 19 before we found a single native born Canadian. The twentieth we interviewêd was a native born Canadian, a chap from the University of Ottawa, and we hired him. The other person we hired was a Chinese who had taken some of his training in Canada. Of all the people we saw there were not many of them that were really well qualified. Some of them were pretty easy to reject, considering what our particular needs were.

Senator Robichaud: Was it due to lack of experience in a particular field?

Dr. Stuart: No, lack of training.

The Chairman: In this case they would be too academic?

Dr. Stuart: Too specifically orientated.

The Chairman: These were at the PhD level?

Dr. Stuart: PhD and post-doctoral level.

Senator Robichaud: Have you had any discussions with universities regarding this?

Dr. Stuart: Yes, we have had discussions with universities on it. Some university people do not agree with us. There are others who do agree. If one reads the publication, *Science Forum,* which I would recommend to you because it talks about the things you people are interested in, particularly in the last few issues...

The Chairman: It is well known around here.

Dr. Stuart: If you read some of the recent articles by Professor Arthur Borins of McMaster University, I think you get the feeling that the universities are commencing to realize that they are turning out people who are not necessarily people the country needs, speaking from the point of view of training. They are well-trained people, but it is not the training we need to do the work we have. That is what we have reference to here.

The only pharmacologist applications we get are from foreign people. After looking for two years, we finally got an Egyption. They are hard to get in the United States, because they are very scarce down there too.

Senator Yuzyk: Do you offer scholarships to encourage scientists to go into particular fields?

Dr. Stuart: Not generally, although we have on particular occasions done so. We have done a little bit of that but not very much. I might say something that is probably well known to you, that with the slowing down of support by the government of the United States and the Government of Canada as well as other people, we are being approached by hospitals, by universities, by many other people with good projects, and far more projects that we could hope to support in the way we would wish to do so.

Senator Grosart: Have you initiated discussions with the universities on the development of the kind of curricula that would suit your industry? The students seem to have done it fairly successfully.

Dr. Tishler: May I answer that question? I hope, as a result of these deliberations, you do not come up with the idea that universities ought to train people specifically for industry. I think there are certain disciplines we need. Dr. Stuart has mentioned pharmacology and the biological sciences. There is a lack of people in specific biological sciences, and also in pathology. But what we want for industrial research is a good research man, a man who has been trained in the best tradition of research in a university. I do not care what he has learned except that he knows how to tackle research problems. The thing we need from universities is a motivation to go into industry. This is a thing that has been lacking. I am referring to the difference between the university environment, the industrial research environment, and even government research environment. There has been a cleavage. It is pretty big in England. I do not know exactly how it is in Canada. That is the situation in the United States and it is probably having some influence here too. I have spent a lot of time in Canada and I think it is here too. So, as I say, this is what we need. Do not get the idea that you should train people specifically for industry. That would be a big mistake. They have to do basic research in the university, they have to learn what it is all about. The only difference between us and the university is the objective. The methods are the same. I think that is the answer to your question.

Senator Grosart: The recent evidence I have seen indicates that there is animus among university people at the undergraduate and graduate levels against a career in business. Business has to take some responsibility for that.

Dr. Tishler: That is right. It is on both sides.

Senator Grosart: The orientation is towards teaching. Therefore the tendency will be to broaden the base of their education and research rather than to narrow it.

The Chairman: Do you have any comments, Dr. Schaus?

Dr. Schaus: The comment I have is that our experience is not too dissimilar from that of Merck Frosst. We run a smaller and a different type of lab, but we encounter the same type of problem. The work in our lab is about 35 per cent basic research, and the rest is applied research. We can get all the help we want, but we cannot get all the help of the type and calibre that we want. We have many applications every week, and I am sure the same is true at Merck Frosst, but most of these people are very theoretical people, and, since we only have a very small proportion of our effort on the theoretical and basic side, we are unable to fit them in. What we really require are people who are oriented to industry and to the application of research as much as doing research. Even though they have a PhD is no reason why they cannot be interested in the application of their work. The background training they have had while they have taken their PhD is an excellent background to use in applying the research of others because, as I said before, we are a small country and many times we have to apply the research we read from the United States or England or any other place. So our problem is obtaining the type, not the quantity but the type that we want.

Senator Bourget: Are you doing research for your companies in the United States?

Dr. Schaus: Yes.

Senator Bourget: Are the scientists working in your labs of Canadian or foreign origin?

Dr. Schaus: We have a large percentage of Canadian-trained people in our lab. However, as to their basic origin, probably 60 per cent or 70 per cent would be European.

Dr. Leger: I would like to comment a little further on this "excellence" question raised by Senator Robichaud. It is true that we have more and more PhD's in our academic community but I believe, and I hope I will be forgiven by my colleagues if I am not stating this correctly, that the Canadian society is still at the stage where industry is more criticized than respected. A good number of scientists believe that they would just decrease their prestige if they worked anywhere else than in the academic field. I am convinced that industry is not as bad as it is painted. I am sure that industry has contributed to advances in science. I do not think that I am perhaps the right voice to be expressing this, and I wish Dr. Tishler would elaborate a little more on the quality of research in industry and on the freedom of scientists working in this field and the prestige that any scientist could gain, and also what other advances for the whole community would result from the initiation of industrial research.

Senator Grosart: Might I just add that perhaps Dr. Tishler would include in his remarks some comment on what national science policy in the sense of a policy laid down by politicians can do to help this situation. That is our job here, to answer that question.

Dr. Tishler: Dr. Leger has sort of put me on the spot because what he suggests as a topic for discussion is one that could take quite a bit of time. However, the subject you are deliberating is one I have been quite concerned about in the United States, and I have also been asked to speak about it in England. I have two talks here, which I believe have been filed with this committee. One was a talk I gave to the Royal Society in England called "Secrets of High Moment", which is a slice from Macaulay's History of England. It is a discussion about making a success of research in industry. The second one is a talk I have before the National Research Council and the National Academy of Sciences on the "People's Welfare, Health and Medicine", and the role of industry in national science policy. So you can see I have given a lot of thought to this.

In addition to that, I know some of the problems in Canada. I have been associated with the Canadian subsidiary—the initial subsidiary, the Merck Company subsidiary—since 1937, and I have participated in a number of different break-ins, bringing processes to Canada, the manufacturing, and actually with Dr. Stuart I have personally participated in these things many years ago.

I have a feeling that some of the things that have been said today and the things you are thinking about probably ought to be assessed in terms of what it is that makes science tick in both industry and universities and governments. I made a series of points here that I just want to read off, and I will elaborate if anyone asks me to do so.

I am not very rigid. I do not think we should try to get the universities to do the work for industry. I think the university is for two purposes, for scholarly knowledge; for training people in scholarship, as well as advancing knowledge. Those are the two functions, I think, of the university. I do not expect them to do the job of industry or government. Keep that in mind because this is where your new ideas of the future are coming from.

Government laboratories do some basic research as well, and they must do it, as well as trying to carry out the directives of government; that is as government conceives policy. This to be done. The same with industry. Industry has to do basic research and it has to do applied work also. It has to do one thing particularly; it has to account to a different audience, namely to its management and its stockholders. This accountability is the difference that all three segments have. Therefore you have the different aspects of how you get research done in the different areas.

I think this matter of accountability is something that you folks will have to address yourselves to when you start thinking in terms of supporting research in industry. The one thing I object to is actually giving grants to industry to carry out specific research. The reason is that I think you get to the point where the accountability now is to whom? It is not really to management because you are paying the bill. And it is not really very strict as far as government is concerned. My feeling is that you try to do it through some type of tax method. We have accountability in industry. If I do not produce as head of research for the company I am going to be fired. We have 1,800 people who have to earn their living in research, and we all have to do something right in order to keep these 1,800 people and their families off welfare. We have that written into everything we do in research.

The thing you have to do in these three segments is have good intercourse and communication on all these things. How do you do that? Not by committees. I think these committees are deadly. I think you have to encourage an interchange by lectures, sending people to universities, all kinds of things where you bring university people to industry and industrial people talking to the universities, and the same with government laboratories. They are all scientists. Try to get them on an equal footing somehow. If you do that, then there is going to be an interchange of ideas. There is no question about that. You are going to learn what is going on in government labs and what is going on in industry and in universities. If the university man wants some help he will know where to go once he begins to realize that industry research people are pretty human beings and they are pretty capable and they can be of some help to him, and vice versa.

So we have to break down what I think exists here, maybe not as much as in England, but it is probably to the same extent as in the United States, the so-called social barriers that exist between these three segments. And I do think there are ways of getting around it.

As I said before, try to train researchers in universities for research and not train them for industry. I think that is a very important thing.

You have to encourage top-flight scientists in industry. This was alluded to by both these other gentlemen here. You are not getting these top-flight people because of these barriers, these social barriers. The universities have to point this out to their students, and industry has to help, making students realize there is a good research career in industry. This is what is missing now. The difference is the objective.

Senator Grosart: But how do you explain the case put before us that of 20 applicants only one was acceptable? The applicants obviously thought they were fit to do this job. If they are not going to be somehow oriented towards a job in industry, which these 20 wanted, how do you reconcile this with this rather laissez faire theory?

Dr. Tishler: It is difficult for me to understand that, sir. In other words, it is hard for me, knowing the calibre of universities you have in Canada, to understand how 19 out of 20 applicants for a specific job or for a specific discipline, say organic chemistry—are you referring to that?

Dr. Stuart: Organic chemistry, yes.

Dr. Tishler: That 19 of them just did not meet the standards you had.

Dr. Stuart: I did not quite intend that. If I said that, then it is not quite what I intended to say. I said 19 were non-Canadians and one was a Canadian. We hired him. We hired two people. We hired one of the others who, as I said, was Chinese. Of the 18 who were not hired, some were obviously not qualified for what we wanted them to do.

Senator Grosart: Let me put it another way. What percentage of the 19, if they had been Canadian, would have been eligible for the job?

Dr. Stuart: At the standards that we set, not more than a third of them. It is partly a case of what you said but I wanted to clarify the record, that we did not turn down 19 because of lack of qualifications.

Senator Grosart: That is quite right. I took an implication from your statement that was not there. I agree.

The Chairman: Would you like to carry on?

Dr. Tishler: The other thing is that industry has a lot to learn too, and we are still learning here as in other countries. Industry has to learn to support research and devote part of its earnings to research. In the long run, and I think this is very important, the basic type of work has to be sponsored too, and people should have that available to them because this is the thing that motivates people in research. In addition to that, it is the thing that is going to attract people from universities and government labs to come into industry. We have to find a way whereby industry will spend more money. I don't care whether it is in the brewing industry the metallurgical industry or the pharmaceutical industry.

Our company, in its research department, publishes close to 200 scientific papers that go into all the good journals, the same journals in which anybody from McGill or Harvard would publish. So you have to have that given to them. The thing that attracted me to Merck & Company in 1947 was the publications that came out of Merck, publications on things that I thought were tremendous for a research organization to do. That is why I came to Merck & Company.

I think a strong patent position is essential to encourage research. I will not go into this because I am sure you have deliberated that a great deal.

I have down here an item: discovery, development and production in Canada. I think this is the so-called reverse brain drain that I ran into in England where they say, "Sure, you set up laboratories here but the stuff goes back to the United States and you produce there and you take the place of Great Britain". Well, we have a research group in Canada. We have three fields. We limit ourselves to only three fields, which we are not covering in the United States or in any other part of the world. We have given them this responsibility and I hope these fellows will discover something in one of those fields which has to be supplied to the world because I like that challenge. I think we are going to work something out, and Canada then is going to be the revolving point of this whole thing. This is something I hope we can get to when these fellows make the discovery we want.

Mr. Chairman, I think I have now pretty well covered my points.

The Chairman: Thank you very much. We will be coming back to you, I am sure.

Senator Bourget: There is one thing I would like you to eleborate. You mentioned that you did not like the idea of committees. However, who would do the co-ordination?

Dr. Tishler: I do not think you really need coordination. I am peculiar that way, I guess. I think in the type of system we are in...

The Chairman: You are talking really about more personal contacts?

Dr. Tishler: More personal contacts, yes. There are certain things, for example, that you have to do. If you are going to do satellite work, it is so big for any one company you are going to have to give out contracts, and you must have some way of coordinating that, of course. Whether it is ever going to give a return, God knows. Perhaps there will be a return by going to the moon or some other place. This is where government comes in and says, "You have to have coordination". That is, of course, a different story.

If we are talking about the whole idea of putting things into useful items, all things, not just specific projects, then I think these committees can be awfully deadly because, from my point of view, committees are dominated by certain people and they can go in the wrong direction. The strongest person, the most vocal person, is the one who wins.

Senator Haig: You must be referring to this committee.

Dr. Tishler: I apologize.

Senator Robichaud: My last question arises from page 4 of the Merck Frosst Laboratories brief where at the bottom of paragraph 4:1 it states:

> ... a number of good scientists have remained in, or been attracted to Canada to form the nuclei from which really first-class centres could be built. However, the number is too small and the support they have had too meagre to achieve anything like the full potential of their capabilities.

It goes on to say in Paragraph 4:2:

> A striking example of this lack is seen in a comparison of the support of research in eighteen universities in the United States with that in all Canadian universities in the year 1964.

I suggest that that is quite far enough back to make a realistic comparison. However, it goes on to say:

> For that year Canadian universities had a total support of \$26.8 million for research support while the eighteen U.S. universities had a total support of \$534 million and all but seven of these latter had support of more than \$26 million. Thus, the Canadian total was then less than the average paid to one of these universities in the United States. This

leads us to disagree with the suggestion of the Science Council that Canada is doing too much fundamental research at the expense of applied research; and to agree with the Medical Research Council that we have a thinly spread effort of overall modest achievement.

The Canadian pharmaceutical industry, when they appeared before us claimed in their brief a total research expenditure for the Canadian pharmaceutical industry of $12 million. If we look at the eight major companies in the United States we see that their expenditures averaged $25 million per company, which is twice as much as the total investment made by our own Canadian industry.

My question is: Would it be true to assert that the total pharmaceutical research in Canada is about half that of a typical single international company, and therefore we have a thinly spread effort of overall achievement on the part of our own industry?

Dr. Schaus: I think any of those numbers are very dangerous—and I have read through this brief and many other briefs—because it depends on what universities you select. If you compare Memorial University in Newfoundland with the University of California, naturally you can come up with any of these comparisons. So many of these comparisons that I read must be approached on the same basis. It depends on the basis you select.

The Chairman: I suppose Senator Robichaud assumes that the comparisons are scientifically based.

Senator Robichaud: If you gave that total to all our universities, considering the total contributed by all our industries, and compared that with a single unit in the United States, you would find that our proportion is only a half. Could there be a more active effort of the part of the industry? You are asking the government and the universities to do more, but what about the industry itself?

Dr. Stuart: I would like to make some comments on that and, no doubt, Dr. Tishler will add to them. First of all, I admit these statitics of 1964 are old, but they happened to be available and we give them for what they are worth. I do think they indicate something of which we should all be aware.

Senator Robichaud: We had a similar experience yesterday with another report that was given, and which was out of date.

Dr. Stuart: I realize the shortcomings in this, but it is very hard to get up-to-date information.

The Chairman: It is not too much out of proportion, because if your compare our total scientific activities in Canada with those of the United States, you see that we have a budget of about $1 billion now, including all scientific activities, and that the United States spends about $25 billion, so the proportion is 1 to 25.

Dr. Stuart: Yes. To continue, I think the $12 million that you have mentioned the total industry is spending in Canada is the figure I know, and this was one of the bases on which the Medical Research Council made its statement that we have a thinly spread effort. Incidentally, they were talking about universities as well as industry when they made that statement; they were covering the whole sector.

I would like to add that in our own case we are spending between $1.2 million and $1.3 million per year in research, which is about 5% of sales.

The Chairman: In relation to the parent company in the United States.

Dr. Stuart: Dr. Tishler can answer that.

Dr. Tishler: About ten. However, there is an awful lot of development work being done in the United States which is being done for the whole world that we are not doing here. I look at Canada and the research we are doing here as coming to the fore in the last five years. I suspect that once there is a taste of the blood of accomplishment this is going to grow without any problem.

Senator Robichaud: What progress have you made in the last five or six years, say, in the percentage of your sales or in relation to the volume of business?

Dr. Stuart: In the growth of research?

Senator Robichaud: Yes.

Dr. Stuart: The table is in the back of the brief.

Dr. Leger: Pages 13 and 14.

Senator Robichaud: I am sorry. The figures are available?

Dr. Stuart: Yes.

The Chairman: Chart H.

Senator Grosart: It indicates about the same rate of growth in Canada and the United States from 1961 to 1968. It is Chart H.

Dr. Stuart: Yes. If you look at Chart H you can see the actual expenditures by the total company and by ourselves in Canada, including Frosst who we did not unite with until 1965. You can see that our rate of growth parallels theirs.

There is one other comment I wanted to make. In a recent survey in the United States by size distribution of research and development budgets among the pharmaceutical industry they had seven classifications among their companies down there doing research starting at Group A which spent $20 million and more on research, and Group B, which spent $1 million to $5 million, and there are still three groups below that. We would be equivalent to Group B in the United States. So we are not, considering that we are young, as Dr. Tishler has pointed out, and just beginning to get the bit in our teeth, doing all that badly as far as our own company is concerned. We hope that what we do will stimulate other people to do more as well.

Dr. Tishler: I think we have helped in the United States to train some of the people in Canada today, and this is important to us obviously, but we have had them down there, and Dr. Stuart has been there, we have had a lot of people spend time with us and we send people up here. Incidentally, we get a reverse bonus on that. They come down and show us new techniques. They know everything that goes on in our original planning which is very important. When we make up our programs for the whole world they are there; they contribute to that.

We are concentrating, as I said before, on three fields. Nobody else does this. In other words, it is reserved for them. So that there is no excuse if they do not succeed.

Senator Grosart: It has been suggested, Mr. Chairman, that we have the 14 points. I will keep quiet while Dr. Tishler gives those, if he will.

The Chairman: I think he has gone through them.

Dr. Tishler: I did not count them but I did go through them. I was talking about the encouragement of communication between the three segments of research, breaking down the social barriers, training scientists, and so on. I covered it all, although I did not put it down as 1, 2, 3, etcetera.

Senator Bourget: I would like to ask one question so that I may have something clear in my mind.

The Chairman: You are not usually confused, senator.

Senator Bourget: Well, it depends. Instead of grants to universities, you would like tax concessions?

Dr. Tishler: Not to universities; to industry.

Senator Bourget: You would prefer tax concessions?

Dr. Tishler: Yes, and not complete tax concessions. You have basic research, you have development, and then you have the facilities for production. There are three segments which I think have to be looked at separately from the point of view of motivation. I think, on the basic research, you ought to support basic research in industry up to a certain point, but not 100 per cent; I do not believe that. So that industry also has to pay for part of it. And then there is the accountability factor. What have you done for me? What have you given me? This is inside the company now, you see. My boss gets after me, and his boss gets after him. I think that is important.

Then when you get into development it is a little different story. The goals are clearer now in development. You have achieved in the laboratory an accomplishment. How do you bring it now to the consumer? You begin to do all these things. The goals are different. The costs are different. Again, the risk is not as great as it was initially.

The Chairman: The cost is higher but the risk is lower.

Dr. Tishler: That is right. You begin to see clearer what you are doing. There is a risk but it is a pretty good one, ordinarily speaking, if the concepts are good to begin with.

Senator Bourget: Dr. Schaus, what is your answer to that?

Dr. Schaus: I think it is a very good idea. We will still be spending 25 to 30 per cent of our own money, and we also have the accountability factor to our management. I believe it is the only way to operate, where there is an accountability for everything that is spent.

The Chairman: As a committee, perhaps we shall also have to make recommendations as to what should be the total government budget awarded to science and technology. I wonder, with your long experience in this field, whether you would tell us how your own company arrives at a research budget?

Senator Bourget: The formula is in the brief but it is not easy to arrive at a conclusion.

Dr. Tishler: It is actually a matter of how well I sell the program to the company. I must say that we get about 98 per cent of what we ask for each year. Thank goodness, we have been able to justify it.

Senator Robichaud: Can you show government how to achieve that percentage?

Dr. Tishler: We never talk about it in percentages. It comes out that way. Actually, this is an interesting thing. The research people make out their research program. We do a research program with no dollars attached to it. Then we give it to the financial people to tell us how much it is going to cost. We present it then to management and go through about a month's discussions with management on and off, and they will approve it. Oddly enough, over the years our percentage of sales has remained almost constant, and yet ours sales have gone up. When I came to the company sales were something about $60 million, and today they are up over $600 million. Our total research budget around the world now, including Canada and everywhere else, is running about $54 million. So about 9 per cent of our total sales is going into research and development. Fifteen years ago it was about 8 per cent, or something of that order of magnitude. The interesting thing is that, while our budget has gone up, our sales have gone up in about the same proportion.

Senator Bourget: Does your budget on research vary very much from year to year?

The Chairman: It is going up?

Dr. Tishler: Up, yes. We have had a few dips over the years.

Senator Bourget: A lot of people have mentioned here that the figure that might be set could be 1.3 to 1.5 per cent of the gross national product, but others have said "No, you cannot do it that way. You have to analyze what kind of research you are going to do and how much it will cost." It is all right for a company like yours, or a company like Canadian Breweries, because you have the experts, but here in the case of the government who is going to do this?

Dr. Tishler: I think you should have very good experts advising you. I am sure you have Canadian people, scientists, who could do that.

The Chairman: Do you look at the programs of competitors? For instance, the former director of research of Union Carbide was saying that as a kind of rule of thumb a company which wanted to remain in the race had to have a research budget which was higher than the average in that same industry. Would you say that is a good rule of thumb?

Dr. Tishler: We have operated on the basis of what do our scientific people think they can do, and do well? What have they in the way of people, what have they in the way of ideas, and what capacity is there? And it is for them to put together a program, and then add it up. The company has to look at what they think their sales are going to be the next year, and how much they can support. While they can take a dip one year, they cannot do that sort of thing indefinitely. That is pretty obvious. So it comes down to what the company can afford to pay when we give our program. If they think they have a good year ahead they will accept the whole thing because management are management and they have to rely on me, as a top scientific man, in respect to the validity and promise of a particular program. They are not scientists, they are lawyers or business people; they are people like those who make up the Senate. They have to depend on the scientific person. I will recommend that program. I will screen it and cut it back, if necessary. I have done a lot of that.

The Chairman: That is, before it goes to the Treasury Board?

Dr. Tishler: That is correct. So they take my word. The only thing is they can come back saying, "Next year we expect to have a bad year and we will have to cut out $2 million". They sometimes pare them. A lot of people cry about it. However, $50 million is not a poor budget; it is not a poverty program.

The Chairman: Would you say that management tries to maintain more or less a continuous relationship between your research budget and the total volume of sales of the company?

Dr. Tishler: Yes, I think that is right.

The Chairman: In the long run?

Dr. Tishler: Yes. I think back of the whole thing is this parallel curve that they see. They have to be able to afford it or think they can afford it. If it is too rich for their blood they will talk up. It is the same thing with you people. You have all kinds of problems, all kinds of demands for money, and you have to think of priorities.

The Chairman: So we are back to a comparison with the MP's at the national level. I am sorry we have taken so much time but I think this is the first time we have investigated the way private industry goes at its own research programs and budgets.

Senator Bourget: Do you divide your budget into long and short-term research programs?

Dr. Tishler: We talk about short-range and long-range, but we have very few short-range programs. We think they are short-range but then we find out they are 15 years in the making. None of these discoveries we have are short-range. From the time we get a concept in the chemist's mind or in the biologist's mind until we get a product could be 15 years. From the time we make an observation in the laboratory, the first lead or the first observation in the laboratory for something like for tuberculosis, we can talk about 10 years before we go to the market. That is, if everything goes well you can talk about 10 years. So these are in fact all pretty long-range. At least 95 per cent of our research is that way. We do not have something where someone comes in and says, "Look, I have a car that gives me trouble; fix it up because I have to go down to the beach," we do not conduct that type of research. Every one of these things takes a long time.

These things are all in our green book. That is the book in which we keep a study of them, and keep tabs on them all the time. They are in there for years. We will change objectives but they are still there. We will change how we go about it. The approach may be changed but they are still there as a program.

Senator Grosart: On the other hand, if antihistamines are suddenly selling, you have a pretty short-range program to get an antihistamine product on the market.

Dr. Tishler: If you are talking about a "me too", it used to be that way, but not today. It still takes an awfully long time to get up a "me too". If you are looking for an antihistamine which is something you yourself have developed with your own chemistry, this can take 10 years. I am not sure whether I am making myself clear.

Senator Grosart: You mean the original development. However, if somebody else has the product and it happens to be highly marketable and getting a large percentage of a certain sector of the pharmaceutical market, you are going to be in there very fast. All the evidence we have heard indicates that.

Dr. Tishler: We do not do it. Again, I come to this positive business of our own people wanting to make their own discoveries. With these things we call "me too's"—where somebody has come out with something and you can make a little modification and have the same activity. In today's thinking it is going to take at least five years to do that. You cannot just do it tomorrow. We have the regulatory agencies we have been speaking about. They make big demands today.

Before you go to the clinic—and this is after you have enough of the compound and you know what it is; you have made it and it is economical and everything else—it will take you from eight months to a year to get ready for this process that we were speaking about with the Food and Drug Directorate. It will take that much time before you put it in a single patient, and you are going to have it in at least 1,000 patients before Food and Drug will say, "Yes, we will accept those data as good evidence." This could take another two years, you see. Food and Drug have to mull it over, and that takes another year say. So by the time you are all through it takes about five years for even a "me too". In years past you could take a "me too" and put it on the market in six months or so but you cannot do that any more.

Senator Grosart: Could I just follow this up with a supplementary question, and this has to do with the footnote on page 9 of the brief which it refers to the fact that Canada is the only country with these demands, and the demands are those that set up the long time lag prior to the human pharmacology phase. How did it happen that Canada is the only country in the world that has this long time lag? How is it that we are the only country that has this restriction?

The Chairman: It is because of the rigidities of our system.

Senator Grosart: Obviously it is because of the rigidities, but where do they come from?

Dr. Stuart: I think this all happened with the thalidomide incident back in 1962 when everybody in both government and in industry got very concerned. The Canadian government regulatory authorities reacted far more strongly than did any other regulatory agency in the world, including the United States which has extremely high standards as well.

Senator Grosart: This dates only from 1962?

Dr. Stuart: Before that you did not have to go to them. When you felt you were ready, and had the necessary toxicology, etcetera, and felt the drug was safe, and so on, on your own initiative you could go. Since 1962 in this country, and the United States and England—to name three countries that are very concerned with this type of thing—you have had to do this preliminary work and demonstrate to the government that you have done sufficient before you go. Now, Canada differs in that it demands that more be done. It also demands that what is done be studied and agreed to by the Food and Drug Directorate before the material can be given to humans. In the United States you do what you consider sufficient to demonstrate safety, and everything else you have to demonstrate, and upon filing with the Food and Drug Administration there you can immediately put it into humans without waiting for them to review and say whether they are in agreement with your conclusions or not.

Senator Grosart: When you say put it into humans, are you speaking of doing it on an experimental basis?

Dr. Stuart: On a very, very restricted basis, and in an extremely well-controlled program, in a hospital, for example, where there are all the facilities for doing all sorts of tests, checks and controls, and under the top man. It would be under the direct supervision of the top man you could find in that particular field, backed up by all the facilities that are necessary to follow it through. He would start with one or perhaps two patients, with a very small dose, and gradually build up the dose until he began to see what happened. So that when I say you can give it to humans, I do not mean you can give it willy-nilly. It is done under the most carefully controlled conditions you could possibly find.

Senator Grosart: I am glad to hear that. It explains what happened to me about a year ago.

Senator Cameron: Mr. Chairman, this discussion seems to me to relate to something we have discussed earlier, and that is the question of the national inventory of what we should or could do in Canada. It seems to me from a management standpoint—and I think our committee must be concerned with the management of science in Canada—that the project approach is a sound one. In other words, you say, "All right, here is a program that we think Canada as a corporate entity should embark upon." This is not just pharmacy; it is everything. We should have a body of people who say, "We think this should be the Canadian program for five years." Then we turn it over to the financial types who say what it is going to cost.

I think from a management standpoint that is a good approach. However, it has complications because it all comes back to the financial end of it. All of you people have been suggesting a tax holiday. Suppose, in terms of our present expenditures of $1 billion roughly on research and development in Canada, this committee in its generosity says, "All right, we are going to recommend $1.5 billion for 1970." The treasury people are going to have something to say when we suggest, "You do this and give a tax holiday". They would likely say, "Where is the money coming from?"

Suppose this committee in its wisdom said, "We will give you a tax holiday. We will give the oil fellows a tax holiday, and all the others. It is going to cost $500 million." None of you has suggested alternatives as to where this money is going to come from. Yet this committee is going to be asked that very thing, "Where is the money coming from?" Have you any suggestions in that respect?

Dr. Tishler: I thought I might have it in one of these talks, but I recall now it is not there. I think you have a very tough problem in setting priorities. On the other hand, if you really mean what you say about getting ahead in science you must realize that science is a very expensive thing. If you really mean to pick yourself up through research and development, you must consider that it is expensive. In the States we had tariffs all the time and were protected in other ways, and I think to some extent this built our industries, particularly during certain periods of our history. I think you have to think in those terms, if you really mean what you say about creating a research environment and a research capacity. Sweden, which is a smaller country than Canada, which has done a tremendous job that way. Switzerland has also done a tremendous job that way. Maybe you have something to learn by looking at how they did it there. They are smaller. They have had a very great capacity in research. As you know, many universities in Germany, and in Europe generally, were just flooded by Swiss and Swedes for a long period of time because they were creating so many good scientists.

I cannot help you but I realize you have a problem of priorities. In the United States we have all kinds of priorities. I can understand what is happening. I think it is good for our souls to sort of hold back for a while, and get ourselves re-oriented from the point of view of our society.

Senator Cameron: I think we accept that we must establish priorities. This comes back to something you said this morning, speaking as a group, about academic freedom. If we establish priorities, and, as I say, I think we must, then somebody must say to the universities, "We cannot permit the continuance of random research to the extent we have."

Dr. Tishler: I do not like the term "random research."

Senator Cameron: Well, to be realistic, this is what goes on.

Dr. Tishler: Would you go to the history department and tell the historians, "You cannot write a book on some little aspect of history; you have to write it on the big issues because otherwise you will not sell your books and we will have to pay you more salary"?

Senator Cameron: The history department does not cost so much.

Senator Grosart: We do that now by saying, "We will fund A but we will not fund B".

Dr. Tishler: In the universities?

Senator Grosart: It does not matter where it is. If you are talking about federal Government funding, we are making these selections. Our problem here is to decide whether we are making them on a rational, sound, logical basis, or whether it is just an *ad hoc* network of decisions more or less unrelated and uncoordinated.

Dr. Stuart: You have to do that, as Dr. Tishler said. We, as individual scientists, including all the scientists in my group as well as the groups elsewhere in the world, come up with projects. We do not have an unlimited budget to work with but we want to get all the ideas together that we possibly can and then, as Dr. Tishler says, we have a scientific screening and we have it followed by a financial screening. No matter who is funding the research, I do not know how you can do it any differently. You get the good projects and they are proposed to NRC by the universities, or to the Department of Industry by industries, or however it turns out, and some way you have to have the kind of evaluation that the projects I propose to Dr. Tishler are subjected to in our company. They must stand or fall or be cut down or expanded, depending on their worth relative to the worth of the 500 projects that come up, or whatever the number may be.

Senator Cameron: But in effect your group and others have suggested that university research has not been as effective as it should have been because it is not sufficiently directed to applied research.

Dr. Stuart: I am sorry, but we did not say that. If we said that, then we did not intend to.

Senator Cameron: Others have said that.

The Chairman: I think Dr. Schaus said that.

Dr. Stuart: What we intended to say—and perhaps we did not make it clear—is that the universities have an obligation to themselves to establish, as our friend from the Canadian Breweries has suggested, either one very excellent MIT type university or have in the various universities a really top department of pharmacology that is as good as any department of phamacology you can find anywhere in the world, or similarly a department of chemistry.

They do not necessarily have to be in the same university, but it seems to me that the funding authority, whether it be government or private, should have this very much in mind so that the funds are directed in such a way that perhaps McGill will build up a capability in pharmacology, and have the top pharmacology department on the continent, if possible, and perhaps at the University of Montreal the department of physiology would be similarly placed. We are suggesting that kind of thing.

I think the same is true, as far as industry is concerned, speaking broadly. However, we cannot cover the whole waterfront. We do not pretend to cover the whole waterfront in the pharmaceutical industry ourselves. We have a small piece of it. What we have we intend to cover as well or better than any other group anywhere else in Merck. That is our objective. It has to be our objective. If the government wants to sponsor research it has to sponsor research in such a way that it builds up this type of capability, whether it be university or industry.

Senator Cameron: I think universities today are being forced, because of economic necessity, to specialize. For example, in Alberta we specialize in petroleum geology. Toronto has a first-class aeronautics department. This is coming about gradually and that is right. However, the suggestion has been made, and this is a serious implication, that university research is not being effective. You have made that point, Dr. Schaus, and I think there is some justification for it, because it is not related directly to applied research. How do we correct that? How do we get at it?

Dr. Schaus: First of all, I think as to the university's academic freedom, that people have taken liberty with that term and they have used it to do almost anything they care to do. I was at university for a while teaching and there was no real control on what area of research you were in. If you had two graduate students you just worked in some area that was of interest to you. Everyone else did the same thing, with the result that there was no planning or coordination of the research that was done. You could work in almost anything under the sun.

I think that the National Research Council could do quite a bit in this area by not granting postgraduate fellowships to such a large proportion of people who are working in random areas, as I call them, and by tending to favour some other groups.

Senator Cameron: Have you made a direct representation to the National Research Council?

Dr. Schaus: No, I have not.

Senator Grosart: Could I make this comment, Mr. Chairman? The suggestion has just been made that if NRC did this it would help. From our evidence here we would have to say, "If the 22 departments of government which are funding research had done the right thing then we would have the right answers. If the Canada Council did the right thing we would have the right answer in the cultural-humanities field." So if everybody does the right thing we would have the right answers.

Senator Haig: We would have no committee.

Senator Grosart: This is not a national science policy. I am going to make a suggestion that I am quite sure will frighten the gentlemen here, but I am wondering just how much it will frighten them. First of all, if we have to correct this situation, would you agree that a national science policy—that is a decision by politicians—should be that of our funds in universities so much will go into basic, so much into applied, so much into development, and so much into innovation research?

Dr. Tishler: I am not frightened.

Dr. Schaus: I would agree because this is exactly what we do when we go to our board of directors with our research programs. We say that we are going to do 35 per cent basic, 25 per cent applied, and so much will be spent on development.

Senator Grosart: That is wonderful. That is the first time we have ever had anybody agree with that.

Dr. Tishler: I would say only one thing, that I hope you would have a little flexibility in that.

Senator Grosart: Oh, yes, we always have flexibility. It usually goes the wrong way. I will not mention where this was, but we had a building where the flexibility was such that we went from \$8 million to \$50 million.

The Chairman: That is a liberal exaggeration, not a conservative one.

Senator Grosart: My next suggestion will be more practical.

Dr. Stuart: I think what you have said is a very good idea but I think it has to be done by building up the departments which can do this in the universities. That has to be part of the objective in addition to getting the kind of man who will be interested in development, if that is what you want.

Senator Grosart: As with everything.

Dr. Stuart: So that you build up the engineering departments because they are the ones which are going to tend to do the development and innovation in contrast to the basis science departments.

Dr. Tishler: I do not think the senator meant all this money was going to the universities.

Senator Grosart: No. I was only saying in this area we might do the same thing in industry, and we might do the same thing with in-house. I was relating it for the moment to the universities.

Dr. Stuart: I would add this comment, when you are talking about industry, that you still talk across the whole spectrum from basic right through applied.

Senator Grosart: Oh, yes, of course. My second suggestion comes out of the Merck practice, which we are told is that you are spending $1,300,000 in Canada and $41,700,000 in the United States.

Dr. Stuart: It is $41,700,000 world wide.

Senator Grosart: Is it?

Dr. Stuart: Yes.

The Chairman: You said about $25 million—or was it $12 million?

Senator Grosart: In the chart we have $41,705,000.

The Chairman: How much does your company spend in the United States?

Dr. Tishler: I think it is $41 million.

Dr. Stuart: I am sorry. Yes, that is correct.

Dr. Tishler: $41,700,000 is the United States plus Canada. It says that here. You substract $1,300,000 from the $41,700,000.

Senator Grosart: So there is about 3 per cent of your total expended in Canada. I am not criticizing or commenting on that. You have also a policy that you selected three main areas which you give exclusively to your Canadian complex for research. As a national science policy, would you be terribly frightened if the Government of Canada made this, or something comparable to this, a rule for all subsidiaries of foreign companies in Canada? To put it another way, would you be frightened if the national science policy said any company with a subsidiary in Canada has to relate its funding of research in Canada to its Canadian market?

Dr. Tishler: I think, as far as Merck is concerned, it is not going to hurt us, but over the whole spectrum it is a pretty tough one. Perhaps you can help me, and here we are asking suggestions of you; we are finding that this concept of yours is beginning to affect every nation in the world. They want research carried out on their soil, whether it is Columbia in South America, England, Canada, or the United States for that matter. We just do not know how to face that problem because this is not an idle thing. They are all rumbling along in this vein, "You have to have a research laboratory here. We are worrying about our technical people."

Senator Grosart: We are a developing nation, you know.

Dr.- Tishler: I am sorry; you are a developed nation. The point is, how do you meet that if you are an international company? What I am trying to say is that I think the moment you start putting that type of restriction on, you have to see that you do not get the same thing happening the other way around. Are other countries going to come back to the Canadian people and say, "You have to put research in"? I am not sure what countries are involved—whether, for instance, France is involved—but there are countries that are getting manufactured products that are sent out from Canada.

Senator Grosart: In view of the fact that two-thirds of our manufacturing industry is owned outside of Canada, we have to win.

Dr. Tishler: I realize that the question I am asking, from your point of view, really is not anything you should worry about, but it is a question we have to face.

Senator Grosart: Of course.

Dr. Tishler: I worry about it when you raise that concept of having everybody, no matter who they are, do research in Canada. If that spreads around the world, then we are going to get into a ridiculous situation. I would like to see you encourage it, but not to lay down something very rigid because, as far as we are concerned, we are spending that money. I do not expect it to go down; I expect it to go up.

Senator Grosart: We thought you were on the right track with guidelines a year or two ago in the United States, but we have been getting pretty discouraged as to their effectiveness in getting anything done.

Senator Cameron: Merck is a big drug firm, and Canadian Breweries is a big brewery firm. They are talking in terms of large amounts of expenditures for research. The other morning we had the Department of Trade and Industry of the Province of Manitoba here making a special plea for the allocation of funds for small industries. They had a point. However, how can it be done?

Dr. Tishler: I would definitely give them encouragement through tax forgiveness, to have them start thinking about research and hiring technical people, no matter how small the operation is, even if it is only two or three people.

Senator Cameron: Do you think that is practical?

Dr. Tishler: I think it is practical. They may keep the man in the university. In other words, they may not want to build facilities, but that is something else you can think of too. As you know, the United States Department of Agriculture has these regional things around the country. I am not sure that this system has been very effective from the point of view of industry, but it has from the point of view of agriculture.

Senator Cameron: Do you think it would be practical, as a policy, to say to a certain industry in Manitoba or anywhere else, "We will assign you either a tax concession or a grant to employ people on a research program related to your industry," and have them based in some university?

Dr. Tishler: In a university or, if they wanted to set it up themselves, that would be fine. If they want to set it up in their own shop, that would be all right too.

Senator Cameron: That would not be practical in many cases because they would not have the plant facilities for it. Do you think it is practical to do many of these things in university labs?

Dr. Tishler: Yes, I do. You suggested a moment ago a technical institute. I think that would be an ideal place for it. However, I think we ought to make these people work for it, and not just say, "Here it is, do something about it", because you have to remember that if you discover something in a government laboratory it has to be open to all the public, and therefore no individual is really going to spend a lot of effort, investment, and time in trying to develop it when he knows that A, B, C and D can do the same thing, and may be waiting for him to start with it in order to get in and improve it.

Senator Cameron: On the basis of your long experience in research work, you would think it might be practical for the science policy committee to suggest that university facilities be mobilized?

Dr. Tishler: If I may make the point that it not be at the expense of basic research in the universities.

Senator Cameron: No, I am not suggesting that, but that they be mobilized to provide facilities for small companies.

Dr. Tishler: I do not see anything wrong with that concept. I would want to think it out further, of course—I do not mean myself alone, but it ought to be thought out further. It ought to be discussed with people. Perhaps people in the universities have overlooked it.

Bear in mind that around Cambridge there are a lot of small companies that have sprung up as a result of two people.

Senator Cameron: We have looked at that situation.

Dr. Tishler: Sometimes it is just an idea more than anything else. This is what you want to encourage. This is the entrepreneur who starts off as a scientific entrepreneur. Being a small company, it is only one man sometimes, but he needs a lab to be able to try his ideas out.

Dr. Schaus: The only thing that occurs to me is that when you operate a small one or two-man lab, and there are quite a few of them, financing always becomes a problem. In order to do successful research, as the other gentlemen have said, and as we have found in our own experience, it takes quite a long time from the time of getting the idea until it is a practical product. It takes a lot of money to go along the road, and even when you get to the end of the road and you are ready to build a facility it requires a lot of working capital. Most of these little companies fail financially because they have not enough capital. That is why it is difficult to comment on a small research establishment because it really requires someone who can carry it for five or six years and then can arrange enough financing to get the thing going. Then once it gets going there has to be enough working capital to keep it expanding. I do not think the results in general have been that favourable, particularly where risk capital is not as readily available as it is in the United States where you can get a sponsor to carry your entrepreneur.

The Chairman: Perhaps a tax holiday in that field would not be as effective because very often the profit might be very low.

Senator Grosart: Of course, we are talking now about research institutes, which is pretty much the idea, I think, that Senator Cameron has; it ties with the idea of centres of excellence. We have in five provinces provincial research institutes, and their evidence was that nearly all their customers are big industrial concerns; that the small companies just are not able to use their facilities.

On this matter of tax incentives, tax holidays, rebates and so on, practically every business organization and association that has come before us, if my recollection is correct, has been very strongly in favour of this type of government support. Yet we have what appears to be the anomaly which you mentioned, sir, of the government in the form of the Department of Industry, Trade and Commerce, after thinking the whole problem over, deliberately switching over from the tax incentive concept of section 72 of the Income Tax Act to controlled funding. The answer I received, whenever I asked why, was, "We want to know what the money is doing."

The Chairman: In order to avoid random research in industry.

Senator Grosart: To some extent, but it is the principle of accountability that we have talked about this morning.

Secondly, from the point of view of national accounts, the Treasury Board will say it is much easier to allocate a specific amount and know what you are allocating it for than merely have a rebate where you do not really know what happened.

Senator Cameron: An open-end commitment.

Senator Grosart: Yes. Why does industry feel that the tax concessions concept is better?

Dr. Schaus: I think it is more from the administrative point of view.

Senator Grosart: The amounts are about the same.

The Chairman: In one case it is an unconditional encouragement to research, as the universities seem to like so much, being able to say, "Give us the money and we will do it ourselves, doing as we see fit."

Dr. Schaus: I do not think that is quite accurate, Mr. Chairman, referring to my own experience. I spent about a month with the tax auditors, when we were taking advantage of section 72 of the Act, going over detailed statements of what we had done, the number of people involved, and precisely the amount of time we had spent on it.

The Chairman: Yes, there is always financial accountability.

Dr. Schaus: The point I was really trying to make with regard to the tax concession aspect is that we remove the base. I would not care whether it was on the IRDIA program, which is the 25 per cent grant, and which is accountable in almost the same manner with the tax auditors. It was really the removal of the base which was the key point in the suggestion I was making.

Senator Grosart: The time base or the project base?

Dr. Schaus: No, the minimum base over the last five years.

Senator Grosart: But you also object to the time base, do you not?

Dr. Schaus: Which time base is that, senator?

Senator Grosart: My recollection is that the IRDIA and the PAIT support is on a short term basis.

Dr. Schaus: That is not really critical because again they do not assess the validity of these programs until after they are a fait accompli. In other words, you do not get your grant until the year is complete and the work is complete. I know that has been one of the criticisms of PAIT and IRAP. It is my feeling that this base should be eliminated because it tends to penalize those who have been involved in research previously.

The Chairman: What about research contacts, for instance in the Department of Agriculture, where they do some research in biology and in other fields which are closely related to your interests in research?

Dr. Tishler: May I tell a little story in that regard?

The Chairman: Of course.

Dr. Tishler: This is something that has happened very recently in our country, and it has to do with the development of a vaccine against German measles. We started doing research in that regard some seven or eight years ago, and we spent quite a fair amount of money in doing that research, in terms of the effort expended by a great many people.

About three or four years ago the National Institute of Health got a directive from Congress to the effect that this was a very serious thing. They said, in effect: "Get going; let us have this vaccine against German measles." They went around to the various pharmaceutical companies and said, "We would like to give you a contract to develop a German measles vaccine." They came to us too. We said to them, "Look, we have been doing research and development on this now for some three and a half years. We have spent about $2 million on it. We do not really need or want any government support. And the reason is that we want to be out there first and we want to hog the market. In other words, we want to go out there and make a killing on this. We want to be the first ones with it." I might say that is how the private enterprise system works, and it is all right as long as it is done within the bounds of good public responsibility.

They were pretty unhappy about our attitude. However, they went to the rest of the firms in the field, and gave out contracts to do this to about half a dozen companies. I knew that we were in a much better position than the other companies because we had a greater motivation, and a greater accountability.

If you have kept up with what has been happening in the United States in this regard you will recall that it has now been licensed down there, and we are the only ones wo have the licence. And I am not sure that any government contract is going to be licensed in the near future.

I give you that as an example of what can happen in this regard. You can read it any way you care to, but I think it is a good illustration of the workings of private enterprise with its own motivation—that is the motivation of profit—versus government funding of such an undertaking. I cannot define precisely difference, but there is certainly a difference.

The Chairman: Are there any other questions? Thank you very much, gentlemen. This Committee stands adjourned until eight o'clock tonight.

Whereupon the committee adjourned.

APPENDIX 154

SUBMISSION

TO

THE SPECIAL COMMITTEE

ON

SCIENCE POLICY

By: Merck Frosst Laboratories,
350 Selby Street,
Montreal 215, Quebec.

February 28, 1969

CONTENTS

TABLES AND CHARTS

BIOGRAPHIES

1. SUMMARY

1:1 Canadian science during the past years has made good progress through the outstanding contribution of scientists such as Banting, Osler, Steacie, Jane, Genest and Gaudry. The capabilities of Government, University and Industrial research have been developed following the efforts of these men. However, except in periods of National emergency, there has been little co-ordination of our research effort among these three groups. This lack of co-ordination and collaboration is reflected in the fact that while we have many well qualified scientists, we have rarely been able to support them vigorously so as to gain the most from their capabilities, or to use these capabilities to build up strong groups or centres of international competence. There is a great need for defining and setting objectives of research at Government, University and Industrial levels in such a way that lively exchange and collaboration can be established and maintained. It is only when clear objectives have been set and are being carried out that we will have the climate for the training of our best young people and the opportunity for them to exercise their talents to the fullest capacity in Canada. These objectives must include the possibility of doing research that is both complementary and contributory to research on the international scene. The example of how Merck has developed a research base in Canada is used to show one practical way of setting up and carrying out research objectives.

2. INTRODUCTION

2:1 It is our belief that the current level of Canadian accomplishment in fundamental and basic research, as well as in the development of new technology and products, is well below the potential capability of this nation. We feel it essential that means be found to rectify this situation in order that future Canadians may enjoy the standard of living, the opportunities, and the prestige and influence which are the fruits of advances in research and technology, In order to realize such progress, we submit that co-operation amongst scientists in Government, University and Industry is essential in the establishment and achievement of national goals.

2:2 Our parent organization, Merck & Co.Inc., has had more than thirty-five years of experience in successful industrial research. The general policies which have led to their success and the experience of Charles E. Frosst and Merck, Sharp & Dohme Canada have been used to develop a research program in an attempt to discover new drugs for the prevention or alleviation of diseases in the cardiovascular, respiratory and nervous systems. Administering this program, which is integrated with Merck's world wide research efforts into human health, are scientists who have been involved in pharmaceutical research in Canada for more than twenty years.

2:3 Our very productive research relationship with the parent company - Merck Sharp & Dohme Research Laboratories in the United States - fulfills the Canadian need for specialization and excellence. By close association with the parent research we obtain the cross-fertilization and interchange of ideas essential to scientists carrying out fundamental, applied or developmental research.

2:4 The knowledge and skills of the parent organization thus become an asset to Canada. The programs and objectives are the result of extensive knowledge of the broad needs of mankind around the world, of the Company as a whole, and the medical community from the short and long term points of view.

2:5 Based on our own experience, this Brief will be concerned primarily with the development of a viable research effort in the pharmaceutical industry in Canada. From this viewpoint, it will also be related to the need for a general science program for all sectors of Canadian enterprise.

3. DEFINITIONS

3:1 Throughout this Brief, for the purposes of clarity, we have retained the definitions given in Report No.4 of the Science Council of Canada,(1) which were:

1. *Basic or Fundamental Research which is a generalized search for new knowledge without specific application in mind, and which is one of man's crowning cultural achievements. Any piece of basic research is judged on the contributions which it makes to the conceptual development of science.*

2. *Applied Research is the search for new knowledge to provide a solution to a specific problem which is defined at the outset of the research program. It does not differ radically from basic research in methods or scope, but in motivation. Applied research programs must be judged by their relevance to the pre-selected objective.*

3. *Development is really a final stage of applied research which is most clearly seen in the evolution of new goods or services. It is a costly activity inasmuch as the building of prototypes, the construction of pilot plants or the conduct of full scale trials are costly undertakings.*

4. *Innovation is the practical implementation of the results of research and development to provide new or improved goods or services. Innovation is often a capital intensive activity since new production facilities are often required. In deciding to undertake programs of development and innovation, the expenditures foreseen must be weighed against the probability of achieving economic gain or social benefit.*

(1) See Section 2, page 7, Report No.4 Science Council of Canada

These definitions are not those ordinarily employed in the Pharmaceutical Industry (for comparison see Chart A).

<u>Government</u> *Since all levels of Government can and should participate in setting the climate for industrial research and also promote collaboration between Government, University and Industry, or any two of them, we have used the word "government" without restriction to either federal, provincial or municipal levels.*

4. <u>RESEARCH IN CANADA</u>

4:1 Canadian research achievements since the turn of the century have been by no means insignificant but only a few have had real fundamental importance. Certain individual scientists, such as Banting (physiology), Osler (medicine), and Genest (medicine) have performed research of international quality and of tremendous benefit to mankind. Others, such as Steacie (National Research Council and academic research), Jane (industrial research), and Gaudry (industrial and university research) have used their talents for the development of the scientific community. As a result of these efforts a number of good scientists have remained in, or been attracted to Canada to form the nucleui from which really first class centres could be built. However, the number is too small and the support they have had too meagre to achieve anything like the full potential of their capabilities.

4:2 A striking example of this lack is seen in a comparison of the support of research in eighteen universities in the United States, with that in all Canadian universities in the year 1964. For that year Canadian universities had a total support of \$26.8 million [1] for research support, while the eighteen U.S. Universities had a total support of \$534 million [2] and all but seven of these latter had support of more than \$26 million. Thus, the Canadian total was then less than the average paid to one of these universities in the United States. This leads us to disagree with the suggestion of the Science Council [3] that Canada is doing too much fundamental research at the expense of applied research; and to agree with the Medical Research Council [4] that we have a thinly spread effort of overall 'modest achievement.'

4:3 It is true that the deficiencies have been more evident as one moves outside the university to the industrial and government sections. [5] In industry most of the research has been relatively short term and supplementary to its foreign parent in the case of international companies. There are signs that the pharmaceutical industry is moving beyond these confines to complementary and contributory research. [6]

4:4 On the other hand government research (save for a few emergencies or national needs) has rarely been co-ordinated with industrial needs or realities. This latter factor, plus the lack of communication between university and industry, explains why fundamental findings from government and university laboratories cannot often be translated into Canadian industrial developments. The deficiency seems to exist because of lack of co-ordination in planning and in carrying out objectives in such a way that all three sectors are involved.

(1) Canada Year Book 1967 p.410 (see Chart B for details)
(2) Robinson Varsity Graduate Spring 1965 p.23 (see Chart B)
(3) Science Council Report No.4, p.21,22
(4) Medical Research Council Report No.2, p.10
(5) For comparison of sources of research funds see Chart C
(6) As just one indicator see Chart D for papers published in two Canadian scientific journals

4:5 Science is, of course, international and has an important role in the development of international corporations. Industrial science in Canada is closely allied with the the international corporation. Many companies, including some Canadian, have found that there are business advantages in becoming international. This provides, not only a larger financial, but also a more potent manpower base. Canadians, generally, have reluctantly accepted this idea and consequently our industrial research has lagged.

4:6 A third component which has influenced the kind of science and research that has developed is the professional scientist. We have not as yet reached the stage generally where the industrial scientist is accepted for his professional worth in the same sense as is the academic scientist. This has resulted in irretrievable losses to industry and to Canada of scientific and intellectual talent. Moreover, there are few instances where we have proceeded beyond the development of individual scientists to the stage of groups or laboratories of international standing in specialization and excellence.

5. ETHICAL PHARMACEUTICALS - A RESEARCH BASED, INNOVATIVE INDUSTRY

5:1 The ethical pharmaceutical industry has conducted outstandingly successful research. Products resulting from this research have played an essential role in improving or maintaining the health of Canadians. One recent survey shows that 57 of the 66 most valuable drugs discovered in the past 25 years have come from the laboratories of the pharmaceutical industry.(1)

(1) Sir Derek Dunlop, the Jebcott Lectures, England 1966

5:2 There have also been notable research accomplishments by the universities. Insulin, the use of which was discovered in the 1920's, and two war-time products, penicillin and streptomycin, are examples of brilliant university contributions. At the same time, the role of industry in purifying, testing and developing these products was essential in making them available to the medical profession.

5:3 In Canada, sales of prescription drugs are estimated at about $250 million, or about 8% of the health care bill.(1) The contribution of this industry to the health of the nation, already great, can be expected to become even more significant as newer products emerge as a result of an ever-growing sophistication in the field of drug research.

5:4 Drug research involves an interplay among academic, hospital, industrial and government laboratories, as well as the team work of many disciplines within each industrial research laboratory. We feel that it represents, therefore, an excellent example of the results which can accrue through such co-operation. There are nine pharmaceutical research laboratories in Canada, all in companies that are subsidiaries of international corporations. The pharmaceutical research and development process is complex. A general understanding of it is essential to the development of more such research in Canada, especially in the selection of aspects in which excellence and specialization can be fruitfully developed.

5:5 One general route for drug research begins with the identification of a broad target in the health field - normally a disease for which fully adequate methods of treatment are not available. This choice will be made in consultation with medical specialists, both within the company and from universities and other institutions. Once the target is

(1) 1967 projections. For expenditures on Personal Health Care 1956-65, see Chart E.

established, the Company's biologists attempt to simulate the disease on a laboratory scale (experimentation on man at this stage is obviously precluded). Frequently, much basic work must be done before suitable *in vivo* (animals) and *in vitro* (test-tube) systems can be developed. When the biologist has an apparently suitable laboratory model the testing of substances in the special system will begin. If the assay system can accommodate a large number of substances much of the initial selection will be done on an empirical basis. In a typical assay, one can expect to screen many hundreds or even thousands of substances (often over a period of years) before finding a lead. (A lead is a chemical structure causing some of the desired biological effects). The medicinal chemist becomes very actively involved at this stage attempting to devise chemical structures which will achieve the desired biological effect. In fact, the research becomes truly interdisciplinary as chemists, biochemists, pharmacologists, physiologists, bacteriologists, parasitologists, biophysicists, and others all join forces.

5:6 The initial phase, which often requires many years of persistent effort in the face of repeated failures, ultimately is expected to yield one or more potentially useful compounds. Once such a compound is in hand, and providing that it lacks obvious toxic side effects, it becomes a candidate for more extensive biological investigations to determine whether it is indeed suitable for clinical trials.

5:7 The next phase will involve long-term studies (up to approximately two years) in a variety of animals to establish with certainty the nature of any toxic effects in these animal species. Skilled pathologists must examine all types of tissue for evidence of deleterious effects.

Experiments in more sophisticated animal models (frequently primates) will be carried out to further establish efficacy. Biochemical studies are also necessary to determine the intricate details of the mechanism of biological action, and the ways in which the substance may be modified inside the animal itself (its metabolism). The length of time required for such studies is normally several years. During this period, increasingly larger quantities of the chemical compound must be made available. This brings into play a team of chemists (microbiologist's, if a fermentation process is involved), and engineers who must develop interim procedures for making the product in large quantities. The first chemist to have prepared it may have been able to make only a fraction of an ounce by a very laborious route which does not lend itself to scale-up. Frequently entirely new and basic chemistry will have to be explored before a workable process can be found.

5:8 When sufficient data is available to assure efficacy amd safety in experimental animals authorization to test the material in man is sought from the Food and Drug Directorate. Arrangements must be made with clinical specialists to commence studies in humans.[1] This stage is crucial. The long road from demonstrated safety and efficacy in test animals to safety and usefulness in clinics must be followed with extreme care. Such work is started in one or two cases and is gradually expanded as clinicians learn more about the drug. Finally after extensive preliminary studies of this nature, the drug will be

(1) In Canada while we do have the centres with adequate testing facilities we cannot often permit them to make worthwhile contributions. Food & Drug Directorate regulations not only demand more information than is normally available at that stage of drug development but also insist that the human pharmacology cannot begin until full agreement on interpretation of the data is reached. The fact that Canada is the only country with these demands often means that we cannot offer collaboration on this phase of drug research because it has already been done abroad. A valuable chance for industry and the most skilled investigators to work and plan together is, therefore, irretrievably lost.

demonstrated to be efficacious and relatively safe from toxic and unwanted effects. This sometimes involves studies of thousands of patients. Ultimately, when the data demonstrates an acceptable balance between safety and efficacy, on the one hand, and unwanted side effects on the other - and once appropriate direction for physicians has been prepared - approval for marketing to the medical profession must be obtained from the Food and Drug Directorate.

5:9 It is difficult to generalize on the length of time for the initial development of a drug to the production stage. It may be said to be in the range of six to fifteen years and to cost $1 - 5 million. The percentage of product candidates from the early stages which survive processing to become marketable drugs is, in our experience, about one tenth of one per cent. The investment (time and money) in each of such failures is considerable and may approach that of the marketed drug for those failing in the final stages. (See Chart F Reactions and Results of Merck R & D).

6. DEVELOPMENT OF MERCK RESEARCH IN CANADA

6:1 The antecedence of Merck research in Canada was that of Charles E. Frosst & Co. (Frosst) which began in 1926 and of Merck & Co. Limited which began in 1950. The acquisition of Frosst in 1965 by Merck & Co.Inc. and the combination with certain activities being performed by Merck Sharp & Dohme Canada Limited (MSD) led to the formation of Merck Frosst Laboratories (MFL). Frosst pioneered in research in anticoagulants and vitamin D preparations and made useful contributions in hormones, antibiotics and other vitamins. Because of its size and lack of new products Frosst relied heavily on developmental research, particularly in superior pharmaceutical formulations. Special mention should be made of its radio-active pharmaceutical research and development. This endeavour which was started in 1950 in co-operation with Atomic Energy of Canada Limited has led to considerable commercial success and is an example of the results of good communication and co-operation between government and industrial research laboratories.

6:2 Merck & Co. Limited and Sharp & Dohme of Canada have been in Canada since 1910. Research and development began in the Merck Valleyfield plant in 1950. Early research pertained to new and improved processes concerned with production of vitamins, antibiotics and other fine chemicals.

6:3 Another early project was concerned with stable isotope chemistry (which by chance is complementary to the Frosst radio-pharmaceutical project). It is important to note that this project is also a result of good communication and co-operation between government (in this case, the National Research Council), and industrial research laboratories. It has also met with commercial success and related research projects are still being continued. Co-operation with the Research Council has been close throughout and, for the past five years, grants-in-aid under the Industrial Research Assistance Programme have been used. This and the Frosst example, while small projects in themselves, show that the communication and co-operation we advocate can be mutually helpful, and at the same time shows our willingness to pursue actively programs of interest which arise from government or university sources. We have been on the alert for other useful findings, and have closely examined several, but no others have led, as yet, to useful programs.

6:4 MSD Canada initiated research for new drugs in 1958. A medicinal chemistry group was started and an attempt made to obtain inter-disciplinary reaction with biologists in our

U.S. laboratories. Difficulties with this arrangement forced abandonment of the project in 1963. The acquisition of Frosst research in 1965 brought with it the desired chemical and biological efforts and active research for new drugs began again. At the same time isotopic research and pharmaceutical research were continued. Frosst and MSD have been active in the use of clinical research in Canada for about 35 years. This too is continued on a very active scale.

6:5 We have adopted the view that international business commitments include research. In Canada we have been able to attract outstanding scientists because our programs offer the challenge of being the Merck specialists in the specific disease we seek to alleviate and by the fact that we have close collaboration with our own scientists in the U.S. and a full interchange of information and ideas with them. This makes our potential for worthwhile accomplishment very much greater than would be possible for an independent group of similar size.

6:6 Results have already been achieved. Isotopic research has resulted in products that are marketed world wide. Drug research has produced three product for advanced development and clinical study. (We are aware that these are far from being products and that in addition to the $2.5 million already expended perhaps an equal amount of money and 3-6 years of time will be necessary to demonstrate their usefulness in medical therapy).[1] We have several publications and patents pending. This rate of progress compares favourably with that of other project groups in the Merck organization and with what we know of the progress of other groups in Canada.[2]

(1) See Chart F for the results of Merck & Co.'s total R and D efforts.

(2) Forbes Magazine (Jan 15/69) reported that Northern Electric's R and D in 1968 at $34 million was 8% of revenues, but, says the article, Bell Canada & Northern have "not too much" to show for this continuing and extensive research effort. This effort was begun in 1957. The experience of Bell Canada, the pharmaceutical industry and others, shows why the current Federal Research incentives have accomplished little. These incentives provide only short-term support in research when it is a known fact in the most developed countries that really valuable results cannot be hoped for in under 10 years.

6:7 We are studying ways to do more basic clinical investigations on new drugs in Canada, as soon as the Food and Drug Directorate Regulations permit these to be done on a basis competive with conditions in the United States. (See footnote (1)p.9) Finally, we have succeeded in a small way in reversing the brain drain - one of our top-flight chemists has returned from our U.S Laboratories, and we have two other Ph.D scientists who have returned to Canada and joined us after doctoral and post-doctoral work in the United States.

7. ROLE OF MERCK IN THE CANADIAN SCIENCE COMMUNITY

7:1 Several factors give us a basis for playing an important role in the development of Canadian science. We are part of an international research-orientated company. The total output of this research, including drugs discovered in our Canadian laboratories, is available to Canada for the advancement of the health care of Canadians. We have brought together a research group in Canada which we are building to the highest standards of specialization and excellence. We are ready and anxious to work with others in improving the standards of health care or to diversify beyond present interests (as we have already done with isotopes) as the opportunity to make contributions arises. Our determination to be complementary and contributory to the total Merck effort and to take advantage of, and not duplicate skills in the Merck organization, as well as to use a strong multi-disciplinary approach, provide a strong research base. We believe our policies which have brought this about offer one practical way to develop productive industrial research in Canada.

7:2 Our growth in research personnel and in budget are a measure of what we have done and permit us to project. In 1961 (Frosst included) we had a total of 53 scientists and assistants and an annual budget of $570M, while in 1969 we have a total of 76 and an annual budget of $1,300M - about 5 per cent of sales. In R and D as a percentage of sales, the pharmaceutical industry ranks second in Canada behind aircraft and before electrical products. These two industries receive government R and D support in excess of all other industries combined.(1) In the last three years our growth has been slowed by the fact that we have been having difficulty in finding the best of highly skilled personnel. This same situation may exist in the coming years because without such people we cannot devise programs offering a real basis for contribution.

7:3 The incentives which we use to attract talented young scientists to our research group are those which Merck has found to be successful elsewhere. These are (1) Freedom within reasonable limitations to work out problems of their own choosing, including the opportunity to do basic research; (2) Freedom to publish and present papers at professional meetings, thus offering an opportunity for scientists to add to the general store of knowledge and to get recognition from their peers for their achievements (this is not the traditional secrecy thought to surround industrial research); (3) The opportunity to discover and develop actual therapeutic agents that will control disease and alleviate human suffering; (4) Close collaboration with leading scientists in related fields in universities, medical schools and hospitals; (5) An inter-disciplinary approach to the solution of medical problems, unavailable in the academic environment.

7:4 The fulfilment of our goals requires an increasing and closer contact with scientists in the health community. Successful discovery and development of new drugs thrives on collaboration to search out needs, to set objectives, to verify experimental biological techniques, and to conduct

(1) For comparison with other industries, see Chart G
(2) See Chart H for details

clinical pharmacology in man. This collaboration whether it be between government and/or university and our laboratories is the cornerstone on which we have placed our hopes for research progress. For this collaboration to be fruitful we will try to make it the result of inter-disciplinary action whether this be in our own laboratories or those in the external groups. This process can be illustrated as follows:

UNIVERSITY

Chemist ↔ Pharmacologist ↔ Physiologist ↔ Biologist
Medical Specialist ↔ Pharmacist

Professors, Graduate Students & Students

INDUSTRY ↔ HOSPITAL

Chemist ↔ Pharmacologist
Physiologist
Biochemist
Pharmacist

Professionals and assistants

Pharmacologist ↔ Medical Specialist
Biochemist
Pharmacist

Professionals, internes, graduate students and assistants

The benefits of such interactions include the ability to train personnel, the creation of facilities of international calibre, increased prestige for Canadian science, and ultimately earlier realization of dramatic improvements in Health Care.

7:5 To summarize: our role in the Canadian scientific community is to maintain and expand a first rate drug research laboratory and to catalyse collaboration and fruitful working relationships with university, hospital and government scientists. Attainment of these goals will result not only in the development of new drugs and an enhanced capability to translate Canadian fundamental research into practical applications, but also in expanded opportunities to brighter Canadian minds and increased prestige to Canadian science.

8. THE ROLE OF A SCIENCE POLICY

8:1 A science policy must take into account the diverse factors which make up the science community. Government, University and Industry participate in the science community each with special roles and needs. A science policy should set priorities and goals within which objectives can be decided. The policy must provide for the incentives, support and climate which are necessary for a reasonable possibility of fulfilling these objectives.

8:2 The problem of deciding what the objectives should be has been so great that often objectives have not been set at all. A close examination of the Canadian situation leads to some objectives which should be obvious. We are, for example, a young nation with limited means. If we want to make more significant scientific progress we will have to plan better, train and select better, and improve our scientific leadership and efficiency. This is a clear-cut objective that we should be able to attain, through developing the components that make up the total objective.

8:3 Better planning is necessary if we are to find a way so that more of the major research done in University and Government can be transferred into results useful to the public. Obviously the planning should be carefully co-ordinated to take full advantage of the capabilities and experience of University, Government and Industry. One example would be to plan to develop research groups in University or Hospital of international size and calibre which would be dedicated to research in the health field.

8:4 Better training would be the immediate result of the example just suggested. To obtain the most from the best students and scientists we must be prepared not only to support centres of excellence but also to establish and maintain an increasing number of such centres so that the newly graduated scientist can continue his self-development in Canada. These centres must extend beyond University and Government and be a vital part of future industrial research. Better training implies, as well, equipment, facilities and research support equivalent to that found abroad.

8:5 Better selection implies more than vocational guidance. It should acquaint the student with national needs at all levels, and all sectors, where science is used. This will permit the student to select fields and activities that interest him and at least will make known to him the areas where lively and productive research is being done in Canada.

8:6 Improvement of scientific leadership involves both the individual and the sectors in which science is being carried out. Obviously our scientific programs must be sufficiently appealing to attract those with leadership qualities into science. In the broad areas Government provides leadership in the way it does in-house programs, in the standards it demands for contract research, and in the policies it sets. University provides leadership through the departments it establishes, the research scientists it selects and the support which it gives them. Industry should provide leadership by establishing research on a broad base that attracts, supports and gives freedom to the most qualified and talented scientists.

8:7 Improvement of scientific efficiency is most likely to come about when there is active collaboration in planning and carrying out research between Government, University and Industry. Furthermore, efficiency involves contribution to, not duplication of research already underway elsewhere. Efficiency can be considered in terms of incentives, grants and their use. Government incentives should support the build-up of long-term research. Such incentives should include not only grants but, perhaps more important, tax concessions which will encourage individuals and companies to invest in risk enterprises, such as long-term research. Industrial managements can only achieve efficiency if this research is complementary to that of their parent companies when foreign owned, or if it is so based that it is concerned with a reasonable proportion of long-term problems.

8:8 Beyond these a science policy should seek to develop the self-assurance that, as a whole, Canadian scientists lack. One way is to take greater advantage of our bi-lingual culture and background so that we develop the habit of making contacts with scientists in Europe and Japan as well as the U.S. Use of our two languages may be a starting point. One of our objectives should be to arrive at a situation in which many more Canadian industrial scientists exchange ideas as euqals with other scientists in other sectors, both here and abroad.

8:9 Another objective is better use of advisory groups to help set national objectives and policies. Such groups would provide a consensus of experts representing all research fields, and all private and public resources. These groups, together with research groups of critical size, excellence and specialization with adequate support for such research, can be the real cornerstone of an effective national science policy.

9. CONCLUSION

9:1 Modern society depends heavily on research as a major force in meeting its goals of higher standards of living, full employment and many other facets of a full life. Some suggest that the question to be decided in Canada is whether we really want to contribute to this research, or rather depend upon foreign sources for all of our new technology. The latter choice must result inevitably in a continuing loss of many of our better minds to more technologically advanced countries. We believe that this is unacceptable to most Canadians and therefore the only question to be answered is that of how to build up a stronger and more productive research community. While government can play a role in creating a climate and providing financial incentives, the co-operation of universities and industries is essential in finding the answer.

9:2 The most important ingredient in research is people. Many of our Canadian professionals have gone elsewhere and made real contributions, so there is no doubt that we have the supply of people necessary to do research. We have also made great strides toward bringing our training of scientists to international standards of excellence, so that this problem too is being resolved. We must, however, increase the depth of specialization and excellence and thus perhaps as part of an overall objective, emphasize areas for intensive training where the national goals of government and industry are being concentrated.

9:3 The second ingredient in research is objectives. Canada needs overall research objectives. These must relate to national needs, to the needs of universities and to the needs of both primary and secondary industry. They must take into account the fact that more than 90% of our research information will come from sources outside of Canada. Thus, the objectives selected become of paramount importance. They must lead to research that is competitive and contributory not only in the national but also in the international area. They must provide for full collaboration between all research sectors without destroying the academic freedom of the universities to perform their role in training new professionals and also in developing fundamental knowledge. The objectives must provide a stimulating environment for research scientists if Canada is to function as a contributor instead of a borrower of research.

9:4 Many of the problems that can be resolved by research in Canada are also of vital interest to the United States. We must be prepared to work together on common problems internationally where indicated. In doing this, we can and must make vital contributions, thus at the same time while pursuing our objective, we must not isolate ourselves. Our universities must strategically strengthen their research capability not by broadening but by specialization and concentration to build up their best capabilities. Our primary industry must take more advantage of our national resources.

9:5 Secondary industry must resolve the problem of doing research complementary to the primary industry or to that of its parent. This should be done with the overall objective of increasing our ability to compete in and contribute to international research.

9:6 We must accept the fact that too much of Canadian industrial research is short term and that industry as a whole does not have a sufficiently broad research base. We must also accept the fact that long-term research cannot be expected to have a quick pay-off. We must be prepared to wait five, ten, or even twenty years before some of our industrial research can be productive in terms of new technology, new plants or new products. We can expect, if we work in this direction, the possibility of more immediate returns because a research-orientated industry will definitely be more receptive to and ready to implement new findings and new technology as it appears abroad. We can also expect a build-up of our returns from the licence of patents and technology.

9:7 Government incentives should support our overall objective of strengthening and broadening our research base. They must be used strategically to achieve this with a balance between support for short-term, intermediate and long-term research with increasing emphasis on the latter. In developing these policies, it must share and consult with industry so that the latter may look to the design of long-term programs.

9:8 The case for research in Canada must be built on general concepts of specialization and excellence and on common objectives in Government, University and Industry. The role of each sector is suggested in Chart I in which all three sectors play a role in each segment of research with Government and University carrying out and supporting the bulk of basic research.

10. <u>RECOMMENDATIONS</u>

A practical national science policy should deal with the total situation as well as individual situations in the three sectors where science is practised.

A. For the total situation the policy should encourage -

(1) The setting of national or industrial goals and objectives

(2) The creation and support of specialized research groups

(3) The carrying out of research of international calibre and excellence

(4) Collaboration in planning objectives between Government, University and Industry

(5) Ease of research collaboration and exchange of ideas among scientists.

B. Within the overall objectives -

I <u>The Government should</u>:

(1) Set national and international goals and research objectives and carry these out by in-house or contract research

(2) Use contract research and other incentives to strengthen existing industrial research or build-up new industrial research

(3) Support the creation of highly sophisticated research groups with special skills in University or Hospitals to improve Health Care and collaborate with Industry in the development of new drugs.

(4) Establish and use committees with adequate representation of active scientists from all sectors to plan overall objectives for government research, university research and training, including adequate incentives to support such objectives.

(5) Provide tax incentives which will encourage corporate and private investors to provide more money for long-term research, especially when such research adds to our national capability.

II <u>The University should</u>:

(1) Expand research areas of excellence and specialization by appointing and providing full supporting staff and facilities for research professors (i.e. those with minimum teaching loads).

(2) Collaborate with government and/or industry to set and achieve overall objectives and work closely with either or both on special programs. This must be done without limiting academic freedom and independence.

(3) Include in its training programs which will develop skills in techniques of development and innovation for those students interested in such skills.

(4) Work together with government and industry to provide students with knowledge of specialized needs and objectives at the national level.

III <u>Industry should:</u>

(1) Form groups of highly skilled research teams of sufficient size and standards of excellence and with sufficient inter-disciplinary reaction to make viable and vital contribution to research in the whole corporation, whether Canadian or foreign-owned. Canadian managements must give this objective high priority.

(2) Collaborate with government and university in setting common objectives, research programs and aid in their fulfilment. This collaboration should include encouraging its research leaders to participate actively in government and university committees.

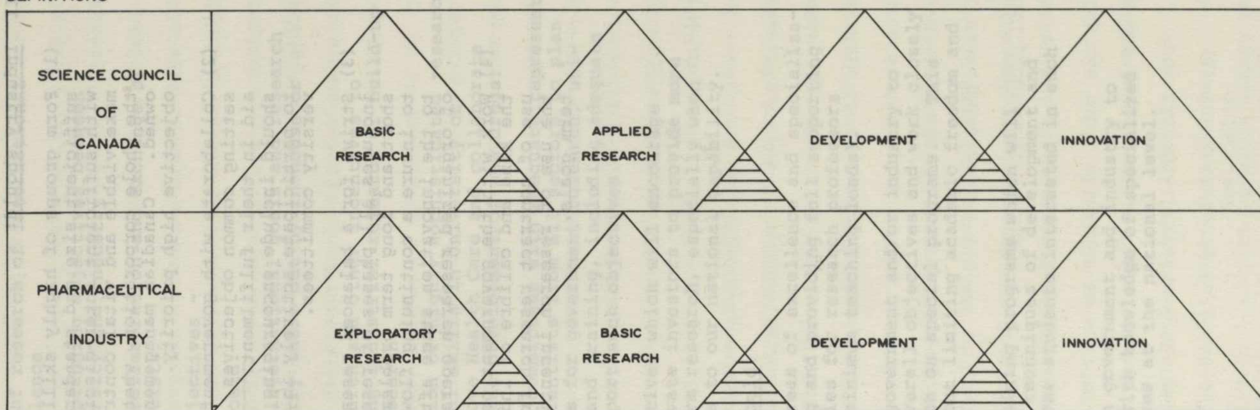
(3) Strive for a balanced research program that includes all phases of research so that both short and long term problems are being studied to insure a continuing flow of new developments to the innovation stage after five to ten years of organized research operation.

(4) Work with the government on ways of improving the kind and calibre of industrial research by the use of contract research from the government and the use of research incentives to arrive at long term goals.

CHART A

PHASES OF :- RESEARCH & DEVELOPMENT — PHARMACEUTICAL INDUSTRY

DEFINITIONS



RESEARCH FUNCTIONS

Determination of structure, and synthesis of complex bio-chemicals.

Molecular biology.

Fundamental studies of interactions of drugs in biological systems.

Development of biological screens.

Chemical synthesis.

Natural product isolation.

Pharmacological and bio-chemical screening.

Clinical pharmacology.

Process research.

Pilot plant.

Pharmaceutic research.

Pharmacologic evaluation.

Toxicology.

Clinical investigation.

Process development.

Development of quality standards.

Development of production.

Development of marketing.

Clinical followup.

= MAJOR EFFORT OF MERCK IN CANADA.

= MINOR EFFORT OF MERCK IN CANADA.

CHART B.

COMPARATIVE SUPPORT of U.S.A. and CANADIAN UNIVERSITIES

1. U.S. Universities - Annual Expenditures 1963-64

Note: Except in the case of Wisconsin (45%), Illinois (60%), Texas (68%) and Indiana (80%), about 90% of every entry in column (2) comes from the Federal Government.

	(1) Total Acad. Budget ($000,000's)	(2) Sponsored Research ($000,000's)	(3) % of Academic Budget
Berkeley	131	72	55
Cal. Tech.	20	10	50
Chicago	81	37	46
Columbia		35	
Cornell	108	34	31
Duke (1962-63)	24	10	42
Harvard	110	37	34
Illinois	120	35	29
Indiana	25	15	60
M.I.T.	65	40	62
Michigan	130	36	28
Pennsylvania	74	26	35
Princeton	50	25	50
Stanford	80	38	47
Texas	41	16	39
Washington	70	22	30
Wisconsin	90	26	39
Yale	60	20	33
TOTAL:		534	

SOURCE: Robinson Varsity Graduate - Spring 1965, Page 23

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6.—Summary Statistics of Federal Government Expenditures on Scientific Activities, Years Ended Mar. 31, 1963-66

Activity and Department or Agency	1962-63r	1963-64r	1964-65r	1965-66[1]
	$'000,000	$'000,000	$'000,000	$'000,000
Scientific Activity—				
Conduct of research and development	170.8	195.4	204.6	244.5
Grants-in-aid of research	20.9	26.8	36.1	49.5
Capital expenditures on plant for scientific activities	28.9	37.2	50.2	56.8
Scientific data collection	24.1	25.6	24.4	25.3
Scientific information	9.7	10.1	12.8	14.5
Scholarship and fellowship programs	2.6	2.8	3.8	5.5
Totals, Scientific Activities	**257.0**	**297.9**	**331.8**	**396.2**
Department or Agency—				
Agriculture	29.6	30.6	33.4	39.4
Atomic Energy (incl. Atomic Energy Control Board and Atomic Energy of Canada Ltd.)	39.4	46.5	54.3	57.0
Energy, Mines and Resources	42.4[2]	42.3[2]	43.6[2]	51.2[2]
National Research Council (incl. Medical Research Council)	44.7	52.5	60.8	79.0
National Defence—				
Armed Forces	27.6	31.7	30.7	43.3
Defence Research Board	31.8	38.5	30.2	42.6
Others	41.5	55.8	69.8	83.7
Totals, Departments and Agencies	**257.0**	**297.9**	**331.8**	**396.2**

[1] Estimated. [2] Revised to include the Water Resources Branch, which, until 1966, was part of the former Department of Northern Affairs and National Resources.

SOURCE: Canada Year Book - 1967

CHART C.

For all Canadian industry, the performing company is by far the most important source of funds. However, Table 4 gives sources of funds for total current and capital research and development expenditures. Since capital expenditures are not usually financed by governments or other companies supporting a firm's research and development program, the performing company would be a less dominant source of funds for current intramural expenditures—perhaps accounting for about 65 p.c. rather than 71 p.c. Other significant sources are the Federal Government, foreign governments and foreign related companies. Industries and firms do not rely on the same sources to the same extent. For example, about 67 p.c. of the research and development funds for the aircraft industry seems to come from outside the performing company. The direct support of the Federal Government goes mainly to two industries—aircraft (52 p.c.) and electrical products (31 p.c.). Funds from foreign sources account for about one fifth of all intramural expenditures for the drug, petroleum and aircraft industries.

4.—Sources of Funds for Intramural Research and Development, by Industry, 1965[1]

Industry	Canadian Sources				Foreign Sources[3]	Total
	Reporting Company	Parent, Affiliated and Subsidiary Companies	Government of Canada	Other[2]		
	$'000	$'000	$'000	$'000	$'000	$'000
Mines	9,428	22	511	105	315	10,381
Gas and oil wells	1,926	427	—	—	601	2,954
Manufacturing—						
Food and beverages	6,903	16	299	1	—	7,219
Rubber	1,922	—	202	—	852	2,976
Textiles	4,269	54	50	18	30	4,421
Wood	224	—	—	116	—	340
Furniture and fixtures	114	—	—	—	—	114
Paper	21,307	974	320	2,198	428	25,227
Primary metals (ferrous)	7,634	—	47	—	12	7,693
Primary metals (non-ferrous)	10,201	815	288	203	21	11,528
Metal fabricating	3,418	—	193	4	—	3,615
Machinery	7,474	—	101	128	729	8,432
Aircraft and parts	17,798	219	25,982	3	10,608	54,610
Other transportation equipment	1,955	—	46	—	—	2,001
Electrical products	43,219	37	15,468	853	3,456	63,033
Non-metallic mineral products	1,013	20	220	5	647	1,905
Petroleum products	17,767	—	65	87	4,807	22,726
Drugs and medicines	7,542	—	403	—	2,289	10,234
Other chemical products	27,282	188	601	—	397	28,468
Scientific and professional instruments	4,020	—	2,953	263	477	7,713
Other manufacturing	2,106	78	1,769	—	50	4,003
Totals, Manufacturing	186,168	2,401	49,007	3,879	24,803	266,258
Transportation and other utilities	3,488	—	—	—	—	3,488
Other non-manufacturing	603	172	421	381	222	1,799
Totals, All Industries	201,613	3,022	49,939	4,365	25,911	284,880
Percentage of total funds	70.8	1.1	17.5	1.5	9.1	100.0

[1] Includes capital expenditures. [2] Includes the membership fees of research institutes and payments for research and development performed under contract for non-related companies. [3] Includes foreign governments.

Source: Canada Year Book - 1968

CHART D. SOURCE OF PAPERS PUBLISHED IN THE CANADIAN JOURNAL OF CHEMISTRY AND THE CANADIAN JOURNAL OF BIOCHEMISTRY

1966 - 1968

	% of Total
Government	
N.R.C.	10.1
Other Canadian	7.1
Foreign	1.4
Universities & Research Institutes	
Canadian	52.4
Foreign	20.0
Industries	
Canadian Pharmaceutical	1.5
Other Canadian	2.5
Foreign	5.0
	100.0%

(Total Number of Papers Published -- 1895)

CHART E.

EXPENDITURES ON PERSONAL HEALTH CARE 345

2.—Expenditures on Personal Health Care, 1956-65

(Millions of dollars)

Year	Hospital Services: General and Allied Special Hospitals	Hospital Services: Psychiatric Institutions	Hospital Services: Tuberculosis Sanatoria[1]	Hospital Services: Government of Canada[2]	Hospital Services: All Hospitals	Physicians' Services	Prescribed Drugs	Dentists' Services	Other Personal Health Services[3]	Total
1956..	380.8	77.6	30.6	40.8	529.8	240.1	71.8	81.5	65.0	988.2
1957..	422.9	87.5	31.0	45.3	586.7	271.8[r]	84.5	87.3	70.0	1,100.3[r]
1958..	462.3	99.0	30.4	48.4	640.1	301.3[r]	90.3	98.1	85.0	1,214.8[r]
1959..	543.6	111.6	29.6	50.3	734.1	325.7[r]	106.5	98.7[r]	95.0	1,360.0[r]
1960..	625.2	120.2	30.1	53.9	829.4	355.0[r]	109.6[r]	109.6[r]	105.0	1,508.6[r]
1961..	713.4[r]	134.9[r]	29.9	63.9[r]	942.1[r]	388.3[r]	112.8[r]	116.6[r]	115.0	1,674.8[r]
1962..	802.9[r]	144.4[r]	29.1[r]	70.3[r]	1,046.7[r]	406.1[r]	114.6[r]	121.5[r]	125.0	1,813.9[r]
1963..	900.1[r]	163.0[r]	28.1[r]	73.8[r]	1,165.0[r]	453.4[r]	128.0[r]	132.7[r]	135.0	2,014.1[r]
1964..	1,003.7[r]	182.1[r]	25.9[r]	76.8[r]	1,288.5[r]	495.7[r]	137.6[r]	147.6[r]	145.0	2,214.4[r]
1965..	1,125.9	210.7	25.9	79.8	1,442.3	545.1	149.1	159.8	155.0	2,451.3

[1] Excludes federal hospitals (Department of National Health and Welfare). [2] Excludes Department of National Defence hospitals for 1956-60. [3] Estimates of expenditures for services of private nurses, chiropractors, osteopaths and optometrists; excludes hospital employees.

SOURCE: Canada Year Book - 1968

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CHART F - Interdisciplinary Reactions and Results (Merck R&D)

Activity	Numbers of Tests or Compounds 1967	1968 est	Interdisciplinary Profession Interaction: Microbial	Chemical	Biochemical	Pharmacologic	Pharmaceutical	Medical/Veterinary	Other
			Development of New Screens		Development of New Screens				
Biologic Screening	72,000	90,000							
			Screen ⟷	Selection & Resynthesis ⟷	Screens ⟷	Screens ⟷	⟷	Etiology, Need, Incidence	Studies of Biochemical & biophysics of interactions at the molecular level.
Chemical Selection	ca 12,000	ca 15,000							
Lead Compounds	ca 7	ca 9	Fermentation ⟷	Synthesis or Isolation ⟷	Screen Evaluate ⟷	Screen Evaluate	--	--	
Lead Evaluation	ca 2,000	ca 1,500	Fermentation ⟷	Synthesis or Isolation ⟷	Screen Evaluate ⟷	Screen Evaluate	--	--	
Compound Selection	ca 20	ca 25	Selection ⟷	Selection ⟷	Selection ⟷	Selection ⟷	⟷	Selection	
Compound Evaluation	ca 20	ca 25	Process Improvement for kg quantities ⟷	Process Improvement for kg quantities ⟷	Metabolism ⟷	Advanced Pharmacology Toxicology ⟷	Formulation Studies ⟷	Clinical Research plans	
Rejection	ca	ca 7	--	--	--	Toxicity or Therapeutic Ratio	--	Therapeutic Ratio	
or									
IND	ca 17	ca 18	Intensive Process Development ⟷		Advanced Biochemistry ⟷	Chronic Toxicity ⟷	Advanced Formulation Studies ⟷	Human or Animal Pharmacological & Clinical Evaluation	
Rejection	ca 16	ca 17	--	--	--	Toxicity or Therapeutic Ratio ⟷	⟷	Lack of Efficacy, Human Toxicity, Side Effects	
or									
NDA	1-2	1-2	Economic Process ⟷	Economic Process ⟷	Clean Biochemistry ⟷	Clean Pharmacology & Toxicology ⟷	Formulation assuming Optimum Biologic availability ⟷	Clear, complete Medical/Veterinary Product Description incl. Indications, contraindications, side effects, etc.	
Useful Product	1-2		⟶ Production ⟷	Production ⟷	Continuing Follow-up ⟷	Continuing Follow-up ⟷	Production ⟷	Follow-up in Routine Medical use.	

CHART G. RESEARCH IN INDUSTRY AS A PERCENTAGE OF SALES

Product Group	1965 Value of Goods ($000,000)	1965 Research & Development ($000,000)	R & D as a Percentage of Sales
Aircraft	394	36.8	9.34
Drugs and Medicines	237	7.3	3.08
Electrical Products	1,902	54.3	2.85
Other Chemical Products	1,736	20.3	1.17
Machinery	1,235	11.8	0.95
Petroleum Products	1,430	12.1	0.85
Fabricated Metal Products	372	3.1	0.83
Rubber Industries	474	3.2	0.68
Pulp & Paper	2,104	12.8	0.61
Textiles	1,276	6.5	0.51
Motor Vehicles	2,120	3.1	0.15
Food and Beverage	6,428	5.2	0.08

SOURCE: Canada Year Book - 1968

Page 428 (Research & Development by Product Groups)
Pages 700-703 (Value of Shipments of Goods of Own Manufacture)

CHART H.

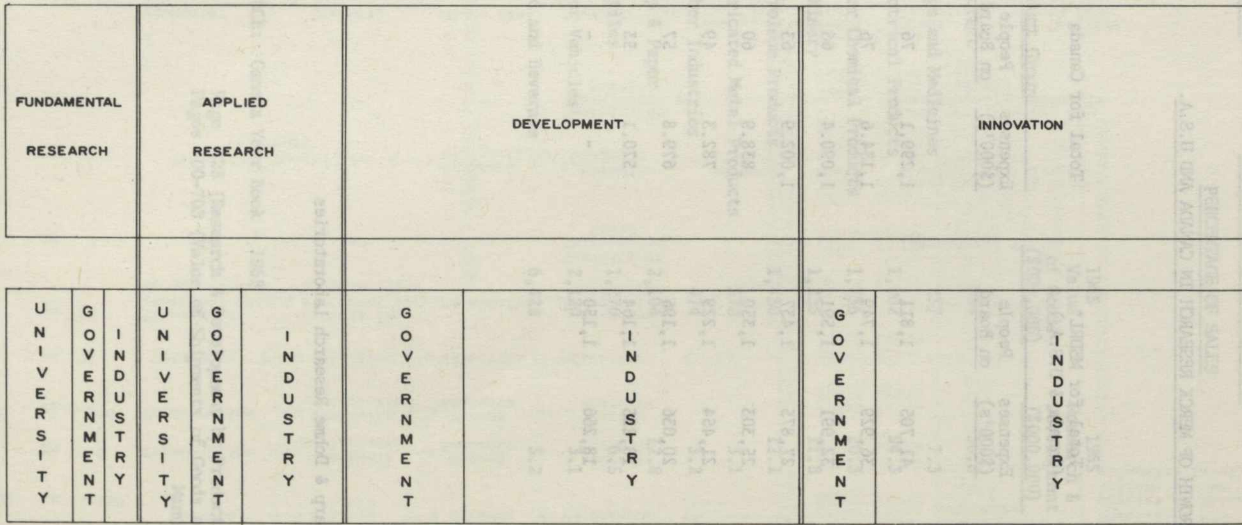
GROWTH OF MERCK RESEARCH IN CANADA AND U.S.A.

	Total for MSDRL* (Canada & U.S.A.)		Total for Canada	
Year	Expenses ($000's)	People on Board	Expenses ($000's)	People on Board
1968	41,705	1,811	1,299.1	76
1967	36,929	1,749	1,134.6	76
1966	32,991	1,591	1,090.4	66
1965	27,875	1,437	1,002.9	63
1964	25,303	1,350	838.9	60
1963	21,454	1,229	782.3	49
1962	20,036	1,196	679.8	57
1961	18,235	1,164	570.1	53
1960	18,266	1,150	-	-

* Merck Sharp & Dohme Research Laboratories

CHART I. SUGGESTED ROLE OF GOVERNMENTAL, UNIVERSITY & INDUSTRY, IN RESEARCH & INNOVATION.

SCIENCE COUNCIL DEFINITIONS OF RESEARCH



UNIVERSITY - TRAINING, FUNDAMENTAL, KNOWLEDGE, CONCEPTION, TECHNOLOGY.

GOVERNMENT - GRANTS, INCENTIVES, CONTRACTS, IN-HOUSE RESEARCH, NATIONAL PROBLEMS.

INDUSTRY - FUNDAMENTAL KNOWLEDGE, CONCEPTION, APPLICATION, DEVELOPMENT, INNOVATION.

APPENDIX 155

BRIEF SUBMITTED TO

THE SENATE SPECIAL COMMITTEE ON

SCIENCE POLICY

BY

CANADIAN BREWERIES LIMITED

BRIEF TO SPECIAL COMMITTEE ON SCIENCE POLICY

PREFACE

1. This brief is submitted for your consideration by Canadian Breweries Ltd., 79 St. Clair Avenue East, Toronto 7, Ontario.

2. The information given below is a summary of the material contained in this document.

(a) A form of assistance to Canadian industry is necessary to enable it to make the large capital expenditures required to adopt new or more modern processes. This could be in the form of a tax holiday for a period of time after these new facilities have been introduced.

(b) To provide an incentive for greater Research and Development activity in Canada, 150 % of all Research and Development capital and operating expenses should be chargeable against taxable income without a deductable base.

(c) Consider the establishment of a "Super" Technical University in Canada devoted solely to technology and its application.

(d) Orient National Research Council grants from primarily basic, fundamental research to primarily applied Research and Development.

(e) Gradually build up National Research Council staff with applications scientists rather than basic fundamental scientific staff.

3. Canadian Breweries Limited was founded in 1930, under the name of Brewing Corporation of Canada. The Company has grown steadily since that time through acquisition, construction and amalgamation to the point where it is among the larger brewing companies of the world. The Company is incorporated in Canada and has its head office in Toronto. A subsidiary, Carling Brewing Co. Inc., is operated in the United States and a substantial interest is held in the United Kingdom brewer, Bass Charrington Limited. Working and trade mark agreements are in force in other areas of the world.

PREFACE (CONT'D.)

4. The principal products of the Company are malt beverages of the lager, ale and stout variety with minor activities in the by-products of the industry such as spent grains and dried yeast.

5. Total sales including excise taxes in 1967 were $ 376,920,998 and the Company employed 6,000 persons of which 3,700 were employed in Canada.

RESEARCH AND DEVELOPMENT IN COMPANY

6. Since its inception Canadian Breweries has employed professional laboratory personnel for Quality Control and plant development purposes and has operated laboratories at its plants.

7. A formal research and development function was organized in 1947, and operated in a temporary laboratory in one of the operating plants. In 1951 a new and separate research and development laboratory was constructed at 369 Lake Shore Blvd. East, Toronto, Ontario, and this facility remains in operation today. This laboratory started with a relatively small staff of about twenty which increased steadily reaching a maximum of about 55 in 1964. The average number of the staff of this laboratory in 1968 was 40 of which 20 were professionally trained including 5 Ph.D.'s, 3 M.Sc.'s. and 12 B.Sc.'s. The remainder were technicians and service personnel such as secretaries, janitors, etc.

8. The combined capital and operating budgets of the Research and Development department has varied from $ 250,000 per annum to a high of $ 900,000 and was $ 434,000 during 1968.

9. Research and Development carried out in this laboratory is related to the brewing and malting processes and includes basic research studies in the fields of proteins, polyphenols, sugars, enzyme systems, yeast and microbial behaviour, colloidal phenomena; amino acid and higher alcohols studies.

RESEARCH AND DEVELOPMENT IN COMPANY (CONT'D.)

10. A considerable portion (approx. 65 %) of the efforts of the Research and Development Group is expended in applied research and process development. These groups are primarily responsible for determining ways of applying the results of the basic research group and others to the brewing process. This section consists of engineers and applied chemists and a substantial proportion of their work is carried out in the operating plants of the company.

11. A great deal of technical success has been achieved through the research and development effort and has resulted in the following major technical achievements:

(a) Worlds first totally continuous brewery.

(b) Worlds first continuous malting plant.

(c) The conbrew wort concentrate process.

(d) The polyclar process for beer stabilization.

(e) The definition of factors causing poor product shelf life.

(f) The Canadian Breweries system of yeast purification.

While technical success has been achieved in these areas, in most cases the commercial advantages of these developments have not been realized.

12. Breweries, like many other large industries in Canada, require very large capital investment in plant and equipment and once this expenditure is made, it is not necessarily economically sound to abandon this investment even if a more advantageous process is available. During the last ten years the brewing industry has built approximately one new brewery in Canada each year and of these only three have purchased other than second hand equipment. Thus there has been practically no opportunity in Canada to exploit the new technology developed. To pursue these new developments would require a very large and difficultly justifiable capital outlay, coupled with the abandonment of workable undepreciated assets.

FUTURE OF RESEARCH AND DEVELOPMENT IN THE BREWING INDUSTRY

13. Like most other industries, there is a large amount of research and particularly development work to be done in the brewing industry. Many of the techniques and much of the equipment used in this industry are based on obsolete technology, and processes can be developed to remedy these deficiencies and, in addition, greatly reduce the amount of money required to construct and operate a brewing plant. However, before this work can be undertaken or supported financially, there must be a means available to utilize these developments within the foreseeable future.

14. There is no economic reason to develop through Research and Development a new and better system for producing beer or any other product if the industry involved cannot justify scrapping its present large investment and re-investing in the newly developed process. This same phenomena is true in most capital intense industries such as steel, pulp and paper, certain chemical and base metal producers, etc.

15. This is an area where government assistance might help bridge the gap by allowing a tax holiday for a period of time during which the transition from the obsolete process to the new one is taking place, somewhat similar to the tax holiday allowed to mining companies at this time. An example of what can happen when the re-investment and modernization cannot or is not justified can be found in the deterioration of the British economy since World War II.

16. In general, under present conditions, one would not expect an increase in Research and Development activity in the brewing industry unless a strong economic motive to replace existing plants with more modern facilities can be found and one would expect Research and Development in this industry to continue at its present rate or gradually decline to trouble shooting and minor process improvement work unless a reasonable incentive is available to stimulate this type of work.

GOVERNMENT RESEARCH INCENTIVE PROGRAMS

17. Certain programs have been introduced to stimulate the expansion of Research and Development in Canada such as IRDIA, PAIT, etc., and these programs have had some effect. This effect has been greatest in the very small laboratories and has led to a large number of small companies "taking a flyer" at Research and Development. The application of these programs to the older larger laboratories where nearly all Research and Development of any consequence is undertaken has been less dramatic. The use of base periods has penalized those who have continuing research programs and the administrative and restrictive problems of the assistance programs have largely offset their incentive effects for the larger laboratories. The best incentive to Research and Development expansion would be a flat 150 % allowance for taxation purposes for all Research and Development expenses carried out by bona fide research laboratories on industrial Research and Development without the use of a base period or prior approval by N.R.C.

18. The current programs, while providing some assistance, do not provide a true incentive to the large, well organized research establishments.

UNIVERSITY RESEARCH

19. A very large percentage of all Canadian research expenditure is spent on university research. The primary purpose of the universities is to train and educate people and in spite of the old cliches, research is generally a fallout of the training process. It is difficult to visualize how much of direct value to industry can result from research presently carried out at universities. Most of this work is done by graduate students under the direction of a professor and realisticly the graduate student has only one real goal in mind, to complete his work and move to gainful employment. The professor on the other hand is interested in pursuing his pet subject, however remote from application it may be, and of publishing papers regardless of the usefulness of their contents. The results of this diversity of purpose and so called university freedom is the production of large amounts of work which is totally random and lacks any specific objective or purpose.

UNIVERSITY RESEARCH (CONT'D.)

20. The universities have and continue to do an excellent job in training technical and research personnel. There is little possibility, however, that under their present method of organization and operation they can contribute much research which will aid the industrialization of this country.

21. While Canada has numerous and very good universities, it would be advantageous if a University were established which would be oriented solely to technological development and would maintain extremely high standards for admission and achievement and be devoted completely to basic and applied technology like M.I.T. or Caltech in the U. S. A.

NATIONAL RESEARCH COUNCIL

22. The National Research Council has functioned for many years in Canada and while its purpose is vaguely stated in the act which founded the council, it has not made a major contribution to industry in Canada.

23. It appears that the late president of N.R.C. Dr. Steacy assumed, and with much justification, that if the number of scientifically trained people in Canada were dramatically increased the amount of scientific and research activity would also increase. Unfortunately the majority of people trained with the assistance of the National Research grants program either migrated to the U.S.A. or entered government departments or the teaching profession. The other disappointing factor regarding the N.R.C. student assistance programs is that they have resulted in the training of large numbers of theoretical, basic research type scientific people and left an almost complete void in the training of applied research personnel. The grants might be more profitably applied if fewer were given for basic fundamental research and more given for the training of applied research and applied engineering students.

NATIONAL RESEARCH COUNCIL (CONT'D.)

24. The same comments might be applied to N.R.C. itself: it is staffed with extremely well qualified people, who are primarily fundamental basic research oriented and can offer very limited assistance on an applied problem. Possibly for a country like Canada the staff of N.R.C. should be primarily applied scientists with a minority of basic or fundamental scientific people instead of visa versa as now exists.

25. In summary the following suggestions are made for your consideration as possible means of increasing the amount and effectiveness of the whole innovative process as applicable to the peculiar Canadian scene.

(a) Assistance to Canadian industry to make the large capital expenditures necessary to adopt new and more modern processes such as a tax holiday for a period of time after these new facilities have been introduced.

(b) Allow 150 % of all Research and Development capital and operating expenses against taxable income without a deductable base.

(c) Consider the establishement of a "Super" technical university in Canada devoted solely to technology and its application.

(d) Orient N.R.C. grants from primarily basic, fundamental research to primarily applied Research and Development.

(e) Gradually build up N.R.C. staff with applications scientists rather than basic fundamental scientific staff.

****

The Queen's Printer, Ottawa, 1969

First Session—Twenty-eighth Parliament
1968-69

THE SENATE OF CANADA

PROCEEDINGS

OF THE

SPECIAL COMMITTEE

ON

SCIENCE POLICY

The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*
The Honourable DONALD CAMERON, *Vice-Chairman*

No. 67

WEDNESDAY, JUNE 18th, 1969

WITNESSES:

Chevron Standard Limited: Dr. G. G. L. Henderson, Vice-President of Exploration; Syncrude Canada Limited: Mr. S. Stewart, Vice-President and Chairman of the Executive Committee; Shell Canada Limited: Dr. G. [illegible], Director of Research, Mr. M. Mazzrobbs, Manager, Tax Research and Administration; Imperial Oil Limited: Mr. J. Cogan, Senior Vice-President, Dr. C. H. [illegible], Deputy Manager of Research; Gulf Oil Canada Limited: Mr. Hugh S. [illegible], Vice-President; Shawinigan Chemicals Ltd., (Gulf Oil Canada Limited): Dr. B. C. Downing, Director of Research.

APPENDICES:

156—Brief submitted by Chevron Standard Limited
157—Brief submitted by Syncrude Canada Limited
158—Brief submitted by Shell Canada Limited
159—Brief submitted by Imperial Oil Limited
160—Brief submitted by Gulf Oil Canada Limited and its subsidiary Shawinigan Chemicals Ltd.

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NATIONAL RESEARCH COUNCIL (CONT'D.)

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First Session—Twenty-eighth Parliament
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The Honourable DONALD CAMERON, *Vice-Chairman*

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20658—1

MEMBERS OF THE SPECIAL COMMITTEE

ON

SCIENCE POLICY

The Honourable Maurice Lamontagne, *Chairman*

The Honourable Donald Cameron, *Vice-Chairman*

The Honourable Senators:

Aird	Grosart	Nichol
Belisle	Haig	O'Leary (*Carleton*)
Blois	Hays	Phillips (*Prince*)
Bourget	Kinnear	Robichaud
Cameron	Lamontagne	Sullivan
Carter	Lang	Thompson
Desruisseaux	Leonard	Yuzyk
Giguère	McGrand	

Patrick J. Savoie,
Clerk of the Committee.

ORDERS OF REFERENCE

Extract from the Minutes of the Proceedings of the Senate, Tuesday, September 17th, 1968:

"The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That a Special Committee of the Senate be appointed to consider and report on the science policy of the Federal Government with the object of appraising its priorities, its budget and its efficiency in the light of the experience of other industrialized countries and of the requirements of the new scientific age and, without restricting the generality of the foregoing, to inquire into and report upon the following:

(*a*) recent trends in research and development expenditures in Canada as compared with those in other industrialized countries;

(*b*) research and development activities carried out by the Federal Government in the fields of physical, life and human sciences;

(*c*) federal assistance to research and development activities carried out by individuals, universities, industry and other groups in the three scientific fields mentioned above; and

(*d*) the broad principles, the long-term financial requirements and the structural organization of a dynamic and efficient science policy for Canada.

That the Committee have power to engage the services of such counsel, staff and technical advisers as may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to examine witnesses, to report from time to time, to print such papers and evidence from day to day as may be ordered by the Committee, to sit during sittings and adjournments of the Senate, and to adjourn from place to place;

That the papers and evidence received and taken on the subject in the preceding session be referred to the Committee; and

That the Committee be composed of the Honourable Senators Aird, Argue, Bélisle, Bourget, Cameron, Desruisseaux, Grosart, Hays, Kinnear, Lamontagne, Lang, Leonard, MacKenzie, O'Leary (*Carleton*), Phillips (*Prince*), Sullivan, Thompson and Yuzyk.

After debate, and—
The question being put on the motion, it was—
Resolved in the affirmative."

20658—1½

Extract from the Minutes of the Proceedings of the Senate, Thursday, September 19th, 1968:

"With leave of the Senate,

The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That the name of the Honourable Senator Robichaud be substituted for that of the Honourable Senator Argue on the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—

Resolved in the affirmative."

Extract from the Minutes of the Proceedings of the Senate, Wednesday, February 5th, 1969:

"With leave of the Senate,

The Honourable Senator McDonald moved, seconded by the Honourable Senator Macdonald (*Cape Breton*):

That the names of the Honourable Senators Blois, Carter, Giguère Haig, McGrand and Nichol be added to the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—

Resolved in the affirmative."

ROBERT FORTIER,

Clerk of the Senate.

MINUTES OF PROCEEDINGS

WEDNESDAY, June 18, 1969.

Pursuant to adjournment and notice the Special Committee on Science Policy met this day at 8.00 p.m.

Present: The Honourable Senators Lamontagne (*Chairman*), Belisle, Blois, Cameron, Carter, Grosart, Haig, Phillips (*Prince*) and Robichaud—9.

In attendance: Philip J. Pocock, Director of Research (*Physical Science*)

The following witnesses were heard:

CHEVRON STANDARD LIMITED

Dr. G. G. L. Henderson,
Vice President of Exploration

SYNCRUDE CANADA LIMITED

Mr. S. Stewart, Vice-President and Chairman
of the Executive Committee

SHELL CANADA LIMITED

Dr. G. Shane, Director of Research
Mr. M. Mezzrobba, Manager,
Tax Research and Administration

IMPERIAL OIL LIMITED

Mr. J. Cogan, Senior Vice-President
Dr. C. H. Caesar, Deputy Manager of Research

GULF OIL CANADA LIMITED

Mr. Hugh S. Sutherland, Vice-President

SHAWINIGAN CHEMICALS DIVISION
(Gulf Oil Canada Limited)

Dr. D. C. Downing, Director of Research

(*A curriculum vitae of each witness follows these Minutes*)

The following are printed as Appendices:

No. 156—Brief submitted by Chevron Standard Limited
No. 157—Brief submitted by Syncrude Canada Limited
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At 10.20 p.m. the Committee adjourned to the call of the Chairman.

ATTEST:

Patrick J. Savoie,
Clerk of the Committee.

CURRICULUM VITAE

Caesar, Dr. Cameron H.: Birth place: Guelph, Ontario, 1910. Marital status: Married, 4 children. Education: University of Toronto, Chemical Mineralogy and Geology, B.A. 1933; University of London, England, Chemistry, Ph.D. 1936. Experience: Employed in June, 1933 as a Chemist in the Research Department of Imperial Oil Enterprises Ltd.; 1943, Senior Research Chemist; 1948, Chief Research Chemist; 1954, Assistant Manager, Research Department; 1967, Deputy Manager, Research Department. Professional association: Chemical Institute of Canada (F.C.I.C.).

Cogan, Jerry A.: Senior Vice-President and Director, Imperial Oil Limited. Born Canon City, Colorado, U.S.A. 1910. Educated Colorado College (B.A. 1930) and Massachusetts Institute of Technology (M.S. 1932). Process Engineer, Standard Oil Company of Louisiana 1932-34; Technical Analyst, Standard Oil Company (New Jersey) 1934-43; Foreign Program Director, Petroleum Administration for War 1943-45; Member and Manager, Co-ordination and Economics Department, Standard Oil Company (New Jersey) 1945-54; Assistant Manager, Manufacturing Department, Imperial Oil Limited 1954-56; Director (1956-); Vice-President (1957-69); Senior Vice-President (1969-), Imperial Oil Limited; Director, Interprovincial Pipeline (1969-); Member of National Research Council's Advisory Committee on Industrial Research.

Downing, Dr. D. C.: Born: Brandon, Man. Education: B.A. Brandon College 1938; M.A. in Organic Chemistry, Univ. Toronto 1940; Ph.D. in Organic Chemistry, Univ. Toronto 1942. Employment: National Research Council, Division of Chemistry, 1942-44, 1947-48; Royal Canadian Air Force, 1944-46; Shawinigan Chemicals Limited, Research Chemist 1946; Director Research Laboratories 1955 to date. Memberships: The Chemical Institute of Canada, Corporation of Professional Chemists of Quebec, American Chemical Society, Canadian Research Management Association, Research Sub-committee of Canadian Chemical Producers' Assoc.

Henderson, Gerald Gordon Lewis, B.Sc., M.Sc., Ph.D.: Vice-President and Director of Chevron Standard Limited and The Standard Oil Company of British Columbia Limited. Dr. Henderson was born in Vernon, British Columbia, on June 10, 1926. He attended Portora Royal School in Northern Ireland prior to commencing his studies in the Art Sciences at Trinity College, Dublin and Oxford University. Returned to Canada and graduated from McGill University —Honours B.Sc. Degree (1948) and M.Sc. (1950). Continued graduate studies in Geology at Princeton University—obtained Ph.D. in 1953. Career: 1951, 1953, employed by British Columbia Department of Mines; 1953, employed by Chevron Standard—holding positions of increasing responsibility; 1958, Appointed Professional Specialist in structural geology; 1962, Assistant Chief Geologist; 1963, Chief Geologist; 1966, Vice-President and Director. Memberships: The Alberta Society of Petroleum Geologists—Member; The American Association of Petroleum Geologists—Member; The Geological Association of Canada—Fellow; Technical Advisory Committee to the Research Council of Alberta—Member; The Solid Earth Science Study Group of the Science Council of Canada—Member; 1965-1967—Member of the National Advisory Committee for Research in the Geological Sciences. Publications: Extensively on the geology of the Canadian Rocky Mountain where he did extensive studies (field) during 1947-1962.

Mezzarobba, (Mel): Born October 27, 1934 at The Pas, Manitoba. Married, Attended University of Manitoba; graduated with B.Comm. 1956; R.I.A., 1969. Career: Shell Canada Limited, Commenced 1956, Position: Manager, Tax Research and Administration.

Shane, Dr. G.: Education: B. Chemical Engineering, McGill 1937; MSC Physical Chemistry, McGill 1938; Ph.D. Physical Chemistry, McGill 1940. Experience: Shell Canada Limited, Various Engineering Positions at Montreal East Refinery and Shellburn Refinery in Vancouver; Head Office Manufacturing Manager (Technical); Head Office Manufacturing Director Research. Memberships: Chemical Institute of Canada, Fellow Petroleum Institute of Great Britain.

Stewart, Sam: Born: July 13, 1915 in Portland, Oregon; Graduate of ULCA in 1938 with B.A. (Honors in Geology); Employed by Richfield Oil Corporation 1937 to 1966; Atlantic Richfield Company 1966 to present. Served as Manager of Canadian Division of Richfield Oil from 1952 to 1956. Manager of Synthetic Crude Exploration and Development (Canada) for Atlantic Richfield from 1966 to present date. Also serves as Vice President, Director, and member of the Executive Committee of Syncrude Canada Ltd. Member and former Chairman of the Board of Directors of the Alberta Division of the Canadian Petroleum Association from 1954 to present. Former member of the Board of Governors of CPA. Vice Chairman of Panel Discussion—"Occurrence and Prospects of Tar Sands"—1967 World Petroleum Congress. Member of Alberta Society of Petroleum Geologists, Canadian Geologists Institute. Mr. Stewart is a Certified Petroleum Geologist and member of the American Association of Petroleum Geologists. He is also a registered Professional Petroleum Engineer in the State of California.

Sutherland, Hugh S.: Title: Vice-President, Gulf Oil Canada Limited. Place of Birth: Amherst, N. S. Education: Mount Allison University, 1928, B.Sc.; 1963, LL.D. (Honoris Causa); McGill University, 1929, M.Sc.; 1931, Ph.D. (Physical Chemistry); Imperial College of Science & Technology, 1935, D.I.C. (Chemical Technology). Employed as a summer student by Shawinigan Chemicals Limited during undergraduate and post-graduate years. Joined Shawinigan Chemicals Limited in Plant Research Laboratories 1931, Research Chemist, 1931-42; Works Manager—St. Maurice Chemicals Ltd. (a wartime subsidiary) 1942-45; General Sales Manager (Shawinigan Chemicals), 1945 (Director of Company 1946); Vice-President Sales, 1947-56; Executive Vice-President & General Manager, 1956-58; President, 1958-66; Chairman of the Board, 1966—Apr. 1/69; Vice-President—Gulf Oil Canada Limited, 1967- to date. Past President & Past Chairman of Board—The Chemical Institute of Canada. Past Chairman—Society of Chemical Industry, Canadian Section. Past President—Montreal Board of Trade. Past Member of Advisory Council, Export Credits Insurance Corp.

of Canada—Member; 1965-1967—Member of the National Advisory Committee for Research in the Geological Sciences. Publications: Extensively on the geology of the Canadian Rocky Mountains where he did extensive studies (field) during 1947-1962.

Mezzarobba, (Mel): Born October 27, 1934 at The Pas, Manitoba. Married. Attended University of Manitoba, graduated with B.Comm. 1956; R.I.A., 1963. Career: Shell Canada Limited, Commenced 1956, Position: Manager, Tax Research and Administration.

Steele, Dr. G.: Education: B. Chemical Engineering, McGill 1937; MSC Physical Chemistry, McGill 1938; Ph.D. Physical Chemistry, McGill 1940. Experience: Shell Canada Limited, Various Engineering Positions at Montreal East Refinery and Shellburn Refinery in Vancouver; Head Office Manufacturing Manager (Technical); Head Office Manufacturing Director Research. Memberships: Chemical Institute of Canada, Fellow Petroleum Institute of Great Britain.

Stewart, Sam: Born July 18, 1915 in Portland, Oregon; Graduate of UCLA in 1938 with B.A. (Honors in Geology); Employed by Richfield Oil Corporation 1937 to 1966; Atlantic Richfield Company 1966 to present. Served as Manager of Canadian Division of Richfield Oil from 1952 to 1956. Manager of Synthetic Crude Exploration and Development (Canada) for Atlantic Richfield from 1966 to present date. Also serves as Vice President, Director, and member of the Executive Committee of Syncrude Canada Ltd. Member and former Chairman of the Board of Directors of the Alberta Division of the Canadian Petroleum Association from 1954 to present. Former member of the Board of Governors of CPA. Vice Chairman of Panel Discussion—"Occurrence and Prospects of Tar Sands"—1967 World Petroleum Congress. Member of Alberta Society of Petroleum Geologists, Canadian Geologists Institute. Mr. Stewart is a Certified Petroleum Geologist and member of the American Association of Petroleum Geologists. He is also a registered Professional Petroleum Engineer in the State of California.

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THE SENATE

SPECIAL COMMITTEE ON SCIENCE POLICY

EVIDENCE

Ottawa, Wednesday, June 18, 1969.

The Special Senate Committee on Science Policy met this day at 8.00 p.m.

Senator Maurice Lamontagne (*Chairman*) in the Chair.

The Chairman: Honourable senators, I am sure that all of you know our procedure here. We would like to have a brief statement, from five to ten minutes duration, from each of the witnesses and then we will conduct a kind of forum. I will first call upon Dr. Henderson.

Dr. G. G. L. Henderson, Vice-President of Exploration, Chevron Standard Limited: Mr. Chairman, honourable senators, my company, Chevron Standard Limited, was pleased to receive your invitation and I am delighted to be their representative at this meeting tonight. We have been following the deliberations of this special study group with a great deal of interest and we are aware that the commi tee has had the benefit of advice and testimony of many experts relating to your study of science policy in Canada.

Chevron Standard Limited believes that two of the principal objectives of such a policy should be to strengthen industry's participation in Canada's research and development activities and to develop a more favourable employment environment for Canada's scientific manpower. We have one specific recommendation which we would like to put forward which we feel would further the aims that I have stated. This would be to amend the Industrial Research and Development Incentives Act to provide that companies incorporated outside Canada, but carrying on business in Canada, be eligible to receive research incentives.

This proposed amendment would re-establish the incentives to research and development as contained in the Income Tax Act of 1962 which made them available to all companies working in Canada regardless of their country of incorporation. We see no basic difference between two international companies carrying on business in Canada, one of which is under Canadian incorporation and the other incorporated outside of Canada. Both are contributing to Canada's economic welfare and both, in our opinion, should be given the same incentives to establish and increase research and development activities in Canada.

I am sure the members of this committee are aware of numerous companies incorporated in Canada and carrying on business in Canada but with their control vested within a foreign parent. It seems to us that the circumstances of these corporations are no different from those of a foreign corporation such as Chevron Standard operating solely within Canada. Furthermore, we believe that ministerial approval can ensure that the incentives are only granted to companies conducting research and developments that qualify under the Act.

Chevron Standard Limited is incorporated in Delaware and conducts all its business in Canada as a wholly-owned subsidiary of the Standard Oil Company of California. Our parent company is cognizant of the benefits of research and development and has established two subsidiaries, Chevron Research Corporation at Richmond, California, and Chevron Oilfield Research Company at Lahabre, California, to concentrate on research and development and to disseminate new technology to the many worldwide operating companies of the parent structure. Most of the R and D work for our Canadian companies is carried out by those two research companies, although a minor amount of inhouse research is conducted at our head office in Calgary.

We believe there is an excellent possibility that Chevron Standard would expand its R and D facilities in Canada and also take over some of the work that is currently being conducted by those affiliated companies if the

Act were amended as we recommend. We are sure that other companies are in the same position as ourselves.

Mr. Chairman, one obvious question arises from this discussion and that is: Why do not companies such as ours change their incorporation to Canada if they wish to qualify for research and development incentives as defined by the Act? The answer to this question, so I have been advised by our tax advisers, is that the tax costs of such a re-organization would be prohibitive at this time.

In conclusion, Mr. Chairman, I would like to reiterate that Chevron Standard Limited believes that the main objective of providing R. and D. incentives is to give industry the initial financial assistance to expand R. and D. in Canada. The need for this has been pointed out by many scientific and political figures, including Prime Minister Trudeau in an address before the Chamber of Commerce in October, 1968, at Calgary.

The Chairman: We do not necessarily recognize him as an authority.

Dr. Henderson: No.

Senator Haig: I am glad you mentioned that first.

Dr. Henderson: I do not think I will make any comment on that. However, I think that I could quote another authority which you might recognize.

The Chairman: You can quote the Prime Minister if you wish.

Dr. Henderson: I guess he got his information from the Science Secretariat. I will quote him:

> Only 42 per cent of the research in Canada is performed by industry. This is the lowest proportion among nine leading European and North American countries. Our incentive and assistance programs to stimulate research and development programs in Canadian industries are one method of correcting these imbalances.

We sincerely believe that the availability of research and development incentives to all companies carrying on business in Canada will increase the amount of research and development in Canada and provide expanding job opportunities for Canadian scientists and technologists. Chevron Standard believes that our proposed amendment to the Industrial Research and Development Incentives Act will assist in achieving these objectives.

I would like to express my thanks again for your invitation to come before this meeting.

The Chairman: Thank you very much, Dr. Henderson. Now we will hear the opening statement of Mr. Stewart, who is vice-president and chairman of the executive committee, Syncrude Canada Limited.

Mr. S. Stewart, Vice-President and Chairman of the Executive Committee, Syncrude Canada Limited: Thank you, Mr. Chairman. Honourable members of the Senate, we welcome this opportunity to tell you about the Syncrude Canada Limited organization. The "Syncrude", as you have probably surmised, stands for synthetic crude. The major objective of the organization is to develop the Athabaska tar sands. Syncrude Canada Limited was formed about three years ago and is a cost company which represents four major oil companies, three of whom hold 30 per cent each in Syncrude Canada Limited, those companies being Imperial Oil Limited, Cities Service Athabaska, Inc., and the Atlantic Richfield Company, with Gulf Oil Canada Limited holding the remaining 10 per cent.

The company must be classed as truly a research organization although it has attempted on many occasions to apply its techniques. We are currently awaiting the results of a decision by the Alberta Oil and Gas Conservation Board on an application for an 80,000 barrel a day commercial plant which would go on stream in mid-1976 under our amended application.

Perhaps we should tell you a little about the Athabaska tar sands since they represent one of Canada's major resources. They are located about 200 miles north, northeast of Edmonton and contain about 626 billion barrels of oil in the ground. It is estimated that about 285 billion barrels of this would be recoverable with current techniques. About 15 to 20 per cent of the tar sands can be extracted by surface mining and the balance would require in situ techniques, injecting steam or similar techniques. There are associated with the tar sands a number of other possible by-products, sulphur, nickel and titanium, and these would be, we believe, recoverable at the same time as the primary target, the oil.

Perhaps the magnitude of the reserves should be emphasized. Canada's proved liquid hydrocarbon reserves are currently 9.6 billion barrels and, as I stated just a minute ago, the recoverable reserves in the tar sands are 285 billion barrels.

Senator Haig: 9.6 billion as against what?

Mr. Stewart: 285 billion. The Athabaska tar sands represent an area of roughly 10,000 square miles. The north-south dimension might be perhaps 120 miles and the east-west dimension 40 or 50 miles. They have been known since 1778 when Peter Pond first saw them on the banks of the Athabaska.

In addressing ourselves to a national science policy, the Syncrude submission is basically directed at the promotion of economic growth in Canada through research and development. The major aspects that we have considered are evaluation of resources, overcoming the development obstacles posed by the remote location and the difficult terrain, maximizing use of current technology and the co-ordination of university, industry and government efforts. I expect everyone has touched on that.

In the evaluation of resources there are two key aspects mentioned in our submission. We feel that in the development of any natural resource there should be a total approach, one which in the first pass hopefully recovers anything that may be of economic value. There are of course problems in that some of the associated minerals may not be at this point in time of commercial value but there is the possibility perhaps of stockpiling. This is one of the areas in which we feel that perhaps government research or the universities may be of substantial assistance in calling attention to the possibilities of associated industries.

There is also a strong role for government and the universities to play in co-ordinating the efforts and in disseminating information about the nature of the tar sands. I think there has been a great deal of conflicting information in part based on rather careless sampling techniques, and as a result it is with difficulty that a new company engaged in tar sands work can find the proper information.

In the problem of overcoming development obstacles it should be fairly obvious that the temperature extremes and the muskeg, which is common to all of the north country, require much research in order that the area can be developed. Government activity and support of research in this area would appear most desirable. It coule take the form of research in basic construction conditions and practices, studies of long distance transportation, and an overall study of the ecology, town planning concepts and transportation and communication systems adaptable to the north.

There are sociological aspects too. There is not a heavy population density but there are a number of Indians, Metis, in the northern part of Alberta which could be a source of technical skills if they were trained. We feel they must be utilized. This is an area in which we feel industry could perhaps receive some tax benefits or some support since this would eliminate the necessity for carrying the native population on welfare.

In maximizing the use of current technology we have endorsed a suggestion others have made that an overall information retrieval system be set up. I think this would be something that the government would probably be best suited to take on. This would cover mainly the field of basic research. Basic research information becomes available fairly rapidly throughout the world. If it was collected and readily available to all the universities and to industry this would perhaps enable stronger emphasis to be placed on applied research.

In the area of university-industry-government co-ordination we have read and find much that we can agree with in the Engineering Institute of Canada's brief, and we are particularly in agreement with the portions of that that would affect industries concerned with resource development, including the associated secondary industries. We feel that there is also an opportunity that is not being fully realized for the expansion of both open and closed types of research institutes, and we would very much like to see a research institute established to study the tar sands, although we may actually constitute one ourselves if we don't get a permit for commercial development.

The Chairman: You should not declare that kind of interest at this stage.

Mr. Stewart: We have tried two or three times, starting in 1962, so we are not making any announcement as yet. Perhaps the most important need for co-ordination of the three—I believe you have heard them referred to as the "three silences"—

The Chairman: Perhaps the "three solitudes".

Mr. Stewart: Yes, the "three solitudes", is the attendant possibility of setting resource priorities in educational objectives which will more truly reflect the requirements of the growing Canadian economy. I am sure those of us in industry would admit that probably if industry set all of the priorities they would be fairly narrow in scope. The same is true of the government and the universities in another direction; they would probably emphasize basic research and perhaps some of it might not seem to us to be too relevant to the problems.

We also feel that perhaps there is a tendency here and there for too many graduates in certain areas of science for which there are really no gainful opportunities in Canada and that perhaps there should be more attention directed to courses in disciplines which are particularly pertinent to Canada's problems. Thank you, sir.

The Chairman: Thank you, Mr. Stewart. Now we will hear from Dr. Shane of Shell Canada.

Dr. G. Shane, Director of Research, Shell Canada Limited: Thank you, Mr. Chairman. Honourable senators, I would like to thank you for the opportunity to appear before this committee. We in Shell Canada take this opportunity to commend the Senate Special Committee on Science Policy for undertaking this investigation into an area that is so vital to Canada's industrial and economic development. The impact of the Committee's recommendations could well determine the future of research and development activities in Canada and thus play a significant role in the future development and growth of our economy.

The importance to the welfare of our nation of a well established dynamic industrial research and development program is widely recognized. The rate of our economic growth and our competitive position in world markets depends to a great extent on the development and exploitation of new and advanced industrial technology. A research oriented environment enables industry to develop a nucleus of a highly skilled research staff able to interpret and exploit available knowledge and to adapt technological improvements to Canadian conditions, since in addition to carrying out research, a country must be able to translate new knowledge into actions that lead to real contributions to economic growth. The creation of challenging opportunities in a research-oriented environment entices our creative scientists and engineers to remain in Canada and attracts gifted research personnel to Canada from other countries. In short it is very important to a young industrial country like Canada to create the right environment for both the industrial and social development of the country.

In recent years, the federal government has introduced several programs to encourage and support scientific research and development activities in Canada. There is no question that these programs have provided a measure of assistance to some companies; but the amount of assistance provided falls far short of what is required to sustain sufficient impetus in research activity. New efforts are needed to encourage industry to establish long range scientific programs and exploit the results for the betterment of the whole country and not just the corporation or industry.

Shell Canada entered the research field in Canada because of specific research needs due to the Canadian environment, and research which was not covered by other Shell group laboratories. We would anticipate that the growth of our research activity in Canada would be at a modest pace to a large extent because of high research cost in Canada in comparison to European laboratories. I would point out that most of the Shell group's labs are in European countries. We feel that if the present research assistance program was modified to make our costs competitive there is good reason to believe that our growth would be accelerated.

Our recommendations have been tabled in the brief. I would like to repeat them, if you don't mind, at this stage. They are as follows:

On the IRDIA program the rolling average base for current expenditures under IRDIA should be eliminated. Assistance should be based on total expenditures incurred on research and development at the existing rate of 25 per cent. Our reason for this is that, unless there is a rapid growth in research programs, the effect of this incentive at present becomes very unimportant, particularly in corporations of our type.

The Chairman: Size.

Dr. Shane: Size, yes, where we undertake research in very many areas, such as Syncrude has, in the Athabaska and Peace River areas and various other places where large expenditures are incurred in a year or two and then the programs are held up for various reasons which I do not have to describe. Our other research programs which we carry on on a continuous basis in our labs get drowned out by these surges and swings in other areas of the company. The overall effect is that the IRDIA program has really contributed very little to our growth or development. Our second recommendation is that the administrative aspects of the IRDIA program should be simplified so that applications for grants are quickly and inexpensively prepared and are processed without undue delay. As it is now, it takes a considerable amount of time to work through the system and find out where you are financially, and from the point of view of trying to administer a research program you cannot tie in a grant with the activities. It is quite difficult to show the advantage of these programs to our management

On the PAIT program, which I think could be of great help in areas such as Athabaska, there are very many clauses in the agreement that are difficult to work with. I will not go through the list of them because they are tabled in the brief, but we find it very difficult to get involved in the PAIT program the way it is written at the moment, and we sincerely hope that some modifications can be made to it which will enable us to make use of it.

Finally, I would like to say that we feel that a greater effort should be made to encourage and support research in industry as contrasted to government in-house programs. The problem that we find with in-house programs, and I suppose you can say this too as far as university programs are concerned, is that it is very difficult for us in industry to get the results and implications of these programs in time to be of any use to us. We feel that research done in our own labs is much easier to exploit. The research programs are directed in a way that is commercially necessary. We know what we want when we start with the research program and we direct it in such a way that we get results that we can exploit rapidly. In addition, we feel that there is a lack of liaison between industry and government labs and universities so as to enable us to get a quick return from research done there.

We also think that one way that the government could help industrial research labs and industrial research generally in Canada would be a contracting out of government-sponsored research. This is done to a large extent in the United States and this enables laboratories to build staff and to build expertise. Thank you, Mr. Chairman.

The Chairman: Thank you very much. We will now hear from Mr. J. Cogan of Imperial Oil Limited.

Mr. J. Cogan, Senior Vice-President, Imperial Oil Limited: Mr. Chairman, honourable senators, I guess it is pretty clear that brevity is the essence of diplomacy so I will try to be diplomatic and make my remarks brief. I would like to take time to say that both my company and I consider it a privilege to be invited to appear before you on a subject that is pretty dear to our hearts.

In our experience in the industrial research and development field, and in this case the problems are primarily economic, we have been unable to find any magic formula for establishing a level of distribution of resources that we want to allocate to this function. I think it is quite clear that the additional dimensions involved in the national determination you gentlemen are concerned with make this even a much more complex task. We have been very much impressed by the well-organized and in-depth inquiries that this committee has undertaken in order to really obtain an accurate assessment of this problem.

Research and development are important components, of course, of the nation's economic, social and educational activities. Similarly, and in parallel, industrial research and development are a very integral part of our business. The appropriate level and the distribution of research effort in one country or in one company compared with another is not going to be determined by any simple formula or percentage but rather by individual and changing indigenous characteristics in various sectors. We certainly find that in our own business we have to really build up a composite sum of all the sectors rather than assessing it on any formula basis.

In other words, our industrial research and development is evaluated by business criteria, and, being mission-oriented, it must be directed towards anticipated technological needs or a recognition of opportunities and also, to be realistic, to the ability to carry through to some successful commercial utilization. Its rate of growth therefore as a justifiable use of scientific and financial resources is limited by these factors and by the efficiency with which it is carried out.

The quality of work through the entire innovative process is, I feel, of greater importance than the quantity. I might say that research is expensive, very expensive, and poor research, I think, is fantastically expensive. There are therefore limits to the pace at which it is realistic for industrial research and development to expand effectively. That does not mean, I feel, that within these limits there cannot be much done. Also the limits themselves can be expanded and here government policies will play an important role.

The needs and the opportunities for industrial research and development are strongly responsive to the economic environment and obviously the industrial base which the environment forces. In other words, the industrial load really sets the basis for the demand for technological needs, although it is a chicken-and-egg proposition beyond any doubt.

The recognition of the opportunities and their successful commercialization is strongly influenced naturally by the effectiveness of the communications at the various interfaces and stages of innovation and between the parties to the innovation.

Finally, the cost of the research and development operations themselves are a very important factor in determining what risks can be justifiably taken in what is necessarily a speculative function.

We feel strongly, and I think this has been repeated a good many times, that in Canada we can develop only a small proportion of the total technology upon which our business operations are based and that there should be no restriction to taking maximum advantage of the most efficient and particularly low cost technology available from any other source.

In our company, with international affiliates, we endeavour to do this but we still find it very good business to maintain a large research and development effort in Canada. We feel that our broadly based Canadian research activities are essential for an efficient and timely translation of new technology into commercial practice and to the continuing improvement and optimization of our operations and our products.

We feel that the very close communications we endeavour to maintain between our research and operating departments stimulate innovative approaches and assist in uncovering areas for research specialization and for rationalization within the international scene.

I think that summarizes the views which we deal with more specifically in the brief. I would like to echo the comment of Dr. Shane that, with regard to perhaps latitude for growth in the field of industrial research, one of the strong possibilities is in the line of contracts for research.

The Chairman: I am sure that we will come back to this later on. Now we will hear from Mr. Sutherland. Before he speaks I would like to clear up some confusion. I don't know whether it is the CPR or the CNR that is the author of this mistake. I want to express on behalf of the committee our apologies for the wrong time that was mentioned for our meeting this evening, which, I understand, in your interpretation was to have taken place this afternoon.

Mr. Hugh S. Sutherland, Vice-President Gulf Oil Canada Limited: Thank you for your kind words, Mr. Chairman. I can assure you that the problem was not very great as far as we were concerned because we were here anyway.

Mr. Chairman and honourable senators, we of Gulf Oil reiterate the words that have already been said in welcoming the opportunity to be here and we thank you for the invitation.

Our company, that is Gulf Oil Canada Limited, is, as you perhaps know, an amalgamation of the British American Oil Company, Royalite Oil and Shawinigan Chemicals Limited. This amalgamation occurred just about the time this particular brief was being prepared.

Senator Haig: Excuse me. Was Gulf Oil in Canada before or did you buy British American?

Mr. Sutherland: Gulf Oil was in Canada some years ago in a company which was an exploration company called Canadian Gulf Company, and it was amalgamated with hte British American Oil Company about 1954 or 1955.

Senator Haig: In the exploration field?

Mr. Sutherland: Yes, in the exploration field. At that time, with a change of shares, Gulf Oil Corporation of the United States ended up with a controlling interest in the British American Oil Company and they have still this controlling interest.

Senator Haig: Thank you.

The Chairman: I always understood that René Lévesque had something to do with this new alliance.

Senator Haig: I have no comment to make on that, Mr. Chairman. I just asked a simple question and I got the complete answer.

Mr. Sutherland: I have no comment either, Mr. Chairman. The capital invested in the company is about $700 million. The company is a completely integrated oil company. Last year we paid something more than $23 million in income taxes, so this makes us at least a citizen. We have 11,000 employees, and 780 of them are technically trained. We have two major research laboratories and about one-fifth of the technically trained people, roughly 140, are engaged in research. We have something like 300 people in total engaged in research.

Our approach to research is this, that we are very conscious of the need of continual innovation, and we think that research efforts should be directed to fulfil one or more of the following functions: It should pave the way to the production of a new marketable product; it should lead to the development of a new and improved project; it should upgrade existing processes or products; and it should be a mechanism for upgrading and maintaining a high level of technical competence in its employees. The company is unlikely to support a substantial amount of fundamental research in its own laboratories unless this research in itself is in support of an existing mission-oriented project.

We feel that the objective of any national science policy should be to encourage the use of various forms of science in enhancing the national well-being of our country. This could make itself evident in higher Gross National Product, in an improved social and cultural climate, and in a proper national security.

In order to participate in this effort the scientists must draw on an existing pool of fundamental scientific knowledge, a pool in which no person or no country has any proprietary interest, and it is a pool that must be constantly replenished. It is presumed that Canada, as a member of the club of free nations, has some responsibility in contributing its share to this universal pool of fundamental knowledge.

If Canada is to progress we must not only draw on this universal pool of knowledge but we must also draw on proprietary information which the country may possess or which the country may develop. This comes under the general heading of technology which may be vested in individuals, institutions, corporations or the government. It is the use of this technology which will help the country to prosper. And care should be taken to encourage the development of those technologies which can be used, and to encourage the creation of an economic climate in which they will be used.

Technology is inevitably bound up with people and the retention of a neat balance of properly skilled people in the country is a necessity if our technology is to be maintained. Skilled people will remain in the country only if they have the opportunity to earn a proper living and have the opportunity to practise and extend their particular lines of scientific endeavour. These opportunities can only be provided by the existence of suitable industries which are able to earn a profit, and the willingness and the ability of the public to support our scientific institutions, be they educational or governmental.

The effectiveness of any science policy is thus dependent on many factors outside of the immediate realm of the science policy-makers but to a great extent is not outside the realm of governmental decision. It is suggested that, as a means of supporting and stimulating scientific research endeavour in Canada, the government could let research contracts on problems of national interest to co-operative groups from industry, universities, research institutes and governmental departments with each group being assigned responsibilities according to its capabilities. This has been more or less said by some of the other speakers.

A certain amount of the knowledge developed would be in the field of pure science and as such it would find its way into the universal pool of scientific knowledge. A major part of the knowledge developed would be proprietary to Canada and would be used in solving some of Canada's problems, and it is suggested the proprietary interest in the scientific fallout which always occurs in the course of large projects should devolve on the group or the institution which makes the discovery and thus provide a substantial incentive to participate in the program.

Scientific progress cannot be assured by legislation. It can only be achieved by the interaction of the minds of men working in an atmosphere that provides not only freedom of thought but also the opportunity to exploit new ideas. Government policy can go a long way towards creating such an atmosphere. Thank you, sir.

The Chairman: Thank you, Mr. Sutherland. Mr. Sutherland is a member of the Sheridan Park Association and in that capacity I had the privilege of meeting him before. I am sure that he understood the opportunity I took before he spoke to explain some of the confusion which unfortunately arose.

New the free-for-all is about to begin. I would ask Senator Cameron to open the discussion.

Senator Haig: He is from Alberta.

The Chairman: He is from the west. And you are from the east.

Senator Cameron: I would like, first of all, Mr. Chairman, to compliment the witnesses upon the conciseness and forthrightness of their briefs. Like many other witnesses who have appeared before us in the last few days, they are all in favour of motherhood and against sin. They are all in favour of larger government grants and less taxes. They put us now in a very embarrassing position in this respect, because, if we accept their recommendations in that regard, I am sure the Treasury Board is going to ask us how we could do this magic trick. Unfortunately, none of them suggested quite how we make up for the deficiencies that would arise by giving tax holidays, and so on. However, that is just by the way.

I am going to take them now in order, and I will hit only a few of the high spots just to start the ball rolling. Chevron Standard, in section 2, says:

> Chevron Standard Limited recommends that the Act be amended in such a manner that these incentives be extended to companies incorporated outside Canada but carrying on business within Canada as was the case prior to the enactment of the new legislation. It appears to us that the place of incorporation is not relevant for the purposes of achieving the objectives of the Act.

The Government of Canada provides the funds for this. Can you see them being very enthusiastic about providing funds which would assist a company in Canada and the effect of the investment might be used somewhere else? I know that all companies, international companies particularly, make a strong point of the fact that they draw on the research of other companies, of their parent companies or other countries to benefit Canada. Just how does this work out in selling the policy to change this Act or the approach to change this Act so its benefits can be extended to companies incorporated outside of Canada?

The Chairman: Should we start to build a new empire?

Dr. Henderson: I think the point I was trying to stress here, Mr. Chairman, was that companies such as ours have the opportunity of doing their research, shall I say, either in the United States or in Europe or elsewhere. What we are trying to do from the national point of view would be to entice them to come to Canada. They have the option. We already have two research companies in the United States.

It is much cheaper to expand existing research facilities than to start new ones. There are good reasons to start new ones sometimes but economics becomes one of the major considerations. However, the amount we are talking about being done outside of Canada is quite substantial. In a recent Science Council survey the amount of research being done for the oil industry companies outside—and this is mostly in the United States but it could be in Europe as well—is about one-third of the total amount being done. So that we are talking now of sums of probably around $45 million in total. If you can bring part of that back into Canada we feel that this would encourage growth in the scientific community and provide further job opportunities for our graduates coming out of Canadian universities.

The whole point to us here is the question of incorporation. It is not a question of ownership. It is quite happenstance where you happen to incorporate. We did incorporate in Delaware, where some of the other gentlemen around the table happened to incorporate in Canada. However, once you have decided on your point of incorporation it is quite difficult to change it.

The Chairman: Just to follow up, before Senator Cameron asks his next question. Suppose, for instance, that you have nothing to do here in terms of production and you come here under your proposal, you get a grant, you hire consultants to do your research, and you get, let us say, 25 per cent from the Canadian Government to do your research. Then you go back to the United States and you have had a nice windfall on your research operation. Do you think that we should go on like that in Canada?

Dr. Henderson: No.

The Chairman: It would be possible under your proposal.

Senator Grosart: Mr. Chairman, you said 25 per cent. Twenty-five per cent of what?

Dr. Henderson: It is 25 per cent of the capital investment, 25 per cent of the amount of research done over a five year average.

Senator Grosart: I know the Act very well but I just wanted that clarification.

The Chairman: Well, as you know, senator, we have had a lot of proposals to get rid of this period, this increment approach, and to have a straight 25 per cent.

Senator Grosart: I am still asking, 25 per cent of what?

The Chairman: Twenty-five per cent of their research expenditures.

Dr. Henderson: To qualify under the Act.

Senator Grosart: That is exactly what I wanted.

Dr. Henderson: I have some comments on that later but...

Senator Grosart: Make them now because I want to know what the 25 per cent is.

The Chairman: I have already asked my question first.

Dr. Henderson: Yes, there are two questions being asked of me here.

The Chairman: I have priority here.

Dr. Henderson: Mr. Chairman, I will answer your question first. I feel that the Act itself has adequate precautions against such a situation because it does state that it must be of benefit to Canada, and the ministerial control on this is still available. From the other briefs I have seen put before this group, it is obvious that the Department of Industry is being very selective. They are taking a long time in actually carefully going over all the research and development that is put in to qualify under the Act. So I don't think there is any danger of misuse of it. The company must also be paying taxes in Canada, or taxable anyway. So, as I say, I do not see much danger of any fly-by-night misuse of the money.

Senator Cameron: Suppose this committee recommended to the government to extend this provision that you are asking for, that the benefits of the Act be extended to companies incorporated outside of Canada?

Dr. Henderson: But working in Canada?

Senator Cameron: Yes, but working in Canada. Would this have the effect of costing the government more money?

Dr. Henderson: I don't think so. Well, it would make more companies eligible for the incentive. Ultimately presumably it would cost more money but it would achieve the purpose of the act, which is to increase the amount of industry research and development and increase the facilities for research and development. I mean, this is what the Act was brought out for. I think you will find that in most cases the major cost of this would be in the facilities, the capital costs, not in the actual operating costs, except in the very initial period.

Senator Cameron: There is a bit of a contradiction here between the witnesses. For example, we are all in favour of having more research done in Canada. This is one of the purposes of this Act, and yet Dr. Shane of Shell comes along and says that there is quite a substantial differential between the cost of doing research in Canada and in Europe. Percentagewise, what would be the cost differential between doing a certain piece of research in Europe or in the United States or somewhere else as against doing it in Canada?

Dr. Shane: I would have to give you a rough estimate but I think it is about 25 per cent more expensive in Canada than in Europe.

The Chairman: Than in Europe?

Dr. Shane: Yes, Mr. Chairman. Of course, I think it is probably a little cheaper in Canada than in the States. However, there is the other problem which was mentioned earlier, and that is that it is usually cheaper to expand a large existing organization than to start a series of small ones. This balance presents a problem.

The Chairman: Why would it be 25 per cent cheaper in Europe?

Dr. Shane: Wages and salaries mainly are considerably lower there.

The Chairman: Efficiency has nothing to do with it?

Dr. Shane: I don't want to say anything about efficiency.

The Chairman: Oh, well.

Dr. Shane: I am discussing it on the matter of straight salaries.

Senator Robichaud: Are you speaking of Europe generally or specific countries?

Dr. Shane: I am speaking of specific countries where we have research labs, that is the United Kingdom, France, Holland and Germany. I am not sure about the comparison with Germany. I cannot say as to that country.

Senator Phillips: Changing the Act is not going to meet any of your objections.

Dr. Shane: I think what I am trying to say is that if the IRDIA grant was completely available and did not tail off the way it does, that would probably make the research cost equivalent. However, if you are operating on a more or less level plateau with smaller growth, the average effect is about 12 per cent rather than 25 per cent.

Senator Cameron: What you are saying then is that really for your cost there is no benefit from the 25 per cent grant, that the costs here are 25 per cent higher, that it cancels out?

Dr. Shane: It cancels out as compared to European costs, yes.

Senator Cameron: But the benefit would be that Canadians are being employed and we are developing a technology in our own country.

Dr. Shane: That is it exactly. The real incentive is to have trained people who can put this technology and research work to use.

Senator Cameron: I will go now to Shell for a moment. They have been analyzing and indicating the basic weaknesses of the incentive programs, IRDIA, PAIT and IRAP, and they want all these programs changed. Could you give us some of your own personal experiences with these programs, how they might be improved and the effect of the changes you are recommending, as to how they would improve the picture as far as you are concerned?

Dr. Shane: Most of our experience has been with the IRDIA program on which we have made submissions for the past two or three years. We find, as I mentioned that from a capital investment point of view it does certainly give us an incentive and, as a matter of fact, we are building a new research lab near Toronto at the moment. The incentive has helped us in that way. However, as far as current expense is concerned, the effect of IRDIA has been very small, so it has not given us this opportunity to be able to say it is just as cheap to carry on research or just as expensive to carry on research in Canada as in Europe. In fact, it turns out it is more expensive. So in a competitive environment we find it hard to...

The Chairman: Still on the basis of the differential as far as wages and salaries are concerned?

Dr. Shane: Yes.

The Chairman: I thought we were more efficient.

Dr. Shane: Well, I think so too, but it is hard to persuade some of our friends.

Senator Cameron: Could you expand your views regarding PAIT requirements that the projects should be exploited in Canada?

Dr. Shane: Well, as I understand the requirements of the present contracts for PAIT, if you find it is uneconomical to proceed with the project in Canada that you have done the research on, then it is at ministerial discretion whether the program can be exploited outside the country, and if this discretion is withheld then the research results become the property of the government. In carrying out these research programs, to a large extent know-how from outside Shell Canada would go into the program and we are reluctant, and I am sure that our compatriots or friends in the other companies who have done some of this research would also be reluctant, to release this as public knowledge. We feel that there should be the ability to exploit this wherever it is economically sound. It may not be economically sound or it may be impossible, for example, to exploit the tar sands development because of political reasons.

Senator Cameron: Yes, for political reasons. Can you tell us how we can sell this idea to the government, if you have spent some money, the government putting up 25 per cent or whatever it is, to develop a project and then you drop it but you use it somewhere else? Somebody has to sell the government of Canada, saying, "Well, we have invested this money and there is no direct benefit to us at the moment but it is being used somewhere else." What is your answer to that, that we are benefitting by what we are getting from these other countries; is that the answer?

Dr. Shane: No; I think what we would recommend is that the loan would be repaid and possibly some penalty provided because it is not exploited in Canada and it could be exploited elsewhere. Or if it is an invention, it would be patented in Canada and the royalties would come to Canada.

The Chairman: Of course at this stage all the members constitute a panel here, so if you want to intervene at any time it would be most welcome. Do you have any comments, Mr. Sutherland?

Mr. Sutherland: No, Mr. Chairman. I think it is difficult for an international company to be hampered by this inability to exchange information. I think these are facts of life really. You can say it should not be this way but these are facts of life and I think it makes it very difficult for a company with international affiliations to be hampered this way and therefore it makes the companies reluctant to use the program.

Senator Cameron: In this committee we have to be very realistic and practical in our recommendations, and we are trying to get some hard answers from you people. The Shell brief at page 5 says:

> The basis for termination of the agreement should be broad and not be subject to ministerial discretion.

The Chairman: We hear that too from the universities.

Senator Cameron: Yes. Nobody wants to have control, but in reality somebody has to have control.

Dr. Shane: That is very true. The corporation, however, will be investing a large amount of money as well having a loan from the government, which will be repaid.

The Chairman: You are still speaking about PAIT. However, what about the other programs?

Dr. Shane: Can I answer as to the PAIT one first? It is very difficult to invest money, knowing that you finally may come to a decision that further research funds are not worth spending—you know, that is a hard decision for research people anyway, but you do come to that decision some imes—and it is hard, knowing you cannot terminate it without the minister's agreement. He may not agree with your decision. Therefore, there has to be some way of coming to an agreement on this, that it can be terminated, and by which the company can protect itself. It feels at this stage that there is no way of protecting itself, that it is involved in an agreement which it cannot terminate under any circumstances.

Senator Cameron: The minister may feel he has to have some protection too.

Dr. Shane: I realize that. However, you were just asking why we cannot use the program and I am trying to point out what bothers us about it. How it can be resolved is something, I am sure, can be worked out. I am not a lawyer and I cannot tell you exactly how it would be. However, I feel that there has to be some give and take in this arrangement in order to be able to terminate a program rather than to have to continue it.

Senator Grosart: Mr. Chairman, could I make a comment on PAIT? I was interested in the suggestion I thought was made that funding under PAIT was not applicable to research and development fundings outside of Canada. I went upstairs to get my documents.

The Chairman: I noticed that.

Senator Grosart: I would like to quote this, and it is something from the department:

> This program seeks to promote the growth and productivity of efficient and competitive manufacturing in processing industries in Canada by the application of science and technology to the development of new and improved products and processes for commercial markets at home and abroad.

This is PAIT. Is the department saying something that industry does not understand? This has been a quotation from the annual report of the department, what was then the Department of Industry.

Dr. Shane: If you are asking me to answer this, I think the problem is in the contract, the way the contract is worded, that it leaves all of these things completely at the discretion of the Minister. It is very difficult for a corporation to enter into a contract to spend money without any knowledge of whether, when the time comes, if you decide it cannot be exploited in Canada, that you don't know that you can exploit it elsewhere.

Senator Grosart: But if the department is correct, it is not a criterion that can be applied by the minister or anybody else. If the department is correct in the statement I have read, you are entitled to funds to develop new or improved products and processes for commercial markets at home and abroad. Is the evidence we are now having that the department is, in its ministerial decisions, running contrary to its own statement? That is all I am asking.

The Chairman: We will let you answer, if you have an answer, Dr. Shane, or if you have any comment at the moment.

Dr. Shane: Why don't we let somebody else comment because I am sure others wish to speak too.

Mr. Cogan: I think you refer, Senator Grosart, to exploitation of products in domestic or foreign markets rather than technology? I believe that is the interpretation.

Senator Grosart: No, it says the application of science and technology to the development of new or improved products and processes for commercial markets at home and abroad. I cannot think of a broader definition of the eligibility of any corporation for funding by the Department of Industry, Trade and Commerce.

Dr. D. C. Downing, Director of Research, Shawinigan Chemicals Division, Gulf Oil Canada Limited: I have read with great attention the fine print of the contract forms of the Department of Industry and they go somewhat beyond what is in the general report that Senator Grosart just read. I think the wording is something to the effect that no technology developed is to be transferred outside of Canada or to another company inside Canada without the consent of the Minister. So, although you can market abroad, and of course they are very happy that you do, you cannot transfer the technology outside of Canada without ministerial consent.

Senator Grosart: I am sure there is nothing wrong with the minister being able to use his discretion as to whether there should be a transfer of technology. This is a question we are up against, Mr. Chairman, over and over again where industry says, "We don't like the ministerial discretion." There is an Act which spells out very clearly what their rights are and we are over and over again up against this proposition where industry, universities and other people come here and say, "We want a shoulder to cry on but we will not be specific as to our rights under the Act."

If the Minister is not administering this act in terms of the provisions of the act, then you have a complaint to the minister. This is what I do not understand. You may have a contract, as our friend Dr. Downing here says, that seems to restrict it. The only restriction I could see in it is that the minister has some discretion.

The Chairman: You mean you don't want ministers to be eliminated.

Senator Grosart: Certainly not. I come back to what we have said over and over again, if you are going to have the funding and spending of political money, you have to have accountability, and there is one person who will have to account for it and that is the minister.

The Chairman: This is the first time, Senator Grosart, that I have heard you being so anti-Marxist, for Marx once said that at some stage of the evolution of humanity the state would wither away. I am glad that you are against it.

Senator Haig: I think you should direct that question to the oil companies, Mr. Chairman.

Mr. Cogan: I think I would like to make it clear that we do not see anything wrong with the PAIT act for its purposes, and I think it is entirely correct that there should be discretion as it stands. I think the question really is, is it applicable under the circumstances to an international company? I think the fact is that it probably is not, primarily because of the question of the technology referred to and the inability to keep one piece of technology unscrambled from another piece in case the effort is unsuccessful and the inability really then to transfer all of the technology to the government when only part of it was probably started from the experiment in question. I think that PAIT is useful where these conditions do not exist but I do not think it is the answer to the question of what might be done under the circumstances where you have international technology involved that way. I do not think we can complain about it and I do not think we have really a solution as to what the alternative is. It is not an objection; it is just that we don't accept it.

The Chairman: That is worse.

Dr. Shane: May I comment on that? I think that is exactly the point that I was trying to make, that we have been approached by the Department of Industry asking us why we find it impossible to use PAIT. I am trying to demonstrate the problem that we have. I think it is because—and I mentioned this earlier—any research we undertake under PAIT would undoubtedly have a background of research that has been done outside the country, and to try to unscramble, as was, I think, the expression, what was developed in Canada and what was fed into it from outside Canada becomes rather an impossible situation.

Senator Cameron: I assume, however, that when this act was being drafted the department called in people from the oil industry and discussed it. This act was just not a brainchild of the Department of Industry but has been hammered out in consultation with the oil industry. Is this not correct?

Dr. Shane: No. As far as I am concerned, and I am not sure about the other oil companies, we were not brought into consultation in the development of the act but we have been approached rather recently, within the last year, as to why we have not been able to exploit it. These are the reasons. I thought it would be worthwhile presenting them to this committee.

Senator Cameron: We are not trying to be difficult.

Dr. Shane: No, I realize that.

Senator Cameron: In fact, there is unanimous agreement that these acts could be changed. We are trying to find out what are the alternatives.

Mr. Cogan: They need to be changed if you want them per se to apply or some other method of obtaining a similar result.

The Chairman: Senator Robichaud.

Senator Robichaud: Mr. Chairman, I do not want to interfere with Senator Cameron's questions. We are on the subject of PAIT, and this is a related question. Dr. Shane on page 4 of his brief states:

> The PAIT loan interest rates are high and this essentially amounts to high cost financing for a successful project.

On page 5 he states:

> Interest charges on repayments of loans should be reduced to a level competitive with commercial financing.

Would you elaborate on that insofar as what would be the difference between the commercial financing rate and the interest charged under PAIT?

The Chairman: That might be considered an unfair question.

Senator Grosart: It is a very hard question, Mr. Chairman. What is the PAIT interest rate?

Senator Robichaud: As compared with commercial financing?

Dr. Shane: I have a calculation.

Senator Grosart: What is the PAIT rate? We don't have to have any calculation.

Dr. Shane: Assuming that the PAIT rate...

Senator Grosart: But what is it?

Dr. Shane: I imagine it changes with each contract and it would depend to a large extent on what the commercial rate is.

Senator Robichaud: On what basis are the PAIT rates charged? There must be a basis.

Dr. Shane: There is a basis that is set in the agreement. It is the way the different programs work together that...

The Chairman: Would it not be the government rate plus something?

Dr. Shane: If you assume that you get a commercial loan at the same rate as the PAIT loan, because of the various income taxes and IRDIA grants and such, it turns out that a PAIT loan costs more than twice what the commercial loan would cost.

Senator Robichaud: Could you give us a concrete example? I am not completely satisfied with your answer.

Dr. Shane: I have a calculation here that has been made. Perhaps I could call on my colleague to explain this calculation to some extent.

Mr. M. Mezzrobba, Manager, Tax Research and Administration, Shell Canada Limited: Basically the calculation was based on two loans, one a private loan and the other a PAIT loan, on a particular research and development project. What happens is that under PAIT, and I better just have a look at the calculation, you are allowed an income tax deduction only on the amount of the company's expenditures. This amounts to 50 per cent of your initial outlay in the first year. One must also consider the fact that under IRDIA you could only obtain 25 per cent of the company's cost, which again is 50 per cent of your total outlay. If you use the discounted cash flow method on pay-back within one year, you find that, and this is based on interest rates of $6\frac{1}{2}$ per cent, you find that on a loan or a PAIT grant of $500, in one year the additional cost under PAIT is just in excess of $22. In other words, it is a rate of about 9 per cent before tax. This is using identical rates under both methods. The difference here is mainly the fact that it is the present value of the income tax dollar that you do not get under PAIT plus the IRDIA grant that you do not get under PAIT until you repay the loan.

The Chairman: You say it does not have anything to do with the interest rate though?

Mr. Mezzrobba: No, it is the cost. I think that is the point Dr. Shane was trying to make.

Senator Grosart: That sounds like a little bit of specious reasoning to me. I have heard this argument by accountants and actuaries before about the difference between the interest rate and interest cost. The interest rate is something laid down by the grantor of a loan. The interest cost is something that is dependent entirely on the ability and the efficiency of the loanee to handle it. If your inability to handle the loan is caused through inefficiency, then I think you should stop criticizing the government and start worrying about your own ability to handle money. The essential thing is the interest rate at which you can borrow money from the government. I would suggest to Shell Oil that it is a very, very serious charge to say that under a government incentive program the interest rate for borrowing money is higher than that at which you can borrow money in the market.

Mr. Chairman, I think we should just resolve this. It is a very, very serious charge that also runs through IRDIA, where again we have the same kind of concept. If the government is this stupid, let us know, and let us have it clearly laid on the Shell Oil Company and say that the government is this stupid, that it is offering an incentive program that is more costly than borrowing money on the market.

The Chairman: I will allow your question, Senator Grosart, but I want to warn you that there is a limit to you defending the government.

Senator Grosart: Mr. Chairman, may I just say something further?

The Chairman: I appreciate that it is a very serious matter.

Senator Grosart: I would just like to say this, that we are not in any way political here, I would like to believe that when the Department of Industry, Trade and Commerce comes up with what they call an incentive program, knowing that they have consulted industry as they have, that it is not as nonsensical as we are now given to believe. This has nothing to do with politics; this is part of my belief in the democratic process and the government of Canada.

Senator Robichaud: I wanted to ask that very question.

Dr. Shane: May I say that there is nothing in this brief meant to be a criticism of the government. We have been asked to indicate the problems we saw with these various programs. If you think we are implying that the government is charging too high a rate of interest, this is not really what we are trying to say. Perhaps we have said it poorly. What we are trying to say is that it turns out that one of the things that is difficult to handle with PAIT is that it turns out to be more expensive to borrow money under PAIT than it is with commercial loans. This is not because they are charging too high a rate, it is because of the way the various acts work together, the Income Tax Act the IRDIA program and so on. We are just pointing out some of the difficulties that we have run into. We are not criticizing anybody.

Senator Grosart: But this is called a government incentive program. It does not seem to be an incentive at all.

Senator Robichaud: Would you like the government to get rid of it?

Dr. Shane: No. I think certainly it must be useful to people who are using it. I am explaining why we find it difficult to use.

Senator Grosart: I would like to ask this. The water bomber people, the satellite communications equipment people, the electromagnetic prospecting equipment people, the flight safety devices people, the advanced machinery and machine tools people, the techniques for the transportation of solids by pipeline people, the woods harvesting equipment people, the data display devices people, the air pollution monitoring instruments people, all of whom have taken advantage of PAIT, of the PAIT incentives, are they paying higher rates to take advantage of the PAIT loans than they could have borrowed money on the commercial market? Are they crazy?

Dr. Shane: I cannot say.

The Chairman: You do not have to justify their behaviour.

Senator Robichaud: I think it costs them more to take advantage of PAIT than it would if they were going to use regular commercial financing, according to this.

Dr. Shane: If our calculations are correct, we think it does.

The Chairman: I think there was a gentleman who wanted to make a comment earlier.

Dr. Downing: Mr. Chairman, last December I was at our meeting by invitation with the Department of Industry officials in Ottawa along with a number of other industrial people, and a similar calculation was offered then. It was done by another company and the basis may have been slightly different but it did show a similar thing. I think the Department of Industry already realizes this and is thinking hard of ways to correct it. However, they did admit to us at the time that the calculation was correct, that it was somewhat higher than had been expected.

Senator Cameron: Mr. Chairman, if we accept this statement as it is, in effect it is a disincentive program.

The Chairman: Yes, creating clients for the banks.

Mr. Cogan: I think it depends on the circumstances completely. What really happens is that it is not the interest rate; it is the interaction between that and the IRDIA. Due to the time payments on those it does not turn out to be much of an incentive for a successful development. For one that is highly risky it is probably well overcome. It certainly has its place and it is obvious, since these companies took it up, that they felt it was going to be an incentive. I think we have just been talking about why it has not proven to be an incentive in particular cases.

Senator Cameron: I don't want to spend more time on this but it does require more looking into to see how the interaction between these different programs may be cancelling each other out. I had some other questions for Shell but I would like to get on to Syncrude because I practically grew up with the tar sands.

The Chairman: I knew you would come to this eventually.

Senator Cameron: The time is getting on and I did not want to monopolize things.

Senator Robichaud: You are not. We are taking advantage of your time.

Senator Cameron: That was a very good intervention as a matter of fact, that last one.

The tar sands development is a tremendous process. To me it is one of the most exciting things in Canada. Again, however, there are some contradictions in this brief in relation to the current policy. Just in the last week or two we had the independent oil producers down here who wanted to get a pipeline to Montreal, and we had some well known oil companies looking upon this with some disfavour. We may come back to that later on.

The Chairman: Yes, that had very little to do with research.

Mr. Cameron: It is a product of research though. Could the witness give a description of the present-day relations between Syncrude, the government and the universities regarding the tar sands project? The suggestion is made here, and it has been made by several others, that there is no co-ordination between government labs, universities and industry. This is a multidisciplinary project.

Your submission raises a number of questions: Have university researchers shown any personal interest? I know quite a few who have. Is the work in the government and university sectors making any contribution to this development? Are there any hindrances to effective collaboration between the various sectors? And how is existing federal government science policy related to the problems concerning this project?

Mr. Stewart: There were a fair number of questions there. I think we have been quite fortunate in the co-operation we have received from the federal government through the mines branch. They have been carrying on studies of a rather narrow segment of the overall process for a number of years and at one time owned the experimental plant on the site, as you know. The Alberta research council is very seriously interested in the tar sands and have published many papers. Their studies are not so much on processes as on, let us say, the composition of the tar sands, the heavy mineral content and the overall geology. There are a number of University of Alberta professors who do consulting for us. And we utilize a number of professors of chemistry, organic chemistry, to supplement our own staff. So I would say we have been quite fortunate in the relations we have had with the universities and the federal and provincial governments.

Senator Cameron: There is a suggestion, and not just by your company but by others, that there has been lack of collaboration between universities, the government and industry. We would like to pin this down in specific terms. Right here on page 5 of your brief you have a heading "Need for Co-ordination".

Mr. Stewart: As the brief points out in, I guess it is, the next to last paragraph, it is unfortunate, although we can understand some of the reasons, that the provincial government and the federal government have backed in and out of the tar sands two or three times. There have been occasions during world war 2 when the federal government was quite active, and then when the emergency became a little less intense their interest logically evaporated. I think this is probably the main thrust of our argument, that there has bee^n no continuity. It is just difficult to justify even academic research when the provincial policy has prohibited development of the tar sands.

Senator Cameron: Why has the provincial government prohibited development of the sands?

The Chairman: We of the east are very much interested in this kind of dialogue.

Mr. Stewart: As you are aware, I am sure, the province of Alberta normally obtains 40 to 43 per cent of its commercial revenues from the oil industry. Since the markets for Alberta crude are quite severely prorated, it has been felt for a number of years that any substantial amount of tar sands production would deflate conventional crude and might reduce this source of income. We have very few friends and lots of enemies in the club.

The Chairman: You are not part of the club yet.

Senator Cameron: We wish you luck anyway. You go on in connection with this matter at page 5, the last paragraph, and say:

> Much effort has been expended on abnormally high-grade coarse-grained tar sand, the type most accessible from outcrops. Industry in Canada has been severely misled by these studies.

Mr. Stewart: I think unfortunately in the past a great many samples were collected almost at random along the banks of the Athabaska and from various core holes. I think there has been a tendency to categorize the entire tar sands as being represented by individual samples, and this is not the case because it varies to a very marked degree even within distances of 200 to 300 feet laterally. Sometimes the analyses would perhaps lead you to undertake the development of a process which would be suitable for the specific sand analysis but you would find that there was no sand like that once your equipment was built. However, I think perhaps there should be a self-accusation as well as a condemnation of others because anyone who is guilty of that type of work deserves the type of information he gets.

Senator Cameron: This is what I would think. As a matter of fact, I used to keep a sample in my office. I used to show visitors from the far east how I could squeeze the oil out with my fingers.

The Chairman: Visitors from Winnipeg.

Senator Cameron: Yes. I could hardly credit it, the number of people, university people and oil people who have worked on this, that they could be guitly of such poor sampling.

Mr. Stewart: I do not think it was appreciated for quite a number of years that there was such a tremendous variation in bitumen content, in the fines content and in the grain size, and it is only with the more intensive drilling in the last 10 years, let us say, that people have begun to appreciate the tremendous variations throughout the deposit.

Senator Grosart: Perhaps we need a national science policy, Mr. Chairman.

Senator Cameron: I would think this was an elementary thing, that there should be a uniform system of sampling. However, that is just a detail.

The Chairman: However, it is still an important detail.

Senator Cameron: Yes, indeed. One can understand how in 10,000 square miles there is bound to be a variation in the content. Has a system of sampling been evolved that can give a more accurate documentation than we have had so far?

Mr. Stewart: Yes, sir, we think we have it. We are currently co-operating with the one commercial venture in the area to try to develop a set of benchmarks in analysis so that we both know where we are going. So in that respect there is progress being made.

Senator Cameron: Are you going anywhere until we get another oil policy?—

Mr. Stewart: I do not believe there is an answer to that. The conservation board has yet to reach a decision on our last hearing.

Senator Cameron: You say that there is a need for a continuing program to update, broaden and disseminate material on problems, namely basic construction conditions, and practices, frost penetration rates in various soils and under various conditions, protective measures against frost, and so on. This is a problem of the whole north country actually. Have you any specific suggestions as to how this might be handled?

Mr. Stewart: I do know that the federal government has extensive muskeg studies under way. I think it is Dr. Radforth, is it not, who is the world expert on muskeg. I am not able to offer any concrete suggestions to you at this moment.

Senator Cameron: You touch on another thing, apart from the industrial aspect; you are one of the few who recognizes the sociological problems there. You referred in your submission to the training of the Metis and the Indians, and so on. I believe that under the program New Start, which is designed to do some of the things you suggest, the premier of the province is reported in the newspapers to have taken a delegation up through this country and to have come back with a statement that he has very great reservations about this program New Start being capable of meeting the needs. I don't know whether you say that comment or not. He seemed to feel that the whole concept was not sound. I am paraphrasing that a bit. I don't want to be unfair to the premier or anybody else.

Mr. Stewart: I am sorry, I did not see that reference. I saw the newspaper coverage of the trip in general but I was not aware he had said that.

Senator Cameron: In any case, what expeirence have you had with trying to train the Metis and the Indians surrounding a plant to work in this area?

Mr. Stewart: We have had basically no firsthand experience. Our operations in the McMurray area were terminated about four years ago when our first application was turned down. We had to reduce our work force and we moved back to Edmonton where we have an engineering office and a laboratory. We have a total of about 62 technical people in Edmonton. Because of the waiting game we have had to play we have not been in a position to expand and move into the area of training. Certainly another commercial project in the tar sands, I think, would have to employ and would have to train the population in the McMurray area.

Senator Cameron: Isn't that a pretty long-term project though? How long do you think it would take to train people who could work in that plant effectively and efficiently?

Mr. Stewart: Well, sir, the only analogy or similar situation about which I have firsthand knowledge would be the utilization of Eskimos on drilling rigs by the Peter Boden Drilling Company. They had, I think, quite a happy experience with Eskimos as rig hands. I think the actual oilfield experience period was something like six months before they were put on a rig. They do, I believe, get a somewhat higher level of education in the schools at Aklavik.

The Chairman: Or Univik.

Mr. Stewart: Yes.

Senator Cameron: Well, I think that is another kettle of fish though.

The Chairman: Well, Senator Cameron, if you wish, please ask another question. Then I think we may even have time to come back to you.

Senator Cameron: I have had my share anyway.

The Chairman: You have had a good share, yes.

Senator Cameron: On the question of the Eskimos, I think we must recognize that anybody who has worked with the Eskimos and the Indians finds a very great difference between the adaptability to modern technology of the two. I have seen some of these cat-skinners up on the DEW Line, and they seem to take to it like a duck to water. I am referring to the Eskimos in that employment. They can haywire a motor together and go scooting down the MacKenzie River whereas an Indian will throw up his hands and just abandon the ship, so to speak. So there is quite a difference between the adaptability of the Eskimos and the Indians.

The Chairman: The Eskimos have been exposed to the white civilization for too long, I guess.

Senator Cameron: I will shut up now.

The Chairman: Senator Robichaud.

Senator Robichaud: Mr. Chairman, may I proceed from the tar sands to pure oil and direct a question to Mr. Cogan? As a regular listener to Hockey Night in Canada, I am well aware that Imperial Oil is involved. My question is based on the statement in your brief at page 12 where you have this:

> The performance of university graduates (question B2)—we have found the performance of top-ranking men from Canadian universities to be fully equivalent to the performance of their counterparts trained abroad.

I must say we are pleased to hear that. Then further down you say this:

> The Supply of Scientific Manpower (Question B.4)—At the present time we find there is a good supply of competent chemists and chemical engineers. There is some shortage of geophysicists, geologists and mechanical engineers.

We have been told many time that there is at the present time a surplus of PhD.'s in Canada. What is your experience as a company, one which does a great deal of hiring of scientists, in this field? Do you feel you can get an adequate supply in Canada or do you find there is a surplus of PhD.'s?

Mr. Cogan: I think I would answer this way, that we feel we have no difficulty currently in securing high quality, competent PhD.'s for our requirements. We feel that perhaps the ease with which we can obtain them indicates some degree of surplus. I think there is a problem in some degree of perhaps too high a degree of postdoctoral specialization that creeps into it to some extent. However, our own experience is that there is certainly an adequate number and, based upon our recruiting experience, I think it is fair to say there is probably some surplus.

I don't know whether my colleague, Dr. Caesar, would care to comment.

Dr. C. H. Caesar (Deputy Manager of Research, Imperial Oil Limited): Mr. Chairman, I would support that statement.

The Chairman: Perhaps we might have some general comments from around the table at this time.

Dr. Shane: I would say, from our point of view, that we find there is an adequate number of postgraduate people and possibly a surplus. To be more specific, we hired a chemist with a postgraduate degree recently and he tells me that quite a number of his year are still looking for work.

The Chairman: Mr. Sutherland, would you like to comment?

Mr. Sutherland: I would like to refer this to Mr. Downing of Sheridan Park.

Mr. Downing: Yes, I think up until a few years ago, and I think it was perhaps three years ago, we were having problems in obtaining qualified people in Canada but I think in the last year or so we now find it possible to hire qualified PhD. people fairly readily.

The Chairman: Would you like to comment on this, Dr. Henderson?

Dr. Henderson: Yes, I would, Mr. Chairman. I would state that in our experience the situation is that we agree with this statement, that there is a shortage of geologists and geophysicists just the same as in the earth sciences. We have experienced difficulty in recruiting our requirements and have been forced to go abroad to Europe, to England, Holland, and France.

The Chairman: Is this a scarcity in terms of quantity of quality? That is, with the type of people you want to have?

Dr. Henderson: Yes, the type. We are looking for honours graduates and usually with at least an honours bachelor's degree. We hire them though at the level of masters and the PhD. level. We have found that there are very few PhD.'s interested in going into industry, although there has been a slight improvement in that trend. I don't know that the production in the earth sciences is increasing at the rate that it is in some of the other disciplines. From our experience and as we see the university graduating classes that are coming, I don't think there is going to be a surplus within the foreseeable future.

The Chairman: Perhaps a surplus might be a desirable thing.

Dr. Henderson: Perhaps it might. I think it might be in the more poorly trained levels, at the pass degree level, for instance. These are usually not acceptable to industry.

Senator Robichaud: This is my last question. I think it is a related one. If I remember correctly, we have been told that in certain government departments and elsewhere there has been a tendency for scientists to move out, to transfer or move to some other field. What is the experience of the companies represented here in this respect? I would like to have comments from the different companies.

Dr. Henderson: We have certainly experienced this and found it to be the case, in that the earth sciences seem to have a heavy mortality. We seem to be stocking the government.

Senator Robichaud: What kind of mortality?

Dr. Henderson: Changing allegiance from industry to government and to universities. It just seems that it has been particularly heavy of late.

The Chairman: That is people coming from universities, going to work for you and then moving to the government?

Dr. Henderson: Yes, after anywhere from 5 to 15 years in industry.

Senator Robichaud: This is not what the civil service federation tells us.

Dr. Henderson: I can assure you that we have personally been responsible for staffing some of the departments in government. I am quite sensitive on the point.

The Chairman: And this is not a new way to build a lobby.

Dr. Henderson: Well, we have thought of that.

Mr. Cogan: I think it does depend upon the area you are speaking of. As a whole, our turnover has not been high in, shall we say, the manufacturing and refining chemicals areas; it has been somewhat higher in the earth sciences. I feel there has been some in both directions. I think it is healthy to have a certain amount of it.

The Chairman: Any other comments?

Mr. Sutherland: Mr. Chairman, I think that just because a man has a PhD. does not mean that he is a very versatile scientist. He may or he may not be. I think that industry by its very nature needs to have versatile scientists. Very often a man becomes unhappy in industry because he finds shortly that he is moved to some project for which he perhaps was not trained at the university, and he looks around and sees that the national research council are doing this kind of thing that he likes to do, and so he tends to move there or perhaps go back to university.

I think this versatility of scientists is a very, very important thing in industry because industry cannot afford usually to hew to one particular narrow line; it must move its men around to be able to solve different problems.

Senator Phillips: Mr. Chairman, I would like to get some comments on the ratio of the expenditure on advertising versus research by the different companies.

The Chairman: This is an intriguing question. Perhaps you do not have the figures to-night.

Mr. Cogan: I could give you a very rough approximation. It would be about three times research work to advertising.

Senator Robichaud: Three of research to one of advertising?

Mr. Cogan: Yes.

Senator Phillips: That is a rather pleasant surprise. I thought it would be the other way around.

Dr. Shane: I am afraid I do not have the specific figures but I think it would be research more than advertising.

Mr. Sutherland: Presumably one defines research as innovation and the development of projects. I would say it far outweighs the advertising.

The Chairman: Yes, that is the way we understood the definition.

Mr. Sutherland: If you are just talking about very narrow research, I mean such as in a lab, then probably the other prevails. However, I think that technological innovation is away ahead of advertising.

Senator Grosart: Are you speaking of research expenditures in Canada versus advertising expenditures in Canada?

Mr. Sutherland: I am talking about in our own company.

Senator Grosart: In Canada?

Mr. Sutherland: In Canada, yes.

The Chairman: Senator Grosart, do you have any other questions?

Senator Grosart: Mr. Chairman, if you would allow me, I would like to return to the IRDIA debate because we know that IRDIA, for example, is the result of pretty careful consideration by people whom we regard as intelligent as to a better way of funding research than that provided by section 72A of the Income Tax Act. We have had a substantial number of briefs here praising IRDIA and PAIT and some of the other programs, DIR and so on. We seem though to have had evidence tonight that the people who are responsible for developing charitable incentive programs just do not know what they are doing. And that worries me.

The evidence from sponsors of these programs indicates that they are doing a remarkably good job. PAIT, for example, has resulted, according to the department, in some $46 million worth of Canadian exports abroad. I wonder if any of the critics could say that in their own research programs they could match that or come up with something that would say it is a little better than PAIT? Has anybody had anything like $46 million worth of Canadian exports abroad out of their research programs where they didn't have anything to do with PAIT and IRDIA?

My point, Mr. Chairman, is that this is very, very essential. I am not defending PAIT and I am not defending IRDIA. As you know, I have studied these programs, all of the incentive programs. I have to believe that the kind of people we have in the Department of Industry, Trade and Commerce today know what they are doing. If they are as far wrong as has been indicated tonight, then I think this committee has to sit down and really take a very hard look at the whole Department of Industry, Trade and Commerce. I, quite frankly, do not think it is as bad as we have been told tonight.

Mr. Cogan: I think certainly the result of 46 million in exports, such as the effect of the program has apparently been, is to be commended. I come back to the comment that they have asked why in one area it has not had the success it has had in others. That is all we have been addressing ourselves to. The fact is that, to get at the various sectors of the economy, where there are different circumstances, you probably need to have different types of approach. The PAIT approach, valuable as it undoubtedly has been, does not suit certain circumstances. On the other hand, some of the others have been more successful from our standpoint in providing incentives. That is true of IRDIA, and to a small degree of the IRAP program.

I think all of them have been doing a job. The question is: How can a better and more satisfactory job be accomplished? I think there is no intention, at least not on my part, to criticize the existing programs. We are simply trying to give constructive suggestions as to what the problems are.

Senator Grosart: Except that I cannot think of a more serious criticism than that a Canadian government incentive program offering financial assistance to industry, costs more than you can borrow on the market. I cannot think of a more serious criticism than that. And that is the criticism, if I understood the statements I have heard tonight, that has been made.

Senator Robichaud: On this very point, Mr. Cogan, and maybe I did not understand, it seems to me I heard you say earlier it could be that if a program under PAIT is successful it could cost you more money than if you had borrowed on the commercial market. On the other hand, it it is not successful, then you would save money.

Mr. Cogan: That is correct.

Senator Robichaud: If your program is successful or if this type of research is successful, it is to the advantage of the company. If you look at it on the overall basis you must be making much more money than if you had not undertaken this program. So in the long run it is really to the advantage of the company.

Mr. Cogan: The research is to the advantage of the company, there is no question about that. That is if it is successful research. All I can say is that the way PAIT was working under those circumstances, it would tend to attract more risky rather than the less risky ventures. Maybe that is what it should do.

The Chairman: Why not?

Mr. Cogan: I am not criticizing that.

Senator Robichaud: That is perhaps really its objective.

Mr. Cogan: It obviously was. We were simply asked our views as to how we viewed it.

Senator Cameron: And I think you have pointed them out.

Senator Grosart: May I ask this further question, Mr. Chairman? Would it be the view that tax concessions of various kinds, including rebates, tax holidays and so on, would be a preferable method of assisting research and development in industry rather than PAIT, IRDIA, DDP, DRB, IRAP, and so on? Would you prefer the tax concession route?

The Chairman: With about the same amount of money available?

Senator Grosart: Well, the IRDIA example is that the money is about the same. The net result, if you do the arithmetic on it, is about the same at the moment as under section 72A of the income tax act. I am now speaking of the principle. Is it a better way?

Mr. Cogan: I think in principle it makes very little difference. The IRDIA program of grants has a definite advantage in the case of development of companies that are starting and have no taxable income. It is obviously an incentive to them to get going on research under the IRDIA program.

In the case that goes with it, the tax route, as opposed to the incentive route, has an advantage perhaps solely from a timing point of view, that it is a claim or deduction when making your tax payment rather than a grant received at a later date.

Senator Grosart: You would not have to pay these exorbitant PAIT interest rates.

Mr. Cogan: Well, if it were not those it would be the exorbitant commercial rates we would have to pay.

The Chairman: Any other comments?

Mr. Sutherland: I think Mr. Cogan has said it correctly, that you perhaps need both. You have to have a tax base to start with. If you have a tax base you might as well get it by that means. If you haven't one, though, you are dead. You have to have some other mechanism.

Dr. Henderson: If I might comment, Mr. Chairman, our company is faced with the alternative of favouring the tax routes because we are a taxpayer but we don't qualify for IRDIA.

Senator Grosart: I think that is a very good point.

Dr. Henderson: That is in our brief. We did qualify under the old act but not under the new one.

The Chairman: I was going to say that again we need in Canada a kind of variety of approaches.

Senator Grosart: I agree with you, Mr. Chairman. We come back to this thing that bothers me more than anything else, and that is that we had the incentive program or the tax concession program under section 72A of the Income Tax Act and, after looking at it, very knowledgeable people in the Department of Industry, Trade and Commerce have said, "No, this is not the right way. We are going to have a new way and from here on in there will be no concessions under 72A of the Income Tax Act." Are these people so wrong? Did they take a universal approach when they should have taken an industry-integrated approach? It is the kind of question, if I may suggest this, Mr. Chairman, that we have to come up with some answer to. That is why I am not really being critical of the industry's viewpoint because I have spent most of my life being an apologist for industry in Canada. I have learned that, by and large, there is a great deal to be said for the industry point of view. However, I have also learned that they are not always charitable towards the attempts of politicians to help them.

The Chairman: Senator Belisle.

Senator Belisle: Mr. Chairman, I wish to say that I have many questions but the time for questioning was allocated to our very able vice-chairman. He did a very good job with the help of Senators Robichaud and Grosart as well as Senator Phillips. Knowing that we have heard from the witnesses very frank statements which created to some extent doubts in our minds, nevertheless this is a problem that this committee has to face, and I wish to say that, having been on deck since 8.00 o'clock this morning and some of us will be going on deck again at 9.00 o'clock tomorrow morning, may I move the adjournment without being unfair to anyone?

The Chairman: Before I entertain your motion, Senator Belisle, I would like to have the opportunity to ask one further question.

Senator Belisle: You have that privilege.

Senator Phillips: Remember the admonition about brevity, please.

The Chairman: My questions are always quite brief. Since we have Mr. Sutherland where and he is a member of the Sheridan Park Association, I would like to say that we were told by some people last week that this kind of exercise was not too useful to spread around a country. When we visited the Park I had the other impression. I would very much like to have your feelings, after having been a member of that joint research operation, joint to a certain extent.

Mr. Sutherland: I think that there is a place for joint research efforts regionally. I am not too much in favour of having a big centralized setup in Ottawa, Toronto or elsewhere. I think there are regional problems. The big thing, I think, is that you have to maintain a high level of individual competence spread out geographically. Certainly you have to have a focus, but you cannot have one in every town in the country. I think that you need to have sort of little catalytic points across the country, maybe at half a dozen places, which could act as a spark to your universities, if you wish, to your industries that are in the area.

I think that those groups could well be specialized to some extent. It may be that you could have a tar sands group. It may be that you could have a fish group. We know of course in some of the government departments that there are these sort of things. I think that regional laboratories, for example, of the NRC have done a good deal for certain areas of the country. So I would be all in favour of having a limited number . . .

The Chairman: Of Sheridan Parks?

Mr. Sutherland: Of Sheridan Parks or even government research laboratories.

Senator Grosart: Senator Phillips is one of the causeway advocates.

Senator Phillips: There have been too many of those now with no results.

The Chairman: I prefer to call it the "pauseway". I want to thank you on behalf of the members of the committee. We thank you very much. Now, I will accept Senator Belisle's proposal to call this meeting to an end. We will adjourn until 10.00 o'clock tomorrow morning.

The hearing adjourned.

APPENDIX 156

BRIEF SUBMITTED TO

THE SENATE SPECIAL COMMITTEE ON

SCIENCE POLICY

BY

CHEVRON STANDARD LIMITED

SUBMISSION
OF
CHEVRON STANDARD LIMITED
TO
THE SENATE COMMITTEE ON SCIENCE POLICY

Recommendation

It is recommended that the "Industrial Research and Development Incentives Act, Chap. 82, 14-15-16 Elizabeth II" be amended so as to provide that companies incorporated outside Canada, but carrying on business in Canada, be eligible to receive research incentives.

1. Chevron Standard Limited endorses the Government's incentives and assistance programs to stimulate research and development by Canadian industry. Also, we commend the Government for the 1967 revisions (Bill C-252) to the program which removed the provisions for incentives from Section 72A of the Income Tax Act and included them in the "Industrial Research and Development Incentives Act". This revision produced a larger degree of incentive equity between eligible corporations.
2. Chevron Standard Limited recommends that the Act be amended in such a manner that these incentives be extended to companies incorporated outside Canada but carrying on business within Canada as was the case prior to the enactment of the new legislation. It appears to us that the place of incorporation is not relevant for purposes of achieving the objectives of the Act.
3. It is our view that the suggested amendment will result in more research and development being conducted in Canada and in a lesser dependency on imported technology. A stimulus will be created for those companies which are not now eligible under the Act, not only to expand in-house research but also to utilize Canadian independent laboratories, technical consulting services and universities for research related to industrial problems.
4. We are confident that the Act contains sufficient protection to prevent any abuses which might result from this amendment, as Ministerial approval can ensure that incentives are only extended to research and development that "is likely to result in benefit to Canada".[1]

[1] Industrial Research and Development Incentives Act, Chap. 82, 14-15-16 Elizabeth II, Section 3 (2).

SUBMISSION OF CHEVRON STANDARD LIMITED
TO THE SENATE COMMITTEE ON SCIENCE POLICY FEBRUARY 17, 1969

5. It is our understanding that the Government policy has been designed to give industry the initial financial assistance to establish or expand research and development in Canada and we believe the program is favorably formulated to attain this goal.

6. We believe that the main objectives in providing this assistance is:
   - to encourage industry to develop and innovate new technology through research and development that may be applied to Canadian business ventures, to assist in developing a favorable employment environment for Canadian scientists and to prevent emigration of trained personnel by providing new and challenging research opportunities.

7. It is the contention of Chevron Standard Limited that the objectives of the "Industrial Research and Development Incentives Act" are not being fully realized by restricting the incentives to companies incorporated in Canada and we therefore feel that the recommended amendment is justified.

8. There is an excellent possibility that Chevron Standard Limited could establish research and development facilities to complement its Canadian operation if the Act were amended as suggested.

ADDENDUM

Chevron Standard Limited

400 Fifth Avenue, S.W.

Calgary, Alberta

Directors and Officers

			Citizenship
L. I. Brown	President and Director	Calgary, Alberta	U.S.
H. G. Nicholson	Sr. Vice President and Director	Calgary, Alberta	Can.
A. B. Bristow, Jr.	Vice President and Director	Calgary, Alberta	U.S.
G. G. L. Henderson	Vice President and Director	Calgary, Alberta	Can.
J. L. Lebel	Vice President and Director	Calgary, Alberta	Can.
W. B. Patrick	Vice President, Secretary and Treasurer	Calgary, Alberta	Can.
L. A. Swanson	Director	San Francisco, California	U.S.
K. H. Crandall	Director	San Francisco, California	U.S.

(a) Chevron Standard Limited, incorporated in Delaware, is a wholly owned subsidiary of the Standard Oil Company of California. Chevron Standard conducts its operations solely within Canada and is registered to do business in British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Northwest Territories and Yukon Territory.

(b) Chevron Standard Limited or predecessor companies have been operating in Canada since 1939.

(c) The scope and size of the business activities of Chevron Standard Limited are described in the following statistical table.

CHEVRON STANDARD LIMITED

	1968
Producing and Exploration Expenditures	$48,023,000
Production Income After Royalty	$51,326,000
Production - Crude Oil and Natural Gas Liquids	54,600 B/D
Employees	614*

*Of which 16 are U.S. citizens.

APPENDIX 157

SUBMISSION TO THE SENATE SPECIAL COMMITTEE ON SCIENCE POLICY

SYNCRUDE CANADA LTD.

MARCH 1969

SUBMISSION TO THE SENATE SPECIAL COMMITTEE ON SCIENCE POLICY

INTRODUCTION

Concern has been expressed in many quarters that Canada as an advanced country is not doing nearly enough research and development. Various reasons have been suggested for this. Undoubtedly the relatively small population, the fact that until recently Canada has been a predominantly agricultural nation, and the large numbers of relatively small companies, many of whom are branch operations of foreign-owned corporations, are among the more important. The dearth of research and development in this country will soon be highlighted by the much larger output of engineers and scientists, many with postgraduate degrees, who will be leaving our universities to seek careers in science in other countries because Canada is not able to provide employment in scientific fields which are challenging and of interest to the individual graduate.

In relative terms Canada is a new nation. It is endowed with many natural riches but it is impossible to overlook the fact that the number of its people and its supply of capital are both limited. Yet, in spite of these limitations, Canada must become deeply and seriously involved in research if its rate of progress is to meet modern standards. Our immediate problem is the development of a science policy which will relate our resources, our manpower, and our available dollars in a manner which will give Canada the greatest return on its research investment.

A nationally acceptable Science Policy might be considered as serving one or more of several causes: economic growth, stability through diversification, national prestige, reduction of the "brain drain", among others.

In this brief, however, Syncrude Canada Ltd.(1) will confine its remarks to that area most pertinent to its operations - promotion of economic growth.

In pursuing the idea of economic growth through research and development, several aspects of the approach to the problem must be considered: evaluation of resources; overcoming development obstacles; maximizing use of current technology; and the coordination of university, industry, and government efforts. In discussing these various aspects, Syncrude will draw primarily upon its own experience and observations in relation to the

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(1) Syncrude Canada Ltd. is a company owned 30% by Atlantic Richfield Company, 30% by Cities Service Athabasca, Inc. 30% by Imperial Oil Limited, and 10% by Royalite Oil Company, Limited. It was established for the sole purpose of carrying out research and development of the Athabasca tar sands. Its activities together with its predecessor company, Cities Service Athabasca, Inc. were started in 1958 and since that time work has been continuously directed towards the basic understanding of the tar sands and the application of this understanding to the development of a commercial project. Major pilot facilities were operated for five years at Mildred Lake near Fort McMurray and are still maintained and held in readiness for future testing. Since early 1964 a basic and applied research laboratory, also incorporating a small size pilot plant, has been in continuous operation near Edmonton. In addition to the research staff, the company also maintains an engineering development group charged with economic evaluation and commercial process design of a plant based on principles established at the research laboratory.

For the eleven years of operation the total staff, including both professionals and non-professionals, has averaged about one hundred persons and research and development expenditures have amounted to approximately $30,000,000.

development of the Athabasca tar sands.[2] Because of the size and the complexity of the Athabasca deposit, and because of its importance to the nation, Syncrude is hopeful that suggestions and comments based on this resource will have application to an overall science policy.

EVALUATION OF RESOURCES

We believe that there are two key aspects in the development of any major natural resource, and for both of these, the Athabasca tar sand deposit is a conspicuous example. The first aspect is the need for a total approach in the development, rather than an orientation based on a specific product. We believe that the stage for the exploitation of a single value from a national resource without regard to its total potential has passed if Canada is to enhance its position in the world wide competitive markets. The second aspect is the need for the government, universities, and industries to coordinate their activities to prevent needless duplication and delays. In developing our thesis on resource development,we would like to enlarge on these two themes:

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(2) The Athabasca tar sands must be considered as one of Canada's most important natural resources. These sands contain in excess of 600 billion barrels of oil of which 285 billion barrels are now considered recoverable by existing techniques. At today's prices the potentially recoverable oil has a market value estimated at approximately $800 billion. Along with the development of oil production of necessity will come major thermal power developments and the establishment or improvement of transportation systems. Also, the tar sands contain vast quantities of other minerals worth additional billions of dollars. The recovery of these minerals, as supplements to oil production, will become feasible. The efficient development of this vast resource will therefore, provide a unique combination of many basic sciences - a true case where coordination of major effort becomes essential.

Total Approach

Historically, mineral type resources are usually only exploited once, although there are a number of exceptions in which the tailings from a project are reworked for recovery of other values. The most efficient scheme, however, would be one in which an integrated processing sequence was planned to fully exploit the potential of the deposit in a single pass. This is a difficult concept to apply in that the economics and marketing requirements of various products may not overlap sufficiently to permit such an approach. Nevertheless, if a total approach is not taken, recovery of "secondary values" may be impossible if missed in the first development. The economics effected in sharing mining and slurrying costs, heat loads and power requirements could vastly enhance the total value of a resource to the Canadian people.

It is possible that a private developer may not fully appreciate the overall potential of a deposit or have the incentive to exploit it in areas outside his own sphere of interest. It is here that research by the various research councils is needed to evaluate this "total approach" and develop the "missing links" of technology.

A specific example of an integrated complex based on the Athabasca tar sands, would include the raw bitumen and its derived petrochemical product, heavy metals such as zirconium and titanium, iron, aluminum, water soluble organic acids, clays, cements, and various building products. Not all of these would be amenable to exploitation in a single pass, but at least the preparation of a "master plan" would result in a scheme to permit stock piling and segregation of materials for later development.

We would stress here that we are not advocating governmental control over these resources; we are only suggesting that certain types of research are needed to help industry realize their full potential. In certain of the examples cited above for the Athabasca tar sands, small companies would be very suitable participants in the project, companies which have experience in depth in narrow areas.

Need for Coordination

The inventor in his basement workshop and the prospector in his lonely cabin have long been stereotypes in the development process. Unfortunately, when this principle of individual research and development effort is applied to the study of a large and complex resource, it can result in unnecessary duplication of work, too little consistency of study, and too many blind alleys. The Science Policy should aim at fostering coordination in major developments to promote maximum benefit from the efforts expended.

The tar sands, with its multi-disciplinary research problems, is a good example of the need for the systematic development of a unified technology.

In reviewing the last 60 years of tar sands development, one cannot but be disturbed by the fluctuating interest of the federal and provincial governments. The federal government undertook the early geological studies prior to the turn of the century, and continued into the 1920s. The provincial government initiated its development of the hot water process in the latter part of that decade, with the federal government becoming involved again in the early '40s in the pilot plant at Abasand. The provincial government renewed its interest with the construction of a demonstration plant at Bitumount, and then both governments settled back into a period of more fundamental research on narrow aspects of the deposit. In addition to this governmental sponsored work, there have been dozens of studies by private groups around the world, using samples collected at outcrops or from some of the pilot stations.

Although adaptation of the hot water process has formed the basis of the first commercial plant, we believe that much of the tar sands research work is invalid due to unrepresentative sampling. Much effort has been expended on abnormally high grade coarse grained tar sand, the type most accessible from outcrops. Industry in Canada has been severely misled by these studies. Even now samples of feedstock of ill-defined origin are being sent to various laboratories on this continent without any attempt at documentation. The least that the government should do in this area is to provide laboratories with reliable samples and information. Presumably this could extend to some pooling of information. Those who have had experience with the sensitivity of most mineral ore dressing processes to the variations within an ore body will well realize the importance of this aspect.

OVERCOMING DEVELOPMENT OBSTACLES

Any resource development project in Canada faces physical or social problems which can be serious disadvantages. These conditions are to some degree peculiar to the country, and solutions to the problems would be of general benefit. Government activity in and support of research in this area would appear to be most desirable.

Physical Problems

The resource areas of Canada are renowned (or infamous) for their remote locations, their extreme climatic variations, and their rugged topography. Underestimating these conditions can be disastrous; overestimating them can render a project uneconomic. Much reliable information is already available to the potential developer, but a continuing program to update, broaden and disseminate material on basic construction conditions and practices would help minimize the penalty of remote Canadian construction.

Considering a tar sands project, some examples of the sort of information that would be of value come to mind e.g. frost penetration rates, short term and long, in various soils, and under various conditions; protective measures against frost; surface drainage techniques; more extensive hydrological data; winter construction methods.

Providing the developer with the best basis for attacking the physical problems would be of considerable benefit; overcoming some of the problems would be even better. Long distance transportation research should be actively encouraged. There should be studies on ways of draining muskeg and converting it to arable land. This in itself would tend to alleviate the northern insect problem, although their control certainly warrants an active independent research program.

Housing and commercial buildings for remote areas will continue to be a profitable area for research, both in design and materials of construction. This should be only one phase of a complete study on the ecology, town planning concepts, transportation and communications systems, and facilities design criteria associated with the development of Canadian resources.

Sociological Problems

In resource development planning, sociological considerations have too frequently been given little better than stopgap treatment even though they represent potential major obstacles in the long term cultural and economic growth of the country. This is an obvious area for continuing government research and support of industry efforts to attack the problems.

Upgrading the skills and productivity of the native peoples must be part of resource development. As well as education, there must be the opportunity for employment. Government programs such as the NewStart project are already under way in these areas, but industry must play a part too. Since industrial efforts along these lines will likely be met with economic hardships for many years, industry should be allowed some form of tax credit or other support for their participation in the program. There are undoubtedly many instances where deliberately fostered new industries would not be economically attractive under normal circumstances but would be preferable to the alternate of meeting welfare expense for an unemployed indigenous population.

Living in remote northern areas is a fact of life for most Canadian resource industries. Getting sufficient numbers of highly qualified professionals to work in the north country will present a problem that will require much imagination and a considerable amount of money to resolve. With growing affluence in Canada, financial incentives will become a lesser factor in the selection of a career, with more tendency to seek comfortable employment in attractive surroundings. If Canada's north is to be developed, much study is needed on how to make the north acceptable to the individual participants in its development.

MAXIMIZING USE OF CURRENT TECHNOLOGY

With limited resources, Canadian government and industry cannot expect to be in the forefront of research in all desirable fields of development. Yet at the same time, the Canadian economy cannot afford to operate with less than the most current technology. Science policy might be aimed at fostering the necessary coordination to optimize the balance between search and research.

Information retrieval is possibly one of the most fruitful fields for research in Canada. Unless tailored to a particular organization's needs, current systems tend to be so unwieldy and so lacking in selectivity as to be almost useless to the technical people most in need of these services. It is unlikely that computer search is the complete answer; much study is needed on the most effective ways to assemble, present, and disseminate the flood of new technology. If this information does not reach the technician in the form he wants, it simply is not information.

A national technical information centre could provide the initiative and coordination in the development of a complete information service. Particular institutions - governmental, educational, or industrial - should form the natural centres of expertise in disciplines that are important to Canadian development. The service would help rationalize Canadian research and development efforts in at least three ways:

(a) Worldwide technology would be available for application to any Canadian development project,

(b) Canadian research institutions could concentrate on technologies of particular importance to Canadian development,

(c) Canadian research efforts would be more effectively aimed at complementing available technology rather than duplicating it.

UNIVERSITY-INDUSTRY-GOVERNMENT COORDINATION

The E.I.C. brief presented to the Industry Minister in 1967 referred to the imbalance between the number of graduates of doctorates in Engineering compared to the Physical Sciences. Although we would hesitate recommending any reduction in the basic and fundamental research carried out in Canada, we do agree that an increase in applied research is desirable, particularly as related to industries concerned with resource development, including associated secondary industries.

We believe that such an increase should be carried out in both "open" and "closed" type research institutes, where companies and universities can combine their talents on "industry-wide" problems. We have many outstanding examples of the value of such institutes in Canada, but there is a definite need for additional facilities in the resource based industries. A research institute on the Athabasca tar sands could carry out most of the functions referred to earlier.

Support should be given industrial personnel to accept temporary staff positions in universities. We have recently participated in an interchange with Queen's University, and we feel there is a two-fold benefit. The industrial partner can lend credulity to the problems and assignments of the students, and at the same time he becomes exposed to the fundamental engineering research being carried out in Canada.

Perhaps the most important consideration in the need for closer university-industry-government coordination is the attendant possibility of setting research priorities and educational objectives which more truly reflect the requirements of a growing Canadian economy. Any one group on its own would likely propose an unbalanced program. Industry would tend to be narrow in its scope for research. The universities, and possibly the government, would lean the other way, favouring complete academic freedom in carrying out basic research for its intrinsic interest and prestige appeal. Similar comments would hold for proposals concerning student guidance and course content in school curricula. These differences of opinion should be resolved through frequent contact of all groups. Too much basic research or too many graduates in a discipline of little pertinence to Canada's economy is of doubtful benefit to the country. The use of this limited resource should be optimized.

CONCLUSION

Canada needs research and development work directed more specifically at strengthening the Canadian economy. In this brief, we have discussed several considerations which it is felt are important from the standpoint of resource industries in optimizing the Canadian research effort. Our overall position is that a national Science Policy might contribute most towards this optimization by encouraging government activities which improve the conditions for efficient development work rather than compete with private efforts. In conclusion, certain recommendations on government action might be made:

1. Government research work should promote the exploitation of the total potential of any given resource.
2. Coordination of research efforts in major developments is necessary to avoid waste time and expense, lack of

2. continued

continuity, and proliferation of misleading results.

3. The climate for development work in Canada should be improved through government research on means of overcoming the problems of distance, weather, and terrain faced in most Canadian projects.

4. The sociological and ecological obstacles to resource development should be the subject of continued research.

5. The government should establish a central technical information centre with the objective of promoting the effective use of current technology throughout Canadian industry.

6. The government should encourage increased applied research efforts on the part of industry in areas related to resource development and associated secondary industries.

7. Industry - university interchange of ideas and personnel should be encouraged. Such communication is as necessary for the rational setting of research priorities and educational objectives as it is for the purposes of mutual technical enlightenment.

Respectfully submitted by

SYNCRUDE CANADA LTD.

F.K. Spragins

President

APPENDIX 158

REMARKS TO

SENATE SPECIAL COMMITTEE

ON

SCIENCE POLICY

PRESENTED BY

SHELL CANADA LIMITED

REMARKS TO THE SENATE SPECIAL COMMITTEE
ON SCIENCE POLICY IN CANADA

We take the opportunity to commend the Senate Special Committee on Science Policy for undertaking this investigation into an area that is so vital to Canada's industrial and economic development. The impact of the Committee's recommendations could well determine the future of research and development activities in Canada and thus play a significant role in the future development and growth of our economy.

The importance to the welfare of our nation of a well established dynamic industrial research and development program is widely recognized. The rate of our economic growth and our competitive position in world markets depends to a great extent on the development and exploitation of new and advanced industrial technology. A research oriented environment enables industry to develop a nucleus of a highly skilled research staff able to interpret and exploit available knowledge and to adapt technological improvements to Canadian conditions, since in addition to carrying out research, a country must be able to translate new knowledge into actions that lead to real contributions to economic growth. The creation of challenging opportunities in a research-oriented environment entices our creative scientists and engineers to remain in Canada and attracts gifted research personnel to Canada from other countries. In short it is very important to a young industrial country like Canada to create the right environment for both the industrial and social development of the country.

In recent years, the Federal Government has introduced several programs to encourage and support scientific research and development activities in Canada. In 1962, a special incentive was introduced under Section 72A of the Income Tax Act which permitted a corporation to deduct from its income an additional allowance based on its expenditures in Canada for scientific research. In July 1965 the Program for the

Advancement of Industrial Technology (PAIT) was established by the Department of Industry whereby assistance was available to industry for specific development projects involving a significant advance in technology and good possibility for commercial exploitation. In March 1967, the Industrial Research and Development Incentives Act (IRDIA) was passed by Parliament to continue to provide general incentives to industry when the income tax benefits under Section 72A expired.

There is no question that these programs have provided a measure of assistance to some companies; but the amount of assistance provided falls far short of what is required to sustain sufficient impetus in research activity. New efforts are needed to encourage industry to establish long range scientific programs and exploit the results for the betterment of the whole country and not just the corporation or industry.

The remainder of our remarks will pertain to analysing and indicating the basic weaknesses of the incentive programs established by IRDIA, PAIT, AND IRAP and conclude with our recommendations.

INDUSTRIAL RESEARCH AND DEVELOPMENT INCENTIVES ACT

Basically IRDIA provides a system of cash grants or credits against federal income tax liabilities equal to 25% of:

(a) all qualifying capital expenditures for scientific research and development in Canada; plus

(b) the increase in qualifying current expenditures for scientific research and development over the preceding five-year average.

The assistance provided for capital expenditures at the rate of 25% appears to be a reasonable incentive to induce industry to provide the facilities for scientific research. But it must be recognized that once so committed, it may take a company years to develop any results for commercial exploitation. In this regard the present assistance offered for current expenditures which is related to increases in R. & D. over a 5-year rolling average is completely inadequate. The present program, in effect, provides an incentive for establishing and expanding an R. & D. program but it gives no consideration for continuing expenditures. Consequently, "mature" R. & D. establishments with only a gradual increase in staff requirements receive virtually no assistance. Since the cost of operating an R. & D. establishment is relatively high in Canada, some form of incentive is required in Canada to make R. & D. activities attractive.

In addition the technical and general administrative requirements for successful operation under IRDIA appear unnecessarily elaborate and costly.

The rolling average for current expenditures and the delay in quantifying the grant make it difficult to show the effect of the grant on research costs on a current basis or in long range planning.

PROGRAM FOR THE ADVANCEMENT OF INDUSTRIAL TECHNOLOGY (PAIT)

PAIT provides direct financial assistance to industry for the purpose of upgrading its technology and expanding its innovation activity. The assistance is given by underwriting specific development projects which involve a significant advance in technology and which, if successful, offer good prospects for commercial exploitation. The assistance available amounts to 50 per cent of the current expenditures incurred on the approved projects. If the project is successful and the results are exploited commercially, the recipient is required to repay the contribution with interest over a period not exceeding 10 years. On the other hand, if the project is not successful the contribution is not repayable.

In our opinion the program has a number of serious limitations as outlined below:

(1) The requirement that the company obtain approval from the Department of Industry before transferring results of the research outside of Canada.

(2) The provision that if the results are not exploited in Canada within a reasonable period of time, the information, designs, etc., become the property of the Government.

(3) The termination of the agreement is at the Minister's discretion, and he may withhold consent.

(4) The PAIT loan interest rates are high and this essentially amounts to high cost financing for a successful project.

(5) High administrative costs for both government and industry.

THE INDUSTRIAL RESEARCH ASSISTANCE PROGRAM (IRAP)

IRAP is intended to stimulate the interest of Canadian industry in scientific research and to promote the establishment of new industrial research activities and the expansion of existing activities. The National Research Council shares with industry the cost of specific industrial research projects by paying the salaries and wages of scientific and technical personnel engaged on approved projects, while material and overhead costs are borne by the company concerned.

The IRAP program appears to provide a useful means for supporting research. Payments are made currently to the qualifying applicant and once the specific project is approved the administrative aspects are simple and straightforward. However, for the year ended March 31, 1968 only $5.1 million was provided in assistance under this program, which might indicate that this program is not fully promoted.

RECOMMENDATIONS

IRDIA

(1) The rolling average base for current expenditures under IRDIA should be eliminated. Assistance should be based on total expenditures incurred on research and development at the existing rate of 25%.

(2) The administrative aspects of the IRDIA program should be simplified so that applications for grants are quickly and inexpensively prepared and are processed without undue delay.

PAIT

(1) There should be discretion to exploit the process in Canada or elsewhere, depending on which is more advantageous.

(2) There should be a provision enabling a company to retain ownership of all technical information upon repaying the loan, should the company decide that the project is not economically viable in Canada.

(3) The basis for termination of the agreement should be broadened and not be subject to ministerial discretion.

(4) Interest charges on repayments of loans should be reduced to a level competitive with commercial financing.

(5) The freedom of the Department to disseminate all information supplied by the company to other government departments and agencies should be restricted. It should be possible to identify by name any government departments that need to have the information in question.

NEW PROGRAM

(1) Greater efforts should be made to encourage and support research in industry as against government "in-house" programs. With an "in-house" program it is difficult to make industry aware of the results and implications to ensure that they are commercially developed. It is reasonable to assume that research in industry vis-a-vis similar research in Universities or Government laboratories, can be more quickly exploited.

(2) The contracting out of government sponsored research would allow industry expertise to apply immediately to a problem and would at the same time assist in the long range development of industrial establishments.

APPENDIX 159

RESEARCH AND DEVELOPMENT IN CANADA

A BRIEF TO THE SENATE SPECIAL COMMITTEE
ON SCIENCE POLICY

Submitted by:

Imperial Oil Limited
February 28, 1969

INTRODUCTION

Imperial Oil Limited has a high interest in the strong growth of the Canadian economy and a keen appreciation of the role research could play in such growth. We, therefore, welcome the opportunity to submit this brief.

Research has been conducted in Imperial's own laboratories for over forty years.* During this time, we have dealt with a wide diversity of problems in an environment undergoing continual change. Research policies likewise have been evolved and modified as seemed most appropriate in the prevailing circumstances.

We propose to present our comments in three parts:

I Our current views on research as it relates to the Canadian petroleum and petrochemical industries.

II Our thoughts regarding the specific questions raised by the Committee and listed in the Appendix attached to the invitation.

III A few brief case histories from our experience which illustrate major points.

* At present, Imperial employs 428 personnel, including 145 with professional degrees, in its research activities. Major laboratory centres are located at Sarnia, Ontario and Calgary, Alberta.

PART I

RESEARCH IN THE PETROLEUM INDUSTRY

The petroleum industry is exceptionally capital intensive, with a plant investment of about four times the average for manufacturing in general. Extremely large sums must be spent on equipment which has a long life and must operate with reliability and efficiency. The products turned out, whether petroleum or chemical, reach sophisticated consumers who require high standards and are extremely price conscious. Moreover, the industry is highly competitive. It is, therefore, a major concern of each company to obtain or develop and apply the most effective technology possible.

There is a tremendous volume of technical literature, which is constantly increasing, in this field and some service-type companies thrive by providing modern technology to the industry, but all the major international companies find it necessary to conduct very large research programs of their own. The results of such research are made available immediately to their affiliates operating in Canada.

For effective administration and economies of operation, it has been common for such companies to conduct the bulk of their research in centralized laboratories, mostly in the U.S.A. or Europe. It has been found, however, that the most effective means for the smaller affiliates to select and adapt such imported technology to their particular conditions is to maintain a local research effort if it can possibly be afforded.

It has been our experience that a research group in an affiliated laboratory has some unique advantages, providing short lines of communication are maintained with the operating departments of the company. The local research staff will generate new technology of their own and through direct personal involvement of individuals in the operating departments in setting research goals and in developing research leads, an environment can be established which promotes prompt and effective use of research results.*

There are thus distinct advantages to the international companies to decentralize portions of their research and the optimum balance between centralization and decentralization must be sought.

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* As an example, refer to Case History #1, Part III.

The major problems in decentralization of research are more complex administration and the danger of undue duplication of effort. These problems can be minimized by some degree of "rationalization" of the international research. Thus a Canadian company may assume the main responsibility of conducting research in some specialized and well defined areas of technology, in which it has special interests or qualifications, on behalf of all the affiliated companies wherever they may be. An American affiliate would have primary responsibilities for other research areas and so on. At the same time, of course, each affiliate should maintain a general capability over a wide spectrum of technology appropriate to its business.

Imperial's research policy then is to adapt imported technology to suit our local needs, to originate and develop further technology for our own use as required, and to assume full responsibility for research in specific areas on behalf of all affiliated companies. This policy appears to offer a sound basis for Canadian companies associated with international affiliates to play their full part in the world-wide research of such industries. In some cases, it is the only means of supporting an adequate research program in Canada.* The actual distribution and redistribution of the research of an international company is the result of many complex factors and can be expected to change only gradually with time. The more important conditions which would favour the conduct of a higher percentage of research in Canada are:

1. Particular aptitudes of the Canadian research organization.

2. Particular interests of the Canadian company which may differ from those of other affiliates.

3. Special economic or physical advantages of the Canadian environment.

4. Completely free and unrestricted import and export of technology. (This point is amplified further in Part II of this brief).

5. Lower cost of research.

Government action can be decisive in the last three considerations.

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* Case History #2, Part III.

PART II

COMMENTS ON
SOME CURRENT QUESTIONS REGARDING CANADIAN SCIENCE POLICY

A FINANCING INDUSTRIAL RESEARCH

Government Encouragement of R and D in Industry (Questions A1, A7)

In the long run, the most valuable encouragement which the government could provide for fruitful R and D in industry would be through measures to improve the environment for industrial growth since, to be most effective, research must be closely related to its industrial base. In the short term, the most direct action which the government can take would be steps to lower the costs of research to industry. Further assistance could be provided by avoiding government actions which threaten, inadvertently, to impede industrial research and by some rechannelling of government research activities. These latter points will be discussed in later sections in answer to questions 2 and 4.

The present incentive schemes vary in effectiveness.

IRDIA has much reason to be commended. It provides good incentives for increased research when other business circumstances allow, but is of no assistance when growth in research must be halted for economic reasons. As a long term measure to maintain Canadian industrial research at a high level, it is at least partially self-limiting.

It is suggested that this major drawback could be rectified by provision of some incentive to maintain research at a high level, as during periods of economic stress, while retaining the incentive to increase it. This could be accomplished by a redefinition of the "base" against which current expenditures are measured. In place of the average of the preceding five years' costs, a percentage (e.g. 80%) of the average costs of the past five years could be used.

A further improvement in IRDIA could be effected if the tax payer had the option of choosing between grants or tax allowance systems. We would prefer the latter since they are more certain and provide a better cash flow for the company.

PAIT is primarily helpful to small independent companies with limited financial resources. For the larger companies, it has a number of disadvantages of which the most significant are the provisions restricting the export of technology and the requirements to assign to the government patents and other rights to the technology of unsuccessful projects.

It will readily be appreciated that these provisions are completely incompatible with any attempts to "rationalize" international research. Under any foreseeable circumstances, restrictions on the export of technology can only result in greater penalties to Canada in the cost of imported technology. The inventions involved in a specific project can seldom be disentangled from the great mass of supporting technology on which they are based except in rare and isolated cases.

The principle of encouraging venture capital is most desirable and it is to be hoped that the revisions to PAIT which are currently under consideration will result in a practical incentive, or that a practical substitute will be devised.

IRAP has proved to be very satisfactory as a technique for promoting R and D in industry. It is evidently limited by current budget appropriations and we would suggest that an increased allocation to this scheme should be considered.

Defense research grants have had little impact on the petroleum industry, largely because most projects fall outside of the areas in which the industry has special skills.

Federal Assistance to Stimulate Innovation (Question A2)

Research and Development is an essential component of innovation but by no means the only one. The Panel on Invention and Innovation, set up by the U.S. Department of Commerce, estimated that other components, not usually associated with the innovative process, account for something like 90% of the total effort and cost. This figure is typical of other estimates published on the subject.

Innovation is a risky procedure in any country. In Canada, as compared to countries with a larger industrial base, the major problem is to find a market sufficiently large to support a new product. Not only is the population an order of magnitude smaller than in the U.S.A., but the diversity of industry is also much smaller, thus compounding the difficulty. A need to surmount international borders is another handicap. In addition to the problem of finding at least minimum markets, there is the further major factor of scale to be considered.* A large plant, proportioned to the U.S. market for example, will generally produce products at a much lower unit cost than a small one - a simple fact which underlies the difficulties even of established Canadian industries. Any measures which the government can take to make larger markets available will, therefore, greatly improve the prospects of new product innovation.

It should be emphasized, however, that innovation concerned with new or improved processes to make existing products is equally necessary to maintain a healthy economy. Although not as glamorous as new products, process innovation is needed to avoid obsolescence and is usually easier to assess and apply.** It should not be neglected in any incentive schemes.

Over and above measures to open larger markets, government action which could assist both product and process innovation might include:

(a) Maintenance of strong patent laws to protect and reward invention.

(b) Encourage or provide venture capital as necessary. A modified PAIT program could be helpful.

(c) Accelerate the income tax capital cost allowances on new equipment or at least maintain the present system which assists in the addition of new capital facilities and the modernization of old facilities.

(d) Continue the present favourable income tax treatment of expenditures on scientific research, i.e., the immediate deductibility of expenditures of both a current and a capital nature.

(e) Develop better communications and understanding between business, government and university economic and technical experts to promote concerted action.

(f) Support managerial development programs which would encourage initiative and provide the business appraisal and other skills necessary to foster innovative projects.

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* Case History #3, Part III.
** Case History #4, Part III.

A most important and direct contribution which the government could make to this goal would be to review existing and proposed legislation or regulations which have or could have strong adverse effects on innovation in Canadian industry. Two examples follow.

(a) A substantial disincentive to innovation comes from the refusal of the Department of National Revenue to permit capital cost allowances for income tax purposes on capital outlays for new facilities unless title to tangible property is acquired by the tax payer. Where plans and specifications are prepared for a risky project which is finally abandoned before construction starts, the costs of the plans and specifications (which may be substantial) do not qualify for tax relief. This policy acts as a disincentive to planning new ventures and innovation.

(b) Another problem in this area is the withholding tax proposed for payments "for information concerning industrial, commercial or scientific experience" announced in paragraph 18 of the October 22, 1968 Income Tax Act Resolution. Applying withholding tax to such payments runs directly counter to the proposals of the O.E.C.D. fiscal committee which recommended that they be exempt from withholding tax. Implementation of this tax would increase the cost of information to Canadians by over 17% in those many cases where the non-resident would raise his fee because he is unable or unwilling to absorb the tax. This could well lead to a reduction in the amount of such information obtained. A reduction in the flow of industrial, commercial or scientific information from abroad in turn would lead to a reduction in Canadian research based upon such information as well as a slow-down in the modernization and innovation process in Canadian manufacturing plants.

Assistance by Federal Agencies and Departments (Question A3)

We would like to give full credit to the federal agencies and departments for their willingness to assist industry by every means within their power, and for the very considerable contributions they have made.

Our suggestions for further action are largely implicit in the other sections of this brief. We would suggest here that communications within government circles seems to be a (very natural) problem, leading to inconsistent actions as exemplified in the section above. There also appears to be overlapping responsibilities and it is often unclear which department or agency is the proper one for industry to contact in matters relating to R and D.

We welcome the closer liaison with industry which is developing and which would profitably be extended very much further as by the establishment of the joint ventures discussed below. Government agencies could catalyse interaction between industry and the universities by encouraging the part-time employment of professors as consultants and of experienced industrial staff as lecturers.

The Balance of Federal Support (Question A4)

Government support has been very effective in helping Canadian universities to achieve and maintain high reputations for graduate research. We would advocate the continuance of such support at a level consistent with the anticipated demand for trained personnel. Full advantage should also be taken of special, high cost research facilities installed in conjunction with universities and it should be considered imperative to give substantial support to the research of the few really outstanding scientists wherever they may be found.

We favour the establishment and maintenance of institutes oriented to specific missions or set up to provide exceptionally high cost facilities for common use. Such institutes frequently can be associated with universities. We are somewhat concerned, however, at the establishment of university institutes intended for general contract research, unless a real need for such services can be demonstrated. We would urge that existing provincial research institutes, which are available and anxious to provide such service, and the universities should work together more closely.

It is obviously desirable for the federal government to maintain laboratories to conduct research on behalf of sectors of the economy such as agriculture and fishing where no other organization is competent, to provide and operate, on a service basis, expensive equipment for common use, or to promote national objectives such as defense, to establish standards and to conduct special contract research for industry. However, we feel that the once valid reasons for conducting a large percentage of basic research in government laboratories no longer apply. The universities are competent and anxious to carry on this type of research to any extent which appears to be justified.

We agree with the views of the Science Council that much more of the federal research directed to the achievement of national objectives should be contracted to appropriate industrial and university laboratories, with the government laboratories carrying a much lower portion of the total, but co-ordinating the overall effort. Such a division of effort would promote very close liaison and understanding between the three bodies and would result in the maximum "fall-out" and recognition of unexpected but valuable opportunities for innovation.

We would strongly urge that any changes in the level of support given to research in industry, the universities or in government laboratories should be gradual. Sudden withdrawal of support can be very damaging even to the productivity of such research as is left intact while increases in other sectors may well be accompanied by problems which require time to work out.

<u>The Balance Between Basic and Applied Research</u> (Question 5)

The appropriate balance between basic and applied research varies greatly from one sector of the economy to another, and from one industry to another. It represents a balance between immediate and future needs for technology and is thus a matter of experience and judgment.

In our own case, during the past 20 years or so, we have devoted roughly 10% of our effort to research which could be defined as fundamental in that it was not directed to any immediate problem or requirement. Rather, it was intended to gain understanding of various phenomena so that sound technical developments could be expected to follow. A further 15% of research effort could be categorized as "exploratory". Primarily this research was intended to ascertain whether new scientific developments which came to our attention might have potential application to some of our long term objectives. The great bulk of such research proves to be unrewarding, but the small percentage which is successful leads to most of the significant technological advances.

The 25% of the research effort described above lays the basis for new technology, but it may take five to ten years of development research before the new process or product is perfected to the stage where it can compete with and supplant the old.

This balance of research effort appears to have been reasonably satisfactory as applied to our company in recent years. Beyond our own company, we can only offer some generalizations.

Industries which are initiating research programs for the first time would be wise to concentrate on applied research to simplify the difficult task of reducing research results to practical use as much as possible, and to establish confidence in the capability of research management to pay dividends on the research investment. More mature companies who have already picked the relatively easy fruits of applied research will have to spend an increasing amount on basic and exploratory research if they are to maintain their position in the future.

Government research laboratories, if they follow the policies suggested in the preceding sections, will be influenced by much the same considerations as industrial laboratories. They should conduct basic and exploratory research adequate to support the long term needs of their technical assignments and to maintain a high "tone" or quality in their overall research. If they retain the responsibility for the administration of research grants to individuals in universities and institutes, etc., the government laboratories should also maintain enough expertise in related fields so that they can exercise sound judgment in the disbursement of government funds.

The universities are in a relatively poor position to do much applied research since they do not have direct capability to reduce much of it to practise. They benefit from participation in such research through the insight gained as to the appropriate training for their students, and they can frequently make contributions to industrial and governmental objectives which are very valuable. Nevertheless the most significant long term contributions which the universities can make lie in the area of basic research. Such research is uniquely suited to the special role of the universities in society and is an essential investment for the future. In our opinion, the universities should continue to devote their major interests to basic research.

For the country as a whole, the optimum balance between basic and applied research will simply be the sum of the optima for each of the above sectors.

Criteria for Government Allocation of Research Funds (Question 6)

It is apparent that there are no simple criteria which can be used in a formula for the allocation of research funds. In every field judgments will be required of wise and knowledgeable men.

With regard to industry, Mr. M. W. Mackenzie, in his testimony before this committee on October 9, 1968, presented reasons favouring general incentives to increase and support industrial R and D and pointed out that it would be very difficult to operate an effective scheme which would require prior approval of industrial research programs by the government. We are in full agreement with Mr. Mackenzie's views on these points.

At the same time, we share the concern of those who wish to make the incentives selective to promote innovation efficiently. The provisions of IRAP allow such selectivity in theory and no doubt very weak research proposals can be weeded out, but we foresee severe problems in administration when applications for grants appreciably exceed available funds.

The ability to make a selective allocation of government funds for research in an industrial environment would be one advantage of contracting more of the research associated with national objectives to industrial laboratories. The main criteria for the assignment of such research should be program content and technical competence.

The bases of university research has been discussed in a preceding section. Within that context the main criterion for the allocation of funds should be the support of excellence over a full spectrum of disciplines and with reasonable geographical distribution. The criteria for the allocation of government research funds will be largely determined, of course, by the requirements of recognized national objectives and the priorities they are given.

B INDUSTRY AND ITS ENVIRONMENT

Collaboration Between Universities and Industry (Question B1)

Opportunities for collaboration are most readily recognized when each party has a full understanding of the capabilities and problems of the other. Such understanding takes time to develop and potential benefits may be slow to materialize.

We suggest that industry should employ more professors as consultants and that universities should encourage their staffs to seek industrial experience. Government encouragement could be provided in a number of ways.

Joint projects sponsored by industry or the university should develop spontaneously, upon mutual recognition of opportunities. Other joint projects could be sponsored by the government in the form of contracted research.

The Performance of University Graduates (Question B2)

We have found the performance of top ranking men from Canadian universities to be fully equivalent to the performance of their counterparts trained abroad.

The Long Term Goals of Canadian Science (Question B3)

Regardless of the area in which Canadian science is pursued, it is essential that its quality should at least be on a par with others. In government and industrial laboratories quality may be equated with long term productivity.

The objectives of Canadian science are to provide the technology required to achieve the social and economic goals of the country and to seek out and promote new opportunities for advancement.

The Supply of Scientific Manpower (Question B4)

At the present time, we find there is a good supply of competent chemists and chemical engineers. There is some shortage of geophysicists, geologists and mechanical engineers.

The Effect of Foreign Ownership on Innovation in Canadian Industry (Question B5)

As discussed in the first part of this brief, we consider that Canadian affiliates of international petroleum companies have a very great advantage, as compared with wholly-owned Canadian companies, in that they have access to an extremely large amount of proprietory technology. Within our own company at least, there are no restrictions on the use of such technology, and we are free to seek "outside" technology whenever it would be advantageous to do so.

In general, it is our opinion that a degree of foreign ownership assists rather than hampers economically successful innovation in Canadian industry. It provides the broad, low-cost technological foundation essential for further Canadian research and innovation. It also provides scope for R and D specialization and a stronger, more effective research effort than could be supported on a base limited to Canadian business.

Availability of Foreign Science and Technology (Question 6)

The relatively large proportion of Canadian companies which have international affiliations results in an unusual volume of technology which is available to Canadian industry. In every case with which we are familiar, such technology is available as soon as it is generated, subject only to the normal problems of communication.

Much thought has been given by these companies to developing the best systems of communication possible. The establishment of Canadian research groups is particularly helpful in assimilating and applying such technology.

PART III

CASE HISTORIES

A few brief examples from our own experience may illustrate some of the points we have tried to make in this brief.

1. Invention of a new additive for use in domestic heating fuel oils led to a very profitable Canadian business with a high proportion of exports. When the volume of sales in the U.S. became big enough, tariff costs led to the construction of a U.S. plant and competitors introduced similar products. Despite these limitations, the Canadian business remains profitable.

2. A commonly used plastic which is available in Canada both from domestic plants and abroad is undergoing constant improvements and modifications. The research necessary to remain competitive in this field can not be supported by the Canadian market alone, but is made possible by conducting mutualized research for foreign affiliates with similar plants.

3. Research aimed at reducing the cost of one of the major chemical raw materials sold by Imperial was aborted when low cost sources of this chemical from abroad suddenly increased. However, the research led to a new method of manufacturing still another chemical raw material commercially used in large volumes. Economic studies indicated that despite the lower product costs, as compared to the conventional process, a new Canadian plant could not be justified. The available market was too small. Moreover, because of the scale factor, a Canadian plant would have much higher unit production costs than its equivalent in the U.S.A. It would appear that the best hope of capitalizing on this development would be through licensing for use abroad.

4. Development of a solvent extraction process made feasible the manufacture of many lubricating oils from non-premium crudes, thus saving foreign exchange and lowering the cost of products. Further savings in crude imports have been made by other process and formulation research.

APPENDIX 160

B R I E F

Submitted to

THE SENATE SPECIAL COMMITTEE ON SCIENCE POLICY

by

GULF OIL CANADA LIMITED

800 Bay Street

Toronto, Ontario

and its subsidiary

SHAWINIGAN CHEMICALS LIMITED

1, Place Ville-Marie

Montreal, Quebec

1. SUMMARY

1.1 The development of new scientific knowledge in Canada is of national interest only if it can be exploited in the country in the foreseeable future.

1.2 The commercial exploitation of new knowledge is largely dependent on the economic environment of the country, which is in turn related to geography, international trade relations, social policy, taxation, etc.

1.3 The most important force in the development of new knowledge is the existence of a body of highly-skilled scientists.

1.4 The communication between scientists, either by the written word, or by cooperative labour, will enhance their abilities to develop new knowledge.

2. RECOMMENDATIONS

2.1 That the government's internal research expenditures be coordinated to avoid duplication and to provide a more cohesive research effort within the framework of the Government.

2.2 That the government's external research expenditures be coordinated and periodically reviewed to assess their usefulness.

2.3 That government research grants, limited as to dollars but unrestricted in scope, be awarded university teachers, in aid of avoiding obsolescence.

2.4 That the Government Research Information Services (probably through The National Research Council) be greatly expanded to make scientific information readily available to working scientists.

2.5 That the Government consider the contracting out of research projects of national importance to collective groups from universities, government agencies and industry, according to their abilities, thereby evolving diversified teams to better solve the nation's scientific problems.

2.6 That the Government consider the effect of the country's economic environment on the exploitation of new knowledge and where possible take steps to improve this environment.

3. The Company

3.1 Gulf Oil Canada Limited is the new name adopted on January 1st 1969 by the British American Oil Company Limited. It is currently being amalgamated with Royalite Oil Limited and Shawinigan Chemicals Limited. The company is fully integrated with operations ranging from the exploration for oil to the marketing of refined petroleum products and the manufacture and marketing of chemicals and plastics, most of which are derived from petroleum. Its operations are definitely science-based.

3.2 Capital invested by the company is in excess of $700 million and annual gross sales are of the same order. The company ranks second in size among the integrated oil companies in Canada. During 1968, income tax in excess of $23 million was paid. Sixty-nine per cent of the shares of the company are owned by Gulf Oil Corporation of Pittsburgh, U.S.A., and there are more than 27,000 other shareholders, mostly Canadian.

3.3 There are 11,000 employees in the company, 780 of whom are technically-trained. The company maintains two major research laboratories and also carries out a certain amount of supporting research at various plant locations. There are approximately 300 people engaged in research, of whom 140 are university-trained.

3.4 In addition to the expertise developed within its own orbit, the company has access to a larger source of know-how from the Gulf Oil Corporation, and also avails itself of the opportunity of purchasing foreign techonology when economically preferable.

4. Research Within The Company

The company operates two major research facilities, one located in Ontario and the other in Quebec.

4.1 Sheridan Park, Ontario. This is the larger of the two laboratories and was established in 1964 as a consolidation of the company's geographically-scattered research effort in the petroleum field. The research effort is largely directed to supporting the manufacturing and marketing functions of the company, although research is also done on such diversified subjects as helium, sulphur and heavy water -- all related to petroleum products. There are 149 people engaged in this effort, 73 of whom are technically-trained.

4.2 Ste-Anne de Bellevue, Quebec. This laboratory was established in 1966, replacing a previous laboratory in Shawinigan, Que., operated by Shawinigan Chemicals Limited. Shawinigan has been engaged in active research since 1915 and has been a pioneer in the fields of electrochemistry, organic chemicals, synthetic resins and plastics. The company's innovation record has been good. During the past fifty-four years the company has brought from laboratory bench to commercial production some fourteen major projects. Likewise at least four major novel process equipment developments have been brought to commercial fruition. All of these have received global recognition and several have been used in different parts of the world. In addition to these, a large number of less important processes and products have been developed, and over the years some 246 Canadian patents alone have been issued to this branch of the company. There are currently 102 persons engaged in this effort, 46 of whom are technically-trained.

4.3 At various locations, notably Montreal East, Varennes, Que., and Shawinigan, Que., a limited amount of research supporting the local manufacturing operations is carried out.

4.4 The company has benefitted from certain Federal tax measures relating to research and has received certain grants under the Industrial Research and Development Incentives Act, which permitted the carrying out of certain research projects at a time earlier than would have been normally economically feasible.

5. The Company's Approach To Research

5.1 As a science-based industry, the company is very conscious of the need for continual innovation in its operations. The company believes that its research effort should be directed to fulfill one or more of the following functions:

5.1.1 It should pave the way to the production of a new marketable product.

5.1.2 It should lead to the development of a new or improved process.

5.1.3 It should upgrade existing processes and products.

5.1.4 It should be a mechanism for upgrading and maintaining a high level of technical competence among its employees.

5.2 The company is unlikely to support a substantial amount of fundamental research in its own laboratories unless this research in itself is in support of an existing mission-oriented project.

5.3 The company recognizes that no one research laboratory can be all things to all people, and it is constantly searching for new technology from sources within or without its corporate connections. The company is prepared to purchase outside technology when its own technology is not available or when the outside technology appears superior to that developed locally. The company is also prepared to sell, license or trade its own technology in cases where it is commercially advantageous and where the company will suffer no economic harm.

6. Objectives of a National Science Policy

6.1 Should a National Science Policy be established for Canada an attempt should be made to attain certain broad objectives; e.g.

6.1.1 The improvement of the national economy.

6.1.2 The establishement of national goals in the field of science.

6.1.3 The coordination of internal government expenditures in the field of science.

6.1.4 The coordination of external government expenditures and incentive plans in the field of science.

6.1.5 The encouragement of the commercial exploitation of science-oriented expertise.

6.1.6 The encouragement of the development and maintenance of a high level of scientific and technical competence among the people.

6.2 In order to accomplish these and other related objectives, it will be necessary to consider the policy in the light of national security, national income, international trade relations and the social objectives of the country. It will also require some exceedingly wise men to come to grips with this problem.

7. Development of a National Science Policy

7.1 In considering the development of a National Science Policy, there appear to be three interrelated areas of prime importance; namely,

7.1.1 The development of new knowledge.

7.1.2 The exploitation of new and existing knowledge.

7.1.3 The maintenance of a highly technically competent group of people.

7.1.4 New knowledge has little or no value unless it is exploited; and knowledge can neither be developed nor exploited without the proper people. The "proper people" thus becomes one of the keystones in any meaningful science policy.

7.2 The People

The corps of technically-competent people is found in four main areas of activity -- educational institutions; Government; mission-oriented research institutes; and private industry. It is important that the responsibilities of each group and the order of priority within the group be clearly understood, not only by the policy makers but also by the members of the group. The following are some suggested responsibilities and priorities:

Group	Priority	Responsibility
Educational Institutions		
	1	To teach (and in the case of students to learn)
	2	To develop new knowledge
Government		
	1	To disseminate new and existing knowledge into channels which may augment the national economy
	2	To develop new knowledge
	3	To train people
	4	To exploit new knowledge when it is in the national interest to do so
	5	To coordinate its own and related research activities so as to minimize duplication of effort and concentrate on suitable national goals
Mission-Oriented Research Institutes		
	1	To adapt existing knowledge
	2	To develop new knowledge
	3	To train people
Private Industry		
	1	To exploit existing knowledge and divert it into economic channels
	2	To develop new knowledge
	3	To train people

In framing a National Science Policy, due consideration and proper weight should be given to the group responsibilities and priorities within the groups.

7.2.1 The maintenance of a continuing flow of technically-competent people into our society is largely dependent on our universities and technical institutions. The importance of high quality up-to-date teaching cannot be overemphasized. In order to avoid obsolescence, a limited amount of unrestricted research within our universities is desirable. This will undoubtedly require public support, a fact which brings into focus the problem of Federal-Provincial relations -- a problem which must be resolved before any meaningful science policy respecting our universities can be effectively implemented.

7.2.2 In order to provide some incentive for people to engage in scientific research within the country, it is necessary that the opportunity be provided for people to work in their chosen or assigned disciplines. This will be affected largely by the level of economic activity, but more particularly by the economic, social and political climate, which needs to be conducive to the profitable commercial exploitation of new knowledge.

7.3 <u>Communication of Scientific Information</u>

7.3.1. Every scientist is dependent on the knowledge developed by others, past and present. With the great proliferation of scientific information during the past quarter century, no one institution appears to be capable of collating and making readily available this information to the working scientists. This is a national problem and could well fall into the orbit of the National Research Council or similar government agency. The problem is an enormous one, but one which might well be one of the cornerstones of a National Science Policy.

7.3.2 The written word is by no means the only method of scientific communication. Personal contact between scientists of the same or related disciplines is equally important and in some cases more effective. A National Science Policy might envisage the contracting out by Government of large research projects which were in the national interest. Each project could be broken down, so that the work would be carried out by the universities, the government agencies, private industry and other research institutions, according to their skills and capabilities. With teams such as these working on single large projects, communication among scientists would be vastly improved and the scientific effort of the country undoubtedly enhanced. Such government contracts to the universities, superimposed on the previously suggested limited grants for unrestricted research, would further upgrade the teaching potential of these institutions.

7.4 Economic Environment

The "development of new knowledge" must have as its corollary the "exploitation of new knowledge", if it is to be effective in improving the national economy. In Canada, this is difficult to accomplish successfully. The company's experience in this regard is probably typical of the experience of other process industries. Of the fourteen major projects which Shawinigan brought from laboratory bench to commercial production, eight could be considered successful in Canada. Of these eight, four were also exploited by the company in the United States and one of these four in the United Kingdom. Two were licensed to others outside the country, and one of these exploited in the U.S.A. by others when the Shawinigan patent expired. Of the six which were not successful in Canada, three were exploited by the company successfully in the United States and one was licensed to outside interests abroad. The inability to exploit successfully these scientific and technical achievements within Canada can be attributed to the economic environment in which Canada finds itself and the economic climate which Canada creates for itself. These involve questions of geography, international trade relations, social policy, taxation and a host of other problems, all of which affect our ability to engage in large scale and/or low cost operations. It is obvious that the process of exploiting scientific achievement is a highly-selective one. A change in the climate for doing business in Canada could have a far-reaching influence on the effectiveness of any National Science Policy which might be developed.

7.5 Incentives

There has been a long history of government-inspired research incentives in Canada, extending through the broad spectrum of post-graduate scholarships, post-doctoral fellowships, grants-in-aid to teachers in graduate schools, grants to industry and tax abatement for research expenditure in industry. Generally speaking, these have been effective in varying degrees. There would appear to be room for co-ordination and periodic re-assessment of the objectives.

7.5.1 It is suggested that a quantitative re-appraisal of the post-doctoral fellowships programme might be undertaken in order to equate the demand for the product with the potential supply. Massive grants, finding their way into the graduate schools of the universities, might be profitably replaced by contracts for research projects of a national interest.

7.5.2 On the industrial side, the IRDIA grants provide an incentive to speed up long-term projects. The PAIT grants, which provide a means of exploitation of scientific projects, could be made more attractive to industry by allowing the assignment of know-how from unsuccessful projects to the industry. Government research contracts, in cooperation with universities and other agencies, could give industry an incentive to increase its research tempo. The benefits of government research contracts, in addition to fostering the national interest, are often found in the "scientific fall-out" accompanying the work. It is noteworthy that, of the fourteen major scientific developments of commercial importance originating in the Shawinigan laboratories, two were "scientific by-products" of other research projects.

7.6 Research in the National Interest

As a substantial taxpayer, the company would urge that government-supported research should be meaningful and that mission-oriented projects should take precedence over those of a more frivolous nature. If scientific endeavour is to be supported by the Canadian treasury, it should qualify under one of two categories.

7.6.1 Its objective should be to train people and maintain in them a high level of scientific and technical competence.

7.6.2 Its objective should be mission-oriented in the national interest and of a larger scope than could be normally supported by an existing institution.

7.6.3 The first objective is easy to define but requires stern discipline lest one fall into the impractical trap of considering that all scientific endeavour fulfills this function.

7.6.4 The second objective is less easy to define and requires the deliberations of very astute men to set the practical limits of this interest.

7.6.5 The following are suggested without limitation as falling within a reasonable definition of scientific projects in the national interest.

- Those projects which are likely to increase the Gross National Product of the country.
- Those projects which relate to the unique geography of Canada.
- Those projects which relate to the unique climate of Canada.
- Those projects which relate to Canada's principal natural resources.
- Those projects which relate to national security.

Specific projects could be:

- Long-distance communication - satellites
- Plastics adaptable to low-temperature usage
- Long-range weather forecasting
- Non-corrosive anti-icing agents
- New fast-growing grains
- Artificial live-stock feeds
- Low-temperature lubricants
- Perma-frost studies - construction techniques
- Soil-stability studies - muskeg
- Marine farms
- Atomic power
- Arctic transportation - land, sea, air

These are only a few examples of the vast number of projects which could be supported. Some of them are already receiving support. The number, however, far outweighs the resources available to tackle the problems, making necessary a very careful selection of the projects which might warrant support.

8. Conclusion

Scientific progress cannot be assured by legislation. It can only be achieved by the interaction of the minds of men working in an atmosphere which provides not only freedom of thought but also the opportunity to exploit new ideas. Government policy can go a long way towards creating such an atmosphere.

The Queen's Printer, Ottawa, 1969

First Session—Twenty-eighth Parliament

1968-69

THE SENATE OF CANADA

PROCEEDINGS

OF THE

SPECIAL COMMITTEE

ON

SCIENCE POLICY

The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*
The Honourable DONALD CAMERON, *Vice-Chairman*

No. 68

THURSDAY, JUNE 19th, 1969

WITNESSES:

Northern Electric Company Limited: Mr. V. O. Marquez, President, Mr. J. R. Houghton, Vice-President, Manufacturing and Engineering; E.M.I. Electronics Canada Limited: Mr. B. J. Starkey, Vice-President, Engineering; Canadian Westinghouse Company Limited: Mr. William J. Cheesman, President and Chief Executive Officer.

APPENDICES:

161—Brief submitted by Northern Electric Company Limited
162—Brief submitted by E.M.I. Electronics Canada Limited
163—Brief submitted by Canadian Westinghouse Company Limited
164—Brief submitted by RCA Limited

20660—1

MEMBER OF THE SPECIAL COMMITTEE

ON

SCIENCE POLICY

The Honourable Maurice Lamontagne, *Chairman*

The Honourable Donald Cameron, *Vice-Chairman*

The Honourable Senators:

Aird	Grosart	Nichol
Belisle	Haig	O'Leary (*Carleton*)
Blois	Hays	Phillips (*Prince*)
Bourget	Kinnear	Robichaud
Cameron	Lamontagne	Sullivan
Carter	Lang	Thompson
Desruisseaux	Leonard	Yuzyk
Giguère	McGrand	

Patrick J. Savoie,
Clerk of the Committee.

ORDERS OF REFERENCE

Extract from the Minutes of the Proceedings of the Senate, Tuesday, September 17th, 1968:

"The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That a Special Committee of the Senate be appointed to consider and report on the science policy of the Federal Government with the object of appraising its priorities, its budget and its efficiency in the light of the experience of other industrialized countries and of the requirements of the new scientific age and, without restricting the generality of the foregoing, to inquire into and report upon the following:

(*a*) recent trends in research and development expenditures in Canada as compared with those in other industrialized countries;

(*b*) research and development activities carried out by the Federal Government in the fields of physical, life and human sciences;

(*c*) federal assistance to research and development activities carried out by individuals, universities, industry and other groups in the three scientific fields mentioned above; and

(*d*) the broad principles, the long-term financial requirements and the structural organization of a dynamic and efficient science policy for Canada.

That the Committee have power to engage the services of such counsel, staff and technical advisers as may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to examine witnesses, to report from time to time, to print such papers and evidence from day to day as may be ordered by the Committee, to sit during sittings and adjournments of the Senate, and to adjourn from place to place;

That the papers and evidence received and taken on the subject in the preceding session be referred to the Committee; and

That the Committee be composed of the Honourable Senators Aird, Argue, Bélisle, Bourget, Cameron, Desruisseaux, Grosart, Hays, Kinnear, Lamontagne, Lang, Leonard, MacKenzie, O'Leary (*Carlton*), Phillips (*Prince*), Sullivan, Thompson and Yuzyk.

After debate, and—

The question being put on the motion, it was—

Resolved in the affirmative."

Extract from the Minutes of the Proceedings of the Senate, Thursday, September 19th, 1968:

"With leave of the Senate,

The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That the name of the Honourable Senator Robichaud be substituted for that of the Honourable Senator Argue on the list of the Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—

Resolved in the affirmative."

Extract from the Minutes of the Proceedings of the Senate, Wednesday, February 5th, 1969:

"With leave of the Senate.

The Honourable Senator McDonald moved, seconded by the Honourable Senator Macdonald (*Cape Breton*):

That the names of the Honourable Senators Blois, Carter, Giguère, Haig, McGrand and Nichol be added to the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—

Resolved in the affirmative."

ROBERT FORTIER,
Clerk of the Senate.

MINUTES OF PROCEEDINGS

THURSDAY, June 19, 1969.

Pursuant to adjournment and notice the Special Committee on Science Policy met this day at 10.00 a.m.

Present: The Honourable Senators Lamontagne (*Chairman*), Blois, Bourget, Cameron, Grosart, Haig, Kinnear, Phillips (*Prince*) and Robichaud—9.

Present but not of the Committee: The Honourable Senator Méthot.

In attendance: Philip J. Pocock, Director of Research (*Physical Science*).

The following witnesses were heard:

NORTHERN ELECTRIC COMPANY LIMITED
Mr. V. O. Marquez, President
Mr. J. R. Houghton, Vice-President
Manufacturing and Engineering.

E.M.I. ELECTRONICS CANADA LIMITED
Mr. B. J. Starkey, Vice-President, Engineering.

CANADIAN WESTINGHOUSE COMPANY LIMITED
Mr. William J. Cheesman, President and
Chief Executive Officer.

(*A curriculum vitae of each witness follows these Minutes*)

The following are printed as Appendices:

No. 161—Brief submitted by Northern Electric Company Limited.

No. 162—Brief submitted by E.M.I. Electronics Canada Limited.

No. 163—Brief submitted by Canadian Westinghouse Company Limited.

No. 164—Brief submitted by RCA Limited.

At 12.30 p.m. the Committee adjourned to the call of the Chairman.

ATTEST:

Patrick J. Savoie,
Clerk of the Committee.

CURRICULUM VITAE

Cheeseman, William J.: President and Chief Executive Officer, Canadian Westinghouse Co. Ltd. Born: Barrie, Ontario, July 26, 1921. Educated: Graduated B.A.Sc., University of Toronto 1943. Business: Assistant Supervisor, Works Lab. CGE 1946-47; Research Engineer, HEPC of Ontario 1947-51; Joined Canadian Westinghouse in 1951, serving in various management positions; held executive posts with International Telephone & Telegraph 1961-64 and with RCA Victor 1964-65; returned to Canadian Westinghouse in 1965 and elected to present position in 1967. Memberships: Corp. of Prof. Engineers of Quebec; Association of Prof. Engineers of Ontario; Director, Canadian Nuclear Association; Advisory Committee, Canadian Standards Association; Executive Council, Canadian Manufacturers Association; Director, Canadian Electrical Manufacturers Association; Engineering Institute of Canada. Served with Royal Canadian Navy 1943-46.

Houghton, John R.: P.Eng., company executive. Born in London, Ontario, 2 April 1913; son of Tom and Mabel (Ruse); Educated in Montreal, Graduate of McGill University (B.Eng.—Mechanical Engineering), 1935. Married Margaret Poltrick 1939; one son and one daughter. Vice-President, Manufacturing & Engineering, Northern Electric Co. Ltd., 15 April 1969. Vice-President & General Manager, Communications Equipment Division, Northern Electric Co. Ltd.; Vice-President, Corporate Development 6 November 1967. Joined company in 1935, as an engineer in the Telephone Division. Supervisor, Manufacturing Methods Engineering 1943; Asst. Supt., Manufacturing Methods Engineering 1946; Supt., Manufacturing Engineering 1951; Engineer of manufacture, reporting to the Vice-President, Manufacturing and Engineering 1956; Asst. Works Manager 1958; Works Manager, London Plant 1959; Vice-President & General Manager, Tel. Contract Division 1961; Vice-President & General Manager, Communications Equipment Division 1962; Community and organizational interests: Vice-President, Queen Elizabeth Hospital of Montreal; Director, Canadian Industrial Preparedness Assoc'n.; Member of Corporation of Engineers of Quebec; Member of Canadian Standards Association (Mech. Section); Member of Advisory Committee to Faculty of Engineering Science (University of Western Ontario); Member of Engineering Advisory Committee (McGill University); Member of Montreal Regional Council Executive Committee and Chairman of Camp Jackson Dodds Committee; Boy Scouts of Canada; Member, Quebec Division Executive Committee, Canadian Manufacturers' Association; Institute of Administration. Past member local school board, Lakeshore area, Montreal; 1956—a Canadian delegate to the Duke of Edinburgh's Commonwealth Study Conference on the Human Problems of Industrial Communities held in Oxford, Eng. Past member Board of Examiners and various other committees of the Corporation of Engineers of Quebec. Past member Engineering Institute of Canada. Clubs: Engineers of Montreal; Red Bird Ski Club, Montreal; Interests: Skiing, home workshop, music, community activities; Residence: 4312 Montrose Ave., Westmount, Quebec. Office: 1600 Dorchester Blvd., Montreal.

Marquez, Vernon O.: Company executive. Born in Trinidad, B.W.I., 15 Sept. 1908. Educated at St. Mary's College, Trinidad; Married Margaret Amy 1933. Two sons—Geoffrey and Paul; two daughters—Virginia and Brenda. President, Northern Electric Company Limited; joined Company in 1929 as switchboard wiring operator; held various positions; General Manager, Sales Division, 1957; Vice-President, 1960; Executive Vice-President and Director, 1963; President, 1967. Director of Cleyn & Tinker, Ltd. Member of: Canadian Export Association (Governor); Export Advisory Council; Canadian Standards Association Advisory Committee; Commander Brother, Venerable Order of St. Johns of Jerusalem; Advisory Committee to Department of Business Administration, Bishop's University; Private Planning Association of Canada; Canadian Chamber of Commerce; The Electrical Club of Montreal; The Canadian Club of Montreal; The Newcomen Society of North America. Chairman of the Committee on Expansion of International Trade, Canadian Council, International Chamber of Commerce. Clubs: Saint James, Montreal; Royal St. Lawrence Yacht, Dorval, Que. Interests: Photography, sailing, gardening. Residence: 5 Lancaster Drive, Pointe Claire 720, Quebec. Office: 1600 Dorchester Blvd. West Montreal 108 Quebec.

Starkey, B. J.: Radio physicist, mathematician, and electrical engineer. 40 years experience in the fields of Electronic R & D and Operational Research, including broad areas of Defence R & D in Electronic Warfare and A.S.W. Specialist in signal-extraction techniques and signal-detection theory and analysis; antennas and radio wave propagation. Over 50 published scientific papers, over 200 classified (Government establishments) reports. A text book on Laplace Transforms, a monograph on microwave propagation; several patents.

Marquez, Vernon O.: Company executive. Born in Trinidad, B.W.I., 15 Sept. 1908. Educated at St. Mary's College, Trinidad; Married Margaret Amy 1933. Two sons—Geoffrey and Paul; two daughters—Virginia and Brenda. President, Northern Electric Company Limited; joined Company in 1929 as switchboard wiring operator; held various positions; General Manager, Sales Division, 1957; Vice-President, 1960; Executive Vice-President and Director, 1963; President, 1967. Director of Cleyn & Tinker, Ltd. Member of: Canadian Export Association (Governor); Export Advisory Council; Canadian Standards Association Advisory Committee; Commander Brother, Venerable Order of St. Johns of Jerusalem; Advisory Committee to Department of Business Administration, Bishop's University; Private Planning Association of Canada; Canadian Chamber of Commerce; The Electrical Club of Montreal; The Canadian Club of Montreal; The Newcomen Society of North America; Chairman of the Committee on Expansion of International Trade, Canadian Council, International Chamber of Commerce. Clubs: Saint James, Montreal; Royal St. Lawrence Yacht, Dorval, Que. Interests: Photography, sailing, gardening. Residence: 5 Lancaster Drive, Pointe Claire 720, Quebec. Office: 1600 Dorchester Blvd. West, Montreal 108 Quebec.

Starkey, B. J.: Radio physicist, mathematician, and electrical engineer. 40 years experience in the fields of Electronic R & D and Operational Research, including broad areas of Defence R & D in Electronic Warfare and A.S.W. Specialist in signal-extraction techniques and signal-detection theory and analysis; antennas and radio wave propagation. Over 50 published scientific papers, over 200 classified (Government establishments) reports. A text book on Laplace Transforms, a monograph on microwave propagation; several patents.

THE SENATE

SPECIAL COMMITTEE ON SCIENCE POLICY

EVIDENCE

Ottawa, Thursday, June 19, 1969

The Special Committee on Science Policy met this day at 10.00 a.m.

Senator Maurice Lamontagne (*Chairman*) in the Chair.

The Chairman: Honourable senators, we have with us this morning three companies working more or less in the same field: Northern Electric, EMI Electronics Canada Limited, and Canadian Westinghouse Company Limited.

I will first ask the representatives of these companies to make an opening statement and then we will have a discussion period. Without any further introduction I would ask Mr. Marquez to speak on behalf of his company.

Mr. V. O. Marquez, President, Northern Electric Company Limited: Mr. Chairman, honourable senators, Northern Electric welcomes this opportunity to appear before the Special Committee of the Senate on Science Policy in support of the brief we have presented.

To assist me in answering such questions as you may ask I have with me three colleagues from the company: Dr. Donald Chisholm, Vice-President in charge of Northern's research and development laboratories; Mr. John Houghton, corporate vice-president with responsibility in the fields of manufacturing and engineering; and Mr. J. C. R. Punchard, Assistant Vice-President involved in government liaison and our R & D laboratories.

May I say that we at Northern have been following the discussions taking place before this committee with more than average interest. As a science based company, deeply involved in matters of science and technology and committed to competition in international markets, we obviously have a vital interest in the characteristics of Canada's science policy.

I might add, too, that we have been heartened and encouraged by the emergence of what seems to us to be major themes in your deliberations, because these themes appear to parallel the principal points to which our brief sought to draw your attention. It might serve to launch our discussion this morning if I summarize these salient points very briefly.

In the first place, our brief suggests that it will help our consideration of science policy if we distinguish three distinct scientific processes: Discovery, invention and innovation. There processes are sequential and interdependent, the output of each process becoming the input of the next in sequence.

Our brief points out that in general the discovery process, the first in the sequence, finds its most favourable environment in universities. By contrast the last of the three processes, innovation, finds its most favourable environment in industry.

Our brief emphasizes that in Canada our entire scientific effort seems to have been less than it needs to be but that, equally important, there appears to be a serious imbalance between the relatively substantial effort currently devoted to the process of discovery and the relatively inadequate resources now directed towards innovation.

The brief suggests, too, that industries operating in the Canadian environment seem to have developed a predisposition to be imitative rather than innovative, and speculates that this condition might be due to the proximity of the United States and the easy and economical access enjoyed by Canadians to US innovation.

The brief draws your attention to the fact that this innovative process is a complex process in which there are many elements which are not technological, but which must be integrated with technology.

The brief emphasizes the need for policies and programs designed to stimulate and expand these non-technological elements of innovation simultaneously with efforts designed to stimulate technology.

The brief reminds us that it is the final process in the sequence, the innovative process, which transforms the output of the earlier processes, discovery and invention, into the satisfaction of human wants in the form of goods and services and that, as a consequence, the output of discovery and invention cannot be brought to full fruition if innovative competence remains inadequate.

Finally, the brief suggests that we need to encourage the whole innovative process and points out that in too many instances the innovative process in Canada has failed to reach completion because the technological elements of innovation have been carried out by government agencies instead of in industries, because in industry they would have been in a better position to integrate it from the very beginning with the non-technological elements of innovation.

Mr. Chairman, we would be very happy to respond to any questions you or your committee might ask.

The Chairman: Thank you, Mr. Marquez.

Now, we have Mr. Starkey, from EMI Electronics Canada Limited.

Mr. B. J. Starkey, Vice-President, Engineering, E.M.I. Electronics Canada Limited: Mr. Chairman, ladies and gentlemen: First let me say that our company is quite honoured to be represented here in very good company. I am the vice-president, engineering, of the company and the only representative here today at the briefing.

In order to give you a better understanding of our attitude in this field of research and development in Canada I had better say a few words about our background.

We are a relatively small company. Our sales are of the order of $5 million to $6 million a year at this time, so that we represent a rather different outlook possibly than the giants which are sharing this briefing today.

Our total engineering staff, research and development staff, is of the order of 40 engineers. Our activities are centred in two major areas. One is the ocean engineering area, in which we are specializing in underwater instrumentation. About 90 per cent of our efforts and our sales are in the defence field, in the oceanographic area. This means anti-submarine warfare systems, sonar buoys, various types of highly sophisticated moored buoy systems for deep ocean which offer stable platforms for anybody who needs platforms in the deep ocean.

We have rather unique achievements in this area. We have systems which are a Canadian system, not ours, but Canadian because most of our developments were carried out with the support of the Canadian government, the Canadian Defence Department funding.

Another area of our activities is in the field of telecommunications where again we specialize in somewhat specific activities, also possibly unique for this country.

After this introduction I can offer a few comments on our brief. As I mentioned before, we represent a small company where research funding is a particularly painful area, because research and development to be really productive require a large allocation of funds. In a small company this presents a real problem from the outset. It is probably easier for larger companies to spend a sufficient amount of money in bulk representing only a small fraction of their sales, whereas it is very difficult to do that in small companies. Yet the existence even of small industrial companies depends nearly exclusively on research and development.

Innovation is the first factor in any competitive activities. Our market is primarily in the United States. We are exporting about 90 per cent of our products. We are facing tremendous competition because of this in the United States with all their background of research and development achievements, with unlimited funds available there for the purpose.

In view of many handicaps of a different nature, political in the first place, we are facing a real problem in trying to sell our Canadian products in the American market.

Whatever we are achieving is solely on the basis of our technical achievements. In spite of being small we have to spend a large proportion of our income in the areas of research and development, because this is the only way of beating our competition in the export market. We suffer because of that.

We appreciate perhaps more deeply than many other organizations some of the shortcomings of the research and development outlook in Canada. I do not think I should be going into detail here, but I can mention a few areas which could be greatly influenced, I am sure, by the considerations and decisions of this committee.

One area is the fundamental one of government help for this industry. We have a umber of organizations in Canada whose role is to provide funds and grants for industry in order to help in research activities. One major weakness here is that all these grants, or most of them, offer 50 per cent of research expenditure of a company. This may be attractive enough or good enough for large companies with sufficient funding of their own and sufficient financial strength to undertake research activities on their own.

In the case of small companies 50 per cent on research programs could amount to something like 10 per cent or more of the company's sales which, in our case and that of similar sized companies, amounts to something like $500,000.00 a year, or more. This is definitely the amount of money which is required for any company trying to complete and introduce innovation on the American market. This, as has been already mentioned, is a fundamental factor in all competitive activities in the field of research, development and engineering. $500,000.00 would mean that 50 per cent of this represents still $250,000.00 of the company's own money.

The margin of profit in the defence field in particular is very small. The dangers involved, the fixed price contracts which are imposed on the industry and many other uncertainties in this field, mean that the risk of expending $250,000.00 of the company's money is very nearly prohibitive. This clearly indicates that we are in a very difficult situation in small companies. On the one hand we have to innovate, we have to carry out research. We are very tempted by grant offers by the government but, at the same time, we simply cannot afford to provide the remaining portion of the money. There are many situations where we could be highly competitive, where we know very well that we could beat our competition in the United States for large contracts leading to large production eventually, yet we are unable to enter into this competition simply because of lack of money for research and development required.

Another weakness, or another painful problem we see is the nearly complete lack of domestic market for highly sophisticated products, particularly in the defence field.

This is true especially now, because of defence policy being undecided, with the result that there is no firm planning and no funding in Canada. Defence products, defence research and development in Canada do not find any back-up from the domestic market. This is important probably not only in the defence field but in commercial activities as well.

The first questions we are asked when we go abroad to offer our products and services is, all right, what have you done in your own country? How many of these things have you sold there? What sort of material have you got there? This obviously is highly embarrassing, because there is practically no market for many of the sophisticated products we are designing, developing and manufacturing in this country.

There is one area which perhaps could be mentioned here. This is the area of participation of Canadian government scientific establishments and research and development establishments. These establishments are very vital to the growth and progress of the forthcoming from these organizations is only Canadian research and development activities.

Unfortunately, the help to the industry forthcoming from these organizations is only minimal. There could be a very large demand for services and products from the industry asked on the developments of government research establishments and procurement of products through these establishments.

However, at least the present policy is such that there is no real need for these establishments to go to the Canadian industry for help. If they need anything it is done on a truly competitive basis, without any specific consideration being paid to Canadian requirements.

In other words, their programs and contracts go to the lowest bidder, which usually means the United States. Very large sums of money for research and development establishments in Canada are going to the United States simply because of that.

It is obvious that Canadian industry cannot really compete in these Canadian demands. Canadian research organizations' demands normally call for small quantities involving development from the Canadian point of view. It may not be so in the United States. They very often can offer a ready made, readily available product. Obviously the cost of this much lower. However, this straight away kills a very significant source of ideas, possibilities and lending, apart from money, for the Canadian research and development industry.

I am not sure whether this appears to be a purely political problem, how far we should go in the attempt to substantiate the Canadian industry. However, in the case of the industries competing in the United States the competition becomes unfair because in the United States the opposite is true.

All the large government research and development establishments in the United States place their contracts and share their know how and developments with the American industry. This is one factor which undoubtedly, in particular in the defence field, adds very significantly to the strength of the American industry.

The situation in Canada is completely different. Our feeling is that this is one area where improvements or changes could be made to the greatest possible benefit of Canadian industry in the fields of research and development.

I could go on in this way for a long time, but I think I have taken up enough of your time, Mr. Chairman. Thank you very much.

Senator Bourget: Are you a wholly-owned Canadian company?

Mr. Starkey: No, we are a wholly-owned subsidiary of the British EMI, but we have got a completely Canadian board of directors. We are a completely independent company in all other respects. We do not sell any of their products in Canada. Our products here do not compete with theirs. In fact, we export to the U.K. We have been exporting in various areas because of our specialized activities here.

At the same time in a way if we were to talk about firms which are not fully Canadian, which are owned by either American or British companies, the fact that we are British owned gives us a certain advantage because we are completely free to compete in the American market, which may not be the case, of course, with American parents.

The Chairman: Thank you, Mr. Starkey.

Finally, we will hear from Mr. William Cheesman, president and chief executive officer of the Canadian Westinghouse Company Limited.

Mr. William J. Cheesman, President and Chief Executive Officer, Canadian Westinghouse Company Limited:. Mr. Chairman, honourable senators, gentlemen: Canadian Westinghouse welcomes the opportunity that we have had to present a written brief to this committee; the opportunity that is afforded today to appear before you to say a few words in complement to that brief; and to reply to questions.

I am here today as the sole representative of Canadian Westinghouse Company. In light of what has just been said and discussed here, it might be helpful to the committee if I describe Canadian Westinghouse Company.

It is a company that has been in existence in Canada so long that perhaps we all assume we know what it is, although there may be some misconceptions.

Canadian Westinghouse Company was incorporated in 1903 and in fact started operations in Canada in 1896, some 73 years ago. It has gone through changes in ownership due to changes in the two parent companies, the Westinghouse Electric Corporation and the Westinghouse Airbrake Corporation in the United States.

Today, 71 per cent of our company is owned by the Westinghouse Electric Corporation. They have four members on our board of directors, a board which has a total of twelve, of whom seven are, like myself, Canadians.

The management of the Canadian company is Canadian with one exception, by our invitation, an American who has been with us now for some eight years. We are an indigenous Canadian company, albeit the majority of our equity is owned by foreigners in the United States.

As a long-standing member of the Canadian electrical and electronic industry, we do support the briefs and we did participate in the preparation of them, from the Canadian Electrical Manufacturers Association and from the Electronic Industries Association.

Certainly as a science-based industry Canadian Westinghouse Company fully supports the concept that there must be scientific research and development in Canada. We have no deep seated criticism, in fact, we have very little criticism in the overall program today in the Canadian government research laboratories or in the Canadian universities.

In broad generalities and principles we view these programs as being good. It would be inconsistent for a company like ours, whose whole business is based on science and engineering, to think otherwise.

As for the point which has been brought before the committee repeatedly, as I know from the press, that there is too little of the total scientific research and development effort in Canada being conducted in industry, this is a point that I might more beneficially address myself to for a minute.

I hope that I may be excused for going back to perhaps an even more basic question, which I think faces those of us in Canada: What is the Canadian national social economic policy? Are we going to be a primary resource country like Kuwait, which is No. 2 in the world in gross national product per capita, or Iceland, which is No. 3 or do we aspire to be like the US, which is No. 1, or Sweden, which is No. 4, which to oversimplify have what I might call a mixed economy that is based on both natural resources and on secondary manufacturing?

I think today in Canada we are perhaps at the height of a problem which I might describe as national schizophrenia. We are really trying to go two ways at once. We are talking one way and from our point of view in secondary manufacturing industry acting in another way.

It seems to us in secondary manufacturing industry that we have quite a long way to go before we are fully appreciated for the role and the importance that we have in the Canadian social and economic scene and the necessity of strong secondary manufacturing industry in the future.

Some of the indications seem to us to lead in this direction are the kind of repeated exhortations that we have to become more efficient and more productive.

The tariff adjustments repeatedly remind us that secondary manufacturing industry and the electrical and electronics industry always finds itself high on the list of products which are opened up more than ever to the whims of international competition and are singled out repeatedly.

In the reverse we find that the markets in the world which are in fact, the largest, most active, most realistic markets for the products of secondary manufacturing industry, are in spite of the adjustments in the tariff rates which are arrived at in the GATT negotiations nonetheless continuing to be very effectively protected in their home manufacturing industry by various non-tariff barriers and devices.

Therefore, in many, many of our products lines our export opportunities lie in the underdeveloped countries which, as we all know, suffer from a problem of inability to buy very much of the output of secondary manufacturing.

To summarize that, I feel that one of the problems, perhaps the underlying problem, for the imbalance which has been remarked upon many times by many speakers before this committee, between research and development in industry and research and development in the universities and the government laboratories is in great part the result of there not being a business climate in this country which is conducive to the support of greater research and development in industry.

I believe the previous speakers have supported that.

Another facet of this question of course, of how much research and development should be done in industry and how much in the government and university laboratories is that in contrast with other countries such as the USA we find that projects here stay in those primary or basically research laboratories noticeable much longer in Canada than they do in the US or the UK, to pick only two examples with which I am more familiar than with others.

The argument that is put forward for keeping those projects in the government laboratories is that only the government laboratories have the class, kind and quality of manpower to undertake these projects. The fallacy as we see it in that, of course, is that industry will never have the class, kind and quality of manpower required to undertake such projects until we have the projects to perform.

This is by contrast to the situation in the defence electronics industry back in the early 1950's, when by edict the government research laboratories were called upon to transfer some of their basic and applied research projects to industry.

This applied principally to what is called the avionics sector of the electronics and electrical industry. There was a great reluctance and it was, I am sure, observed by many people whom I see in this room today, at that time because the responsibility for the engineering, design and development of military electronics was put out to private industry.

A survey was done by a team back about 1950, which came back here to Ottawa with the report that the Canadian electrical and electronics industry did not have a research and development capability sufficient to handle the projects which were then under way in government laboratories.

It is a chicken and egg proposition; by edict these projects were put out into industry.

Industry recruited the scientists and engineers and built up the electronic industry, from which you heard last Friday. This is a very substantial industry, which has contributed a great deal to Canada in the some 20 years since it was started as a full-fledged industry here.

We have a more recent example of one government laboratory that saw a large increase in its workload and was exhorted by many to contract this work out to industry. Again the traditional observation was made that industry does not have the engineers and scientists who can perform this work.

However, it is interesting to observe that the same government laboratory within two years was able to find the people to grow from 200 to approximately 800 within its own walls. Obviously I am biased, but I think it is self-evident that if industry had been given those assignments, industry would have...

The Chairman: In order to complete the record we might have the name of that lab?

Mr. Cheesman: It was the power projects organization of Atomic Energy of Canada.

Had industry been given those assignments I think it is fair to say it could have found the necessary scientists and engineers from the same sources that the government laboratory was able to acquire them.

What would be the advantage to the Canadian economy of having this work performed in industry rather than in government laboratories? To us in industry it is self-evident. It makes a much easier bridging from the research and development phase of innovation of new products and new business to the production, marketing and execution of the full business cycle. There has been much said on that and from my point of view there is no argument.

We made a good start with the defence electronics industry back in the early 1950s, but I think in the 1960s we have definitely lost ground in this respect.

Mr. Chairman, with those points, which, as I say, are complementary rather than a summary of our written brief, I will close. I honestly must recognize that our written brief is just a paraphrasing of what was said by EIA and EIMA before your committee here last Friday.

One other comment, if I may take a minute—I was not fortunate enough to be here yesterday but I certainly endorse the statements which are attributed to two of your witnesses before you yesterday from the chemical and drug industry who said, and I quote if I may:

> Too many are trained for fields not required by industry or with too narrow a training to be switched to fields where industry needs them.

This was commenting on the technical and professional education in our universities today. Again, the comment which is made here elsewhere is that scientists seem to think their prestige is decreased by working in an industry. This is a very definite problem to an industry in Canada today. We do not have projects assigned to us in the total requirement of research and development in Canada which carry the prestige which is accorded to, properly in my view, some of the major projects which are being conducted elsewhere.

I think I might leave my remarks at that point, Mr. Chairman, and be prepared to answer any questions.

The Chairman: Thank you very much, Mr. Cheesman. We will begin our discussion period. Senator Grosart will have to leave us early this morning to attend another committee. We will begin the questions.

Senator Grosart: Mr. Chairman, thank you. To excuse my absence I might say that it is a committee which is very closely related to our work here. It is the Senate National Finance Committee and we are preparing our report.

I would like first of all to refer to a discussion we had last night, some might call it an argument, about PAIT. This is a discussion of the relation between interest rate and interest costs.

I raise it here because on page 22 of the Northern Electric brief the matter is commented on. If I may introduce a personal comment, I, by coincidence, am seeing my banker tomorrow to try and borrow some money and I most certainly am going to take the Northern Electric brief with me, because it says in one paragraph, beautifully separated from the rest:

> The program would be much more palatable if pay-back were on a no interest basis.

With that I would like to start in a spirit of agreement. I agree thoroughly that this should be applied to all loans, everywhere in Canada.

Senator Robichaud: Is your name Caoutte?

The Chairman: Are you prepared to join the party?

Senator Grosart: I will join it tomorrow afternoon, because I tink we are going to have a difficult time. It has been said, of course, that because under the PAIT program whatever pay-back there is, is deferred until it is determined whether the project is successful, this raises the effective rate of interest beyond the rate at which that same money could have been borrowed in the commercial market.

This I think is a serious criticism of PAIT, particularly in view of the switch-over from section 72A of the Income Tax Act in the government incentive program. How valid is this criticism? It is a serious criticism if the people who set up PAIT as an incentive program are actually setting up a program where the rates of interest are exorbitant. It seems to me in looking over it that the cost of the money for the project would be included in the cost claimed at the time of pay-back, which would mean in effect the government is going to pay you back your interest cost.

Secondly, it it is successful and you get a 50 per cent pay-back you do not have too much complaint about the fact that you can actuarially make the interest rate look high. I think most of us would very gladly borrow money on these conditions if our project was successful and we got 50 per cent back.

Thirdly, of course, the risk factor is taken out of the investment to a great extent, because if the program is not successful you have got no pay-back.

I would ask is this criticism a valid one? To put it another way, if you are successful, is the interest rate not extremely low actually, if you are getting 50 per cent of your money back and if you are going to include your interest cost in the money you claim?

Mr. Marquez: Senator Grosart, let me answer your question from two or three points of view: In the first place, the Department of Industry, Trade and Commerce are well aware of these criticisms of PAIT. In fact, the proof of the pudding is in the eating. Very few people have taken advantage of PAIT. Northern has not used it at all.

They are in the process of changing PAIT while the new program has not yet been put into effect it definitely is being changed. The objection we had to PAIT was that it was designed as if the major object of a program was to have a failure.

It was a very good program to have if the project you were involved in was going to fail, but surely when we engage in a project it is because we think it is going to succeed. From that point of view there were more economic ways of obtaining money than the way suggested by PAIT.

Senator Grosart: Is that not a little extreme to say? A program that will pay you back 50 per cent of your total investment if your project is successful is hardly one that you could say is designed to put a premium on failure.

Mr. Marquez: The point I am trying to make is not entirely from Northern Electric's point of view. This has been a pretty universal point of view with regard to PAIT. It has not been used. Whether the criticisms as seen by industry were justifiable or not, here was an incentive program offered by the government through the Department of Industry, Trade and Commerce, the Department of Industry at the time, which simply was not being used.

Senator Grosart: It was used. Last year, if my recollection is correct, there was at least \$12 million put into research under PAIT, and we were given to understand that the current figures are very much higher.

Mr. Marquez: I would think that one of the reasons for any of the current figures you are thinking about being high is because the program is being changed to take those things into account.

Perhaps Mr. Cheesman might have a comment to make on that?

Senator Grosart: Am I correct in those other two assumptions? I am interested to know because I am not an accountant or an actuary. Would you include the cost of money in the claim you would make for reimbursement from the government?

Mr. Marquez: I am speaking off the top of my head on that; I really do not know the precise answer to your question.

Senator Grosart: I think anyone in business would. When you consider the cost of projects you consider the cost of money.

Mr. Cheesman: I am not an accountant either; I am a poor confused engineer when it comes to those things. It would be a very pleasant surprise if in PAIT industry were allowed to claim the cost of interest on money. In no other dealings with government contracting am I aware that we are permitted to do so.

I would, as I say, be pleasantly surprised if that were allowed in PAIT.

Senator Grosart: You may not do it directly, but when you are going to put in your overhead costs for your whole operation you do claim the cost of money one way or another. It is part of your cost structure. You cannot pull it out. It is impossible to pull out the cost of money related to a specific project.

Mr. Cheesman: I honestly do not know, Senator Grosart. Should the Department of Industry, Trade and Commerce follow the precedents which were established some ten years or more ago in the Department of Defence Production, then in allocating overheads to projects the cost of interest on the funds to run the project will be specifically excluded.

The Chairman: In any case you would put it as an expenditure when you deal with the Department of National Revenue?

Mr. Cheesman: Yes, like everyone else in the land I think we would do that.

The Chairman: So you have 50 per cent there paid by the government.

Mr. Marquez: We could also say 50 per cent taken by the government; it depends on where you are.

Senator Robichaud: On this point the government takes back 50 per cent. It will take it when your program has been successful, when it has resulted in new business, in innovation, higher sales, which normally means higher profits. Notwithstanding that, you still retain 50 per cent of the cost.

Senator Grosart: My point, Mr. Chairman, is that if you are getting 50 per cent of your principal back on a loan it seems a little picayune to quarrel about the rate of interest.

I would suggest, so as not to carry this on too far, that we might ask PAIT to give us an actuarial breakdown of the interest rate as against interest cost. It would be interesting to have PAIT give us their figures on this. If it is true that they are making a change it seems strange to me that the announcement should not come from the department, if it has not come from them. I have not seen it.

Mr. Marquez: I think perhaps Mr. Houghton may have something to say.

Mr. J. R. Houghton, Vice-President, Manufacturing and Engineering, Northern Electric Company Limited: On a successful program, of course, the government share is paid back, as Senator Robichaud said, later when the project is successful but, nevertheless, it is a pay back type of program.

Senator Robichaud: A hundred per cent or 50 per cent?

Mr. Houghton: The total I believe.

The Chairman: The total cost of research?

Mr. Houghton: You are talking now of this program in relation to unsuccessful projects, then you are talking of the cost of money, which I would agree with Mr. Cheesman is specifically excluded I believe in these kinds of contracts.

Senator Grosart: I believe most industries that I know of would fire their actuary or their accountant if he was not able to sneak in some of those costs.

Mr. Cheesman: There is no question about it, the cost of the money which is required to fund research and development, whether it is a 50-cent dollar or a 100-cent dollar, does have to become a cost of business. It becomes one of the other things that we carry in the line of what Mr. Benson refers to as our problems in being competitive.

Senator Grosart: Again in the Northern Electric brief there is a comment, which I do not quarrel with if it is not misinterpreted, that there can be no fixed percentage of GNP allocated to Federal R & D funding, or total R & D funding in any one year. The word "fixed" bothers me a bit, because that statement, which has been made before, is sometimes taken out of context to say there should be no percentage at all, which of course makes it silly. I am sure that the authors of the brief would agree with me that there has to be an adequate fixed amount for each year.

Mr. Marquez: Indeed. What we are saying is no static fixed amount.

Senator Grosart: Yes. I make this point because throughout your brief you would appear to contradict the misinterpretation of that, that there must be less government inhouse, there must be less basic in universities, there must be more in innovation, and there must be a greater total. All this means is that there must be an amount that in terms of the political process, which is annual estimates, is a fixed amount. It does not matter how you arrive at it.

I merely make that comment because that type of statement has sometimes been used to indicate and support another misinterpreted statement by the Science Council, that there is no relationship between the percentage of GNP spent on R & D and productivity. No I am being unfair—that they were not able to find a relationship. This again is being interpreted as saying that there is no relationship.

Thank you very much, Mr. Chairman; I just wanted to make those points.

The Chairman: In relation to this, before I ask Senator Bourget to raise his questions, I wonder if I would be allowed at this stage to ask more or less the same question I asked yesterday of our guests: how do you arrive at your own R & D budget in your own companies?

Mr. Marquez: I think it is relevant to the question Senator Grosart just asked.

The Chairman: Exactly; that is why I am asking it.

Mr. Marquez: Certainly our way is to determine what projects we think are desirable to do, then fit those projects into what we can afford. This means that you have to establish priorities. I would be inclined to say that our most serious problem, and a problem of anyone who is involved deeply in the scientific process, is to determine what should not be done. It is a much more difficult problem than to determine what should be done, because obviously, whether we are speaking about a country or a corporation, the desirable things to do and the cost of doing them have to be fitted into corporate or national resources.

The great difficulty is to avoid trying to do too many things in not sufficient depth and not committing enough resources to sufficiently few things so that those things are done properly and in depth.

Essentially, the process is no different than the process the nation has to face.

The Chairman: At the starting point, for instance, do you let your own research people come up with projects and proposals?

Mr. Marquez: Projects and proposals originate really, and I am generalizing, from two sources: From the market, which feeds back into the corporation; what our people interpret as its needs.

The Chairman: These proposals would come from management to your research people?

Mr. Marquez: These proposals would come in from our marketing people to management through the administrative organization, as we call it, that covers research. Similarly you have originating from the technological side projects which have a technological base, which because of their novelty or their innovating characteristics tend to resolve things that perhaps the market has not yet become aware of. It is a matter of putting these together and establishing priorities for them, trimming them down so that you fit within your resources. You eventually arrive at the project that you are going to carry out.

The Chairman: You take the needs and requirements of the company and proposals of your own research people. Finally you arrive at the budget for your research program in any year, or in a certain period of years. When you arrive at that budget is there any consideration of the relationship that it may have with your total sales?

Mr. Marquez: Yes, indeed.

The Chairman: So your total sales are comparable to the nation's GNP?

Mr. Marquez: Exactly. You may say that in essence the projects that you are involved in are examined on a project basis. You could put it this way perhaps, if you could consider the possibility that you had a sufficiently low number of projects that you could afford much more than what you were doing then you presumably would not simply develop projects because you had more money.

Of course, that is a highly imaginary situation; it always works the other way. There are more things that you need to do, that you feel are desirable to be done, than you can afford. So you have to set up priorities.

Eventually, one of the rough and ready yardsticks that you use is to relate the expenditure for research and development to your sales figure and see how that compares with what other people are doing. You keep challenging yourself, if you like, as to whether you are perhaps in danger of doing too little or too much. These are rough and ready ways of comparing the effort that is needed.

The Chairman: It has been said also that a company which wants to progress has always to watch its competitors and try to devote more money to research and development than at least the average in the industry. Is this a useful yardstick that you use too?

Mr. Marquez: I think it is one of the things that you take into account also. Of course, I have to remind you that we are generalizing and that these particular figures differ very widely in different industries.

Science-based industries, industries involved in the dynamics involved in which the technology is changing rapidly perforce, because of what they are doing and what their competitors are doing find themselves involved in need to spend more money.

This is a process that is going on continuously. It is perhaps also true to say that the amount of effort that you are devoting to research and development at one particular time may not necessarily be precisely what you would be devoting at any other time. It is very dangerous to become locked into specifics.

The Chairman: I am sure that you within your companies have to take finally what I call a political decision, which is not based on a figure or on any kind of purely mechanistic approach.

Mr. Marquez: One way or another what you do is to fit within the economic parameters of the environment within which you live. That is as true for a corporation as it is for a country.

The Chairman: Would you have comments to add to this with respect to your own experience? It is of great interest to us because we have, of course, to study carefully how the so-called science budget in government is being prepared. I think it is useful to have detailed descriptions of how you go at these problems in private industry.

Senator Bourget: I think, Mr. Chairman, it would also be interesting to know what has been the average increase in their research budget, let us say, in the last five or ten years?

Mr. Cheesman: Mr. Chairman, first of all I will comment on what Mr. Marquez has said. Canadian Westinghouse goes to the same business management school as Northern Electric and our approach to budgeting development is not dissimilar.

We come up with what might be described as a ladder of development projects and try to appraise those on their potential return to us. Of course, the return has to be measured not only in terms of percentages or dollars, but also in timing. If it takes ten years to get a return, then one has to take many more risks as to what will be the business ambient in Canada and the world at the time you bring this product to the market.

We also have to take into account the question of timing in relationship to the availability of earnings of the established and going parts of your business.

Of course, in our business, particularly with heavy electrical apparatus, the utility class of apparatus, this has been a very difficult period or is a very difficult period for that sector of the electrical industry. The earnings are hardly sufficient to keep the industry alive, let alone generate the kind of research and development funds which we wish and in fact see needs for. However, there is room for argument and room for difference of opinion as to whether those opportunities really exist for Canadian manufacturers.

We have seen severe incursions into the Canadian market in the last few years by offshore manufacturers into those product market areas. It would seem that any amount of research and development that we have been able to do as an industry is hardly enough to keep us alive and surviving. We are faced with a non-free trade situation where the countries that are exporting these apparatus products into Canada have a closed market at home.

They provide by one device and another essentially 100 per cent protection to their own home industry. This is a real problem; it is not a question of we don't have the basic scientific knowledge being generated in our industries and government laboratories. It is not a question in the first instance that we do not have engineers and scientists here who are capable of doing it, although they are relatively inexperienced, because the opportunities have not existed within the last decade. We just do not have the feeling of security about the business ambient to take the risks and cut into our already very shallow pool of financial resources to do this.

In connection with PAIT though, I can say that our company is doing a major power transmission development project with the support of the PAIT program.

Our criticism of the PAIT program as it has been and as Mr. Marquez has commented, although we are aware that revisions are in an advanced state of planning at any rate, has been that it has not recognized, but apparently will in the future, that the research and development phase represents something less than 20 per cent, perhaps of the order of 10 per cent of the total cost of the innovative cycle.

Just to get a product to the engineering prototype stage is only the front end of the spear and a lot of energy is required to drive the thing through to a successful project beyond that.

We are very pleased to see that the proposed revisions to the PAIT scheme will take cognizance of this. As to what percentage of our sales dollar we spend on research and development, this varies from product line to product line. The overall percentage for our company has been going down in recent years because of this problem of diminishing opportunities and diminishing availability of funds.

Another way we have to look at this is that in accordance with the GIRD, which was the tax incentive, our tax benefits from research and development were based on the average of the preceding five years.

In our industry we try, for the sake of efficiency amongst other considerations, to keep a fairly steady, at least a slow moving change in the size of our research and development staff. You cannot build up and drop down violently, or you are into severe efficiency problems.

We do get large swings in our industry in the cost of the materials, in the cost of prototypes. For example, if you are going to build an engineering prototype of a power transformer this can be a half million dollar project. In a company even of our size a half million dollars is a fairly big lump in the throat for one piece of hardware in one year. What this does is upset your base for tax benefits until you have washed that lump through.

So that in total R & D in the last two years our company has been declining, although in terms of manpower involved we have been rising. We consider this to be anomalous. As a percentage of our total company sales we have been running at a three year average of about 3½ per cent if we strip out those sales in our company where we are acting as a distributor. This is another function where I do not feel anyone can argue logically that research and development is pertinent.

Most of this distribution function is performed with respect to products manufactured by others in Canada. As a matter of interest, going back to my opening remarks, our trade balance with our parent company at the present time, I am pleased to say, if it carries on as it has been in the past five months will be positive.

We are exporting more to the United States than we are bringing in from our parent company. We have not taken into account some of our suppliers' sources of materials in this calculation, obviously. Our largest single product line of research and development supported by us is running currently at 4.8 per cent.

There is a factor, of course, which Mr. Marquez referred to quite properly in his opening remarks, and that is that a company like ours has access to a large pool of research development and product innovation in a large American company. It just is not a business reality for us to duplicate products that we can receive from them. There are still a great number of holes in the fabric of what would constitute a total product line.

My frustration is that I see more opportunities than I have the wherewithal or the identifiable markets to which we have access, including the United States. Quite frankly, the United States is one of the most accessible markets in the world today for a company like ourselves.

The Chairman: In terms of the adjustment of the consumers' market to change and to novelty you mean?

Mr. Cheesman: That is one feature, Mr. Chairman. The other features are that the cost structure in the United States is nearer to ours. Our wage rates are nearer to the US. To put it the other way, we do not have the great disparity; we are not competing with low cost competitors, low wage countries there.

As I remarked, of course, if we go offshore, off the north American continent and start to look for markets for products such as one of my favourites today, power transformers, we find that all of these industrialized nations close their borders very successfully on products of that nature. The only open markets are the underdeveloped countries.

We recently took part in a trade mission to South America on power transformers. We found there that there is a very aggressive scheme in the majority of those countries that have upcoming power generating and transmission requirements to promote local production. They are erecting tariff barriers of 50 per cent and upwards to ensure that they do get local production.

While there is a large market, for example, in South America for apparatus of that nature, by the time we strip it all down to what we can get access to it comes down to about 10 per cent of the apparent total. There will be a very severe dogfight from all the manufacturers in the world for that small amount. We will be in there, but it is not really going to be enough of an incremental market to create enough incremental sales to solve the problems that we have here.

Senator Bourget: If it was not for the tariff barriers that now exist and which you have already mentioned, could you really compete so far as price is concerned with other countries?

Mr. Cheesman: Yes; if they were selling in world markets at the same prices or even close to the same prices that they are receiving in their home countries.

Senator Bourget: Even if our labour costs are higher than theirs?

Mr. Cheesman: In the majority of the countries which we have studied this applies because these are custom built products. The benefits of skill of production are not as significant in custom built products as they are in mass produced or volume produced items.

The Chairman: Mr. Starkey, would you like to comment on this?

Mr. Starkey: Yes. I can first of all give you a few figures. Although we are a small company we do have a research department, which is rather unusual for a company of this size.

The yearly budget of this department amounts to somewhat less than 3 per cent of our sales, which comes to $150,000.00, or somewhat less. This group and this amount of money is good enough really to initiate some new ideas to provide scientific services to other engineering activities. It is definitely not good enough to carry out any significant amount of research.

As I have mentioned before, for a company of our size and in the competitive field we are involved in, the amount of research effort should be of the order of ten or somewhat more per cent of the sales. The remaining 7 or 8 per cent will have to be found by struggling, by trying to find customers who will be prepared to cover our research expenditures.

This must be, if not 100 per cent, then 90 per cent coverage, because we simply cannot afford to spend more money on research from our own resources. As I have said, we consider in our field of activities that research is absolutely vital. We must have innovation, new concepts, technical improvements which can be provided only by an independent approach. We could not compete otherwise.

As you can see, the amount of money a small company can put to these things is very limited indeed.

Senator Bourget: Do you import knowledge from your parent company?

Mr. Starkey: We could. We try on all occasions when it is required, but we find that the differences between the British and North American requirements and technology and so on are sufficiently large to prevent direct acquisition.

Secondly, as I mentioned before, our field and area of activities is entirely different from the activities in the U.K. We have to build up and develop our own know-how in our fields. There are areas in which, of course, we are borrowing from the UK but I would say that it is a very limited amount.

Senator Bourget: What is the situation in regard to your company, Mr. Marquez, and yours, Mr. Cheesman? Are you importing knowledge from your parent companies?

Mr. Cheesman: Yes, we are.

Senator Bourget: Very much so?

Mr. Cheesman: Yes, I would say a great deal. I do not know the figures offhand in terms of how to measure it in dollars.

We pay a royalty figure which varies from product line to product line. We do not pay any royalty figure where we do not use their knowledge. The figure is of the order of one per cent of the sales of the product involved.

Obviously, with it costing 3 to 5 per cent to even partially support our own product lines it is practically mandatory from a businessman's point of view that we do this. In a make or buy policy for innovation you cannot afford to duplicate that kind of knowledge for one per cent of sales.

We have made great strides in the last decade, although there was some done before, with complementary product lines, rather than simply following on the heels of what was developed for the US market by the Westinghouse Electric Corporation.

As I say, we are exporting more. We have raised our exports as a percentage of total sales from approximately 5 per cent ten years ago, to the 10 per cent order of magnitude this year. I am not at all content with that; my objective is 20 per cent but, a I have said before, we are running into some very stiff opposition.

One other example of a product line is an electronic control device for machine tool control. We have been working on continuous development, innovation, manufacture and sale of the product for about a decade now. We are in what would be the third or fourth generation of this product line.

To put it in the vernacular, we cracked the Japanese market a year or so ago. We did not crack it very far for it was made quite clear to us that we would be well advised to licence a Japanese manufacturer.

Senator Bourget: I am not surprised at that.

Mr. Marquez: I would not want to fail to make the point that Northern Electric has no foreign parent from whom we can get technology.

In the instances in which we do want to procure technology from outside of Canada we have no nice, internal, family arrangement. We have to do it on what usually turns out to be a pretty costly basis. This is certainly one of the reasons that we are doing and have to do a great deal more research and development of our own than perhaps we might be inclined to do if we had easy, ready and fairly economic access to the technology of a foreign parent. We do not happen to have one.

The Chairman: In your research labs are you always working on the discovery of new products, or do you at times do part of the work that has already been established in the labs of your parent company?

Mr. Cheesman: I would assume, Mr. Chairman, that the question is addressed to Mr. Starkey or to myself, probably to myself: The answer is both. I would not venture to put it in numbers, but a considerable number of our projects are in fact filling in what we call a hole in a product line which has perhaps been created in the first place by our parent company.

Again, returning to power transformers, Canada is leading the world in extra high voltage transmission. This is 735,000 volt transmission.

We expended a great deal of our research and development effort in the last five years or so in doing that work.

Now, power transformer research and development, of course, is going on all the time, a very large volume of it, in the Westinghouse Electric Corporation, so that we do not develop 735 kv technology entirely in a vacuum separate from that technology. That is a specific example. This applies to all other product lines. We do have a growing number of product lines in which we are in fact doing all of the applied research and development ourselves. The basic research comes primarily from Canadian government laboratories or universities.

For example, in the field of computer peripheral equipment, display equipment to go on to computer systems, we have launched some new products in the last year. These are entirely of our own development in the Canadian company. They are already being offered and we have made sales from Germany through to California, including a few in Canada.

Senator Bourget: What about you, Mr. Marquez? Could you give us some comments about the question I asked Mr. Cheesman?

Mr. Marquez: I commented first of all, Senator Bourget, that we do not have access to foreign information on the same basis that Mr. Cheesman has.

I think it is true to say that in the kind of world we live in no corporation today can be completely independent of technology.

Technology is a commodity in which we must become increasingly inter-dependent. It is equally true that your ability to command technology from outside sources depends to an increasing degree on your ability to generate technology on your own. This is partly because from the point of view of stature you are in a position to bargain better. It is also partly because in many, many fields, certainly to an increasing degree in the field of telecommunications, you cannot even understand the technology that the other people are developing if you are not doing some of your own, it becomes so complex.

The Chairman: That is what the Japanese found out, we understand.

Senator Bourget: On page 16 of the brief of Northern Electric, in the second paragraph, it is said:

> Of prime importance are the entrepreneurial aspects of exploitation of technological advantage. Many important Canadian advances and discoveries have been exploited elsewhere because of lack of initiative, lack of risk takers or lack of sufficient capital.

Could you tell us what we should do here in Canada to stimulate Canada's entrepreneurial instincts?

Mr. Marquez: I wish I knew the answer to that. I suspect that the problem in Canada is at least partly a matter of national attitude.

I think in a way we have suffered, as so often is the case, paradoxically, in that the existence of the United States south of our border is at one and the same time our greatest strength and our greatest weakness.

The availability of technology from people whose technical standards are similar, if not identical to ours, the fact that the language situation is easy, the common practices, makes technology so easy to bring from the United States into Canada that we have had a tendency to live on other people's technology.

I think to some degree Japan has escaped this, simply by their remoteness. This is not to say, of course, that we should develop a point of view which says that because somebody else has designed it we should not use it; this is obviously ridiculous. We have to get out of a point of view which starts from the assumption that if someone else does it it is going to be better than ours, or that someone else can do something better than we can.

It is interesting to observe that Canadians have in many, many instances gone down to other countries, gone to the United States and they turn up as university presidents, corporation presidents and important scientific people. One of our difficulties or problems is to give them the kind of challenge that they need in Canada in order to carry out those creative activities. The situation is improving but from where I sit it does not seem to be improving fast enough.

Senator Bourget: Mr. Starkey, would you have something to add to this? I think it may apply also to small companies such as yours.

Mr. Starkey: Yes, I could not agree more with the statement made that so many Canadians abroad do belong to the class of world-wide entrepreneurs and they are doing extremely well in all areas.

Why it does not happen in Canada, or the same people cannot show the same spirit in Canada, I do not really know. Perhaps it is the lack of challenge or possibly the lack of appreciation. The same appreciation is not given to Canadians in Canada as it is given abroad. I do not know whether this is something which can be assessed in terms of money, funding or anything else. Probably money is a part of it. Any appreciation usually should go together with some sort of financial rewards or financial encouragement.

I notice lately that there are some activities in Canada which do indicate that this entrepreneurial spirit is growing. Unfortunately, here we had, particularly in Nova Sotia recently, a number of cases where this entrepreneurial spirit finished in disaster.

There were a number of fast growing companies or projects, high risk, but they failed. Now, this undoubtedly is connected, I suppose, with lack of financial incentive or financial back-up, or lack of interest in the circles which should be providing this financial support for entrepreneurial activities.

Senator Bourget: As members of this committee we would like to know if you have some suggestion to make as far as the government is concerned. As I read it, if I understand it well, it means lack of money, initiative of course, but lack of risk takers, lack of sufficient capital.

Should the government set up some kind of crown corporation in order to help the situation?

Mr. Starkey: From my own experience, talking as the head of an engineering group, new concepts, products and certain activities which we are proposing to the Canadian government, to the Department of Industry, Trade and Commerce, bear a tremendous potential. We are talking to our American customers and we feel absolutely confident that we could sell certain ideas and certain large programs if the money was forthcoming.

As I said before, it needs money to start the whole thing, to cover our research and development phase for those large programs.

We do find quite a lot of understanding in the government money dealers, but the reaction there is far from being entrepreneurial.

This is one weakness perhaps, that the government organizations which are responsible for providing support for the industry do not show the same spirit. If we have got business in mind it must be done today or tomorrow. We know that we cannot wait for any length of time. We know about programs where we could come up with solutions or proposals within a period of there, four or five months. It takes much longer than that for a decision to give us support.

In other words, we find that there are very few people within the government organizations who do understand this business side of the money giving problem. It is not good enough for them to tell us you asked for money and we are giving it. We asked for it and we start spending our own money. We find that we finish the program and money is still not forthcoming. This is the other side of the coin.

Mr. Marquez: You asked a question I think about whether something might be done to make risk capital more readily available.

The evidence tends to suggest that Canadians are prepared to put their money into risk ventures. In fact, the evidence suggests that the average Canadian investment in the United States per Canadian is greater than the investment of the United States in Canada per American.

The Chairman: They may feel that there is less risk in the United States than there is in Canada.

Mr. Marquez: I am not quite sure that that is the answer. Quite obviouly, if a Canadian wants to put his money into a risk venture he is going to put it into say Xerox, or US Westinghouse, if it were available. He is much more inclined to buy stock in the parent corporation than in the subsidiary.

I rather suspect that the problem is at least partly conditioned by the absence of growth industries which are offering their stock to Canadian investors.

Mr. Cheesman: Mr. Chairman, if I may comment on that in a complementary rather than contradictory manner to what Mr. Marquez has been saying: The return on investment available in the electrical manufacturing industry in Canada today is just not attractive to risk takers. Some 29 per cent of the stock in our company is available to the general public, but there is not a great deal of interest in it by Canadians.

It may be that I am an inefficient operator, but we seem to be in with the rest of the industry in our problems. The return on investments available in our industry and in much of the secondary manufacturing industry in Canada is not sufficient to attract the people with risk money. They are much more inclined to take a look at a coal mine, where you can wrap up a contract to supply for 25 or 30 years to a customer.

You can work out all the parameters on more or less an actuarial basis for the next 25 or 30 years.

In our industry you have to take a plunge, either by investing money in research and development and starting the innovative cycle, or arranging for a licence for a product. The majority of Canadian secondary manufacturing industry is on this basis. It consists of erecting a plant and taking the risk that your market research was right and that there is a market for your product at a price which is above your cost and will give your investor return on his investment.

The business ambient in Canada currently is not conducive to a great deal of investment in that sort of thing. Witness the kind of things that we are having to do and contemplating doing in order to attract industry to some of our problem areas of the country. They have to be artificially fed. We have seen companies in secondary manufacturing closing down, if I may classify shipbuilding as secondary manufacturing. It is not a primary resource anyway.

We see in this morning's paper another admittedly relatively small assembly plant in the automotive business closing down. This is a trend indicating that the return on investment is not attractive in Canada today.

We seem to be returning to a primary resource industry country.

The Chairman: Or a service industry.

Mr. Cheesman: Or services, yes.

The Chairman: Because we have over 60 per cent of our people now engaged in services.

Senator Kinnear: We heard yesterday that there were too many Ph.D's in the country. In your brief from Northern Electric you say we need more. We heard yesterday of 20 Ph.D's applying for a particular position and only two were accepted. It would appear that there are too many.

Mr. Marquez: We also say, Senator Kinnear, on page 11 that we are in danger in future of producing too many. I think to put it in its proper context what we have been trying to say is that there is imbalance between the discovery process, which is the beginning of the process, the search for knowledge and the translation of that knowledge into the satisfaction of human wants. Quite obviously the Ph.D's that we produce have to find work in this country in one or other of two basic places, either back in the universities, where they help train more Ph.D's, or in industry.

If we are not developing the innovative end of the scientific spectrum, which is the one which takes place in industry, at at least a parallel or balancing rate to support the rate at which discovery is growing, then of course, we are going to have Ph.D's who are going to have to look for employment outside of Canada.

I have some data here which shows that up to now the situation has been one in which generally speaking we have been underproducing. The forecast is that starting in about 1970 we are going to have an over-production of Ph.D's for the present estimated rate of growth of the demand.

The Chairman: Do you accept the projections which have been prepared by NRC?

Mr. Marquez: I have to say that they are the best we have at the moment. Presumably they assume that the situation will continue as it is at the present time.

Senator Kinnear: How could we improve the innovative process despite foreign ownership? Probably Mr. Cheesman or Mr. Starkey would like to answer that?

Mr. Cheesman: If I may attempt an answer, Mr. Chairman: The direction I see for improving the innovative process despite foreign ownership is to create a business climate in this country which makes investment in secondary manufacturing industry attractive.

This is the prime utlizer of the kind of innovation we are talking about here. By that I mean we have got to look at our trade practices and examine them to see whether we are really being competitive or altruistic. We are spending a good deal of our national substance on research and development and a good deal of it on education. There we are proceeding on a trade policy course which encourages the importation in large quantities of the products which require the most advanced technology.

Industry in Canada needs no less protection during the early stages of innovation of new products than does industry in the countries with whom we are competing. If we examine the practices of those competing countries we will find that they give a very high degree of protection to their local industry.

There are various kinds of foreign ownership, but certainly speaking for our own company we are dedicated to a policy of developing a large base of exportable products from the Canadian company. In addition we are continuing to supply the Canadian domestic market for our class and kind of products.

In the majority of foreign owned companies that I am aware of in Canada there is relatively little attempt to strangle at brith, if you will, any desires on the part of the Canadian management to undertake research and development.

I think that applies to companies like yours, Mr. Strkey, equally to my own or to some other companies that I know that have ownership outside the United Kingdom or the USA.

The grim facts of business life are that we do not see that the risks are proper ones to ask our shareholders to take. If we spent large amounts of money on research and development we do not get the support right throughout the total innovative cycle that our competitors from other countries are getting.

The Chairman: Would you say that as a nation we tend to export too much knowledge and to import too much technology?

Mr. Cheesman: Yes, I would agree with that.

Senator Kinnear: I have one other question for Mr. Cheesman with regard to the amount of research you are doing on power lines.

Are your lines that you are anticipating for the very high voltage that you expect to carry, to be overhead or can you go underground? The reason I am asking that is that yesterday we heard that a new way had been found to carry power underground.

Mr. Cheesman: The system that we are working on in the first instance is overhead, but it is adaptable to the system that I believe you are referring to for underground transmission cables.

The Chairman: This has been, apparently, developed by Union Carbide.

Mr. Cheesman: Yes, I am generally aware of the nature of that. It is a cable system for conducting the electricity.

The system that we are working on is for conversion of the electrical energy from alternating current to direct current for transmission. Transmission of direct current results in lower energy losses than transmission of alternating current.

The two developments so far as I am aware can be considered to be largely complementary. There may be areas of competition or conflict, but I am not aware of the details enough to be sure about it.

Senator Kinnear: I think that will come about, because it will free a great deal of land for other things. They are also very unsightly running through the country.

Mr. Cheesman: Senator Kinnear, certainly we have done a lot of development both in Canada and in the United States. We are promoting reasonably successfully underground electrical distribution in urban areas. We have developed unique Canadian products in our distribution apparatus division which are well suited to this.

As a businessman I just wish there was more acceptance of them by the municipal utilities.

Senator Robichaud: Mr. Cheesman, in your brief at page 9 you state:

> There is every indication that our educational system is preparing adequate numbers of most professionals required but they are not moving out of the academic atmosphere because far too high a proportion of government funds is being channeled to government in-house activities and universities.

Are you suggesting here that the government is spending too much money in research for in-house activities and giving too large grants to universities in comparison to the assistance that it is providing to the industry?

I would like to have your comments on this, also the comments of the other witnesses.

Mr. Cheesman: Mr. Chairman and Senators: It is looking at it on a national basis, in the same way that I have to look at my own research and development budget. Can we afford to do more, or do we have to say that the present level of expenditure is approximately the total amount available and therefore we need to re-direct some of it? I cannot answer that question. The government of Canada will have to answer that, whether they believe that we can afford to spend more. In industry, certainly the parts of industry with which I am connected, we are in agreement that we do need to have more help. There needs to be more research and development done in industry.

If this has to be done in the short run at the expense of withdrawing some from the universities and government laboratories I would regret it. I do not think that we are doing too much scientific endeavour in Canada. That is not to say that we may not be doing more than we can afford if we were to balance between research and development in universities, in government and in industry.

Senator Robichaud: Is there real cooperation between industry and universities? In other words, are you, when the occasion is available, taking universities into partnership for a certain type of research?

Mr. Cheesman: Yes, we have quite a number of cooperative projects with McMaster University in the same city as our main research and development laboratories, at Hamilton. We also have projects with the University of Toronto and the University of Waterloo, which are nearby. There are a number of others, but they are relatively minor.

We have a policy and we are working more towards that. Again it is a problem of the total resources available. We need to get to a certain quantum before it is worthwhile.

The Chairman: Do you have any research facilities in Three Rivers?

Mr. Cheesman: No, we do not. We have engineering support there, but the technology of our lamp manufacturing plant which is in Trois Rivieres is supported by our central research and development facilities in Hamilton, Ontario. There is a good deal of work done there on phosphors and materials that are used in the lamps.

Senator Bourget: Mr. Chairman, before Mr. Marquez answers this question I have one which is closely related to it, regarding government labs and universities.

What contribution to the companies' innovations have come from university and government labs?

Mr. Cheesman: I am at a loss to answer that quantitatively but qualitatively I would say a very significant and very large portion of our innovation.

Mr. Marquez: In order to get your question in perspective, Senator Robichaud, it is a question really of balance between these two areas of effort. We have to recognize that we face a fundamental problem in this and even industry faces this problem on a smaller scale: What are the funds that are committed to innovation? Innovation is that process which is the development process, if you like, a translation of technology and the combining of it with other resources into a product or service. That usually takes place in industry.

Consequently, there is a built-in feed-back system that determines in a relatively short time whether you should continue with it or whether the business is going to go out of business. That is the relationship between cause and effect is short enough that if you embark on too many wrong avenues of innovation you are either going to be smart enough to stop it or you will go out of business.

The problem with discovery, which is the area of activity that takes place in the university, is that you are seeking knowledge and the connection between knowledge and its translation into usable goods or services may not take place for a hundred years. There is very little connection.

Consequently, the scientist involved in basic research will almost invariably tell you that the allocation of funds to basic research, whether they are in corporations or in universities, should be allocated on the basis of the reputation of the scientist rather than on the quality of the project.

It is almost impossible to determine whether in fact the project is going to have any long term value.

Consequently, the criteria for determining priorities, the criteria for weighing in the balance whether you should go ahead with a telescope or with a high energy accelerater, are very difficult to obtain. There is no built-in mechanism which will say after 10, 15 or 20 years this was a wrong direction to go and therefore you should cut it off.

Yet it is equally true to say that this is the raw material on which innovation eventually feeds. There must be a balance.

I think that what we are saying is at the present time in Canada there is an imbalance. This is perhaps not to say that there is too much effort and money being spent on discovery so much as it is to say that there is too little being devoted to innovation.

Senator Cameron: Mr. Chairman, the first question I have relates to the question Senator Kinnear raised.

I notice that an increasing number of telephone lines are being put underground. I am wondering how extensive this is and what the economies are in the long run? Is this something that is likely to extend all over the country or is it going to be limited to certain areas?

Mr. Marquez: I think it is true to say that principally in urban areas and to an increasing degree in extra-urban areas the present trend is to put telephone lines underground.

The Chairman: I am sure that Ottawa will be the first, because it will be another occasion to destroy our streets.

Mr. Marquez: There are aesthetic reasons, but there are also very practical reasons and technological reasons. Quite obviously you have to develop the type of product that can operate properly and be reliable underground.

Secondly, in the long run there are obviously important factors. A cable buried underground is not as susceptible to sleet, storm, broken brenckes or destruction in one way or another as a cable that is overground. It is true that underground cables are sometimes carved up by plowshares and digging machinery of one kind or another.

Senator Cameron: For example, I notice that the Alberta government telephones are putting all their lines underground between Calgary and Banff, and others as well.

Mr. Marquez: That is quite right. They have a major program of rural underground wiring.

Senator Cameron: Yes. I was wondering what the economies are? Has sufficient been done yet to work out a projection as to what the economies will be?

Mr. Marquez: The economies in the long run are without doubt very important. Every segment of society is constantly faced with balancing between the things that you need to do to cope with the needs of the short term against the things you would like to do which would cope with the things of the longer term.

Many times things are done in the short term simply because they are more economical than they would in the long term. There is no question about it that in the longer term underground wiring is far superior.

I think it is true to say that there is a very strong trend in the direction, both in the field of power distribution and in the field of telecommunications, of putting cables underground.

Senator Bourget: You save a lot in maintenance also.

Mr. Marquez: Yes, indeed.

Senator Blois: In Nova Scotia the telephone company there, even in the rural areas, now are putting practically everything underground. I talked to one of their officials. They are not sure, but they feel confident that it is much cheaper and easier to handle. There are problems.

I had them do a job in a country place I had. They brought the men out to put in an electric cable for the lights and power underground, but they cut off one of the water lines. That is one of the problems they have.

I notice that they are using a lot of it there now and they do it very quickly.

Senator Cameron: I know on my own campus I have given orders that all the wiring must go underground. It is pretty costly because I live on a rock pile, but it is still important.

The Chairman: You are taking the long term view.

Senator Cameron: That is right. The second question I had was in view of the fact that the development of export markets is crucial to our success in industry in this country, what percentage of R & D funds are going into market research?

If this was asked before I came in, disregard it, but I think it is important, particularly in terms of the development of secondary industry.

What percentage of your research funds are going into market research?

Mr. Marquez: I think it is true to say that in the terminology which most companies use expenditures on market research are not put under the same heading as research and development.

Senator Cameron: This is what I suspected.

Mr. Cheesman: That is certainly our practice. This is a marketing expense. It is also the subject of much discussion.

Mr. Marquez: I would agree with you that product development is one side of the coin and market development research is the other side of the coin. It is no use developing one without developing the other. There are very good arguments for saying that these things should be more inter-connected than they are at the present time.

Senator Cameron: I just wanted to be sure of what the relationship was. I suspected that the answer you gave is what we would get.

The third question I have is that so much of our discussions relate to the kind of training we are giving in the universities. I have always had to be very practical in my own affairs. I am very much intrigued by this University of Waterloo engineering training program and their cooperation with industry. How is this working out? Do you think this is a trend that is going to extend to other universities?

Mr. Marquez: I would say it is a trend I would hope would extend to other universities. I think it is an excellent idea.

Senator Cameron: There is some resistance to it in academic circles, but I disregard that.

Mr. Marquez: I certainly endorse it.

The Chairman: That is why you are attacked by the students.

Mr. Cheesman: One of the practical operating problems that we face—I certainly endorse the so-called Waterloo scheme, which is not an exclusive with them.

To organize ourselves in industry it would be better if all the engineering schools, which are our prime interest, although not our sole interest, were on the same sort of scheme. Then we could schedule the introduction of these people into our operations on a year round basis, regardless of what university they come from.

For many reasons, including the areas of technology, we do not want to look only at one university or one or two universities. I too am doing what I can to get this going, for example, in McMaster University. I am running into heavy resistance.

Senator Cameron: Do you think that this would stimulate the innovative process, if the students started in on their undergraduate work in engineering work in plants, or is this too hypothetical question?

The Chairman: It certainly would change their motivation ultimately.

Mr. Cheesman: Yes, it certainly would help. There is another problem, which I cannot avoid returning to. That is where are we going to get the substance to finance more innovation? As it is done now, when we do find some funds to do this it is rather a paradox. Frequently we have to go offshore to the United States recruiting the scientific and engineering staff we need for it.

In manning any one project you can only assimilate so many inexperienced people at once. I referred earlier to the need to keep a fairly even load on a research team. I am sure you are well familiar with this, but when we do get opportunities they seem to come along in bursts. We have to man them quickly and with a spectrum of experience from straight out of university up to at least 5 to 7 years experience and hopefully even more. It is in the few years of experience category that they are so hard to find in Canada today. That is why we have this problem.

Mr. Marquez: I think it is the experience too of companies that are deeply involved in research and development that even if the graduate comes to you without having gone through this process, then you must embark on a process in which you keep sending him back to school.

The technology keeps changing, the tools which he uses keep changing. A graduate ten years ago in some of the fields is just out of date with the techniques that are being used today. You have to develop a process of working very closely with the universities. The separation which has tended to exist in the past between industry and the educational institutions is tending to become a much more integrated one.

The Chairman: It is more and more true, then, as somebody said one day, that knowledge does not keep better than fish?

Mr. Marquez: Indeed it does not, and sometimes not as well.

Senator Cameron: If this joint industry-university training plan became a uniform policy for all engineering schools in Canada to you think there are any problems in working this out with industry? Would this put a pretty heavy burden on industry and would it lead to increased costs?

Mr. Cheesman: I would venture the opinion that while it would bring some problems in accommodation to it in the first instance, it would certainly give us improved costs in the long run. I think it is definitely a very important step in the right direction.

Senator Cameron: The reason I am labouring this is that I have had a theory for a long time and I have a scientific background myself, that a lot of time in the universities is wasted in labs. The practical laboratory work could be learned much more effectively and in less time on the job if the opportunity is provided. This Waterloo experiment is a step in that direction and I think it is a right one, but I would like to see the evidence of it.

Mr. Cheesman: There is one general statement that I would like to make with a hypothetical example. Our problem is in getting young scientists and engineers who are interested in solving the nuts and bolts problems of manufacturing industry today. These nuts and bolts problems are such things as how to make power transformers that can be transported from the factory, wherever they may be made, into the site of Churchill Falls.

There is not very much in engineering education to day, or 26 years ago as I recall, that really brings you to grips with that.

Young engineers are less and less fascinated or interested with that nuts and bolts problem today even as they were 26 years ago. Perhaps hunger was a help.

Senator Bourget: Yes, it was.

Mr. Starkey: I would strike perhaps a somewhat original note. In the Atlantic provinces, Nova Scotia in particular, it is very difficult to attract engineers altogether to the industry there.

The Chairman: Is it because of wives?

Mr. Starkey: I do not know; no, it is more subtle than that, I suppose. Even the local school graduates as a rule do not want to stay in the Atlantic provinces. Ontario for example, Quebec or the Montreal area in particular, is such an attractive force that is much easier to recruit people in Australia, the UK or in the States. We have got engineers from all over the world, but very few Canadian engineers. They simply do not want to stay there.

The opportunities perhaps are not good enough. Of course, there is not enough industry to make it competitive or attractive as a centre of industrial activity. From the national point of view I suppose that this is one problem which should be taken into consideration. The only possible solution is to increase the rate of growth of industry in these areas. This is a vicious circle, how to do this. Money seems always to be the crux of the matter. A massive injection of money could solve these things, but this could be done only on a national scale. If it was government policy to do so it could be done otherwise.

The Chairman: I was told, to come back to my point, which is not too serious I am sure, that the wives of company presidents were more important in the location of the company than the presidents themselves.

Mr. Marquez: I think there is a point that is of interest to support the points that Mr. Starkey and Mr. Cheesman have made. I will illustrate it by giving you a case in point.

We were talking one day not so long ago to a representative of a country who is interested in buying some switching equipment from us. He was talking about some pretty sophisticated electronic switching equipment.

We suggested that for the particular needs of that country for the foreseeable future they might be well advised to buy something which was not quite as sophisticated, not quite as advanced and which could do the job quite as well. Certainly they were a long way from needing it. He raised a point that interested me and which has a bearing on what we are saying here.

He said, if we do we are not going to be able to get engineers to work on it. The young engineers that we are graduating today out of this particular country want to get into as highly sophisticated or, as Mr. Cheesman says, they don't want to work on the nuts and bolts problems. They want to work up at the sophisticated end of the spectrum.

Consequently he was in a position in which he felt that his company should put in equipment of a far more sophisticated kind than they needed in order to be able to attract the engineers from his home territory who would be required to maintain it and to run it.

Senator Cameron: Would the answer to that not be the Ryerson Institute student, rather than the university graduate?

Mr. Marquez: Of course he has university students too, you see.

Mr. Cheesman: It still leaves no answer to the problem of what do you do with the university graduate, what has he been trained to do in a developing or under-developed economy?

The Chairman: I want to come back to your pleas for better and probably more efficient programs from the government to help you. I was told a couple of days ago that in Switzerland private industry was opposed to government incentive programs, yet that country seems to develop rapidly, to be able to overcome the obstacles to exports. Would you like to comment on this? What are they doing that we are not doing here?

Mr. Starkey: I would only say that they started their process of industrialization 150 years ago probably and we are really starting it only now. When I am talking about the need for heavy support from the government I have in mind just this, it is the beginning of the thing, we are just starting. This is a basic, fundamental problem.

Should we or should we not be interested in developing stronger Canadian industry? As it is we are doing very well with our primary industry exporting our national resources. We do not really need a Canadian industry at this time. We are dong very well. We could manufacture, say, electric bulbs and perhaps television sets and nothing else. We can buy everything. We have got enough excellence in other areas to keep us going. I would say that if we are considering altogether this problem now of Canadian industrialization we must have in mind our future. The time will come undoubtedly when we shall not be any longer in this lovely position where we are sitting on a pile of gold, minerals and so on.

The Chairman: But the Swiss seem to develop a great deal of new industries and new exports based on high technological content. They do not export only watches.

Mr. Starkey: Exactly; they have got also a very strong defence industry, the Braun company and a number of other companies in Switzerland, but these people have been in existence for many, many decades, not years. I am sure that at their beginning possibly it was just a difficult. In the old times when they were starting they must have got very strong support.

Take, for example, Japan. After all, Japan developed to a fantastic degree. They did industrialize themselves to an amazing, astonishing degree over a period of 50 years. But it is only now that Japanese industry became self-supporting. At the beginning there were tremendous amounts of government money spent on them in the defence fields.

I am not talking necessarily about grants for development. I am talking about buying products, creating a domestic market for any country's industry.

At the beginning, in the early stages of industrial development to my mind there is no other way.

There will have to be a planned approach. The government will have to have a policy actually attempting to develop the industry as a program. In the future, in another 20 or 30 years our unemployment rate, our other requirements will decide that we will not be able to exist without a well developed industry.

This is doing something for the future and these things never happen by private enterprise or individual approaches. After all, industry always look for profits. If it is something for the future, something not of direct interest, as Mr. Cheesman mentioned before, there is no attraction, no real benefit for industry to operate in the Candian environment as it is.

The Chairman: We have been told that we have a science policy by accident. Would you say then that we have no proper or no conscious industrial development policy in Canada?

Mr. Starkey: I would say that we have not got a wholehearted industrial development policy. We are doing it in a haphazard manner. We are spending a lot of money on scientific research establishments and so on in universities. We want to do this, but we treat it at the moment only as a prestige operation and not a real requirement on which our existence might depend in the future.

If we decide that we want to do it this way, that we have to build up our industry so that in another 20 years it will become strong, viable and full of entrepreneurship, organization and so on, then at this time I am sure, however unpleasant it sounds, that this can be done only with massive government support as an intentional policy.

Mr. Cheesman: Mr. Chairman, I would just like tu support what Mr. Starkey says. I refer back to what I said in my opening remarks about our need for developing a Canadian overall socio-economic policy.

To look at examples, are we going to be another Kuwait or are we aspiring to be another USA or another Sweden, a mixed rather than a solely primary resources economy?

The Chairman: I would like to be Kuwait provided I would be the head of state.

Mr. Cheesman: I would like to address a question to anyone who might know the answer with regard to your comment on Switzerland. I wonder what the corporate profit taxation rate is in Switzerland? If they do not have other incentives for industry I think you usually find some compensating factors when you look at the details.

Mr. Marquez: Mr. Chairman, I want to make a point which is not necessarily going to support the comments which have been made by Mr. Starkey and Mr. Cheesman. While I do not at all disagree with the point of view that we are at a particular state in our history in which something needs to be done, I do not think all the problems lie on the side of government.

You mentioned Switzerland, but you might equally well talk about Sweden or the Netherlands. All of these three countries did not develop the kind of mythology which Canadian industry has developed, which says that industry can only be developed if it can be supported on a domestic base. They knew from the beginning that their industry had to be supported on an international base. They did not develop industries in Switzerland, Sweden or the Netherlands to sell in Switzerland, Sweden and the Netherlands.

One of our greatest competitors in our field, the L.M. Ericcson Company in Sweden, gets 20 per cent of their business in Sweden. This is their point of view, this is the base from which they start. This never has been the base from which Canadian industry has started.

It has started on the assumption that it must be able to build a viable existence on the Canadian market. Therefore we keep talking about how small the Canadian market is with 20 million people when Sweden has 7 million and the Netherlands is in the same vicinity. This is a problem that has to be resolved as well as infusions of Government money and government support. It is a problem of attitude.

The Chairman: I think it is very important; you bring us back to Sir John A's national policy.

Mr. Starkey: Might I add one comment to my previous comments here: For such countries as Sweden or Switzerland industrialization was a matter of life or death. They had to do it or they would perish. It is not so for Canada.

Mr. Marquez: It should be.

Mr. Starkey: Perhaps it should be, but human beings being what they are, if the incentives are not there. I said as a matter of life and death, this is an incentive in itself...

The Chairman: It was a matter of life and death when the choice was made in 1879. We lost about 2 million people who emigrated to the United States during the latter part of the 19th century, yet we decided as a nation that we would develop a domestic industrial sector.

Mr. Starkey: That is exactly what I was saying, that this must be a matter of national policy and national decision. To my mind it automatically implies government support. In the earliest stages it is not good enough to go to the people and tell them, look, you have to work for Canada, you have to do something. We are being told now that we have to export. Obviously for any individual company already in the field, a company such as ours, this is a matter of life and death. It is not a national problem, it is the problem of a small Canadian company. Its board of directors, its president understands this. We do all we can in order to increase our export capability and to export. We are fighting for it, but this does not apply to the nation as a whole, to all the industries or all the economic factors influencing human processes, decisions and so on.

Once you are in the field, once your living depends on it, you understand it and you will do this. Take all the people who are financing all sorts of ventures abroad, but not in Canada, take all the people whose money is not attracted to the Canadian industry. Why not? Because there are better ways of making profits than in Canada.

Industry is not a natural way as it is. It is not a natural way of making a living in Canada. It could be changed only by artificial means, unfortunately. If we do not do it intentionally, then the time will come when we shall find ourselves in a dire need of fighting for our living again, but this is not at this time.

At this time I would say psychologically there are not enough incentives in Canada for industrial activities to really grow and profit.

The Chairman: We need a new national policy.

Senator Kinnear: Mr. Cheesman appears worried at the moment about which way we are going, that we are going back to the primary resources in Canada for our main source of funds and secondary industry is apparently slowing down. I thought we have had rapid growth in secondary industry and were enjoying it, but certainly there seems to be a slowdown now.

Then I would like to ask anyone who would like to answer, do you see a viable and growing export business based on new innovations? In what product areas would these innovations be developed? For example, military equipment, household equipment or satellites? Where are the markets in mind?

Mr. Marquez: I think the markets are unlimited with the technology. I think that the danger we face, of course, and one of the problems that countries like Switzerland solved, was to recognize that you cannot attack all successfully.

We have to limit the things that we try to do so that those things that we try to do we do well enough and sufficiently in depth as to be competitive with the best in the world.

This is a matter of choice. This is specialization, then within the specialty we need rationalization so that we do not fragment our industry.

All of the areas that you name and many that we cannot even conceive of at the present time and in the developing countries are expanding markets. In the field in which we are involved, telecommunications, the opportunities are almost infinite. We have to take advantage of them and be selective enough so that we do not spread our resources so thinly over the whole extent of possibilities that we disperse that effort.

In this field of research and development the greatest problem that faces us today is to determine what we are going to be best in and then be best in that. We have to recognize that we cannot be best in everything. It is a problem that faces Canada on a broader scale.

Senator Kinnear: Yes, that is true, but do you see a slowing down at the present time?

Mr. Marquez: If you are talking about a possibility of economic slowing down, all of us I think are concerned about what is happening to the availability of capital. I feel about this as I feel about the weather, that I am concerned about it but I cannot do anything about it so I forget about it. I concentrate my efforts on the things that we can do something about. We are concerned about it, but what this will produce in the way of a slowing down of the economy I suppose none of us knows.

Senator Kinnear: I took that trend from Mr. Cheesman's statement. I felt that he intimated that there was a slowing down.

Mr. Marquez: Certainly as far as expenditures of effort in research and development we are definitely running in the opposite direction. We are increasing steadily, sometimes at a far greater rate than we feel we can afford.

When you are in a technologically dynamic field, as I said a little earlier, the great problem, the tightrope you are walking all the time, is to make sure that in your urgent desire to make sure that you survive today you are not taking too much away from your ability to survive the day after tomorrow. You have to look ahead. You have to keep up with the technology that other people are going to develop.

Mr. Cheesman: My reference, of course, was to the fact that there is going to be and there is going to continue to be for a long time a good deal of readjustment of Canadian secondary manufacturing in the light of the new tariff structure which is being introduced. One can use the past tense pretty well now, which has been introduced here. There is no doubt about it. There is a lot of good, sound theory behind that. As one just right in the middle of it, the application of the theory is always easier said than done.

There is some pretty painful re-adjustment to be done in secondary manufacturing industry in the light of these new tariffs. This applies to both the short and the long term effects which we expect from them.

The sort of arrangement we have made as a country in respect to the automotive industry is very attractive to many people and is being considered for application to other secondary manufacturing situations.

Again, I think we can look at that either as optimists or as pessimists. Without being very much of either, but simply trying to be a constructive critic, I would suggest that before Canada enters into any more such agreements, provided always that Washington would entertain any more such agreements, we need to look at the quality of employment which Canadians get out of such agreements, as well as the quantity of employment.

Again, when we talk about innovation in research, development and education, it is questionable in my mind whether or not the extension of pacts like that are in the best national interest. Modifications to the arrangement could be conceived which might be more conducive to maintaining a nation with a broad spectrum of professions and trades required in Canada, rather than just the 20th or 21st century version of hewers of wood and drawers of water in secondary manufacturing industry.

I think this is important. In my segment of industry we have spent something of the order of 50 years or more climbing out of that hole and it is a little bit discouraging to find we are going down into it again.

Back in 1903 when our company began manufacturing electrical products in Canada the opportunities for Canadian professional engineers were pretty few. Today they are pretty significant, but with the trend to lower tariffs the opportunities are in fact going down again.

We have a great deal of re-adjustment to do before we can, like Sweden and Switzerland, to name the two examples, become an industry that is properly oriented to flourishing. The majority of our market is export and all the competitors in the world are allowed free, or relatively free, access to our domestic market.

We are looking at the prime markets in the world where the output of many sectors of secondary manufacturing find that in spite of lower tariff rates their borders are essentially closed, or extremely difficult to cross.

The Chairman: It is almost 12.30. This is going to be a long day, because the Senate is sitting at 2 o'clock and this committee is sitting again at 8 o'clock tonight.

I presume that everybody would agree that we should adjourn, although we could go on with this high-level discussion for a few hours.

Senator Blois: I notice that the industrial people who have been before us in the last few days have referred to the fact that more money is needed to do research work and most of the companies are spending what they think they can afford.

I think one gentleman today said they are spending even more. I have been given to understand that the scientists and research and development engineers of their own staff spend a great deal of their time in trying to improve on methods which are presently being used.

That is something that has been developed but now it takes a long time to improve on it and keep it up to date. I believe it was Mr. Starkey's company which I was at a few years ago. I was told that in some of the very fine apparatus that they are making there, particularly in this deep sea sounding and other things, most of the time was spent in improving this. They were quite successful in doing so, which gave them a chance to be more competitive in the field.

I wonder if anyone would care to comment on that and if my information is correct, that it is taking a lot of your own scientists and money to do this sort of thing?

Mr. Marquez: Certainly in our field and I am reasonably sure that you will find that it occurs in others, when you develop a new product it is not a static process. You then have a continuing responsibility right from the development and research stage to keep updating it, to keep improving it for at least two reasons.

One is to improve the economics of production, to lower the cost without sacrificing the quality or effectiveness of the product.

Secondly, of course, to update it to introduce new features so that they will be competitive with your competitors who are not themselves standing still.

Senator Blois: That is quite expensive.

Mr. Marquez: That takes a substantial part of the R and D expenditure. We call it PI and E, product improvement and evaluation.

Senator Kinnear: I wish you had time to tell us about the picture phone and your regenerative innovation.

The Chairman: He will grant you a private interview, senator, on the phone perhaps, but without pictures.

Thank you very much, gentlemen, for having been with us this morning. You have been quite helpful.

The committee adjourned.

APPENDIX 161

BRIEF

TO

THE SENATE OF CANADA

SPECIAL COMMITTEE ON SCIENCE POLICY

Submitted by

Northern Electric Company Limited
1600 Dorchester Blvd. West
Montreal, Quebec

FEBRUARY 1969

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BRIEF TO THE SENATE OF CANADA

SPECIAL COMMITTEE ON SCIENCE POLICY

Submitted by

Northern Electric Company Limited

1. INTRODUCTION

The Northern Electric Company welcomes the opportunity to submit a brief to the Special Committee on Science Policy, the Senate of Canada. From its position as a Canadian company, wholly owned by Bell Canada, and operating the largest industrial research and development laboratory in Canada, the company has the background and experience to justify comment on the Canadian scientific environment and to offer suggestions concerning Science Policy for Canada.

The company's position is perhaps unique in the sense that it is Canada's major science-based developer, manufacturer and exporter of telecommunication equipment. It has over 23,000 employees, with manufacturing plants and laboratories in many major Canadian cities, and annual sales over 400 million dollars.*

Northern Electric Laboratories now employ over 1800 people in six locations in Quebec and Ontario. The Northern Electric Company Limited's annual gross budget for research and development is about 41 million dollars. The Central Laboratories are located just west of the Ottawa city limits on highway 17.

The intent of this brief is to emphasize the importance of industry's contribution to the country's economic growth through the application of the innovative process, and to suggest that a Science Policy for Canada should provide the environment for efficient implementation of this process. The brief discusses research and development in Canada, climate and policy objectives and the role of universities, government and industry. Comments on the Science Council Report #4, "Towards a National Science Policy for Canada" and the government's research and development incentive programs are included.

*See Appendix A for company structure and products.

2. SUMMARY OF MAIN RECOMMENDATIONS

We recommend that the Federal Government:

2.1 — recognize the importance of the whole innovative process in industry when establishing a Science Policy for Canada. Page 7.

2.2 — arrange for adequate dialogue with the representatives of appropriate industries before planning major research and development programs. Page 8.

2.3 — assume responsibility for research programs which cannot be economically performed elsewhere, in accordance with the guidelines in this brief. Page 13.

2.4 — subcontract to industry the development and production of equipment to meet specific requirements of Federal Government departments on the basis of fully paid development expense, plus the price of equipment in production quantities. Page 13.

2.5 — carefully examine and study the national requirements for Bachelor, Master and Ph.D. graduates in industry, government and universities before significantly increasing research grants to the universities during the next three or four years. Page 11.

2.6 — continue the various research and development incentive programs on the following basis:

2.6.1 The National Research Council Industrial Research Assistance Program (IRAP) be increased in magnitude and period of coverage. Page 20.

2.6.2 Consideration be given to commercial as well as defence orientation on Defence Research Board Program (DIR) with 100% funding. Page 20.

2.6.3 The Industrial Research and Development Incentive Act (IRDIA) be improved by calculating the grant as a direct percentage of the research and development expense — taking into account the expense of the total process of innovation and the reduction of administrative procedures to a minimum. Page 21.

2.6.4 The Program for Advanced Industrial Technology (PAIT) be made more attractive by arranging for no interest on payback. Page 21.

2.6.5 The Department of Defence Production Vote 5 and the Industrial Modernization for Defence Export Vote 20 programs be continued and expanded to provide more support to commercial as well as defence-oriented projects for export. Page 22.

2.6.6 The Department of Industry, Trade and Commerce support proposals for the development of products specifically aimed at commercial export markets, using existing and available technology. Page 22.

We recommend that industry:

2.7 — be encouraged through incentive plans, and also at their own expense, to carry the main responsibility for and the increase in applied research, development and innovation on mission-oriented programs, which will result in saleable products for domestic and export markets. Pages 9 and 12.

2.8 — spend a greater portion of the total research and development funds which can be afforded by all sectors of the economy. Pages 9 and 12.

2.9 — examine with the Federal Government, the operation of the Canadian Radio Technical Planning Board (CRTPB) as a possible model for an exclusively industrial organization capable of providing the much needed interface between government and industry on all matters pertaining to research and development in Canada. Page 16.

We recommend that universities:

2.10 — be encouraged to undertake the responsibility for the largest portion of pure, fundamental or basic research that the country can afford. Page 11.

We submit the following general recommendations:

2.11 — that consideration be given to the use of "regenerative" policies as an accepted part of program planning at all levels of government and industry. This means that the Science Policy should encourage the invention of new methods of program planning. Page 8.

2.12 — that scientific programs, resulting from the establishment of a Science Policy, should be based on priority-determined national goals, derived from extensive human and social science research. Pages 8 and 24.

2.13 — that precise definitive research action be taken in Canada to develop a science which will permit improved planning and designing of communication environments. Page 19.

3. RESEARCH AND DEVELOPMENT IN CANADA — CLIMATE AND POLICY OBJECTIVES

The Fifth Annual Review of the Economic Council of Canada, (September 19, 1968), in Chapter 3 entitled "Science, Technology and the Economy", states, "What is basically involved is the application of a growing stock of knowledge to the satisfaction of human wants". Since we have to be concerned both with the expansion of knowledge and the application of knowledge to human wants, a consideration of science policy must distinguish a sequence of distinct and dissimilar creative processes which, although interdependent and sequential, are different from one another. The policies generated for one process may and perhaps should be different from those which are generated for the others.

Three main processes are involved:

(1) DISCOVERY (RESEARCH) — the process by which new knowledge is added to the existing and available store of knowledge.

(2) INVENTION (INCLUDED IN APPLIED RESEARCH) — the process by which new or existing knowledge is applied to generate a new solution of a practical problem.

(3) INNOVATION (DEVELOPMENT AND IMPLEMENTATION) — the process by which many resources — technological, financial and human — are combined imaginatively by competent management to achieve the satisfaction of a human want by economic and often commercial exploitation of inventions.

Distinguishing the three basic processes involved illustrates the danger of using the words "Research" and "Development" as if they are inextricably bound together. Indiscriminate association of these words obscures many of the critical problems involved in arriving at a workable science policy.

There is a relevant fourth process — IMITATION — which, because it is not creative, is in this context a pseudo-process. It is the process by which methods and practices, resulting from innovation, are copied from some other innovative source, but without the healthy, creative, regenerative by-products invariably associated with innovation.

To a substantial degree, Canada has achieved its growth to date, in the field of secondary manufacturing, by the process of imitation. Unfortunately, imitation, especially when it becomes the broad and common established practice, reduces and inhibits inherent capability to achieve the three creative processes and, more particularly, the process of innovation.

The key process is innovation. It is by innovation that technical knowledge is combined with other resources to generate products and services satisfying human wants. Successful innovation does not necessarily require invention or discovery. It merely requires that the results of discovery and invention be available, regardless of the source, and that ingenuity and imagination be applied to combine resources with organization and skill to generate and make available needed goods and services.

The environment for innovation in Canada has been unfavourable compared to that of the United States for a number of reasons:

(a) The high proportion of subsidiaries in Canada, innovatively dependent on foreign parents, has tended to make a virtue of imitation and to depress innovation.

(b) Because our economy is relatively small, some products, processes, ideas and industrial methods remain impractical for use in Canada.

(c) Failures to realize idea potential and difficulties in obtaining specialized laboratory equipment due to lack of supporting resources and suppliers in Canada, result in delays in moving an innovation from the idea stage to a marketable product.

(d) Conservatism in management reduces the challenge to the scientist so that his professional existence is threatened and he may leave the country.

(e) In Canada, science and scientists have been regarded as contributors to general knowledge and culture. In future, science and scientists must be accepted as contributors to economic development as well as contributors to culture.

It is important to note that the innovative process is best carried out in industry where financial, technological and management skills can be marshalled and integrated to achieve this essential process. In assessing science policy it is most important that government plans include incentives to ensure adequate support of the total innovative process. In addition, it is important to review relevant Acts of Parliament, government rules, regulations and procedures with respect to their compatibility with the process of carrying out efficient innovation. This review should include tariffs, customs, patents and trademarks, combines legislation, taxation and the administration in government and industry.

4. CONCEPTS IN PLANNING OF RESEARCH AND DEVELOPMENT PROGRAMS

Government planning to stimulate the expansion of knowledge and a higher degree of satisfaction of Canadian wants should take place against a background of continuing dialogue with universities and industry.

Planning should include provision for "regenerative" policies to ensure flexibility in adjusting to future conditions. In studies of survival strategies of animal populations, it has been observed that the most successful strategy involves a multiple response — one response to the specifics of the crisis, and the others toward developing exploratory activites designed to counterbalance the restricting effects of the specialization resulting from the first response.

If long term planning is a response to the crisis of change it should be considered in the light of this ecological model. Long term planning should then embrace the practical and immediate adaptive activity associated with clearly defined goals, coupled with a more imaginative, or regenerative activity designed to retain flexibility.

Although this regenerative activity is not yet too significant in terms of our budget at Northern Electric, at least we have begun some of this kind of work, and the effect on our company and our associates has been larger than the budget might indicate. We feel it is a worthwhile program and intend to develop it further.*

One of the aims of a science policy for Canada should be to facilitate the invention of new sciences to preserve the regenerative flexibility so essential to a rich and successful evolution. This includes attention to the human and social sciences in addition to the physical sciences.

*Examples of "Regenerative Planning" activities

(1) Ottawa Information Retrieval Experiment

(2) Search for other alternatives for Picturephone

(3) Development of value systems for assessing the merit of future communication systems.

5. DISTRIBUTION OF RESEARCH AND DEVELOPMENT EFFORT BETWEEN GOVERNMENT, UNIVERSITIES AND INDUSTRY

5.1 GENERAL

Opinions differ as to the correct proportion of "research and development" which should be carried out by government, universities and industry. Some of these differences come from different interpretations and definitions of the words "research and development". In our opinion, there is no fixed proportioning of amounts to be spent in these three sectors. Similarly, there is no fixed percentage of the gross national product which should be spent on total research and development to guarantee satisfactory economic growth of the country. Yet, Canada's research and development expenditure does lag behind that of other progressive countries, and within the limitation of well defined goals, means for increasing it should be explored.

Expansion of the economy and achievement of higher levels of national prosperity depends on the generation of new wealth. New wealth is generated by the application of the creative processes to the exploitation of the country's natural resources. No amount of pure research will contribute to the satisfaction of Canadian wants unless the process is continued through to applied research, development, manufacture and use. From an industry standpoint, it appears that a greater proportion of the total expenditure should be spent on mission-oriented programs. These programs must aim at products and services of advanced design, at competitive price and quality levels which can be sold at reasonable profit in both domestic and export markets.

The funds available for research are partly derived from personal and corporate income taxes. The government's ability to command these funds depends on the profitability of industrial corporations and their ability to pay their employees well. Profits are made by selling competitively priced goods or services produced at costs below the selling prices. The Canadian market alone is seldom large enough to permit economical manufacture and to justify the supporting innovative expenditure. This is especially true for long term programs where expenditures for the three creative processes may have to continue for many years before returns are realized. Export markets are essential, in addition to domestic markets, to permit production on a scale which will result in competitive costs. Yet only by generating unique products by the application of the creative processes can Canadian industries hope to compete in world markets.

As long as Canada imports the major proportion of its innovative technology, and as long as there is insufficient native innovation carried out in industry, it is doubtful if Canada can be successful as an exporter of manufactured products. Directly or indirectly, we are paying a high price for imported innovative technology. Only by producing unique products or services, by reducing the unit labour content of costs by improved design, or by increasing productivity by more efficient methods, can Canada sell at competitive prices in world markets.

Discovery and invention are not always necessary for the successful exploitation of a market. Access to export markets can be achieved by using and modifying existing technology. The PT-6 Gas Turbine by United Aircraft of Canada, the Doppler Radar by Canadian Marconi Company, and the SF-1 Small Crossbar Office by Northern Electric are examples of Canadian developments built on known technology.

5.2 RESEARCH AND DEVELOPMENT IN UNIVERSITIES

From 1953 to 1968, university research expenditures in the sciences and engineering grew from 5 million to 110 million dollars. A very high percentage of these funds came from government grants. These figures indicate the rapid buildup of university facilities. There is some indication that university facilities are now available to turn out an over-supply of Ph.D.'s by 1971 and, also, that universities themselves will employ 70% of the total employed Ph.D.'s in Canada by 1973. ("A Personal Overview", O. Levine, NRC, October 1, 1968.)

Careful study should be given before increasing these government grants significantly during the next three or four years because they should be directly geared to the estimated future requirements for engineers and scientists with Master or Ph.D. degrees. If a proper relationship between supply and demand is not maintained, research in universities and the training of Ph.D.'s to do more research in universities can become an end in itself.

We are quite aware of the need for improving the level of education in Canada; but some discrimination is needed in encouraging people to attain higher levels of education. To determine the magnitude of research grants to universities, we recommend that the government undertake a study of future requirements for Bachelor, Master and Ph.D. graduates on a national basis.

Because the university environment is most favourable to the discovery process, it is reasonable to expect that most pure research should be done in the universities. Research people in universities are less affected by the day-to-day economic pressures common in industry. In a less strict time and cost scheduled atmosphere, creative minds can follow their particular interests. This kind of research should aim at increasing fundamental and basic knowledge as well as training post-graduates to the Ph.D. level for government or industry.

It is important that universities be encouraged to cooperate with industry in the search for ways and means of increasing their effective coupling. The Canadian Organization for Joint Research and the Canadian Research Management Association are attempting to improve relationships between universities, government and industry through better understanding of each other's problems and requirements.

5.3 RESEARCH AND DEVELOPMENT IN INDUSTRY

Scienced based companies in Canada must either create their own technology or purchase it from foreign sources. Few companies can devote a significant share of their expenditures to pure research. It is already difficult enough for them to finance innovation.

Industry should bear the main responsibility for technical innovation. Only by integrating this work with the manufacturing, marketing and other functions can innovation be efficiently introduced. In industry, all the disciplines affecting innovation can be focused on the particular development: financing, tooling, facilities for manufacture and test, costing, sales and marketing considerations, installation, operation and maintenance. Innovation carried out by government laboratories is seldom in an environment which allows all of these factors to be balanced.

Every possible way of stimulating the innovative process in industry should be explored. The guiding principle should be to create an environment in which companies are encouraged in positive ways to carry out their own innovation programs.

The financing of innovation can only be accomplished by funds derived from profits or potential profits or by direct government assistance through incentive plans, grants or contracts. An important means of increasing innovation in Canada is to create a climate in which companies retain a greater percentage of their earnings, provided these retained earnings are applied to innovation programs. The IRDIA Program is an attempt to increase innovation activity by making funds available in the form of a grant. While it has considerable merit, some of its disadvantages, with suggestions for improvement, are discussed under the section concerned with Incentive Programs.

5.4 RESEARCH AND DEVELOPMENT IN GOVERNMENT

The government should restrict its research activities to programs which cannot be performed economically elsewhere or to programs which, although in the national interest, are not likely to be carried out in universities or in industry. In general, government programs should be limited to the discovery and invention processes.

The development of equipment to be manufactured to specific requirements of government departments should be subcontracted to industry with fully paid development expense, plus the price of the equipment in production quantities, because in many cases the number of units required is not sufficient to allow absorption of development expense as part of the cost of the product. Unless the development expense can be amortized, industry would not consider a program commercially viable and would not undertake it.

A subcontract procedure with fully paid development would probably cost less than development in government laboratories with subsequent subcontract to industry for production. In most cases, government laboratory designs must be redesigned or re-developed for production, entailing additional expense. The transfer of design information from one organization to another is always expensive, and this expense is minimized by developing and manufacturing in the same organization.

The following guidelines might be used as criteria for programs to be carried out in government laboratories.

Government laboratory programs should be authorized if:

(a) They do not duplicate work being performed in universities or industry.

(b) The work would not ordinarily be done elsewhere, (agricultural research).

(c) The work cannot be performed economically in industry or universities for lack of specialized tools or equipment, or because of major capital investment which cannot be justified in one institution (aeronautical research involving wind tunnels, nuclear research, etc.).

(d) They provide training and experience for research scientists so that they may later go to universities or industry.

(e) They relate to public health or safety requirements and would not ordinarily be carried out elsewhere (crash position indicator).

(f) They have a defence connotation which may require security classification and would not ordinarily be carried out elsewhere (radio propagation studies, Alouette satellite, etc.).

(g) They relate to research on planning of research programs, although some of this type of work might be done by universities and industry.

6. COMMENTS ON SCIENCE COUNCIL REPORT #4

6.1 GENERAL

Science Council Report #4 covers a wide range of interest and includes a number of fundamental observations of great value if followed through in government, universities and industry. For the first time, the economic implication of science and technology and its relation to secondary industry is being aired publicly. We endorse the recommendations regarding action to be taken by the Federal Government and agree with the statement that Canadian industry has an obligation to make substantial investments of its own funds in innovation.

The word "research" has been used with many meanings and the definitions given on page 7 of Report #4 are helpful. Simply increasing "research" in Canada, as has been suggested in many quarters, could be wasteful and meaningless. Canada can afford and should carry out some basic research programs, but the main emphasis must now be placed on applied research, development or innovation, concentrating on viable programs leading to saleable products or useful processes.

The Report attempts to outline national goals and to provide strategic advice on the development of science on a national scale. It emphasizes the necessity of increasing the share of Canadian research and development to be performed outside government laboratories, but we also believe, as stated in another section of this brief, that the university share should not be increased appreciably in the next few years without careful study of the forecast requirements for science and engineering graduates for industry and government. In general, Canada should not finance the development of university graduates who will seek employment in other countries if opportunities do not exist here.

Among the major goals mentioned in the report is national prosperity, which implies a high economic growth rate. Two of the factors contributing to economic growth are increased industrial productivity and innovation. Carefully selected and planned scientific programs, aiming at new and unique products, can contribute to economic growth. More innovation must be done in industry where designs can be created which are most suitable for economical manufacture with available facilities. These designs must meet technically competitive requirements, but must also meet cost objectives and face competitive marketing conditions.

OECD studies emphasized in the Economic Council's Fifth Annual Report indicate that advanced technology alone is not enough to guarantee economic growth. Of prime importance are the entrepreneurial aspects of exploitation of technological advantage. Many important Canadian advances and discoveries have been exploited elsewhere because of lack of initiative, lack of risk takers or lack of sufficient capital. Some means must be found to stimulate Canada's entrepreneurial instincts if we are to become exporters of manufactured products.

The Report recommends that government laboratories should be mission-oriented and engaged principally in applied research, but it also states that fundamental research in government laboratories is a national resource and must not be eliminated. We have outlined elsewhere our views on the kind of research which should be carried out in government laboratories.

One recommendation calls for a "technical audit" by an appropriate body of users from government, universities and industry. We believe the establishment of an organization from industry to provide an interface between industry and appropriate government departments to be a matter of prime priority. The operation of the Canadian Radio Technical Planning Board (CRTPB) might be examined as a model of an industrial organization established to work closely with a branch of the government, in this case the Department of Transport. This organization advises the government on the development and regulation of radio services in Canada. CRTPB was established in 1944 and its membership includes all of the major users and manufacturers of radio equipment in the country. It operates on an engineering and scientific plane with its own Secretariat and has assisted the government in making efficient use of the radio spectrum in Canada. We believe similar types of organizations embracing other areas of interest could be effective in helping the government in the planning of research and development programs on a national scale.

No industry organization concerned specifically with matters relating to research and development now exists.

6.2 MAJOR PROGRAMS

6.2.1 GENERAL. The Report outlines criteria for determining major programs. We agree that programs must be of real importance to Canada and perhaps even peculiar to Canada. The statement that no major program should duplicate work already underway in other countries should be qualified. Innovation in which we will be competing with the rest of the world must be undertaken in Canada if we are to develop the necessary technology required for world markets. Programs should be established which exploit to the maximum those areas of technology in which Canada has already demonstrated excellence. While Canada must not try to compete in all fields, it must be prepared to compete with other nations in many areas. No nation can be a successful exporter of manufactured products if it imports all its technology.

Of equal importance are control of costs and termination procedures. There is a tendency to allow research programs to run on without careful and unbiased assessment of their value. Critical review procedures are essential if our resources are to be effectively used.

6.2.2 SPACE PROGRAM. The outlining of major programs of national interest is an important step in establishing science policy, and programs which will contribute directly to the country's economic growth should be among those selected. A space program is attractive to scientists and should be encouraged even though it may not affect the economy appreciably for some years to come. The immediate commercial part of this program is the establishment of a Canadian Satellite Communication System in order to build technology, lay claim to parking spaces for satellites and to develop Northern Canada. In all probability, this system will not be economically viable for east/west transmission circuits for five to ten years.

In addition to communication satellites, there are a number of other types which are of interest and value to Canada. Earth resource satellites have potential uses in mapping, weather prediction and the additional experimental uses presently served by ISIS spacecraft. They are generally smaller and lighter than communication satellites. Low altitude orbit satellites of this type could be launched from Canadian soil.

The Canadian Government Alouette — ISIS program is already 10 years old. In terms of space technology, 10 years is a long time and the ionospheric-sounding program should be reviewed. The original purpose of the program was the search for better knowledge of the ionosphere to improve our ability to use the high frequency radio bands. But the significance of the high frequency bands has diminished with widespread use of microwaves. In addition, the value of ionospheric knowledge in assisting high frequency radio communication has also diminished, and the usefulness of these frequencies for reliable communication is not likely to be materially enhanced by further ionospheric sounding.

A reorientation of our space program for earth resource satellites could improve its value by exploration of Canadian land and water areas. Such a program already has support from Canadian scientists. Obviously it is not desirable to have our resources surveyed by foreign satellites.

6.2.3 COMMUNICATION PROGRAM. The Science Report makes no special mention of communications. We believe the Science Council should encourage research and development programs relating to the special communication systems required by Canada's unique environment, both social and physical. These programs would not only focus on communication satellites to provide TV, data and voice communication to the north, but would also research all types of communication systems as required by Canada's social and physical peculiarities. Examples are information handling and retrieval systems, microwave, coaxial cable, waveguide and laser systems. Programs related to Pulse Code Modulation for transmission and switching, including techniques such as spread spectrum and digital communication systems, might also be included.

6.2.4 URBAN PLANNING AND HUMAN ENVIRONMENT. We endorse the recommendation that a systems approach to community planning and human environment should be undertaken as soon as possible. We suggest that the scope of such studies be broadened to include social science research in the field of communication media. Precise, definitive research action should be taken in Canada to develop a science which would permit improved planning and designing of communications environments.

7. COMMENTS ON GOVERNMENT RESEARCH AND DEVELOPMENT INCENTIVE PROGRAMS

Research and development incentive programs administered by the National Research Council, the Defence Research Board, the Department of Industry, Trade and Commerce, and the Department of Defence Production have played a part in encouraging research and development in Canada. Some of the plans have been more successful than others.

7.1 INDUSTRIAL RESEARCH ASSISTANCE PROGRAM (IRAP)

This National Research Council Program, aimed almost entirely at the pre-innovation processes, has been used by Northern Electric. Flexible administration by competent technical officers has contributed to the stimulation of successful projects. We recommend that the program be continued and increased in magnitude, with extension of support beyond five years at NRC discretion.

7.2 DEFENCE INDUSTRIAL RESEARCH PROGRAM (DIR)

For companies engaged in defence production, this program, administered by the Defence Research Board, has been useful. There has been a tendency to limit the projects strictly to "direct military interest" which is generally theoretical in Canada, and more consideration should be given to projects which have a commercial as well as a military focus.

Present projects are shared fifty-fifty. Since most of the projects are high risk because of the fickle military market, they should be 100% funded by DRB.

7.3 THE INDUSTRIAL RESEARCH AND DEVELOPMENT INCENTIVE ACT (IRDIA)

The IRDIA Program is not realistic and not fully effective in encouraging research and development because of the predisposition toward imitation rather than innovation in Canadian industry.

Since the Act offers an incentive only for incremental research and development expenditures over a moving base, it discriminates against companies, already committed to stable programs, that are often the companies which offer the greatest number of new jobs and production growth. It assumes that companies will normally be motivated to make some expenditures on research and development for economic reasons.

In effect the present program is based on the wrong fundamental premise. Since a large segment of secondary manufacturing in Canada is generally motivated to imitate rather than innovate, an effective incentive must be directed at stimulating all innovation rather than incremental innovation. In its Second Annual Review 1965, the Economic Council recommended (and we agree) that the incentive should apply as a meaningful percentage of all expenditures meeting the definition of "scientific research and development", and that the program be introduced for a period of at least ten years.

Actual payments of incentives are invariably delayed for long periods because of the administrative detail, and because of the meticulous examination of the work performed and procrastination in the interpretation of the Act and its related regulations needed to support the expenditures claimed. The substantial delay in claim settlement makes financial planning difficult; the cost of temporary financing resulting from this delay offsets, in part, the incentive which the Act is intended to provide.

The Fifth Annual Review of the Economic Council of Canada tells us "There is danger that policy makers will concentrate on support of research and development, leaving the rest of the process to take care of itself". While IRDIA nominally applies to "research" in the broad sense, the Department of Industry has wide discretionary powers in its application. Interpretations of the legislation should recognize that for the incentives to be effective, they must extend over the expenditures involved in the total process of innovation, and not favour the purer research aspects.

7.4 PROGRAM FOR ADVANCED INDUSTRIAL TECHNOLOGY (PAIT)

The pay-back condition of the government's share (up to 50%) of project cost, if the project is successful, carries an abnormally high effective interest rate, substantially exceeding the rate on private borrowing because the incentive under IRDIA and the tax savings resulting from the expenditures are deferred until the loan is repaid. For some companies, the interpretation of what constitutes a successful development is difficult unless special accounting routines are introduced.

The program would be much more palatable if pay-back were on a no interest basis.

Interpretation of what constitutes "successful" development makes measurement difficult.

7.5 DEPARTMENT OF DEFENCE PRODUCTION (VOTE 5) INDUSTRIAL MODERNIZATION FOR DEFENCE EXPORT (VOTE 20)

It is recommended that these programs, which have been used primarily for the development of military hardware, be continued. We believe they could be improved by also including commercial projects having a military orientation.

7.6 GENERAL

The Department of Industry, Trade and Commerce incentive plans normally support developments which will advance technology in Canada, and we believe this is an excellent long term goal. However, if Canada is to achieve the economic goals outlined by the Economic Council, it is essential that the export of manufactured products be continually increased. For this reason, we strongly recommend that the Department of Industry, Trade and Commerce consider support to proposals for the development of products specifically aimed at commercial export markets, using presently known and available technology.

8. NATIONAL RESEARCH COUNCIL PROGRAM PLANNING

The National Research Council was established by the NRC Act of 1917 — 1952 to undertake, assist or promote scientific and industrial research in Canada. In recent years, NRC staff members and representatives of industry have been disturbed at the reluctance of industry in Canada to interest itself in NRC's patents and new products. No doubt, industry in Canada suffers from a low entrepreneurial coefficient, but one of the contributing factors is that industry plays a relatively unimportant role in establishing NRC's projects. NRC's designs have consistently high technical merit, but this alone is not enough to warrant commercial support.

There should be much closer liaison between NRC and industry at the planning stages of program formulation and it should continue through the earlier creative stages to the point where the project must be transferred to industry for production and commercial exploitation.

Advisory committees composed of representatives from universities and industry, appointed by NRC, are already in existence and some of these committees function well. However, we believe NRC should maintain continuous dialogue with a standing organization of industry representatives from the technical and managerial levels. This organization would be industry appointed only, and would be similar to the Canadian Radio Technical Planning Board (CRTPB) which has successfully represented the radio communication industry to the Department of Transport for more than 24 years.

9. PATENTS, TRADEMARKS, COPYRIGHTS AND REGISTERED INDUSTRIAL DESIGNS

The company recognizes patents as industrial incentives and supports the patent system as a method of protecting industrial property. Our views on patents, trademarks, copyrights and registered industrial designs are contained in a brief submitted to the Economic Council of Canada in July, 1967.

10. COMBINES, MERGERS, MONOPOLIES AND RESTRAINT OF TRADE

Combines legislation is an important factor affecting the industrial climate in Canada and the evolution of Canadian business and industry towards higher productivity. In this connection the company has contributed substantially to a brief submitted by the Canadian Manufacturer's Association to the Economic Council of Canada in July, 1967.

11. CONCLUSION

If a Science Policy is to be effective, it must apply to a healthy and growing economy in which our government, universities and industrial sectors can thrive. From an industry standpoint, this implies critical mass operation under more permissive combines legislation and improved patent, corporate income tax and incentive legislation. If Canada is to prosper, every possible means must be found by both government and industry to encourage innovation and entrepreneurship.

Science Policy should establish priorities for national scientific programs. These priorities should be determined by social science research as a means of evaluating human wants.

It is essential that continuous dialogue be maintained between government, university and industry if we, together, are to find successful solutions to the problem areas outlined in this brief.

APPENDIX 162

BRIEF SUBMITTED TO

THE SENATE SPECIAL COMMITTEE ON

SCIENCE POLICY

BY

E.M.I.ELECTRONICS CANADA LIMITED

E.M.I. ELECTRONICS CANADA LIMITED

BRIEF FOR THE SPECIAL SENATE COMMITTEE ON SCIENCE POLICY

1. Before attempting to answer some of the "current questions regarding Canadian science policy" as formulated in Appendix I of the relevant document of the Committee, we have to define clearly the background of our Company as this undoubtedly determines the limitations and biases of our viewpoint.

Firstly, the Company, due mostly to historical reasons, is Defence-oriented. This automatically means a heavy dependence on Government policies, plans and attitudes.

Secondly, the Company is "export-oriented", with the principal export market in the Defence field being obviously the United States.

Thirdly, in at least one major area of unique achievements - instrumented deep ocean moored platforms and vehicles - there exists a tremendous potential for development in non-defence fields, namely oceanography and atmospheric sciences.

In the light of the above, we can now offer the following comments broadly relevant to the questions of Appendix I referred to before.

2. Research and Development activities requiring funds to be allocated by an industrial organization have to be justified by potential sales. These are particularly difficult to determine in the Defence field, as the requirements are usually unknown to outsiders, i.e. to Companies which are not already deeply involved in broad R & D programs under contract to military authorities. Canadian firms trying to obtain U.S. contracts are, of course, under additional heavy handicaps. Political considerations may add to

these difficulties when exports to other countries are concerned.

It appears that the best really effective help to the Defence industrial firms trying to increase their R & D efforts in order to aid exports could be provided by a sufficiently strong domestic market, which would enable the industry to keep abreast with the current requirements and carry out expensive R & D activities as a part of Government contracts.

Joint Canadian-American programs, funded under existing U.S.-Canada agreements on defence production and R & D projects sharing, offer another satisfactory alternative.

3. It should be pointed out that the large American defence market is probably accessible mostly if not exclusively to Canadian firms without American parents, due to obvious reasons. This indicates that Canadian firms without American associates should be logically favoured in any attempts to strengthen the Canadian R & D capability in the defence field.

4. In general, even in the area of commercial, non-defence, R & D activities directed towards projects of national significance (as opposed to mass-market, customer-oriented products) we feel that Government grants provide a rather insufficient incentive for the industry. It can be argued that, by offering reduced financial risks, they also reduce, at least to a degree, the motivation for success; and this is usually the most powerful factor required.

Fully funded contracts, for well defined programs and services, with all the inherent pressures and responsibilities, probably offer, in the long run, a more economic method for boosting the Canadian R & D efforts.

On large programs, the Company funding required even with the aid of grants may be too heavy to be acceptable.

5. At present, the Government Research Establishments, Laboratories and Institutes in Canada tend to carry out as many of their R & D activities as possible "in-house", entirely excluding the participation of the Industry. Also, any possibly ensuing requests for further development or production are only too often directed to the lowest bidder in open competition, which on many occasions means a foreign supplier; again, a considerable handicap for the domestic R & D prospects.

6. Innovation, which is probably the most important factor required for thriving R & D activities, often appears as a deterrent rather than an asset. Customers' resistance to change, fear of unknown risks, etc., diminish chances of immediate market success; required long period of struggle to overcome the obstacles is unacceptable to most but the very large and powerful companies.

Major innovative R & D activities seem doomed to failure without a full-hearted Government support. On the other hand, rapid successful growth of R & D, and thus industry in general, has been achieved in countries where planned, heavy government participation was available (Japan, France).

7. The enclosed document, "Briefing on Canadian Deep Sea Moored Buoy Technology and its implications concerning "Inner Space" exploration programs" presents, to our mind, a fair example of a failure in the Canadian Government-Industry relations to pursue to a successful conclusion an R & D program initiated by the Government, taken up by the Industry and, although offering an excellent promise for industrial developments of global significance, left for others to exploit, in the absence of further energetic Government support.

The above comments answer broadly questions 1, 2 and 3 of Section A of Appendix I to the Senate Committee document. We shall now proceed to answer briefly the remaining questions.

A.4. Q. Is there a proper balance between the support of the federal government given the three sectors: industry, universities and federal government?

A. The federal government support given to the industry appears to be disproportionately low in comparison to other highly industrialized countries.

A.5. Q. On the basis of your experience what is the appropriate creation of and balance between basic research, applied research and development?

A. We do not feel competent to answer this question.

A.6. Q. What criteria should the federal government use in allocating funds to scientific activities such as the support of R & D in industry?

A. The rate of industrial growth, including R & D, tends to jump by an order of magnitude when a certain critical concentration of activities is achieved. To speed up the process of approaching this threshold, the allocation of government funds should be directed towards R & D programs in the areas of technology promising the most rapid growth. Space research, transportation, computer industry, ocean engineering and medical electronics seem to provide good examples of fast growth areas. Also, the relationship between industrial expansion and export potential should not be overlooked.

A.7. Q. What changes should be made in federal government financial support of Canadian scientific activities?

A. Federal government financial support of Canadian scientific activities should concentrate on fully paid contracts in areas of industrial activities of national interest, as indicated in A.6.

B.1. Q. How can Canadian universities and industry more effectively collaborate in the field of science and technology?

A. A more effective collaboration between Canadian universities and industry will occur automatically with the growth of the industrial R & D potential.

B.2. Q. Do Canadian universities graduate scientists and engineers able to perform effectively in Canadian industry?

A. Yes.

B.3. Q. What should the important long term goals of Canadian Science be?

A. In the area of applied research and development, the answers to this question were hinted at in A.6.

B.4. Q. Is there an adequate supply of scientific manpower in Canada?

A. This question is difficult to answer. There is an uneven flow of scientific manpower into different provinces; also the "brain drain" into the States tends to complicate the issue.

B.5. Q. Does foreign ownership hamper the development of innovation in Canadian industry?

A. Foreign ownership, in the present state of industrial development in Canada, in general helps in the above-mentioned process of accelerated growth. However, on some occasions, innovative activities may be hampered. As explained before, these hampering tendencies are more applicable to American owned companies, because of the direct competition in the American market.

B.6. Q. Are the results of foreign science and technology available to Canadian industry in a timely and suitable manner?

A. Yes.

BJS/or

APPENDIX 163

BRIEF

TO

THE SENATE OF CANADA

SPECIAL COMMITTEE ON SCIENCE POLICY

Submitted by

CANADIAN WESTINGHOUSE COMPANY LIMITED

P.O. BOX 510, HAMILTON, ONTARIO

March 1969

INDEX

PREFACE

1. This brief generally supports the brief submitted by the Canadian Electrical Manufacturers Association.

2. We recommend that the role of government should include:

(a) the definition of Science Policy as an instrument to foster economic growth;

(b) the establishment of an environment conducive to real economic growth;

(c) the establishment of priorities for necessary government-directed scientific activities;

(d) the direction of certain support programs.

3. We recommend a levelling off of in-house government and university expenditures for research in the physical sciences and increased emphasis on quality rather than quantity in that research which is undertaken by government and universities.

4. We recommend industry should be given every assistance to establish its own level of research and development activity as determined by industry's need to innovate for economic benefits and to obtain the technology it needs on the basis of economic values.

5. We recommend attention to the supply of production oriented engineers in Canada.

INTRODUCTION

6. Canadian Westinghouse Co. Ltd. is engaged in the design and production in Canada of a wide range of Electrical and Mechanical products for sale in Canada and some sixty foreign countries.

7. In 1968 the Company directly employed in Canada the skills of about 9,600 people, with a payroll in excess of $65 million. Sales that year were $204 million representing about nine per cent of the entire Canadian electrical manufacturing industry.

8. This Company is a member of the Canadian Electrical Manufacturers Association (CEMA) and supports the Brief submitted by CEMA to the Senate Special Committee on Science Policy. Therefore, in the interest of brevity, this Company's Brief will serve to complement the submission by CEMA.

Broad Principles

9. It is our opinion that the most important thing about a Government Science Policy for Canada is that it be directed towards, and specifically related to, achievement of the national objectives and policies for long term real growth in the Canadian economy.

10. It follows then that the basic role of Government falls into four broad areas:

(a) The defining of Science Policy in such terms that it will be evident that the policy is intended to foster economic growth and not the pursuit of scientific activity as an end in itself.

(b) The establishment of a social, financial and economic environment which allows maximum progress to be made by growth producing elements of the economy.

(c) The establishment of priorities for those absolutely necessary government-directed scientific activities (relevant to major policy programs) that are complementary to programs being carried out in Industry.

(d) The direction of those support programs related to defence, human safety, and national interest, which for reasons of security or other well considered reasons must be directed from Government. Some programs in the national interest include necessary national-level activity in basic research, research data collection, promulgation of scientific information, testing and standardization, and encouragement of education.

11. It appears that whether we are concerned with the Physical Sciences, Life Sciences or the Human Sciences, these basic areas of Government action apply.

12. Our remaining remarks will relate primarily to activities in the Physical Sciences and the much discussed question of which segments of the economy (Industry, Government or University) can best achieve results in the research and development class of scientific activity.

Scientific Objectives

13. There has been much talk of establishing "Scientific Objectives" for Industry, Government and the Universities. It is our opinion that such objectives in themselves are meaningless to the achievement of a national policy unless they arise out of or are directly related to some broad program in the economy indicated by study to be growth-producing for the Canadian economy. There is no lack of scientific objectives for Canada to pursue. The key we must find is that which sets us on the road to achieving those scientific objectives in research and development which will, in fact, be of early and significant benefit to Canada in terms of economic growth. The only scientific objective that makes sense is the development of a technological base upon which viable business entities can be established.

Research in Universities and the Government

14. It is our conclusion and submission that the highest priority must be given to those basic research programs which are not being pursued already in other countries and only then if a consensus of our best scientific, government and entrepreneurial opinion can determine that success in that field will lead to economic benefit.

15. This then requires some forum for the review and definition of that research to be undertaken in Canada which must have available the most up-to-date Data Collection and Scientific Information system. The provision of this system in our opinion is one of the prime areas in which government has the leading role.

16. Canada must capture and critically examine all available world research data in a useful manner for the very simple reasons that first, we cannot afford to be unknowledgeable; second, we cannot afford to engage in research on every front for some time to come; and third, we must make the hard decision relative to the areas in which we should participate.

17. During the past two years a very large proportion of the public funds provided for research has been allocated to government and university research establishments. We believe that the activities of many of the research units in both these areas must be levelled off and their scientific comprehension abilities redirected to communicating with the world research community. These skills should be directed to assist in the selection and establishment of beneficial national goals and programs.

18. Only those <u>applied research</u> programs should be carried out in government and university units which are directly related to defence planning, certain areas of safety-to-life programs, early environmental studies related to major new development programs such as space, pollution of the biosphere, and conservation of natural resources.

19. We believe also that the quality of the work carried out in these research establishments is far more important than the quantity. Therefore it should be a maxim of government policy that continuous review be undertaken of the relevance, depth and scope of government and university in-house applied research programs with the objective of concluding each program as soon as the specific practical application has been reached successfully or it is judged that the need no longer exists, or that economic and technical success is improbable. Follow-on applied research and development programs where justifiable may at this point be turned over to Industry.

20. Finally, major emphasis must be placed on narrowing the gap between the outlook of our scientific community and that of the rest of Canada. We all must come to recognize scientific activity not as a separate force acting on the economy but as an integral part of the economy. The extent to which Canada is able to integrate scientific activity into the stream of all other activities will be a measure of our success in social and economic achievement.

Research in Industry

21. It should be taken as an axiom that, in the long term, industry will not provide funds (investment) to carry out basic research, applied research or development unless some economic benefit can be anticipated. The economic benefits arising from basic research are rarely observable until after some degree of result is achieved.

22. At the other end of the spectrum, product development benefits are usually, if not always, clearly discernible before the investment is made. Although the degree of return on investment may not be accurately predicted, benefits are foreseen or development would not proceed.

23. In the intervening area of applied research, while a specific practical application may be discernible, perhaps only broad estimates of economic viability can be assessed, subject to increasing degree of accuracy as projects proceed.

24. It is for these reasons that much confusion arises in the minds of scientific people, whether they be working in industry, government or university, as to the amounts and direction in which funds should be spent.

25. In fact, so confused has the thinking on this subject become that the motives of industry are suspect in some quarters. It is concluded by some that industry is not willing to carry out research in any field and that since Canada must "have" a Canadian research activity, regardless of its relevance, universities and government must step in and fill the gap. This has no doubt contributed to the action of government and universities in carrying out a wide variety of programs in applied research and even some product development not associated with defence or other "national interest" projects.

26. Nearly all of these programs and projects are funded directly or indirectly by government financial support programs, that is, taxpayers' money - there is no other source.

Where then, does Industry stand?

27. Industry stands or falls on its ability to get profitable orders. It will invest in basic research or applied research or product development to the extent that valid economic benefits are discernible.

28. For the reasons outlined above, expenditures in the pursuit of basic research will always be a relatively small portion of the R & D expenditures of any particular industrial concern. Basic research and much applied research data are available from many existing sources.

29. Applied research however should be considered to be within the province of Industry. Government assistance (primarily through provision of funds) should be readily provided where the economic benefits of applied research are not so immediately discernible that industry priorities (based on economic evaluation) can allow full support of the work with industry's own funds. The normal business analyses of the value of the work in pursuit of profitable products will ensure more efficient use of these public funds than is now experienced. In addition, the resultant strengthening of applied research capability within Industry will stimulate a much needed expansion of our national production base.

30. The field of product development is, of course, the traditional field of the industrial entrepreneurial enterprise, but as technology has advanced it becomes less and less easy to say at what stage applied research should halt and product development commence for any given decision. This is an additional reason for increasing the depth of scientific activity in industry and for relinquishing previous conceptions that government or universities carry out applied research and turn over the results to industry for development. Not only is this becoming impractical, because government and universities do not have to make the hard economic decisions and are not necessarily working on projects leading to needed product development, but it is inefficient because it entails a re-working before industry can evaluate and make decisions to proceed.

31. For industry to successfully carry on applied research and development programs, it needs people with education of varying levels and it needs the best that can be obtained. There is every indication that our educational system is preparing adequate numbers of most professionals required but they are not moving out of the academic atmosphere because far too high a proportion of government funds is being channelled to government in-house activities and universities.

32. It is the view of this Company that the undertaking of applied research projects may be accelerated more efficiently by industry taking universities into a partnership under certain circumstances. Certain projects may thus be directed to universities with industry rendering guidance as to the direction and extent of activities and control of expenditures. This approach provides another avenue towards acceleration of successful product development in industry arising from specific applied research projects.

33. In order to provide further acceleration of the process, Government Incentive Programs for industry will have to be re-aligned to provide assistance, not only in the applied research and development stages, but in the following expensive pre-production and production stages of the innovation cycle.

34. Nevertheless, industry by its nature will invest in whatever technology it can obtain to reach its economic objectives. It will obtain its technology whenever it needs it from wherever it is available depending on its price. There is always a "do-or-buy" decision and the making of such decisions is industry's forte.

35. In lofty discussions of scientific activities, we are inclined to neglect the part played by skilled people in new-product development and production. While there is evidence that we may well be producing an over-supply of Ph.D's, there is no surety that we will have an adequate supply of qualified engineers and technologists to undertake the product development and production processes as efficiently as we would like.

36. In short, since the end-product of most industrial research and development is a more competitive product in North American and world markets, we must be careful that we complete the innovation cycle, and produce goods of quality, performance and cost which will ensure continuing orders. An area of education which needs encouragement is the development of sufficient qualified production engineers for industry. In other countries, notably Japan, the United Kingdom, Germany and Russia, government supported applied industrial research in production engineering has progressed rapidly.

March 1969

APPENDIX 164

BRIEF SUBMITTED

TO

SENATE OF CANADA

SPECIAL COMMITTEE ON SCIENCE POLICY

BY

RCA LIMITED

MONTREAL, QUEBEC, CANADA

Officers of RCA Limited available to appear before

Special Senate Committee on Science Policy:

Mr. J. D. Houlding,	President
Mr. J. G. Sutherland,	Vice-President, Commercial & Defence Systems
Dr. M. P. Bachynski,	Director of Research

Brief Submitted to Senate of Canada, Special Committee on Science Policy

by

RCA Limited, Montreal, Quebec, Canada

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PREFACE

We are particularly pleased to have the opportunity to submit a brief to the Special Committee of the Senate of Canada on Science Policy.

In this brief no attempt will be made to address ourselves to all the factors within the terms of reference of the Senate Committee on Science Policy which relates to industrial research. We would, however, be pleased to try to answer any questions the Senate Committee may have either at a verbal briefing or by letter. In this brief we would like to make a number of points which we consider most important. These are based on our experiences as the first (1955) company in the electronics industry to establish and maintain a viable research activity in Canada. In summary, these points are:

1. Research and development is an increasingly important ingredient for the growth and viability of any technology-based company. The role of r & d is not only to pioneer new areas of technology and new products for company business but in addition to provide the background for entry into a new technology in a manner that will ensure that the company's ventures will be commercially timely, to train people for new company business areas, to provide a readily accessible team of consultants for the technical bottlenecks of the product divisions, to recruit people from universities and maintain liaison between university and government laboratories and to establish and maintain the scientific stature of the company both in the eyes of the scientific community and the public.
2. By conducting research and development in Canada a foreign-owned subsidiary company can gain access to product mandates for international markets and other business opportunities. Once a subsidiary has demonstrated a proven technical competence in a product line it is reasonable to expect that the subsidiary will be given the mandate to manufacture that product and to market it internationally. This level of technical competence, once attained, should enable reductions in the royalty payments on goods manufactured in Canada as well as provide

opportunities to participate in numerous other business activities. The result of aggressive build-up of technical competence is to provide more jobs for Canadians, a better balance of trade position for the country and increased government revenue via corporate and personal taxes.

3. A government commitment of priorities and initiation of major mission-oriented projects could do much to develop an improved scientific and technological base in Canadian industry. A fundamental requirement for industrial investment in r & d is the foreseeable prospect of a resulting business with an acceptable profit position. However, both the current profits and technological base of much of Canadian industry, as well as the market position, is inadequate to permit significant industry expenditures on r & d. The government as a major customer of Canadian industry and by its policies exercises a profound influence on the economy of the country. By the commitment of priorities and initiation of major mission-oriented projects by government, industry would be involved in the complete innovative process - r & d to sales. The result would be an improved technological base created in industry, the prospects of greater markets and a willingness for industry to invest its own funds to see new technologies developed and "spin-offs" from the major programmes exploited.

4. The success of industrial research is determined by the calibre of the r & d staff. An appropriate "climate" in Canadian industry for research and innovation must therefore be realized. Some of the factors which must be established include "critical size", a challenging programme, opportunity for growth and recognition, freedom to pursue individual good ideas, continuity of programme and interaction with university and government laboratories.

5. Federal government incentives and assistance for r & d in industry should be revised so as to become more effective. Consideration should be given to an incentive margin for r & d expenditures in the calculation of corporate tax, to greater carry-back and carry-over periods of r & d expenditures during poor financial years and to elimination of the five-year base for determination of the incentive grant. Cost-sharing schemes should be expanded and put on a sliding scale - the government to industry cost-ratio being determined by the basic research/applied research/development content of the programme. A need exists for fully-funded r & d programmes involving industry and for incentives for the innovation process beyond the r & d phase.

1. The Role of Research and Development in a Technology-Based Company

We shall attempt, in the following, to set down the role of research and development in a technology-based company and then to illustrate these with specific examples taken from our own experience. The dependence of a technology-based business on r & d should emerge from this discussion.

(i) To begin, the most direct and easily understood role of r & d in a technology-based industry is the establishment or pioneering of new areas of technology and new products for company business. This task is self-explanatory and needs no further elaboration.

(ii) No company can afford the costs which would be required in order to have people working in all the technological areas which are pertinent to the business of that company. The best that can be done is to do research in those that appear to be the most important and have people who are knowledgeable in the other salient areas. A second role of r & d is thus to provide the background and knowledge for a company to enter a profitable area of new technology quickly in a manner such that the company's ventures into these new enterprises are commercially timely.

(iii) Since the r & d arm of a company will be engaged on the frontiers of technology, it is here the people obtain the appropriate background and training to be able to play a leading role in establishing new company business areas. Another role of r & d is thus to train and provide appropriate key people to enable a company to successfully venture into new technological business areas.

(iv) The r & d function provides a readily accessible team of consultants for the other technical operation of a business enterprise. Thus the scientific needs of the product divisions - technical bottlenecks, design or product problems, etc. can be served by an expertise which the product division itself could not afford.

(v) The r & d personnel of a company, as a rule, has far more in common with the staffs of the universities and government research laboratories than has any other company department. Thus liaison with the universities and government laboratories on new potential programmes, new products, recruiting of technical staff, etc. becomes a function best conducted by the Research personnel.

(vi) Finally, a research & development activity of high calibre heightens the prestige, "image" or scientific stature of the company with the government, academic institutions, industry and the public. The scientific reputation established reflects not only on the calibre of work done in r & d but is automatically extrapolated by the technical community to the engineering and technical product functions. In the same way the scientific reputation helps promote commercial and consumer products.

It might be instructive to illustrate by a few specific examples what role research and development has played in the evolution of our Company - RCA Limited. Looking first at recent new products one can list Divcon - the video to digital conversion display used to display election returns, stock exchange prices, airport flight information, etc., demonstration kits for assisting the teaching of science in schools and universities, various semiconductor devices, antenna feed systems and solid state communications equipment, to name only a few. In new business areas, our Company is currently involved in solid state radio-relay communications systems, ground receiving systems for space communications, scientific satellites, communications satellites and instructional systems. All of these are the result of recent research and development conducted by the Company in Canada. (See the Appendix for a list of expenditures and products developed.)

In 1963, RCA Limited was awarded the prime contract by the Canadian government for the orderly transition from the Defence Research Telecommunications Establishment to industry of Canada's prime contracting and systems engineering capabilities in scientific satellites. To lead this activity RCA chose key people from the Research Laboratories whose experience and organization developed on advanced semiconductor device research had previously been used to develop telemetry transmitters for Alouette I, Canada's first scientific satellite and for two major NASA scientific satellites - Explorer xx and Pegasus. These people, together with our experienced engineering capability, have proven a very effective team culminating in the successful manufacturing of the ISIS-I Canadian satellite. Similarly, when various semiconductor devices were transferred from the research stage into a business area, some people previously involved in research and development have been used as appropriate to make the new venture viable. We have used people, who as a result of their wide technical background obtained in conducting research and their openness to new conceptual ideas - a direct characteristic of research, to lead state-of-the-art design studies. The recent systems study of a Domestic Communications Satellite for Canada is one such case.

An example of how the research capability can be used in a consulting capacity is perhaps illustrated by a problem encountered in the design of the scientific satellites Alouette II and ISIS-I. It was feared that the perturbations of the ionosphere caused by the long antennas of the spacecraft would invalidate the results obtained by other experiments on board the satellites. This problem was studied in our Research Laboratories, the nature of the perturbation determined and a technique devised to overcome the problem. This technique was then incorporated into the engineering design of the spacecraft. Similar situations have arisen in regard to reliability apportionment of scientific satellites - i.e. how best to deploy the operation of the vehicle in order to reduce the probability of failure or what to do in the event of a failure of a particular unit in order to still obtain valuable results, in regard to antenna design for communications satellites, etc. In each case they have been referred to and resolved by the Research personnel.

Members of our r & d laboratories serve on a variety of government scientific committees, on university advisory councils both on education and research and on international scientific unions. This liaison is helping to bring a closer association of all sectors of the scientific community.

Finally, in regard to the Company "image" afforded by scientific and technical competence which can be used even for consumer products, you have no doubt seen our color television advertisement on which our satellite competence is featured.

In summary, in 1968 alone, about 25 million dollars (25%) of our business was in these new areas which have been opened up by research and development. With the rapid changes in technology there is little doubt that the growth and viability of our business shall be more dependent on research and development in the future.

2. <u>The Effect of R & D on the Role of a Subsidiary of an International Corporation</u>

One of the major concerns of Canada has been the domination of Canadian industry by subsidiaries of foreign-owned companies. In view of the impracticability of trying to create indigenous technology-based industry on any but a small and highly specialized scale, there is little doubt that the foreign-owned subsidiary is here to stay at least within the time span of any of our professional lives. In fact, the growing industrial trend is towards the international corporation, mainly an outgrowth of technology-based business and often with headquarters in the United States, although a number of such corporations based in Europe and Japan are beginning to appear. These corporations are not concerned with national boundaries but rather with profitable businesses and business opportunities. The problem then is to find a mode of operation which is mutually beneficial to the country in which the subsidiary of the international corporation is based and the international corporation itself. It is our experience that by an aggressive research and development activity within the subsidiary in partnership with the government (through assistance and incentives) such a mutually beneficial situation can be achieved.

(i) Product Mandate

One mode of operation for an international corporation is to have its subsidiaries each responsible for the international markets for given product lines. Such a world-wide product mandate is highly desirable for the subsidiary but can only be attained when the subsidiary has demonstrated a proven technical competence in that product line. A foreign-owned subsidiary can thus earn a world-wide product mandate by continually developing new products, new processes and novel innovations to services which are either better, less expensive or perform a new function than those currently available. The only manner a subsidiary can introduce such innovation into its product line is to conduct the necessary research and development and hence develop the necessary technical competence and thence the product line. The starting point is the establishment of a viable research and development activity as an integral part of the operations of the subsidiary. It is not implied that this is an easy entry in order to obtain an international product mandate but that it is about the only realistic entry.

At RCA Limited in Montreal we have been able, in the above manner, to obtain the corporate mandate for research into plasmas, the international market for radio relay communications systems (systems have been installed, for example, in Europe, South America, Pakistan, Egypt, Mexico, etc. as well as Canada), ground stations for communications satellites, photo-sensor devices and we have established the major corporate technical competence in communications satellites.

(ii) Royalty Payments

A normal mode of operation of a foreign-owned subsidiary is to import technology under a licensing agreement and to pay a royalty on the products manufactured whether they be for the home market or otherwise. The terms of the licensing agreement are renegotiated periodically. An important consideration in the establishment of royalty rates is the amount of technology in the product which has been contributed by the subsidiary. Thus a manufactured product based entirely on the design of the parent organization would carry the maximum royalty rate, one designed totally by the subsidiary and not dependent on the technology of the parent would carry no royalty payment. The cost of royalty payments to a Canadian-based subsidiary is therefore directly dependent on the degree of innovation and design contributed by the Canadian subsidiary. Thus research and development conducted by a Canadian subsidiary is the avenue whereby royalty payments for imported technology can be reduced. If use is made outside of the country of technology developed in Canada, then the royalty payments would flow in the other direction. This can take several forms. One may be the withholding of royalty payments by the subsidiary on imported technology in return for the parent making use of technology developed by the subsidiary - a trade. Another may be direct payment to the Canadian subsidiary. We at RCA Limited, for example, have made considerable progress in both reducing royalty rates paid on many products and in eliminating them on others.

In the short term, it may often be more advantageous to import technology than to generate it. In the long term view, however, to prevent continuing dominance of foreign-designed goods in Canada, it is important for the industry of a nation to generate a considerable amount of its own technology in specific areas of its own choosing. (The incentives to industry to undertake more research and development is considered later in this brief.)

(iii) Product Markets

A major disadvantage to secondary industry in Canada is the fact that, in general, the Canadian market is too small to permit mass production technology and the wage rates too high to compete with low labor rate nations. However, Canada should be able to compete in those products which involve a significant amount of technology. In addition, the technology-based markets are the fastest growing and hence represent the greatest opportunities. A viable industry thus increasingly must be one which has sophisticated technology and access to international markets.

The entry into international markets by any science-based industry will be markedly influenced by the technical competence of that organization as evidenced by its research, development and innovation capability. The considerations in regard to product mandate for a subsidiary company discussed earlier are all relevant to an international market mandate. In this manner any company based in Canada will not only be able to supply the demand at home but also conduct a substantial international business.

(iv) New Opportunities

The business enterprise which is prepared to cope with the changes introduced by the rapid expansion of technology can concentrate on an exploitation of the technological changes. The unprepared organization must dissipate its resources solving the problems the new technology has created for it. Preparedness is primarily having a sound technological base provided by science and research in many disciplines and the ability to use this base to innovate new products and new services which serve the continually changing human and industrial needs. Long-term growth must therefore concentrate on technological change and the factors which can make it flourish.

Many business opportunities today require the deployment of a diverse number of capabilities all of which may not be possessed by one organization. By virtue of having a leading technical capability in some areas, opportunities will arise to participate in many such international and multi-disciplinary projects. Without such a capability there is no way possible to participate.

As a result of the competence built up in our research and development laboratories, RCA Limited has been the prime contractor on various international projects in which other divisions of RCA also participated. Similarly, RCA Limited has been a subcontractor to other companies on international projects. Without the technological competence built up in Canada, these opportunities would not have been available to us.

3. Need for Government Commitment of Priorities and Major Mission-Oriented Projects

Recent studies have firmly established that the amount of research conducted by Canadian industry is far below that conducted by industries in other technologically developed nations and far below that required for a healthy innovative industry. A major contributing factor to this situation is the low amount of investment in research by Canadian industry itself.

A fundamental requirement for industry to invest in r & d is a tangible, foreseeable prospect of a business with an acceptable profit position. It is in this regard that a government declaration of policies and priorities and commitments to certain programmes or projects can have a significant influence. The government is in itself a major customer of Canadian industry. By its trade policies, the government exercises a profound influence on exports. Thus, often the success of a given enterprise may be determined more by government decisions rather than business or technological reasons.

An excellent starting point to create a climate for company investment in r & d is for industry to become involved in National Goals and Major Projects. Such an approach has been advocated by the Science Council of Canada and we highly endorse those recommendations. The process is that national objectives are identified and priorities assigned. Following appropriate study phases, programmes are initiated as their feasibility is established and as the economics permit. Factors such as the influence of these programmes on employment, effect on secondary industry, relevance to development of national resources, etc. should be kept in focus. These programmes would be fully funded and monitored by the government. The involvement of industry is essential since it is only through industry that the research and development will be channelled into production resulting in benefits to the economy. Industrial participation would, in addition, permit industry to build up an appropriate research and development base from which to build innovative products and services. (It may be worth while to point out that in 1957-58 the direct federal support for industrial r & d was of the order of \$55 million[1]; 10 years later (1967-68) this had grown to \$85 million. The r & d

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1 - Science Council of Canada - Report No. 4, "Towards a National Science Policy for Canada", Oct. (1968)

inflation - sophistication factor has been estimated by the Science Secretariat[2] based on Dominion Bureau of Statistics data. When these factors are considered, then \$100 - \$129 million (depending whether a 10% per year escalation or a linear extrapolation of the data is assumed after 1965) would be required to support the same staff in 67-68 as \$55 million supported in 1957-58. In other words direct federal support for industrial r & d in 67-68 supported less of the r & d staff than direct federally-supported programmes did 10 years ago!)

Industry would see the realization of the r & d effort in the implementation of the major projects - a complete innovative process. With the technological base created in industry, industry will be in a position to invest its own funds to see new technologies developed and "spin-offs" from the major programmes exploited. The result will be a deliberate step towards a healthy economy. The government will receive its return through corporate and personal taxes. The public will benefit from less expensive and new goods and services and improved living conditions while industry will be able to obtain a return on its investment through a fair profit position.

The national goals and major projects concept has worked well in the U.S.A. as for example - the space programme. In this regard it is worth while to point out that over 80% of the budget of NASA is spent in industry. These programmes are awarded to industry usually on a competitive basis. The research and development programmes are generally on a cost-plus-fixed-fee basis and the fixed fee is quite nominal (5 - 10%). Implementation programmes can be on a fixed price basis with substantial incentives for performance and schedule with resulting higher fee margins possible[3]. In the procurement of space communications system for commercial applications fee and incentive gains can amount to as much as 30% of the programme cost.

There is no reason that the industrial involvement should not include projects with national social goals. A possible approach may be for a government task force or other

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2 - Science Secretariat Special Study No. 6, "Background Studies in Science Policy: Projections of R & D Manpower and Expenditure" - R. W. Jackson, D. W. Henderson, B. Leung (1969)

3 - NASA Incentive Contracting Guide, NPC 403, NASA, Jan. (1965)

such body to outline problems which need solutions. Industry should then be given the opportunity to submit solicited or unsolicited proposals on how these national or regional problems may be solved. By the vehicle of a potential business opportunity, industry would be stimulated to consider how the technology it possesses or can develop can be used to solve national problems.

4. Need for High Calibre R & D Manager & Scientist in Industry

Since industry offers virtually the only vehicle whereby the results of research and development can be translated into economic benefits it is vital that a strong r & d capability be developed in industry. This is particularly important due to the present pace of technology which requires that industry must be in a position to exploit discoveries made elsewhere and to be able to keep abreast of, and have close association with the research being conducted in the universities and in government laboratories. The achievements possible within an industrial laboratory are shown by such examples as the transistor, color television, the laser and communications satellites.

The key to a strong r & d capability is the calibre of people that comprise the r & d activity. Industry must therefore attract and hold top calibre scientists and engineers of the same capabilities as those in the universities and government laboratories. Thus, it may be worth while to describe some elements of the "climate" necessary to attract, hold and make proper use of the talents of the best qualified scientifically-trained people. If we fail to do this, then any discussion of a strong r & d capability in industry is purely academic. (These same considerations, of course, relate to the problem of the brain drain.) Let us then examine some of the essential ingredients of the climate for industrial r & d.

With the rapid strides being made in science and technology - "the technological explosion", size becomes a critical factor. Too small a group may not even be able to keep abreast of developments in a given field. Thus a critical size is essential before a research activity becomes viable. The exact "threshold" for the critical size depends on the nature of the project, the calibre of the members, the geographic location insofar as the availability of colleagues to consult with (who need not necessarily be in industry) etc. However, in general, groups of less than about half a dozen scientists with appropriate technician help and equipment working in a given area are unlikely to be viable entities. With the annual cost of research per scientist ranging from 25 - 50 thousand dollars, it is immediately evident that it is expensive to do any significant r & d even on a minimal basis.

A second requirement for a proper environment for research and development is a challenging programme. This underlines the need for the involvement of industrial laboratories in major programmes and national objectives. Nothing motivates a group more than to be asked to rise to the occasion on a mission of significance. The r & d personnel must "believe" in the mission and in the work they are involved in in order to give the dedication required of their creative tasks.

Another requirement is growth opportunity and recognition. This includes not only the opportunity to establish a scientific reputation, but in industry, also the opportunity to see r & d with which the individual has been associated, evolve into a major business. In many instances the individual, if he so chooses, can grow with the business into positions of greater responsibility.

Any climate for scientific discovery must provide freedom for the individual to pursue individual good ideas. Unfortunately, at present, there is no means whereby an unsolicited idea from a scientist in industry can be funded by any Canadian government agency except in rare circumstances where the idea may be in direct aid of a pressing unsolved defence problem. This situation is in direct contrast to the United States where at least 10 government agencies are available on a competitive basis in most areas. Apart from the company-funded research, to initiate programmes, the only course available to scientists in Canadian industry, therefore, is to seek financial support from U.S. sources. Indeed this is being done and noteworthy programmes have been obtained from the U.S.A. This is not necessarily a desirable situation since the U.S. sponsored programme is naturally oriented towards U.S. needs and the prior access to the results and ownership of the results is vested with the contracting agency. This situation also has an adverse effect on the retention of capable scientists in Canada. Industrial scientists working together with scientists from government laboratories at the conceptual and planning stages of various programmes would provide one outlet for such ideas, which, if appropriate, could be incorporated into the national programmes.

Continuity is a vital ingredient of any viable r & d activity. The kind of talent required for industrial r & d cannot be expected to gamble their careers on short-term involvement. The history of federal support for r & d programmes in industry unfortunately does not reflect this consideration (see for example Fig. 1 of Science Council of Canada Report No. 1). Our experience at RCA Limited in the Research Laboratories has been as follows:

	1964	1965	1966	1967
Federal Govt. fully-funded support: (in units of $1,000)	463	625	368	243

Fortunately, we have been able to obtain research contracts from U.S. agencies during this period which have enabled us to keep our research staff.

Finally, a major stimulation to their scientific creativity is the interaction of the research and development personnel with their colleagues in universities and government laboratories. This is also essential in order to have a greater relevance of the work in universities and government laboratories to industry and in turn industry making better use of the research being done in these other sectors. This interaction can reduce the "threshold" size of the r & d group required in industry. In this regard a more fluid exchange and transfer of staff between government, university and industry would be most beneficial.

5. Government Incentives and Assistance for R & D

The Economic Council of Canada states - "It has already been indicated that in the years ahead much of Canadian growth must come in the secondary industries. Over the past several decades the fastest growing industries in all the main industrial countries have been the science-based industries. Also the products of these science-based industries have been the fastest growing element in world trade" - (Economic Council of Canada, "Economic Goals for Canada to 1970", Dec. 1964).

Thus a viable Canadian industry must be competitive on an international basis. It is then necessary to make an industry by industry comparison with other countries in order to "size up" the competition. In particular, a comparison with the United States industries and their source of funds for r & d is most revealing. The following example taken from the OECD Report No. 1 (1967) - "The overall level and structure of r & d efforts in OECD member countries in 1963/64" shows:

	U.S.A.	Canada
% of total research performed by industry	67	41
% of research in industry funded by government		
Aircraft	90.4	46.1
Electrical	61.8	22.6
Chemicals	15.9	1.9
All industry	51.8	15

These figures are not particularly up to date, but nothing noteworthy has taken place in Canada to suggest that the situation is currently very different. In the electrical industry, for example, the U.S. government funds 3 times the fraction of research in U.S. industry as the Canadian government does in Canada. The point here is that for Canadian industry to stay competitive, some forms of direct government assistance to industrial r & d is essential.

The current government taxation, incentive and assistance schemes, although useful, have been too fragmented and inadequate to have a significant influence on r & d conducted in industry. The following are thus offered as suggestions whereby the current schemes could be improved.

(i) Corporate Tax

Non-capital expenditure on r & d is now treated as any other business expense in the determination of corporate tax. Thus in the current scheme an increase in sales effort and a corresponding decrease in research to keep the company expenses constant would qualify for the same corporate tax exemption. In the short term the company officials may realize more profits by diverting these funds into sales effort rather than into r & d. Therefore, the expense credit for r & d needs to be greater than for other ordinary business expenses. (A relatively modest incentive margin may be adequate.)

There is a view held in some quarters that, due to the fact that r & d is considered as an expense item for corporate tax calculations, any given company ends up paying only about 50% of the r & d it conducts. This view implies that a company pays tax at 50% on its gross sales revenue. It is, in fact, only valid to the extent that the expenditures concerned are not sufficiently related to the earning or producing of income of the business to qualify under general tax provisions as a factor in the computation of profit. To the extent that a company is required to use after-tax profit to finance r & d it might be said to obtain tax recovery through the special tax provisions. However, this is the case only if the company is in a profit position. Thus, for example, if in a given year a company does not show a profit, the full cost of the r & d may have to be borne and hence in a year where r & d may be required most, the company resources would be least able to sustain it. This would result in a discontinuity in programmes, turnover in staff, etc. which would take a number of years to rectify. Hence provision should be included in the tax structure to compensate for a poor year financially. A two-year carry-back and a considerable latitude for carry-over of r & d expenditures from a given year may be a suitable vehicle.

(ii) Incentive Grant

The incentive grant for r & d should be on the basis of r & d conducted, not the increase in r & d. The current tendency is to penalize those established viable research activities which are far more likely to produce results.

A given enterprise requires a certain level of r & d for its growth and viability. Once this level is attained and becomes the five-year base from which the incentive grant is determined there will be a strong temptation on the part of a given business to decrease its expenditure on r & d so as to change its base level expenditure and hence qualify for the grant incentive in future years. Thus, the present incentive scheme has some "disincentive" features. (It is recognized that if an incentive grant scheme on r & d as suggested above is instigated, then an incentive margin for r & d expenses in determining corporate taxes may not be necessary.)

(iii) Cost-Sharing Schemes

The cost-sharing schemes should be expanded to include at least development as opposed to applying only to research. This would require a large increase in available funds for cost-sharing. The cost-sharing programmes should then operate on a sliding scale - the government to industry cost-ratio being determined by the basic research/applied research/development content of the programme. The necessity of such a sliding scale is due to the different risks associated with the r & d spectrum of work. (At the basic research stage only a few of the results are expected to have practical significance. In applied research the risks are still high - only a fraction of the projects will be successful with a lead time of approximately 5 years. At the development stage scientific feasibility has been proven so that the chances of success are somewhat better.) A suggested ratio of industry to government fundings is 0/100 for basic research, 25/75 for applied research and 50/50 for advanced development.

(iv) Fully-Funded Programmes

The need for fully-funded r & d programmes involving industry and directed towards National Goals has been considered earlier. The concept of mission-oriented major projects to attain these objectives is considered to be a sound one. The involvement of industrial r & d working closely with the government laboratories starting at the conceptual stage of these projects is strongly recommended. The programmes could be awarded to industry on a competitive basis. Provision should be made to fund applied research as part of the major mission-oriented programmes and should include available funds for unsolicited ideas.

(v) Loans & Other Incentives

Since the costs of r & d comprise only 5 - 10% of the successful innovative process[1], incentives should be provided to encourage exploitation of the results of r & d. These incentives could take the form of loan schemes to assist the innovative activities beyond the r & d phase (e.g. tooling; market research) and/or tax holidays for products for a given period of time or dollar volume of sales or dollar volume of export sales.

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1 - "Technological Innovation - its environment and management" - U.S. Department of Commerce, January (1967)

APPENDIX

RESEARCH AND DEVELOPMENT AT RCA LIMITED, MONTREAL

1. Organization

The organization of the research and development activities at RCA Limited is shown in Fig. 1. Research and advanced concepts for the entire Company are conducted in the Research Laboratories which are part of the Commercial and Defence Systems (C&DS) Division. Advanced development and product development are carried on in the four business areas of the C&DS Division (Space Systems, Communications, Broadcast and Instructional Systems, Defence Systems), in the Electronic Components (EC) Division and in the Consumer Electronics & Appliances (CE&A) Division.

2. The Research Laboratories

The Research Laboratories of RCA Limited were started in October 1955 when a Director of Research and two scientists were employed by the Company to form a nucleus for future growth. In May 1956, about 5300 sq. ft. of laboratory and office space was occupied. Research programmes were initiated around the abilities and interests of the founding members, namely in semiconductors, microwave physics and electronics. The growth of the Research Laboratories by dollar volume of activity and source of funds since that time is indicated in Table 1.

By early 1969, the Research Laboratories employed 70 people, 42 of which are professionals, 20 of which possess the Ph.D. degree, and occupied 18,000 sq. ft. of office and laboratory space. The current organization and areas of investigation of the Research Laboratories are shown in Fig. 2. The "business" aspects related to the Laboratories are conducted by the Research Programme Development group and by Research Administration. The scientific programme is conducted within the five divisions of the Laboratories which are segregated by subject matter. A given programme may, however, be undertaken by the staff of several of the laboratories and other parts of the Company, depending on the available expertise required to most effectively conduct the programme.

Since RCA Limited is principally in the communications and electronics business, the activities of the Laboratories reflect this. The programmes directly in communication include digital techniques, millimetre waves, laser communications, integrated circuits at microwave frequencies and military systems. Space technology is a large part of the new business of the Company and research is being conducted in relation to scientific satellites, communications satellites, re-entry phenomena and satellite experiments. Electronic component research is primarily in optical and nuclear detectors and laser kits. In addition, new areas such as the application of electronics technology to education are being explored.

3. Advanced Development and Product Development

By far the largest expenditures by RCA Limited is towards advanced development and product development carried on within the various product divisions of the Company.

3.1 Commercial & Defence Systems Division

The Commercial & Defence Systems Division is a combined advanced development, engineering design, manufacturing division organized by business orientation into the 4 major areas of Space Systems, Communications, Defence Systems, and Broadcast and Instructional Systems. The commonality between the different areas is, in general, electronic communications systems interpreted in a broad sense.

The entire business of Commercial & Defence Systems Division is "technology based" and therefore dependent on technological advances in their current and related product areas. This business area is most vulnerable to changes in current technology and requires continual significant investments in advanced product development.

The major areas of product development are:

Space Systems – design of earth stations for use with communications satellites, communications satellite systems and components (antennas, transponders), scientific satellites.

Communications – solid state radio relay equipment for various systems, multiplex equipment, microwave components (circulators, antennas, filters).

Defence Systems - digital to video displays for commercial and military applications, logic circuits for interfacing displays with computers, solid state, low cost greater reliability digital circuits.

Broadcast & Instructional Systems - FM equipment, TV antennas and filters, instructional technology.

3.2 Electronic Components Division

Until recently this Division has been primarily a marketing division whose main function has been to market in Canada components and devices designed elsewhere and manufactured either in Canada or in the U.S.A. However, in recent years an Advanced Development group has been set up with a mandate to develop products for new business areas.

Working closely with the Research Laboratories, advanced development work is being conducted on products for two new business areas, namely:

Science and education kits for schools and colleges - development of kits to teach and demonstrate lasers, optics, semiconductors, mathematics, electronics, etc.

Semiconductor devices - for application to detection of nuclear, infra-red and optical radiation.

3.3 Consumer Electronics and Appliances Division

Although this Division is concerned primarily with manufacturing and marketing of TV's, stereos, radios and tape recorders it is becoming increasingly necessary to perform development on areas such as improved reliability circuits, adaptation of TV (for export) to European systems, advanced design (solid state) of stereo systems and a complete systems approach to manufacturing techniques and processes.

The expenditures on Development over the 5-year period ending in 1967 by RCA Limited are shown in Table 2. Some representative accomplishments of these development programmes are listed in Table 3.

RESEARCH LABORATORIES - RCA LIMITED

	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968
CONTRACTS													
Canadian Government		64.0	169.0	345.0	359.0	367.0	404.0	450.0	463.7	625.0	368.1	243.0	406.6
Other		10.0	20.0	52.0	69.0	231.0	262.0	160.0	253.2	306.4	284.4	465.5	824.0
COMPANY & COST SHARING													
RCA	30.5	145.0	71.0	60.0	140.0	88.0	93.0	112.0	154.0	173.3	207.8	270.5	229.8
DIR							14.0	137.0	190.0	134.3	184.0	141.3	217.3
TOTAL (units of $1,000)	30.5	219.0	260.0	457.0	568.0	686.0	773.0	859.0	1060.9	1239.0	1044.3	1120.3	1677.7

TABLE 1 - Dollar volume growth and source of funds of Research Laboratories, RCA Limited, Montreal, Canada

(In thousands)

	1963	1964	1965	1966	1967
Communications (Satellites, earth stations, microwave, broadcast)	1,381	2,017	1,994	1,705	2,204
Defence & Digital to Video Converters	575	512	494	415	670
Consumer Electronics & Others	18	-	7	47	87
TOTAL	1,974	2,529	2,495	2,167	2,961

Table 2 - RCA Limited 5-year development expenditures

Table 3 - Accomplishments of development programme

- The design and production of a complete ILS system for the Department of Transport.
- The design and supply of Canada's first FM broadcast stations in Montreal and Toronto.
- The design and supply of Canada's first wideband, long haul, CCIR line-of-sight microwave equipment - and the later supply and installation of the equipment from coast to coast.
- The design and supply in 1962 of a solid state wideband transponder for the RELAY communications satellite for the National Aeronautics & Space Administration.
- The design and supply of Canada's first and only operational Communications Satellite Earth Station - which has outperformed, from a reliability and transmission standpoint, other stations of the worldwide Intelsat System.
- The design and supply of the Canadian Electronics Industry's first complete satellite - ISIS-I.
- The design and supply of Canada's first, all solid state, wideband, line-of-sight microwave equipment.

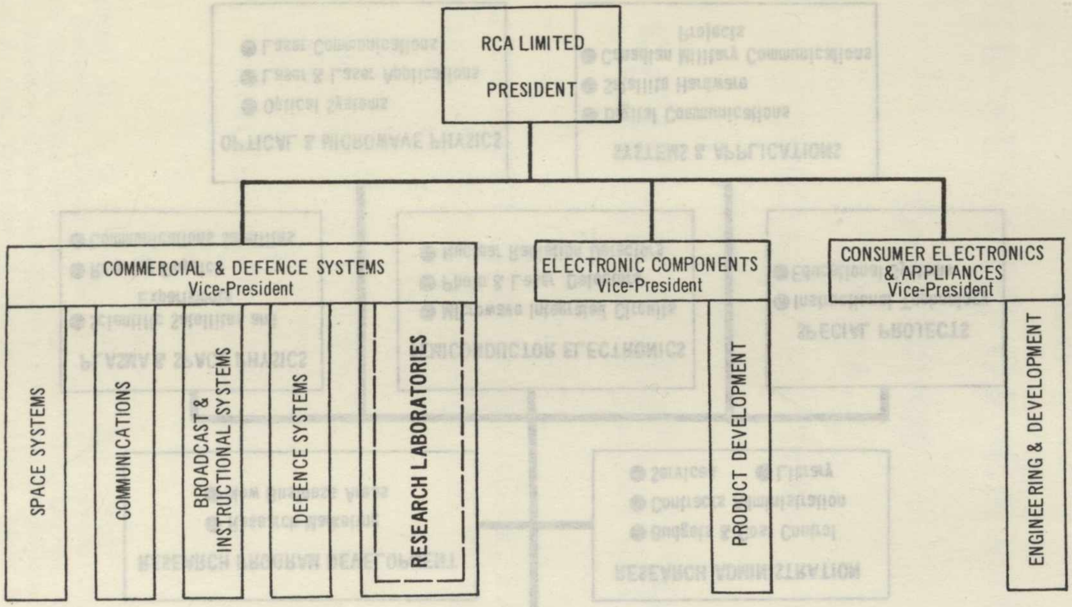

Figure 1 – Organizational structure of RCA Limited showing only those parts which perform research (=) and development.

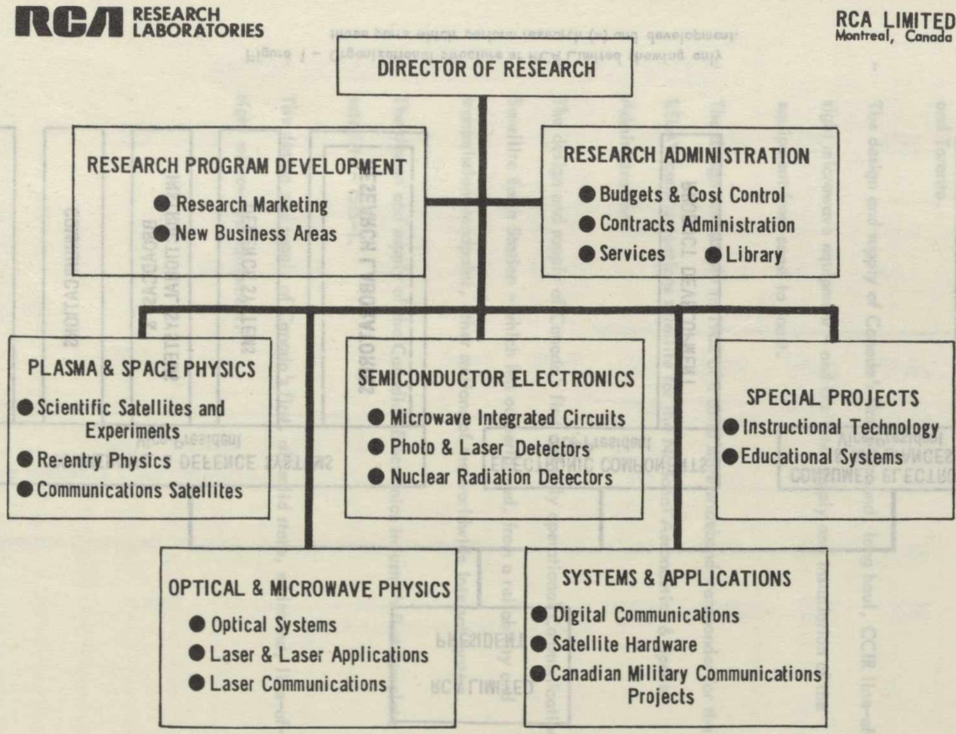

Fig. 2 - Organization and functions of Research Laboratories
RCA Limited, Montreal, Canada

First Session—Twenty-eighth Parliament

1968-69

THE SENATE OF CANADA

PROCEEDINGS

OF THE

SPECIAL COMMITTEE

ON

SCIENCE POLICY

The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*
The Honourable DONALD CAMERON, *Vice-Chairman*

No. [illegible]

THURSDAY, JUNE [illegible], 1969

WITNESSES:

Chemcell Limited: Dr. J. C. Clunie, Consultant and Former Technical Director, Dr. J. P. Sutherland, Manager, Commercial Development, Chemicals Division; Mr. C. O. Edge, Vice-President, Corporate Development, Dr. Luis Monton, Technical Director, Fibres and Films Division; MacMillan Bloedel Limited: Dr. Lionel A. Cox, Director of Research; Abitibi Paper Company Limited: Dr. R. M. Dorland, Director of Technical Development.

APPENDICES:

165.—Brief submitted by Chemcell Limited
166.—Brief submitted by MacMillan Bloedel Limited
167.—Brief submitted by Abitibi Paper Company Limited

29685—1

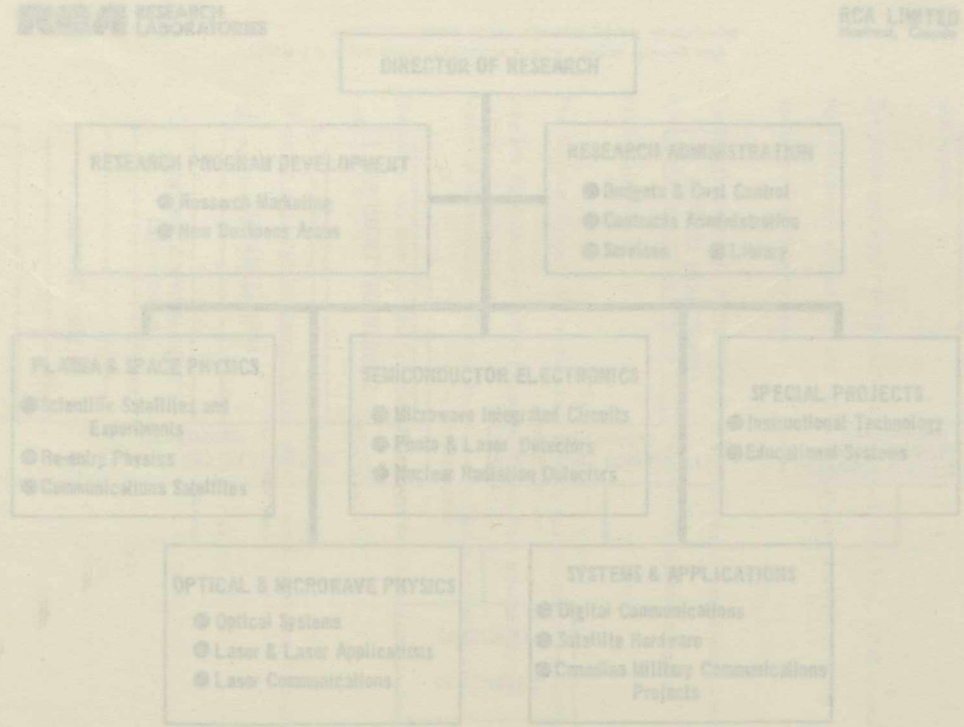

Fig. 2 – Organization and functions of Research Laboratories
RCA Limited, Montreal, Canada

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THE SENATE OF CANADA

PROCEEDINGS

OF THE

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ON

SCIENCE POLICY

The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*
The Honourable DONALD CAMERON, *Vice-Chairman*

No. 69

THURSDAY, JUNE 19th, 1969

WITNESSES:

Chemcell Limited: Dr. J. C. Clunie, Consultant and Former Technical Director, Dr. J. P. Sutherland, Manager, Commercial Development, Chemicals Division; Mr. C. G. Edge, Vice-President, Corporate Development, Dr. Luis Monton, Technical Director, Fibres and Fabrics Division; MacMillan Bloedel Limited: Dr. Lionel A. Cox, Director of Research; Abitibi Paper Company Limited: Dr. R. M. Dorland, Director of Technical Development.

APPENDICES:

165.—Brief submitted by Chemcell Limited
166.—Brief submitted by MacMillan Bloedel Limited
167.—Brief submitted by Abitibi Paper Company Limited

20662—1

MEMBERS OF THE SPECIAL COMMITTEE

ON

SCIENCE POLICY

The Honourable Maurice Lamontagne, *Chairman*

The Honourable Donald Cameron, *Vice-Chairman*

The Honourable Senators:

Aird	Grosart	Nichol
Belisle	Haig	O'Leary (*Carleton*)
Blois	Hays	Phillips (*Prince*)
Bourget	Kinnear	Robichaud
Cameron	Lamontagne	Sullivan
Carter	Lang	Thompson
Desruisseaux	Leonard	Yuzyk
Giguère	McGrand	

Patrick J. Savoie,
Clerk of the Committee.

ORDERS OF REFERENCE

Extract from the Minutes of the Proceedings of the Senate, Tuesday, September 17th, 1968:

"The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That a Special Committee of the Senate be appointed to consider and report on the science policy of the Federal Government with the object of appraising its priorities, its budget and its efficiency in the light of the experience of other industrialized countries and of the requirements of the new scientific age and, without restricting the generality of the foregoing, to inquire into and report upon the following:

(*a*) recent trends in research and development expenditures in Canada as compared with those in other industrialized countries;

(*b*) research and development activities carried out by the Federal Government in the fields of physical, life and human sciences;

(*c*) federal assistance to research and development activities carried out by individuals, universities, industry and other groups in the three scientific fields mentioned above; and

(*d*) the broad principles, the long-term financial requirements and the structural organization of a dynamic and efficient science policy for Canada.

That the Committee have power to engage the services of such counsel, staff and technical advisers as may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to examine witnesses, to report from time to time, to print such papers and evidence from day to day as may be ordered by the Committee, to sit during sittings and adjournments of the Senate, and to adjourn from place to place;

That the papers and evidence received and taken on the subject in the preceding session be referred to the Committee; and

That the Committee be composed of the Honourable Senators Aird, Argue, Bélisle, Bourget, Cameron, Desruisseaux, Grosart, Hays, Kinnear, Lamontagne, Lang, Leonard, MacKenzie, O'Leary (*Carleton*), Phillips (*Prince*), Sullivan, Thompson and Yuzyk.

After debate, and—
The question being put on the motion, it was—
Resolved in the affirmative."

20662—1½

Extract from the Minutes of the Proceedings of the Senate, Thursday, September 19th, 1968:

"With leave of the Senate,

The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That the name of the Honourable Senator Robichaud be substituted for that of the Honourable Senator Argue on the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—

Resolved in the affirmative."

Extract from the Minutes of the Proceedings of the Senate, Wednesday, February 5th, 1969:

With leave of the Senate,

The Honourable Senator McDonald moved, seconded by the Honourable Senator Macdonald (*Cape Breton*):

That the names of the Honourable Senators Blois, Carter, Giguère, Haig, McGrand and Nichol be added to the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—

Resolved in the affirmative.

ROBERT FORTIER,
Clerk of the Senate.

MINUTES OF PROCEEDINGS

THURSDAY, June 19, 1969.

Pursuant to adjournment and notice the Special Committee on Science Policy met this day at 8.00 p.m.

Present: The Honourable Senators Cameron (*Vice-Chairman*), Belisle, Blois, Bourget, Carter, Haig, Robichaud and Yuzyk—8.

In attendance: Philip J. Pocock, Director of Research (*Physical Science*).

The following witnesses were heard:

CHEMCELL LIMITED

Dr. J. C. Clunie, Consultant and Former Technical Director.
Dr. J. P. Sutherland, Manager, Commercial Development, Chemicals Division.

Mr. C. G. Edge, Vice-President, Corporate Development.

Dr. Luis Monton, Technical Director, Fibres and Fabrics Division.

MacMILLAN BLOEDEL LIMITED

Dr. Lionel A. Cox, Director of Research.

ABITIBI PAPER COMPANY LIMITED

Dr. R. M. Dorland,
Director of Technical Development.

(*A curriculum vitae of each witness follows these Minutes*)

The following are printed as Appendices:

No. 165—Brief submitted by Chemcell Limited.

No. 166—Brief submitted by MacMillan Blodel Limited.

No. 167—Brief submitted by Abitibi Paper Company Limited.

At 10.05 p.m. the Committee adjourned to the call of the Chairman.

ATTEST:

Patrick J. Savoie,
Clerk of the Committee.

CURRICULUM VITAE

Clunie, John Cameron, O.B.E., B.A., M.A., D.Phil. (Oxon), F.C.I.C.: Dr. Clunie was born in Sarnia, Ontario in 1918. His studies at the University of Western Ontario were interrupted by World War II in 1939. With the Royal Canadian Engineers, he rose to the rank of Colonel, and was awarded an O.B.E., Croix de Guerre, Ordre de Leopold, and was mentioned in dispatches. In 1946, Dr. Clunie resumed his academic studies, at Balliol College, Oxford, and graduated as a Rhodes Scholar in 1951. The five years following were spent with the Defence Research Board, as Acting Superintendent, Biological Research Laboratory, Kingston and as Secretary in Ottawa. In 1956, Dr. Clunie began his association with the Celanese group of companies. From 1956 to 1963, he was responsible for research and product development in what is now the Chemical Division of Chemcell Limited. After two years in the Central Research Laboratories of Celanese Corporation in Summit, New Jersey, Dr. Clunie returned to Chemcell as Vice President and Technical Director of the Canadian Celanese Division. In May, 1969, he accepted the position of Vice President Research with Radiation Research Corporation, in Stamford, Connecticut. During his years in Canada, Dr. Clunie served on the Research Advisory Panel of the Pulp and Paper Research Institute, as Chairman of the Chemical Economics Division of The Chemical Institute of Canada, and as a member of the Editorial Board of "Science Forum" magazine. He is a member of professional societies in Canada and the United States concerned with chemicals and textiles.

Cox, Lionel Audley, BA., M.A., Ph.D., F.A.A.A.S., F.C.I.C.: Dr. Cox was born in Winnipeg, Manitoba in 1916. He received the B.A. (1st Class Honours in Chemistry) in 1941 and the M.A. in Chesmistry and Physics in 1943 from the University of British Columbia. In 1946 he received the Ph.D. in Physical-Organic Chemistry from McGill University as a student of the Pulp and Paper Research Institute of Canada. He was a teacher of mathematics and science at the University School, Victoria, B.C. from 1935-40 and a lecturer in chemistry at the University of British Columbia in 1943-44. From 1941 to 1944 Dr. Cox was retained as Chief Chemist and Consultant by the Sidney Roofing and Paper Company Ltd., Victoria, B.C. He joined American Viscose Corporation at Marcus Hook, Pa. in 1946 as a Research Chemist and was named Senior Research Chemist in 1951. In 1953 he was appointed Vice-President and Director of Research for Johnson & Johnson Ltd., Montreal, P.Q. After eight years he was transferred to Personal Products Company, a Division of Johnson & Johnson, in Milltown, N.J. as Vice-President and Director of Research & Engineering. In 1965 Dr. Cox joined MacMillan Bloedel Limited as Director of Research. He is a Fellow of the American Association for the Advancement of Science, the Chemical Institute of Canada and the Chemical Society (Great Britain). He is Member of the Engineering Institute of Canada, Society of Chemical Industry, American Chemical Society and its Division of Cellulose, Wood and Fiber Chemistry, British Board and Paper Makers' Association, Technical Association of the Pulp and Paper Industry, Canadian Pulp and Paper Association (Technical Section and Research Committee), Forest Products

Research Society, The Fiber Society, The Textile Institute, Canadian Research Management Association and Society of Sigma XI. He is also a Member of the National Advisory Committee on Forest Products Research for the Department of Fisheries and Forestry, Ottawa, and a Member of the Board of the British Columbia Research Council, Vancouver. Dr. Cox has published about 40 papers in scientific and trade journals and some privately. He is listed in the American Men of Science (11th Edition, 1967) and Who's Who in Commerce (15th Edition, 1968).

Dorland, Rodger M.: Born 1913 in Wellington, Ontario. Pickering College, The University of Western Ontario, B.A. 1935, honours chemistry; Division of Industrial and Cellulose Chemistry, McGill University, Ph.D. 1939; Executive Program in Business Administration, Graduate School of Business, Columbia University, 1962. Masonite Corporation, Laurel, Mississippi, 1939 Research Chemist, 1943 Assistant Director of Research. Abitibi Paper Company Ltd., 1947 Director of Research, 1966—Director of Technical Development. Past-chairman of the Research Committee, Technical Section, Canadian Pulp and Paper Association; past-member of the Advisory Panel to the Pulp and Paper Research Institute of Canada; past-chairman of the Technical Section, Canadian Pulp and Paper Association; Director, Technical Association of the Pulp and Paper Industry; Director, Sheridan Park Association; Member, Managing Board, Canadian Research Management Association.

Edge, C. G., B.Sc. (Econ.), F.S.S, F.I.S, R.I.A.: C. G. Edge was born in England, graduated in Economics and Statistics from London University, and came to Canada in 1951. From 1938 to 1939 he was in the Board of Inland Revenue; 1939 to 1946 served in the British Army in several theatres; and from 1946 to 1951 he was a higher executive officer in the Board of Trade, London, England. He joined Canadian Industries Limited in 1951, serving in the Chemical Division until 1956. At that time he joined Canadian Chemical & Cellulose Company, Ltd. as Manager of Financial Analysis. He was Assistant Treasurer of Chemcell Limited on international operations from 1959 to 1962. He then served as Assistant to the Chairman of the Board of Chemcell Limited and Columbia Cellulose Company, Limited, and from 1966 as Director of Management Services, Director of Corporate Development, and more recently, Vice-President, Corporate Development, for Chemcell Limited. He is also President of Trans-Canada Computer Utility Ltd. He is a Director of the Society of Industrial Accountants and Chairman of their Research Advisory Committee, and is a member of the Financial Executives Institute, the Canadian Operations Research Society, and the Operations Research Society of America. He has published books and articles on capital budgeting and management science in relation to management problems.

Monton, Luis Gonzaga, Dipl. Ing. Chem. E.T.H., Dr. Tech. Sci., F.C.I.C., P. Eng.: Dr. Monton was born in Barcelona, Spain, on December 30, 1923. He moved to Switzerland in 1938 where he received his secondary and university education. He obtained his Bachelor Degree in Chemical Engineering in 1948 and his Doctorate in Technical Science in 1950, both at the Switzerland Federal Institute of Technology (E.T.H.) in Zurich, Switzerland. After completing his studies, he worked for one year as Research Chemist in the Pharmaceutical

Division of Ciba Limited, Basle, Switzerland. In 1951, he immigrated to Canada. From 1951 to 1956, he worked as Research Chemist on polymer and synthetic coatings at the Central Research Laboratory of Canadian Industries Limited at MacMasterville, Quebec. From 1956 to 1958, he held a series of technical positions at the Fibres Division of Canadian Industries Limited at Millhaven, Ontario, where he was primarily concerned with process and product research and development work on polyester and nylon fibres. The Fibres Division was incorporated in 1963 as Millhaven Fibres Limited and Dr. Monton became Technical Manager of that company in February 1967. In October 1968, when the management responsibilities for Millhaven Fibres Limited were passed on to Chemcell Limited, Dr. Monton was appointed to his present position of Technical Director, Fibres and Fabrics Divisions in Chemcell. He is a Fellow of the Chemical Institute of Canada and a Member of the Professional Engineers of the Province of Ontario.

Sutherland, J. P., B.A.Sc., Ph.D.: Dr. Sutherland was born in Rossland, British Columbia, October 10, 1934. Education: University of British Columbia (B.A.Sc. in Chemical Engineering 1956, Athlone Fellow 1956-58); Imperial College, London University (Ph.D. in Chemical Engineering 1959). After graduating, Dr. Sutherland returned to Canada and joined the Chemical Engineering Section of the Division of Applied Chemistry, National Research Council, Ottawa, where he worked until 1965. In 1962-63 he was a part-time lecturer in Chemical Engineering at Queen's University, Kingston. In 1966, Dr. Sutherland became head of the Piloting Section of the Research Department of Chemcell's Chemical Division at Edmonton. In 1969 he moved to Montreal, where he is Director of Commercial Development for the Chemical Division. Dr. Sutherland is a director of the Canadian Society for Chemical Engineering and an associate member of the American Institute of Chemical Engineers.

THE SENATE

SPECIAL COMMITTEE ON SCIENCE POLICY

EVIDENCE

Ottawa, Thursday, June 19, 1969.

The Special Committee on Science Policy met this day at 8 p.m.

Senator Donald Cameron (*Vice-Chairman*) in the Chair.

The Vice-Chairman: Honourable senators, if you will come to order we will proceed. Senator Lamontagne, our Chairman, is otherwise engaged this evening, so I shall pinch hit for him.

We have with us this evening the following delegations. From Chemcell Limited: Mr. C. G. Edge, Vice-President, Corporate Development; Dr. J. C. Clunie, Consultant and former Technical Director; Dr. J. P. Sutherland, Manager, Commercial Development, Chemicals Division; and Dr. L. Monton, Technical Director, Fibres and Fabrics Division.

From MacMillan Bloedel Limited: Dr. Lionel A. Cox, Director of Research.

From Abitibi Paper Company Ltd.: Dr. R. M. Dorland, Director of Technical Development; Mr. J. B. Papoe, Vice-President, Research and Engineering; and Mr. W. Stanley Rothwell, Senior Vice-President.

Gentlemen, we would like you to give a brief summary of your presentations, and then we will throw the meeting open for questioning. If any of you would like to have others of your own team deal with part of it, as long as it is kept brief, they may do so. During the discussion, the questions may be rather general, so I think we shall have the three presentations and then the questions. The briefs have been distributed and read.

Dr. J. C. Clunie, Consultant and Former Technical Director, Chemcell Limited: Honourable senators, you have received our brief, which is a brief brief, I think, or, at least, we have tried to keep it that way. Perhaps in summary I could just say a few summarizing remarks.

I think the first important thing about our brief is that it represents the views of a multi-national company with a large minority Canadian interest. It is in the petrochemical and synthetic fibre business, which are exposed to world competition and the economies of scale which do not favour Canadian location. About 20 per cent of our output is exported. Our basic research in both chemicals and fibres is undertaken in the United States, and we in Canada carry out applied research, especially process research but no basic research.

Chemcell, at the moment, has the opportunity to diversify into areas of business which are viable as far as Canada is concerned; this is our ambition. Therefore, we are anxious to develop an innovative capability over the long haul, particularly in areas of business different from those we are now in, areas perhaps more specifically oriented to Canadian goals and objectives. To this end we believe a basic need is the identification and commitment to national business and economic goals which are reinforced with compatible national science policy objectives.

These are resounding words, but I am sure you will hear them from all of us tonight.

We believe that industry alone will not have the resources to foster such a program, and that these will need reinforcing by Government grants.

We believe that the incentive scheme for research and development should be simple, and we have suggested that annual grants equal to 25 per cent of all R & D capital and current expense outlays would be the sort of solution we had in mind.

Furthermore, we suggest that the definition of R & D be broadened to include the full scope of innovation as far as commercialization. I think all three companies here tonight stress this point, which is becoming increasingly important. It is for this reason that we have suggested that there be an investment tax credit on new production facilities. It will also restore some of the competitive disadvantage versus other countries.

In addition, we have suggested that present "Canada only" restrictions on the reporting of research work and initial exploitation of its results be minimized.

Furthermore, when the above general incentives are supplemented by funds for mission-oriented programs in support of national science goals, we suggest that these be allocated by a system of grants and contracts administered as is the present IRAP of the National Research Council, of which we think very highly.

Essentially, Mr. Chairman, that is the gist of our brief.

The Vice-Chairman: Does any other member of your team wish to make a contribution at this time?

Dr. Clunie: No, I do not think so.

The Vice-Chairman: Then, we shall hear next from Dr. Lionel A. Cox, who is the Director of Research of MacMillan Bloedel Limited.

Dr. Lionel A. Cox, Director of Research, MacMillan Bloedel Limited: Honourable senators, MacMillan Bloedel Limited is the largest forest products company in Canada. Our total income for 1968 was $584,490,606. We are in all aspects of forest products such as wood products, pulp and paper products, packaging products, and logging. Our markets are largely export markets. 76 per cent of the products we manufacture are exported, and the rest stay in Canada.

We are also in the coastal shipping business owning tugboats, rail barges, and chartering deep sea vessels.

Our brief is concerned mainly with research and its commercial exploitation. We feel that the principal reason for doing research and producing technology is to enable Canada to compete in world markets, particularly in respect of exports, and to aid in the economic growth of Canada. If this is the basic objective of a science policy for Canada then we feel that the federal Government and its agencies should help us achieve those economic goals.

I have outlined in my brief what I call the total innovation process, which Ithink has been mentioned many times in this committee. I have put it into a schematic form, which I think clearly illustrates that research and development produce technology, like going out and finding a mineral deposit or an oil well. In other words, I think you should look at research simply as exploration. Now, the making o fmoney, the production of commercial exports, progress, and increased employment in Canada will come about if this technology is exploited. I do not believe that we have exploited technology in Canada as we should. To exploit research you need risk capital and market research, and you need a lot more economic knowledge. As Chemcell mentioned, this is one of the aspects that we would like to see encouraged.

On page 8 of the brief we make two recommendations. We recommend that any incentive program for a Canadia science policy to assist industry must consider all the steps in the "Total Innovation Process" and not just the R & D segment of it, important as that is.

We also recommend that the Government encourage and reward industrial entrepreneurship which assists companies through the critical, expensive, and time-consuming steps of exploitation and commercialization of improved and new products and processess, just as they do for the mining industry.

On page 9 the brief examines the present federal Government research and development incentives. We mention the National Research Council's assistance program called IRAP. We think that it is a good one. In fact, we think that it is an excellent incentive, but it should have no strings attached to it regarding increasing the size of the staff. Right now it helps you to build up your research lab, but once it gets to a certain size then the grant ceases.

The IRDIA grant, which is the tax incentive grant, is a good one so far as capital is concerned. They give you a 25 per cent tax free grant for capital expenditures. We think that this is good, but we would like to see it extended to operating expenditures as well, and on page 10 we have two recommendations.

A second proposal we would like to make is that the administration of IRDIA be reviewed and simplified. It costs us almost as much as it is worth, in some cases, to get an application prepared:

At the bottom of page 10 and over on to page 11 we mention PAIT. We feel that PAIT has been an unfortunate method of encourageing research. We would like to see its interest rates reduced or eliminated since they can run as high as 15 per cent. We would like to see the terms of reference braoadened to include exploitation in foreign countries and free exchange of information with foreign parent companies, which was mentioned by Chemcell. If a patent is a tangible asset, then we feel that we should be able to sell that patent anywhere in the world. This will bring money into Canada.

We would like to see the PAIT application simplified. I have been through one, and the money it cost us, and what it cost the Government, makes us feel that we may not entertain another PAIT loan again. On page 12 I give two suggestions. One is that a so-called "tax holiday" be given for a limited time only to Camadian companies which have discovered and patented in Canada successful R & D work that will lead to new Canadian jobs or to increased exports, and so forth. We feel that this would be a real incentive for us to bring forth more research.

We also recommend that a "National Technology Bank" be established by the National Research Council to assist in obtaining needed technology from anywhere in the world which can be exploited and commercialized by Canadian industry.

I worked for 15 years in the United States. I am a returned Canadian. I found that the Americans seem to know how to go around the world pick up technology, and bring it back and exploit it in their own country. We do not do as good a job and the objective here is to try to see what we can do to improve this particular aspect of research.

Another important thing that we think the Goveornment can do is to set up "contract research". At the bottom of page 13 we make two recommendations. We recommend that the federal Government establish a contaract research system similar to the United States system for all major Canadian national programs. We also recommend that the National Research Council be the Government agency for co-ordinating this type of contract research. I think that this is most important.

On page 17, of my brief I have mentioned something about contract research, and recommend that advanced development work bo done by industry and sponsored by the Government under a "Contract Research System". I think that if the Government did this it would certainly help to bring many research projects to a successful economic conclusion.

In respect to federal agencies and departments, we are very fortunate. We have an excellent relationship with the Forest Research Laboratory in Victoria, and the Forest Products Research Laboratories in Ottawa and Vancouver. They have set up good programs. They have a Research Program Committee and a National Advisory Committee, of which I am a member. Through these two committees we maintain a good liaison with these mission-oriented Government laboratories. So, my recommendation on page 15 is that all Government research laboratories have on their advisory boards appropriate industrial research managers with a strong voice at the policy-making level.

I believe we do help the Forest Products Laboratories in becoming more closely associated with industry. We also help them in becoming more economically minded.

On page 16 we discussed federal Government intramural research. It is MacMillan Bloedel's opinion that government laboratories should not carry out development work which requires close cooperation with manufacturing and marketing people in a particular industry. Therefore, we recommend that advanced development work be done only by industry and *sponsored* by government under some "contract research system" which should be developed by the government.

On page 18 we give some reasons why the return on investment from research is low in Canada. I think this is because we do not have a good enough patent system nor a good enough understanding of methods for collecting royalties. We are really too conservative in Canada. We must look at patents as assets and set up systems for selling them and our technical know-how. This is what many European countries do. Our last point, which you asked about, is the relationships between universities and industry. I should like to refer to a recent article published in "The Decisive Years". Vol. 7, 1969, pp. 4-9 by the Dean of Science at York University, Toronto, Dr. Harold I. Schiff. In that article he said:

> We science professors are a bunch of inbred snobs! We make sure that nothing we teach is contaminated by the outside world. This is because few of us have ever been inside an industrial laboratory. We therefore cover our ignorance by assuming the self-righteous attitude that only 'pure' science is respectable. Any possible application immediately renders it unfit for undergraduate consumption.

Note that last part. I think that the relationship between the universities and industry in Canada is weak and very ineffective. The best thing that has happened recently has been the National Research Council coming out with a modification to their IRAP program, which allows Canadian university professors to be hired by industry and the consulting fees to be charged to the IRAP program. This is an excellent step made by the Government to try to bring universities and industry together.

Senator Haig: Would your company be prepared to do that?

Dr. Cox: We have already hired three of these gentlemen. I have two professors taken on recently from U.B.C. and one from the University of Saskatchewan. We are going to extend this. We think it is excellent, because the professors get into industry and learn how industry operates; they learn how our project system works and this industrial research exposure makes them better teachers. I do not think our professors know enough about how industrial research laboratories operate.

Senator Robichaud: You have hired them for what period?

Dr. Cox: These men are on annual grants, so they will be with us indefinitely, as long as they feel it is worthwhile.

Senator Haig: Do you take undergraduates too?

Dr. Cox: We have taken on twelve summer students in our laboratory this year. Our laboratory consists of 127 people, and is the largest laboratory of its type in Western Canada.

Senator Haig: What disciplines are these students in? Are they in forestry?

Dr. Cox: The professors we have hired are all in the department of chemistry.

Senator Haig: What about the students?

Dr. Cox: Our students are physicists, chemists, forestry, mechanical and chemical engineers.

The last recommendation in our brief is that the Government consider other methods of encouraging university scientists and engineers to collaborate with industrial scientists and engineers, if only for the purpose of developing a two-way educational process, which is so necessary in the development of technical people of value to industry and to Canada.

I am sorry my verbal submission has been a little long, sir.

The Vice-Chairman: Next we will hear from Dr. R. M. Dorland, Director of Technical Development of the Abitibi Paper Company.

Dr. R. M. Dorland, Director of Technical Development, Abitibi Paper Company Limited: Mr. Chairman, honourable senators: we are most grateful for this opportunity to appear before you. Our views are very similar to what you have just heard from Dr. Cox, which perhaps is not unnatural because we are in the same kind of business. We have submitted a brief, and rather than attempt to summarize it and merely repeat the things that Dr. Cox has mentioned I should like, with the permission of the chair, to read a short prepared statement outlining my own views on industrial research and development, particularly as it relates to the company I represent.

Whatever the economic, moral or social responsibilities may be of any business, the role and goal of the industrial research and development arm to me is very clear and simple. It is simply to make a dollar, either in the form of additional revenue for the company or to maintain the economic viability of the business operation. This requires three ingredients: facilities, people and programs, in that order.

Today only good facilities will attract good people, and it goes almost without saying that good programs are possibly only with good people. Parenthetically I should like to say I am certain that our own research facilities would not now be located in the attractive Sheridan Park Research Community without the existence of the federal incentives in aid of research of previous years.

You have heard a good deal about science, science policy and research and development. Scientists are said to have a passion for precision, and I should like to indulge in some definitions in relation to scientific matters within the industrial sector and within my industry. I should like you to consider the three words research, development and innovation.

Research to me is descriptive of the process of searching and researching for understanding and knowledge. It seeks to answer the why and provides the foundation for the development aspect. Thus I regard development as the application of knowledge to the solution of a problem. This is the "how" phase, and may or may not have any economic significance.

This brings us to the word "innovation". I define "innovation" as taking knowledge, developing it into a new product or process and successfully introducing it into the business economy. Thus innovation is a process involving technological skills, managerial skills, financial resources and market intelligence, and above all involving risk. Risk-taking decisions are made by top management. Thus by my definition research per se can really do little to satisfy human needs, except the human thirst for knowledge. Development per se can do little more, and it is only when successful innovation has played its role that the business economy and the economic well-being of a nation improve.

Rewards for risk-taking, therefore, appear to emerge as the single most significant factor in the role that scientists can play in the economic growth of this country. A more carefully planned encouragement of innovation will lead to far more relevant development activity, and this in turn will lead to—indeed demand—new knowledge of the highest order, with a direct pertinence to innovation goals.

If I may, I would like to turn to a specific aspect of Abitibi research and development. I hope we take some justifiable pride in the fact that this Canadian company has subsidiaries in the United States with five manufacturing mills, and we are currently building a sixth. At Sheridan Park we carry out all the research for these United States subsidiaries. Much has been said in the light of American-owned subsidiaries in Canada, but here is the reverse situation. The Canadian Government answers this by saying that the money spent on behalf of the foreign subsidiaries cannot be allowed as a research expense in calculating IRDIA grants, indeed, it also allows fifty per cent of the general research done on the basis it might be useful to be foreign subsidiaries.

Research is not cheaper to do in Canada. We pay for tools of our trade, enough to more than offset the fact that salaries are somewhat lower here. If the cost of doing such work in Canada does not become more attractive then I suggest, in our own company, we will face a very real possibility of some of our people and equipment moving south of the border, and the loss of a significant part of our Canadian-based research operation. Thank you.

The Chairman: Thank you Dr. Dorland. I think that the presentations this evening have been short, sharp and to the point. We are grateful to you for putting it in that form. Tonight, the inquisitors were to be Senators Carter, Belisle and McGrand, but Senator McGrand is not here this evening. Senator Carter, you may lead off. I believe that Senator Belisle has received marching orders to leave early. If you can open the discussion we will then switch to Senator Belisle so he can get away and obey orders like a good soldier.

Senator Carter: I should like to second your comments about the brevity of the brief, Mr. Chairman. It is one very delightful aspect of the brief we have tonight, as compared to some we have had on previous sittings. I should like to start by asking each of the three companies here if they would give the committee some idea of approximately what their research would be for an average year, in dollars.

Dr. Cox: For MacMillan & Bloedel it is $2.12 million.

Dr. Dorland: For Abitibi we spend $1.35 million.

Dr. Clunie: For Chemcell it is $2.7 million.

Senator Carter: What is that in terms of your sales or assets?

Dr. Clunie: This would be on sales of $120 million—roughly $121 million. It is approximately 1.7 or 1.8 per cent of sales in our case.

Senator Carter: Would the percentage be constant for the other companies?

Dr. Dorland: No, sir, ours would be about 0.53 per cent of sales.

Dr. Cox: Ours is about 0.36 per cent. This figure has little meaning except for comparing R & D expenditures with other companies and industries. In a particular industry one must consider the purpose of the above research effort and the value to the company concerned.

Senator Carter: I take it that this would all be applied research and very little basic research.

Dr. Cox: Yes, but we do take a basic approach to solving some industrial technical problems.

Senator Carter: Can you not draw very much distinction between the two?

Dr. Cox: Yes, we do mainly applied research.

Senator Carter: All three of your briefs have stressed that more emphasis should be put on the development aspect of research and more particularly what you call innovation. I think Dr. Cox has called it the "total innovation process". I get the impression from your brief that you are more or less looking upon R & D as a goal in itself. Is that correct?

Dr. Dorland: No, sir, speaking for myself.

Dr. Clunie: The research is true.

Dr. Dorland: Our desire is to use the results of research.

Senator Carter: You are asking us to focus our emphasis more on R & D.

Dr. Cox: If you look at my chart on figure I—I am asking you to emphasize the last part of the "total innovation process" and not the first part. I think we are placing adequate emphasis on research and development. But, we should place greater emphasis on "exploitation" which I think is a better word than "innovation".

Senator Carter: That is what I want to come to, because should not the goal be to assist R & D only if the other requirements for successful innovation exist? In other words, you have to be highly selective.

Dr. Cox: I can answer it this way. We are doing quite a bit of research in trying to utilize bark. We have had little trouble coming up with new products. Our research is successful. Therefore, my problem is twofold; one, how to find markets for the new products and second, how to make them economical. One top company in the United States came up to look at our research and told me that MacMillan Bloedel is doing some of the finest research they had seen of this nature, but none of our new products appeared economical—which is true. What Canada needs is more economic and market research studies of its technological developments.

Senator Carter: You think the Government should produce incentives towards market research?

Dr. Cox: Yes, sir, I think it should. We need incentives similar to the mining and the oil industry where research is like the exploration stage. We find the oil well and the mineral deposit, but they are worth nothing in the ground until some company puts up risk capital and starts to find methods to take them out of the ground and to refine them. They can then turn it into valuable products for Canada.

Senator Carter: Where should the initiative come from? You say you have products and all kinds of new products. Your problem is to find markets for them and produce them at a cost at which you would be able to sell them.

Dr. Cox: Right.

Senator Carter: Should not the initiative come from you or should the Government just say, "Well, let us find out who has products and how we can help sell them." How do you get together on that?

Dr. Cox: That is a $64 question.

Dr. J. P. Sutherland, Manager, Commercial Development, Chemicals Division, Chemcell Limited: May I make a comment? Does this not partly require a look at the Canadian economy to see which segments look viable over the long haul. It is obvious that a country very richly endowed in natural resources—we have an economic advantage in all of these. We have much more difficulty in certain segments, such as large bulk chemical businesses where the vast increase in sales and technology relation in the small Canadian market has made it more difficult to develop new plants compared to the Gold Coast or in Japan.

As we go down the road there will be some moving away from it, such as richly endowed resources towards building a good based profitable business. In some ways, we see a blending between national economic goals and identifying those segments which seem to be most viable over the long haul. We endorse science goals which will develop the sort of knowledge needed to exploit these segments, reinforced by business goals with an entrepreneurial exploitation of these segments. That is a different way of looking at it.

Senator Carter: I would like to ask Dr. Cox how he visualizes Government coming in and helping him with his problem. He has got the products but he has not got the markets. Where does Government come in to help him with that problem?

Dr. Cox: There is still an element of risk when a new product is put on the market. What we have suggested is that financial assistance, once given, should not stop with research and development but should carry through until successful commercialization is achieved.

Senator Carter: You are saying Government should share the risk?

Dr. Cox: They should help us to try to exploit new products, if they are good for Canada.

Senator Carter: Who is going to make all those decisions? Who is going to decide that one is a product which can be profitable and another cannot and that therefore support should be given to one and not to the other? Who will make that decision?

Dr. Cox: I guess you would have to have a group, possibly the National Research Council, which could do it. They are technically competent.

Senator Haig: Would any of these companies suggest that you would like a tax incentive or tax rebate on your research and development—and in what way could it be done?

Senator Bourget: Not only on your R and D but on your innovation.

Dr. Cox: Yes, we need tax incentives on the "total innovation process".

Senator Haig: Senator Bourget has added to my question. Can you help us with the answer?

Dr. Cox: As I put it in my brief:

> The Government encourage and reward industrial entrepreneurship which assists companies through the critical, expensive and time-consuming steps of exploitation and commercialization of improved and new products and processes, just as they do for the mining industry.

This is our recommendation.

The Vice-Chairman: Has this been done in any case outside of mining and oil industries in Canada, so far as you know?

Dr. Cox: I do not believe it has.

Senator Bourget: Dr. Cox, has it been done in the United States? They have tax incentives?

Dr. Cox: They have contract research down there—which is another of our company's recommendations. No, they do not have tax incentives as Canada has.

Senator Haig: Do these companies request tax rebate on your research and development cost? Would they request that? Do you think that is fair? We have had recommendations that 150 per cent on the cost of R and D should be forgiven over a period of three, four or five years. Do our companies request that?

Dr. Cox: We certainly recommend it. We are getting it back from IRDIA for capital, and we are suggesting the same 25 per cent for operating expenses.

Senator Bourget: Not only this, Dr. Cox, because if I understand your point, it is the innovation part that costs a lot.

Dr. Cox: Yes, that part costs a lot more than the research.

Senator Bourget: That can cost 75 to 80 per cent, and that is where you are going to need more money and that is where you are going to help Canada and create employment.

Dr. Cox: That is correct.

Senator Bourget: That is the point.

Dr. Clunie: The Chemcell brief shows that we feel that the equivalent of the 150 per cent tax, that is, the 25 per cent grant, based on a moving average as is now given with IRDIA, should now be given without the moving base. We think it is essential to build up a strong technolnogical basis in Canada.

Senator Haig: How long would that take?

Dr. Clunie: I think we have gone a good way towards that now but I think we are losing it. The momentum that we built up in the past few years is beginning to lessen. This base of our increments is now past and is rapidly disappearing.

Most of the major companies have been reaching plateaux and not qualifying for IRDIA.

It is very important that companies in Canada, especially the subsidiaries of American companies, with a strong technological basis, can take the maximum advantage of the technology that will flow in from the large parent company, because we do not have the means to judge its effect, we do not have the means or the people to do it properly in the Canadian context and make the most of it.

How do you get that? One of the best ways of getting it is to make it advantageous to do such research in Canada.

As far as industry is concerned, the only advantageous way is to make it financially attractive. In our view 25 per cent without any moving base, or 150 per cent tax relief, if you like, would make it attractive to maintain and build up the present technological basis that we now have.

But, in addition, we say that the old concept of regarding R and D as an end in itself must go, and we must look at this whole concept of innovation, markets, economics, the whole business is part of it. No matter how good it is in the laboratory, unless you are able to get into the markets and get a profit on it, you are not going to benefit the company or the country.

Senator Blois: You need good research on your product and then you need to be able to sell it by your company when you bring it into production. You have much to do before you get it to that stage. What can be done? It has to be done by your own research people, apart from that of the Government, who are unable to do it. The Government have not the staff to do it, because they do not understand it. If I understand you correctly, you might need help from the Government to do that marketing, and I am speaking from experience when I say it has to be done very much by your own research. How can you do it?

Dr. Cox: Marketing research through our own staff is very very important. We are suggesting that incentives for our R and D be extended through to market research.

Senator Blois: Yes.

Mr. C. G. Edge, Vice-President, Corporate Development, Chemcell Limited: It is particularly important in Canada, on account of the restraints we have to overcome in almost every case, on a losing market. This is important for us, particularly in our juxtaposition to the United States—more so than it is in any other country in the world.

Senator Yuzyk: But we should have an eye on exports, too.

Senator Blois: Yes.

Mr. Edge: But when this is the case of expenditure on market research, the expenditure on market research goes up, and you are a long way from the market.

Dr. Clunie: Another aspect of this, to which I have alluded before, is this. I do not think the Government, whatever they may be, should pick the projects and say those will be the projects. I think it is instead a question of giving us adequate basis of research. I think we are able to do it now and that we have the technological and marketing skills to pick out the things and to follow through. But we need extra incentive to follow through, to combat the pull which exists south of the border, where there are large American companies and because they can say that they have the "troops" down there and that they have the facilities.

Dr. Cox: We want the Government to encourage us to spend this risk capital. The largest amount of risk capital, as Senator Blois has said, is in market research, economic studies, engineering design and the pilot plant.

MacMillan Bloedel Research is building now a $1½ million pilot plant to exploit our new high yield pulp process. That is quite a lot of money to lose, if the project fails. We would like government financial assistance and/or incentives to carry out more projects of this nature.

Senator Haig: Could I ask any one of the groups—Chemcell, MacMillan Bloedel or Abitibi, what is your relationship with R and D with the universities? Do you get any assistance from them or do you ask for assistance from them?

Dr. Clunie: I might answer that first. Perhaps I must speak personally as it is very difficult to speak as a company in this regard. Certainly we do not have a good rapport with universities. I think we live in two different worlds.

Senator Robichaud: Why? We have heard a different statement from other witnesses. Why should you be in two different worlds? Why should you be different from what we have been hearing this afternoon, this morning, and yesterday?

Dr. Clunie: In my view, universities tend to regard industry as the repository of third rate students. If they are first rate, they stay on at the university. If they are second rate they go to the NRC.

Senator Haig: Why doesn't industry go to the universities and help them, if you say that?

Dr. Clunie: I don't think industry can afford to.

Senator Haig: Why not?

Dr. Clunie: They don't have the profits. We are not able to carry the present tax loads, do research, pay 52 cents on the dollar and then put a lot of money into universities.

Senator Yuzyk: How about specific research?

Dr. Clunie: Why not have specific research projects done at universities?

Senator Yuzyk: Yes, with a view to making money.

Dr. Clunie: We want to do that within the company. We want this expertise ourselves. We want to build up our patent position and have people with the know-how whom we can use ourselves. If it is done in the universities, we lose the ability to keep it secret.

Senator Robichaud: You are not looking for co-operation with universities? So many other industries are.

Dr. Clunie: As Dr. Cox has said, we do want to have university professors as consultants. We should like to see Ph.D. students doing their theses work in industry, supervised periodically by professors on problems they are interested in.

Senator Haig: How are you helping them do that?

Dr. Clunie: We are maintaining liaison, especially with engineering schools in periodic meetings, explaining our problems, and we are getting better rapport with them. We have something in Canada called the Canadian Research Management Association, which meets once a year to pursue this end of trying to get industry and universities together.

Senator Haig: That is fine. Now, Dr. Cox, is MacMillan Bloedel working with universities, for example, in forest products? Where are you working with the universities?

Dr. Cox: We are working with the University of British Columbia and the University of Saskatchewan. We are supporting research projects at both those universities and are working closely with professors from both those universities.

Senator Haig: Are you experiencing the rapport, as Dr. Clunie put it, with the universities? Are you bringing university students or undergraduates into your organization and are you sending people from your company into the universities?

Dr. Cox: Anybody in our industry, for example, technicians, wishing to get a university degree can do so under the system we have within our company whereby they can go back to university.

Senator Haig: In other words, there is a rapport.

Dr. Cox: Yes, but the university-industry relationship, as I have already said in my brief, is not good. It is weak. There is not the constant flow back and forth that there should be. We usually chase them. They don't chase us.

Senator Haig: Why isn't it good?

Dr. Cox: It must be clearly pointed out that they live in a different world from industry. The university professor is interested in exploring and understanding the environment in which we live. He does not have the motivation we have to turn things into commerce and into profits. What he is interested in is getting scientific knowledge for the sake of that knowledge.

Senator Haig: We have heard before that the industry does not indicate to the academic group the need for identification with industry. What have you to say to that?

Dr. Cox: I don't think that is correct, because I have had groups of students and professors whom I have invited down to the laboratory, and I have gone over my research program with them. We did that recently with the physics department of the University of British Columbia and I explained to them what we are doing and how we operate. So I think we are doing our share. However, either we are just both too busy or there is some other reason, but there is a barrier which needs to be overcome.

Senator Haig: How are you going to overcome that, Dr. Cox?

Dr. Cox: One way it has already been overcome to some extent is by the particular financial set-up that NRC has recently established, which I think is good. Under this NRC program professors are able to consult for us, and this is bringing about a limited rapport.

Another way is for industry and universities to take more time to get to know each other. However, the university professor's job is, primarily, one of teaching, and, secondarily, one of doing research to make sure he is up to date in order to properly train his graduates. That is his job. You cannot expect him to do industrial research on top of that.

Senator Haig: Dr. Cox, how are you going to get the trained personnel to go into your industry or into Chemcell or into the paper industry unless industry goes into the universities and indicates to them the possibilities of going into industry?

Dr. Cox: We do that. Every year we hire so many students from universities and we explain what our company is about. We invite the students down and they see our industry. In fact, we have students coming through not only from universities but from high school to look at our research laboratories and other parts of our company. This is done on a regular basis.

Senator Haig: Does your industry indicate to the university people what possibilities are obtainable in chemistry, forestry and paper?

Dr. Cox: I would say "yes".

Dr. Dorland: Sir, the Canadian Pulp and Paper Association has a full-time staff member who is known as the manager of academic relations. As a representative of the industry association, he devotes his whole time to generating this better understanding. There is a definite attempt made to show people, both students and professors in universities, what the opportunities are in our industry.

Senator Yuzyk: Does he communicate with NRC, too?

Senator Haig: You are trying to produce students who would be oriented to your industry?

Dr. Dorland: Yes, sir. We would like to encourage students to become interested in a career with the pulp and paper industry.

Senator Belisle: Which is a bonafide intention.

Senator Bourget: But you cannot direct the policies of universities. If we want to be practical, I think perhaps the Government could in that case help, because of its grants and bursaries to students, by telling universities to direct their research into the fields where there could be development and innovation. That is the way to look at it.

Senator Haig: That is what I am getting at.

Dr. Cox: We encourage professors to work in our field. One of the consultants we have at the University of British Columbia is working in the field of trying to make use of wastes from our industry, and this would be of value to us.

Dr. Clunie: I think, in fairness, the Department of Industry has recognized this problem and, over the past two or three years, has set up organizations called industrial institutes at universities. There is one at McMaster, one at Waterloo, on in Nova Scotia and I think there is one at Guelph. But these are small groups whose function is to bring universities and industry together. However, the problem here is that, essentially, industry depends for its success and livelihood on keeping secret and exploiting what it does. The aim of the university professor is to publicize in papers what he is doing. Therefore, the two don't fit together too well, and to do industrial research in universities with all the publicity that that entrails is very difficult indeed. It is much easier the other way round.

Senator Bourget: Having experienced that, could they not keep a certain part of a laboratory secret? Supposing one company went to a university and said it would like them to do some research in a certain field? Could they not keep that secret?

Dr. Clunie: I would say no. We would have students doing this research and writing their theses, and theses are public documents. When a student goes out looking for a job he wants to show he has published as many papers as possible based on his research.

Senator Haig: But so many of these Ph.D's, and we have heard this before, go off on wild ideas which have no relationship to your industry. Now is there no way in which industry could help universities to direct their Ph.D's, to organize them and suggest subjects where industries have a problem.

Dr. Clunie: Yes, and I think that is where the industrial research institutes are the interface between the two.

Senator Haig: Where does industry fit into university direction on Ph.D. work?

Dr. Clunie: It doesn't.

Dr. Cox: We don't fit in. Perhaps we should have something to say about this, but the university, of course, is a separate body.

Senator Haig: I know it is a separate body, but you people in industry have chemistry and physics and other courses available in the university. Could there not be some influence directed towards these people, scientists if you want to call them that, to direct their attention to your probems?

Dr. Cox: I think the only place this is done is at McGill University which is partly tied in with the Pulp and Paper Research Institute of Canada. There they are doing an excellent job in getting basic knowledge which our industry needs. At McGill we do have a good liaison.

Senator Haig: But McGill is not the only university in Canada.

Dr. Dorland: There is another example in the University of Toronto to which we have been subscribing a considerable sum because work is being done there on gaining knowledge in a field that is useful to us.

The Vice-Chairman: If I may interrupt for a moment, I may be wrong, but it seems to me that the main thrust of these three briefs this evening is admirably outlined in Dr. Cox's schematic diagram which puts the emphasis on the production side, and that of course is innovation. I would like to direct the discussion to this aspect of the matter. How do we do this?

Dr. L. Monton, Technical Director, Fibres and Fabrics Division, Chemcell Limited: I would like to add something which might explain why we have in our industry, and I am in the fibres business, some difficulty in relating to the universities. We are doing applied research of a very specific kind which is in practical terms very different from what professors and students of chemistry are interested in. We are doing work trying to develop a polymer that will spin and for this purpose you need equipment which the universities do not have. We are interested in the spinning process and the drawing process and applied research oriented toward the development of a new product, or the improvement of a new product or improving a process for a product or developing a modification thereof. In practical terms we are interested in something which is very different from that which is the main interest of professors and students of chemistry and physics.

Senator Haig: That is exactly the point I wanted to make. You have answered my question. Thank you.

Dr. Monton: There just is not any common basis.

Senator Haig: But why doesn't industry go to a graduate student who is taking his Ph.D and say "Joe Blow, we would like you to take a subject of interest to our industry," and you subsidize him and when he takes his Ph.D he goes into industry.

Dr. Monton: If I may interrupt you, this is partly the result of the approach of the universities in this country. If you think in terms of some technological universities in Europe you will see that some of them in the last 25 or 30 years have had people getting their Ph.D's in, for example, the development of a new dye stuff. Let me quote an example; recently I went to the University of Zurich where there is a complete department with a professor who came from industry and this is the kind of thing he was working on. This does not exist in most universities in this country because industry has not promoted it.

Senator Haig: That is the point I wanted to make.

Dr. Monton: If you want to do this in universities, what you really need is professors who have been in industry and who are interested in these areas and know what the problems are. This is an area that government should try to develop with industry.

Senator Haig: No, not government. It should be done by industry and the universities. I got my point across.

Dr. Monton: It is a practical problem, a practical difficulty.

Senator Haig: All the science policies are practical. What we are trying to get is co-operation between government, industry an the universities. So far as I can see industry has failed in the university sector.

Dr. Cox: Can I put it in this way, that both universities and industry have failed.

The Vice-Chairman: Mr. Sutherland has been trying to get in here for some time, and I am going to put a silencer on Senator Haig for a few minutes.

Dr. Sutherland: Speaking from the point of view of the chemical division I would like to say a word on this, because I feel that co-operation from industry is quite a good point so far as the chemical industry is concerned. We have found in our location in Edmonton that we get very good co-operation from the University of Alberta and also from the University of Saskatchewan. We have arranged for post-graduate programs on all sorts of topics that are of interest to us, and we have supplied them with operating data that they can use in studies in mathematical analyses of the processes. They have published some of these but in some cases have not revealed the details of the information so that our confidentiality is protected, but at the same time the content of the data is available to them and it does allow them to do some work. We have also found that they are only too pleased to come out to our lab and give us courses to up-date our people. This has been done particularly in the engineering area so far, but we anticipate we can extend this into other parts of our company. We have found also that they are quite eager to get our ideas on projects that they can do with their graduate students. We have made in one or two places arrangements where a student who is finishing his M.Sc. project will come and work wih us for the summer and start on some project and will continue this when he goes back to start work on his Ph.D. We have also found in some departments of the university that they are very willing to do joint projects with us. In fact we have a number of these in hand at the moment.

Senator Haig: Do you go to them and ask for help on a particular project or do you submit the project to the university?

Dr. Sutherland: It is working both ways. They have been coming to us and we have been going to them. We have been learning a little more of each other's point of view, each other's potentiality and each other's interest.

Senator Haig: Of course Alberta is a very progressive province. Our vice-chairman is from that province.

Senator Bourget: Mr. Chairman, may I be allowed to ask one supplementary question, because I think we should have an answer that will help us in our report? It is about the universities and graduates, researchers, and everything.

Could this problem be settled by establishing a research institute either on the university campus or centre of excellence, where we could have scientists working on basic research and also have some research men from industry, who would work together and there would be a closer relationship? Would that help? This has been recommended on previous occasions before this committee.

Mr. Edge: It might work. I think it possibly could work, but it depends very much on the attitudes of the three groups, in this case, because you have added a research institute. If the attitudes are right, you may be able to get a fair bit or work done without the institute. There is room for direct contact, but it is probably true the institute could serve as a sort of middle ground where problems of confidentiality could be dealt with without interfering with some of the goals of the university.

Senator Yuzyk: Would you favour such an institute as MIT, in Boston, that we should establish a similar institute in Canada?

Mr. Edge: It is a university, but one that is intensely aware of the implications of the work it is doing. I would be delighted if we could get this attitude more widespread in the universities in Canada.

Senator Yuzyk: MIT has almost—well, not a monopoly in the field, but certainly it is rated very high. Would you favour the establishment of such an institute here in Canada that would be, as somebody mentioned here, the technology bank, where we would have a technological university?

Dr. Cox: I am not in favour of adding to the number of institutes in Canada. After all, we have good universities, and let us extend them and build up something like this within them. I think the universities have to become more practical minded. When I was in the States I used a number of professors from MIT and they are all very practical men. I think maybe our university professors have to get more practical and think about the needs of people rather than just knowledge for knowledge's sake.

The Vice-Chairman: Do you think the contract arrangement might be a substitute for the establishment of a research institute; in other words, by that means allocating money for a university to do a certain piece of work, which could be classified to whatever point was felt necessary? Would this extension of the contracting principle, using universities, or government agencies for that matter, be a practical means of getting this integration of university research people and industry?

Mr. Edge: It could be.

The Vice-Chairman: It has been suggested that might prove useful.

Dr. Cox: I think it would but, again, we have the attitude problem. The universities have to get more industrial minded. Of course, there are professors like Professor Schiff, who is excellent.

The Vice-Chairman: I agree.

Dr. Cox: But they do not all think like this particular gentleman. If they did, I do not think this problem would exist.

Senator Haig: Is industry at fault?

Dr. Cox: I do not think you can point the finger at any one group. Whenever there is a problem there are always two sides to it. I think we have to get together to try to solve it.

Senator Haig: Who do you think should take the initiative?

Dr. Cox: We are making initiatives, and I think we both should.

Senator Bourget: I think the Government should do something too, because, after all, Government is spending quite a lot of money on universities. We do understand your problem, just as we try to understand the problems presented to us by the universities, but I think that this is an important area and I am glad it has come up tonight and you are speaking your minds, because that is what we want to know.

Senator Belisle: Mr. Chairman, at the outset, may I be permitted also to add my congratulations on the quality of the brief and the way it has been condensed? You were frank and honest.

May I also say to you, Mr. Chairman, that you did well in practising patience, because those of us who are willing to practise patience gather wisdom, because the question I was going to ask was on universities, and it is obvious my honourable colleague knows much more than I do about universities, and the discussion has been very fruitful.

I would like to add this on the comment made by Dr. Cox, when he said that he feels that industry and the universities are probably at fault. I feel that probably the Government is also at fault in not suggesting to industry and the universities that there is a new field in which the three of them could work together, and I think the Government should venture into this and approach the universities.

In the past—and I say this as chairman of a university board—we have always approached the university as a basis for getting bricks and mortar, but yesterday we were told by Dr. Hoerig that it is their intention now to spend money on professors instead of bricks and mortar. I think this is a new venture and that it is a good way.

We have had a good discussion, and there are quite a few questions I would like to ask of Abitibi. However, before leaving the field of universities, I have a question.

What do you suggest as a long-term strategy in order to assist the Government in achieving the dialogue or the co-operation needed among the three? You said a while ago, and Senator Haig suggested, that you were only training or assisting university professors on the basis they would be oriented towards your industry. I say that charity starts at home, and I think it is a bona fide intention to have people who will continue your work because, after all, if you do not, who is going to look after you? However, are there other ways you would suggest that we could attain this objective?

I will close with one more remark, Mr. Chairman. Perhaps sometimes we ask questions on this committee that seem to be in conflict with the opinion or the statement made, but this is not because we are not sympathetic to your cause, but because we are given a job and we would like to make recommendations, whenever we make our report, and make suggestions to the Government that will assist them in formulating a new policy so that we will try to get better value for the dollar we are spending on research.

To come back to my question, would you try to answer it, Dr. Cox?

Dr. Cox: Yes, sir. It is a difficult question to answer. I think that perhaps the Government when it gives out its basic research grants—and it does give out quite large sums of money—could put conditions on those grants that would sort of force the universities in some way to be in touch with their respective industries in these areas in which they are doing research.

Senator Belisle: But that is a very touchy problem.

Dr. Cox: "Force" is not a good word.

Senator Belisle: Nobody is more touchy than the university administrator or professor.

Dr. Cox: That is right.

Senator Belisle: Education is a provincial matter, and there is a field of very ticklish relationships.

Dr. Cox: I really would have to have some time in which to consider your question. It is an excellent question, but I do not really know the proper answer to it. As I have recommended here, we need a two-way educational process. Universities need to know what industries' needs are in order to exploit these products. They can help us with economic studies, as well as in research and development. You see, what Canada lacks, as I have said before, is entrepreneurs. We are fairly good at research and development, but we need entrepreneurs who can take this research technology and bring it into the economic growth of the country. Perhaps the universities can help us develop this type of people, but first they have to talk to us in order to find out what our needs are.

I think we get too wrapped up with research and development. In my opinion, there is more to this whole process. I do not think the universities realize this. They are producing knowledge for knowledge's sake, but they have to realize that knowledge has to be applied for the good of Canada so that our country can grow.

Senator Yuzyk: I think that this is the way the Government looks at the problem too.

Senator Belisle: May I be permitted to make one more comment? You said that the universities and industry must get together. There is a fact there that we must not overlook, and that is that the university has grown in the past in a community because industry was already located there. I am thinking, for example, of Inco at Sudbury. They have done very well in the enhancement and betterment of the community, but they have labour problems, and if it is known that the university people are directly connected with the industry then not only will they have student problems but they will have labour or union problems. It is a very ticklish matter.

Dr. Cox: I think we have just got to get to know each other better. We have had some professors say that we are not doing the right kind of research, but many of them have not come down to explore our projects. As I mentioned earlier, it has to be a two-way street. We have to talk to each other more. You people are giving us an opportunity to talk with you, which we greatly appreciate, and the universities will have to give us the opportunity to talk with them.

Senator Haig: Who makes that approach—the industry or the universities?

Dr. Cox: Both, I think, and perhaps the Government can do a little prodding in some way to encourage both of us.

Senator Belisle: Thank you.

The Vice-Chairman: Then, does it not come down to this, that there is an apparent breakdown of whatever machinery exists to provide this three-way co-ordination that seems to be necessary. What, in the collective judgment of this group, is understood to be the machinery for providing this co-ordination which does not seem to be working? What agencies do you go through when you try to get a two-way or a three-way co-operative endeavour under way.

Dr. Monton: I should like to propose that a very strong incentive really would develop out of economic reasons. I studied with Professor Ruzicka in Zurich. The reason why he was doing work on hormones was because he was selling his patents and his know-how to CIBA and other industries in Basel. There was a common interest there, in which Ruzicka wanted to make money—and he made a fortune—and at the same time industry wanted to get these patents so that they could exploit them and make another few fortunes.

I think that any scheme to force these three groups together is just not going to succeed. I think that if we can get an economic reason for working then it is going to be the most effective, and the one that is going to stick.

Dr. Clunie: May I take it a little further, because I have a personal theory? I think that we are prisoners of too much restricted thinking. We think of massive existing industry. We spoke earlier of MIT, and I think one of the strengths of MIT has been, and continues to be, that it spawns a large number of small innovation companies. The interface between government, industry and university can be found in the small innovation companies, because here you are relying on brain power, which is what might be called a basic resource. A good idea is more exportable than a ton of wheat, and probably a lot more profitable. The problem is: How do we get these ideas which are going to generate in the forefront of knowledge at universities into innovation companies with Government help, amd in such a way as to interest large industry? I think that this has to be done in the small innovation companies which start in the engineering departments of universities, and which need small factories of only a few thousand square feet, such as you find around Boston on Route 28. Then, as the new ideas blossom, larger industry will step in with more management and more funds to take them over.

I think we have to inculcate, especially in the universities the excitement of getting these ideas to the forefront, and getting them to the market place, and not just publishing a paper and going on to the next bit of pure science.

The Vice-Chairman: We were in Boston, and I think we came back with the idea of wanting to start one of these companies. I want to emphasize that the thrust of this discussion tonight is on this innovation, and how we are going to make it work. Can you spell this out a little more precisely than you have done?

Senator Yuzyk: I think it is very important because this is a new element we are bringing into our discussion. We have mentioned it before, but I think it would be very profitable tonight if we take this idea of innovation right to the stage of marketing and try to see the logical sequence in whatever can be done.

The Vice-Chairman: Innovation is the crop or the end product of all this work, and we are neglecting it.

Dr. Sutherland: One aspect of this is that it tends to flourish in small companies. In a large company there are many people who do not get an opportunity to practise entrepreneurship such as you get in a small company. These computer related industries are usually very small in size, but they all have a person who is bursting with knowledge that he wants to sell, and he creates a market for it. Even though he is highly technologically-oriented, his work still has that business flavour of getting this product out to a customer. It is the small business organization that certainly fosters the developments of high technology.

I think that if we can provide assistance in the initial risk-taking period, then it may help this kind of development.

Dr. Clunie: I think that there are two things that can and should be done in this area. One is that we have to have clearly understood in Canada that we are specialists in certain areas. Let us say we are going to become the best in the world in dealing with aspects of cold weather, which we hav plenty of. There are lots of problems there. Once the problem is clearly in the minds of university people, they will come up with ideas. Once they know support will be given for, say, a method of keeping roads free of ice in the winter, which could save millions of dollars, so that automobiles will not be corroded. Once it is clear we are going to make a real advance in this direction in Canda, then ideas will come forward. If it is known that funds will be provided to set one or two people up in a small operation and get them going to see whether it is viable, and that their results will be funnelled out to industry to try to get them interested, I think they will take it up.

I find in talking to people at universities, especially in engineering, that they are coming more and more to realize that they must think in terms of objectives that fit into national products, in terms of interdisciplinary groups, that they cannot just speak as engineers, but that chemical and biological people can contribute to these modern projects. Above all, they must feel that this is the direction Canada wants to go, because just to do it in the hope that it will interest someone is not enough. There has to be a real feeling that they are problems.

I was talking the other day to a man named Brown who has written a history of inventions in Canada. I asked him why he thought there had been so much more invention in Canada in the late nineteenth century than there is now, and he said one reason was that people then very clearly realized what our resources and our problems were. Today it is very difficult to have a clear problem area and say, "This is where we are going". Certainly one of the challenges facing the Government today is to elucidate some areas in which we are going to be paramount in Canada, and I am sure we can do it.

Senator Carter: I do not think the reverse process should be ruled out. Down in Boston the students started companies on the campus; three or four little companies were founded by the students because somebody just had an idea.

Dr. Clunie: I suspect they were able to get contracts because they fitted into the space program or the moon project, something like that; they could tie them quickly into the national...

Senator Yuzyk: No, they were small businesses. Small entrepreneurs were there looking for ideas and they were ready to buy up these ideas, or even promote some of the work at MIT, or even Harvard, I understand; they will take advantage of whatever is discovered and is practical. This is something we do not find in Canada. I do not know of any area in Canada in which we have such an attitude, where there is this approach, yet I think in the interests of the economy and of science it is necessary.

Dr. Clunie: I agree.

Senator Yuzyk: It is also necessary in the interests of industry. What do you suggest should be done to promote this sort of thing? I have the feeling that most Canadians think that large companies dominate the economic field and there is not much of an opportunity for a small man, for the little entrepreneur. Many people who come from Europe will start up small businesses much more readily than Canadians. How did we get into this situation? I do not know how far back we can go, but a number of years ago the situation was probably the reverse.

Senator Carter: I think Senator Yuzyk has put his finger on it, and that is attitude.

Dr. Clunie: Environment. It is different in the United States.

Senator Carter: Many things invented by Canadians are picked up in other countries. The electronic microscope was a Canadian invention that was developed by Germany. Nobody bothered about it over here; the inventor could not interest anybody, could not interest government, could not interest a company. Nobody was interested, so the inventor had to go to Europe.

Dr. Sutherland: What you have in MIT is a very close blending of science and business. In many universities there are business administration courses designed to graduate people for major positions in companies. There are also space scientific disciplines in universities. I have tried to think of one in Canada where there is a close science-business relationship, which is at the heart of MIT, which leads to the technological entrepreneur, if you like, who will obviously play a much greater role in a different climate.

Senator Bourget: That is it, the climate.

Senator Yuzyk: It is not only scientists. They will use economists and even social scientists. In Canada these people seem to be on the periphery. I consider that the innovation process requires the employment of economists, and even the training of economists and other personnel in business administration, who would be able to bring success to the launching of a new company and the marketing of the product. There are now computers that can almost work out in advance the demands for or popularity of any product. I understand that with a computer it is possible to find out how viable a product could be. Am I not right?

Dr. Sutherland: I think I should say that the results you get out of a computer are as good as what you feed in.

Dr. Cox: If you feed garbage in you get garbage out.

Dr. Sutherland: The computer enables you to look at many more alternatives going into the future, which you could not do by manual methods. There are techniques which help you to be more sure of the road you are going, so it is an aid.

The Vice-Chairman: On page 16 of the MacMillan Bloedel brief we see this passage:

> A very large amount of research is done in Canada by the government. In 1963-64 only 13 per cent of every research tax dollar in Canada was returned to industry, while in the United States the government returned to industry 67 per cent of every research tax dollar.

Dr. Cox: There is in the United States a contract research system, which encourages the second part of my graph, the exploitation part. My main recommendation is that if we had a contract research set-up in Canada, we could bring some of these research projects to completion, because exploitation is where you start to spend large sums of money. R & D expenditures are relatively low, but when you get into the exploitation end of the research business you are spending large sums of money. This is where company managements start to worry, because they have to put up such a large amount of risk capital. I agree with you, senator, and I think that a "contract research" system is what we need in Canada, and here the Government could help us.

Senator Yuzyk: The Government has a number of agencies, and the Government is not always sure of what it wants. It is very often looking for the same thing you are looking for and cannot arrive at any particular conclusion at a particular time. Therefore, it tends to put off matters that probably would require a decision much earlier, because of the numerous agencies. I am going to ask this question. Do you think that if we had, in our Government, a minister in charge of science or a ministry of science, that this could assist this innovation process in relationship with government, university and industry?

Dr. Cox: I think you have that body now in the National Research Council.

Senator Yuzyk: There is no minister.

Dr. Cox: No, the title is not there, but I think NRC could be the body that could act in that capacity.

Senator Yuzyk: They do not have the powers. I understand they are not a decision-making body.

Dr. Cox: Yes, but they could be given certain powers. You have a very competent group at NRC.

Senator Robichaud: Dr. Cox, your brief and the Abitibi Paper brief are very interesting. I may say that it may differ somewhat from some of the representations which we have received before. Personally, I am impressed to see that you recognize the work and the advantage of the NRC.

Dr. Cox: I might say in liaison with NRC we have had discussions but I do not think our company has had as good liaison with the NRC in the past as we could have had. I have recently established a proper liaison with NRC through Dr. Schneider and his group. I think it will be quite fruitful. Such liaisons are very expensive for western industry due to the distance from Ottawa, but they are important.

Senator Robichaud: You mean we should take it that you recognize NRC as the proper government agency to operate between industry and government?

Dr. Cox: I do. The Government's role through NRC could be one of initiating, co-ordinating and financing "contract research" of value to Canadian industrial laboratories.

Dr. Clunie: I would say "yes". You phrased the question, could a minister do this? The answer is yes for "could". Whether it would be yes for "would", I do not know. It would depend on the minister inasmuch as a minister of science, sitting in the full Cabinet and conscious of some of these priority problems, would be able to influence the deliberations of the senior body of the Government in this country. This could be effective.

Senator Belisle: Do you not believe it would be better to lobby through three persons rather than through only the minister?

Dr. Clunie: You have three representatives in Cabinet?

Senator Belisle: We have the Science Council.

Dr. Cox: As far as I am concerned it is confusing, sir.

Senator Belisle: We have the Science Secretariat, the Science Council and the Treasury Board.

Senator Yuzyk: That is the decision-making body, the Treasury Board.

Dr. Cox: We are recommending that NRC would be the best spokesman for that group.

Senator Belisle: With more power.

Dr. Cox: Yes, if that is necessary.

Senator Yuzyk: You would favour the elimination of a Science Council of Canada?

Dr. Cox: This is not a fair question and therefore I would rather not comment.

Senator Yuzyk: The work of the Science Council does not particularly appeal to...

Dr. Cox: They have done a good job.

Senator Belisle: You would favour the other way around?

Dr. Clunie: I would be positive. I think a minister in Cabinet, the right sort of person who had a feeling for the need for priorities and who would have influence in Cabinet and who is not a rear-rank private and who also had some influence with the Prime Minister, would be of infinite value at this time. We have to formulate some priorities. We cannot focus our efforts on three or four bodies and hope to reach the highest levels of decision.

Dr. Dorland: I agree with what Dr. Clunie said. I think we find it a bit confusing in some matters. Go to the National Research Council for IRA grants, and for IRDIA go to the Department of Industry, Trade and Commerce. I am convinced that if it was one body handling all these matters there would be far better co-ordination, better understanding and quicker processing.

Dr. Cox: And it would be less expensive for the taxpayer.

Dr. Clunie: Dr. Dorland and I were discussing this before we came here. We have been concerned since last October with this problem of R and D in Canada which was discussed at our Canadian Research Managers meeting at Sheridan Park. We are very concerned that a lot of the focus then apparent is getting lost in a number of committees and Government bodies continually examining things to the point that we are more confused than we were then about our problems. There is a great need to sharpen this focus on priorities.

The Vice-Chairman: Literally dozens of witnesses before us have talked about duplication and lack of communication, and yet we know there are hundreds of advisory committees. It seems to me this is probably one of the reasons it is so confusing. We have got too many people who are too expensive and we must have some central body.

Dr. Sutherland: I should like to add that if we are going to specialize in Canada, and I see us moving in that direction, it seems essential to blend economic goals with science goals. This must be done at Cabinet level if we are going to be successful.

The Chairman: You have suggested that NRC should be the main scientific body for Canada.

Senator Yuzyk: Dr. Cox was proposing that.

The Vice-Chairman: We have had people suggest to us that the talents of NRC should not be wasted in administrative work; they should concentrate on scientific work. A Minister for Science Policy in Canada would have a large administrative job. What do you think about this? This is a suggestion that has been made by other witnesses, that NRC should not waste its time and energy on administration.

Dr. Monton: I should like to suggest that there is even another reason the National Research Council should not be the one administering it. I think they have an interest in doing research themselves. We should have a separate body at the ministerial level.

Senator Belisle: Who would be more impartial?

Dr. Monton: Yes, more impartial. There is a danger that if you have NRC administering schemes you are also involved with money. If there is one R & D group in Canada which I think needs help, it is the industrial R & D group. I say this very strongly.

Dr. Clunie: We cannot do all we want to do. To have one vitally interested body is not as good as having an impartial person.

Senator Robichaud: I should like Dr. Clunie to clarify his position regarding NRC, because on page 3 of his brief it says:

> The Committee for Industrial Research Assistance (operated by the National Research Council). This is an excellent program, well conceived and ably administered. It should definitely be retained and if possible broadened in its application.

And it then gives the strong points.

Dr. Clunie: I am faced with a dilemma of being asked about the National Research Council. They administer their research grants very well indeed. They have liaised downward with the scientific people. They take rapid decisions and they do not leave you hanging, whether your budget is going to be X or Y, Sometimes our relations with other bodies get a sort of bureaucratic red tape treatment. While in theory I would certainly favour having the National Research Council doing research, I would hate, by achieving that, to lose the flexibility and simplicity of administration they have brought to bear. If we can achieve that in another way we would have the best...

The Vice-Chairman: Some university administration leaves you hanging in the air for a long time and waiting for decisions.

Senator Robichaud: We had a very valuable session on university and its relationship with industry. I just want to ask one question on another subject that came up last evening particularly, and again this morning. This has to do with the PAIT program. Dr. Cox, in your brief you refer to the PAIT program and say:

> The PAIT program could be one of the Government's most important incentive programs for the 'total innovation process', of which R and D is actually only a part.

Then you recommend that the PAIT program should be modified as follows: "(a) Reduce or eliminate interest rates."

This is a point that was discussed, as I mentioned, last evening and this morning. You then say: "Broaden the terms of reference to include exploitation in foreign countries and free exchange of information with foreign parent companies." You also suggest" (c) simplify the administrative procedure in the handling of PAIT applications."

We have had similar complaints from different industries, last evening and again this morning. In referring to the interest rate, I think you quoted in your remarks earlier, in your introduction, that the rate of interest sometimes goes up to 15 per cent.

Dr. Cox: That is the figure that has been calculated, I think, by Northern Electric, was it not?

Dr. Dorland: Yes.

Senator Robichaud: Do you have any experience with PAIT?

Dr. Cox: Yes and no, as MacMillan Bloedel has only one PAIT project, which it obtained two years ago and has not yet started to pay off. If it is a successful development our officials will be disturbed if our interest rate is as high as 15 per cent.

Senator Robichaud: Have you complained to the proper authorities about that?

Dr. Cox: We have talked to them and they have told us that PAIT is going to be improved. I find, as Chemcell has, that NRC are excellent at administering grants. They are technical people and they understand technical matters and people. It takes one to know one. That is a good philosophy.

Senator Robichaud: That is where your third point comes up: " (c) Simplify the administrative procedure in the handling of PAIT applications."

Dr. Cox: Right.

Senator Robichaud: You feel the NRC would be better qualified to handle the PAIT applications?

Dr. Cox: I think they would be, yes.

Senator Carter: Dr. Cox, we had quite a discussion about the relationship between industry and university and the science department, too.

On page 14, Dr. Cox, you intimate that we do not have as good a liaison as we might with Government departments, then that is causing some unnecessary duplication and I gather that Government projects are prolonged far beyond their usefulness in Government laboratories?

Dr. Cox: I think this has happened. In the forest products laboratories they have made an excellent review of their projects in the last few years and have rapidly overcome some of their duplication, but it was there and they admitted it.

Another point is that in a laboratory it is a common thing in Government, once you get a research program going, to keep it going, more so than in industry where economically we have to stop it at some point. I cannot speak for all government departments, as I am not aware of them all.

Senator Carter: You advocate that Government should do less work of this kind in its own laboratoires and use industrial laboratories more?

Dr. Cox: Yes, use industry and universities. I think the government could contract out more of their research work.

Senator Yuzyk: That would decrease the role of the NRC.

Dr. Cox: No. It would reduce their actual research work, which would give them more time to do the necessary administrative work and to direct it to the universities and to industry. Furthermore, it would help to bring the industries and the universities closer together, as NRC would be dealing with both.

Senator Belisle: Would you suggest that this contract work be given to universities, that they should be able to take a crack at it with their equipment?

Dr. Cox: That is a role they play when we do contract research in the United States.

Dr. Clunie: I can tell you of contract work in the United States because I had one for something over a million dollars. It was decided that a high temperature fibre was needed for a space program and the order was sent to polymer groups at the major universities from the air force, that they would like proposals for polymers that would withstand high temperatures. At the University of Illinois, Professor Marvel said: "I have polymer I produced in my laboratory, which I think will do the trick." They put more money into this and worked out a sort of basic research on it. Then they circulated the major fibre companies and said they would like to have two or three pounds of fibre made from this, would they submit proposals for doing this.

We in our laboratory said we could do it at something around a million dollars, we could install spinning equipment, hire three or four Ph.D's who would get the experience. In the event, this was done and a million dollars was spent for a few pounds of fibre. This was the next stage. In the course of about a year, this polymer was extruded and a small quantity of fibre which would withstand high temperatures was produced.

While that was being done, industry itself was picking up quite a bit of expertise in this area. They were learning the problems that obtain in space as regards this fibre. They were learning how to spin something which had to be handled at very high temperatures.

When this was examined by the air force, they said they would like a ton of this—or a thousand pounds—and they asked how much that would cost. We had the trained people and we had the spining equipment, so we said it could be done for X thousand dollars, much less for this next lot. So this was spun.

I think the important side reaction product of that was that, at this point, internally within the company, people were able to say that there were applications for this high temperature fibre in various things which might be of commercial value. Had the board of directors, in the previous year, been approached to support the development of high temperature fibre—which had a very limited use, in space vehicles—they would have laughed, because of the obviously uneconomic nature of this. By the time some work had gone into it, they discovered it had properties that could be used in high temperature filters, and so on. So it began to have commercial importance within the company.

It is this sort of spinoff which can be terribly important in contract work. You start with something very esoteric and if you experiment with it you find it has applications of commercial importance and that it can be used internally. There has been much progress of that type in the United States.

Senator Yuzyk: This was a mission-oriented project?

Dr. Clunie: Yes.

Senator Yuzyk: Could there be any other kinds of contracts except those that would be offered by governments, except for mission-oriented purposes?

Dr. Clunie: There can be. You can have a contract for basic research in certain areas. I think we have had a lot of money go into that sort of thing, since the war, in Canada.

Our need, now that we have built up universities and built up the NRC, is to put an equivalent effort into building up a technological base in industry, because of the obvious short and long-term effects on the Canadian economy.

Senator Carter: What sort of communication have you? How do you exchange information with Government departments? You seem to know what is going on. Do you know what is going on in their laboratories?

Senator Belisle: One hopes not.

Dr. Clunie: In those areas of the National Research Council, for example, who had a community of interest in our work, and maintain fairly close contact, we have had people come down in our laboratories and we have visited the NRC laboratories. The same is true in the chemical side. I think there is a fairly close liaison.

Senator Bourget: Mr. Chairman, some of the briefs have called for technical information to be supplied in respect of world scientific and technological matters. I think we all agree with that. Now, most of the witnesses tonight stressed that marketing research is important. Should it not, therefore, be equally important to have a kind of central marketing intelligenec service in the Department of Industry and Commerce? Perhaps this does already exist; I don't know.

Dr. Clunie: It is my opinion that the department is doing a good job in this. They are getting a lot of information from other countries. For example, I think they wrote an excellent survey on powdered metallurgy, and they have looked at the electronics field, and they are doing studies of the sort of economic situation of the chemical industry today.

I think they are doing good work in this area.

Senator Bourget: Are they doing the kind of marketing research you were talking about tonight?

Dr. Clunie: In a general way. Each company and each new product would have to go from the general to the more specific, but certainly my experience has been that they are trying, and succeeding, to get a fair amount of information together. If you are interested in a new area, they will go out of their way to get as much information as they can for you.

Senator Bourget: So in a way they are saving you a certain amount of money?

Dr. Clunie: Probably they are doing a better job in that than they are in research and development, where PAIT and IRDIA are rather slow.

Senator Bourget: Could that branch of the department be improved in any way?

Dr. Clunie: Yes, I would take it out of the Department of Industry.

Senator Bourget: No, I am relating it to marketing research.

Dr. Cox: That has to be done in a company. The Department of Industry can do general marketing research and look at a broad field. In this respect they do a good job, but when you get down to specific products, industry has to do it.

Dr. Sutherland: I think the Department of Industry is moving towards a sharper evaluation of some basic policies in relation to the chemical or textile industries. These are badly needed so that industry can shape its investment policies and new developments knowing much more clearly what the basic Government policies are in these industries.

The Department of Industry has been most helpful in fostering a chemical industry study where they have done a complete survey of the value of the industry in the Canadian economy and the value of the competitiveness of the Canadian chemical industry versus other countries, and I believe the same thing is being undertaken in the textile industry now.

That provides you also with a framework in which you can do market research and develop policies; and companies can invest capital with safety once they know the basic goals of economy which are subscribed to by the Government. The Department of Industry plays a very valuable role in shaping those policies.

Senator Carter: If you extend research and development, as you have suggested, to include this, that is going to be very expensive, and you have already said that you were on the expensive end of things now. Would the Government, because of the extra money involved, not have to be more selective in applying its programs?

Dr. Clunie: Personally, I feel that the work that the Economic Council has done and is doing on productivity in Canadian industries has to be followed up. Some industries that are basic, such as the pulp and paper industry, are probably more productive than in other countries.

Dr. Cox: I question what you mean by "productivity". Do you mean the speed of our machines?

Dr. Clunie: No, the length of run which affects the cost of operation and profitability. Whereas in another area of industry productivity is low because so many colours of something are required in short-runs so that the machines are down 20 per cent of the time, in the United States they change perhaps only once a year on a run so that our productivity is 50 per cent of that in the United States. Perhaps with raw materials the cost is 100 per cent. Obviously, if you are going to support sectors of Canada's industrial economy which are going to go ahead, there is no doubt which of those two you would pick. In a positive way you support those where you are good and try to make up for impossible situations by pouring research money into areas where productivity has no hope.

Senator Carter: You would select on the basis of productivity in the industries involved?

Dr. Clunie: Yes, it is our chance of competing in world markets.

Dr. Sutherland: That is one factor. There would be others, when you consider the total view. One has to look at the total perspective of the industry in relation to other industries and the employment situation over a period of time. There may be a lot of workers in certain industries in Canada. If you give some weight to the effect of eliminating immediately such an industry, then you would have to consider what impact that would have on the workers. One has to look at the technological capability developing. Is this industry going to develop over the long-haul? It is not just a question of its immediate productivity. How does it fit in with other industries? For example, the chemical industry fostered a lot of other industries around it. You cannot just look at the one industry in isolation. You have to see how it fits into the economy as a whole.

The Vice-Chairman: Unless somebody has a vital question that has not been dealth with, I think we can bring this session to a close. May I just sum up? The main points put forward by this group tonight are: one, that there needs to be greater emphasis on the integration of economic and scientific goals; two, this group has put more emphasis on the importance of innovation than any group we have had yet; three, like many other groups that have gone before them, they feel that the incentive programs need to be modified; four, there seems to be a feeling that the relationship between industry and universities is not all it should be. This is not the first time that suggestion has been made, and I think it bears some examination.

I think those are the main points. The fifth and final point is the question of market research and its importance in relation to the innovation program.

Does that cover the main points fairly well?

Senator Yuzyk: That sums it up exceedingly well.

The Vice-Chairman: Gentlemen, we thank you very much for your contribution. I want to emphasize again that the papers have been brief, concise and to the point, and because of that they are very helpful to us. Thank you very much.

The committee adjourned.

APPENDIX 165

CHEMCELL LIMITED

BRIEF
TO THE
SPECIAL COMMITTEE
ON
SCIENCE POLICY
SENATE OF CANADA

SUMMARY

CONCLUSIONS

1. Canada needs to strengthen its profitable and efficient primary industries and introduce and/or build up appropriate secondary industry.

2. Science can make a greater contribution to this goal than has been the case in the past provided that:

(a) Some national guidelines or priorities are set which indicate where increased support of industrial R. & D. would be most desirable.

(b) Simpler, more effective R. & D. incentive schemes are enunciated within such a framework.

(c) Greater efforts are made to encourage the flow of technology from foreign parent corporations into Canadian enterprises.

(d) Innovation, which is the whole process of getting inventions into the market place, is given greater attention and assistance.

RECOMMENDATIONS

3. 1. That there be a simple incentive scheme for R. & D. in selected industries.

2. That such a scheme be in the form of annual grants equal to 25% of all R. & D. capital and current expense outlays for that year.

3. That the definition of R. & D. be simplified and broadened to recognize that Canada's need is to innovate, i.e., to get into commercial production ideas deriving from R. & D. regardless of their source.

4. That present 'Canada Only' restrictions on the reporting of research work and initial exploitation of its results be minimized.

5. That there be an investment tax credit on new production facilities.

6. Where the above general incentives are supplemented by funds for mission oriented programs in support of National Science goals, these be allocated by a system of grants and contracts administered as is the present IRAP of NRC.

CHEMCELL LIMITED

BRIEF
TO THE
SPECIAL COMMITTEE
ON
SCIENCE POLICY

INTRODUCTION

4. Chemcell Limited is a major producer of petrochemicals, fibres, fabrics and carpets. Approximately 57% of its common shares are owned by Celanese Corporation. Brief information on the company is contained in the 1968 Annual Report at Appendix A. In addition, Chemcell has management responsibility for Millhaven Fibres Limited in which it has a 40% financial interest, the remainder being held by Canadian Industries Limited. This company makes nylon and polyester fibres.

5. Chemcell has laboratories at Edmonton, Alberta, Drummondville, P.Q., St. Bruno, P.Q. and, through its Millhaven Fibres connection, at Millhaven, Ontario. In general, these laboratories are concerned with applied research and development in cellulose acetate flake, chemicals derived from petroleum raw materials, carpets and fibres made from secondary cellulose acetate, cellulose triacetate (Arnel), polypropylene, polyester and nylon.

PROBLEMS OF PRESENT INDUSTRIAL R. & D. INCENTIVES

6. Canada's major industrial R. & D. challenge today is to protect its position in those primary industries that are profitable, efficient and have a future potential and to introduce and/or build up such secondary industries as are likely to contribute quickly and decisively to the nation's economic well being. In other words, Canada needs to move to a situation in which the possession of resources is mainly important because of the opportunity which these provide for exploitation in profitable, knowledge intensive ways. None of this can be done without the fostering of an improved technological base through R. & D. activity on an increased scale in industry.

7. To achieve increased R. & D. activity in Canada, various incentive schemes have been instituted over the past ten years. These are summarized at Appendix B. Comparisons of Canada's R. & D. expenditures with other industrialized countries of the 'free world' indicate that, in spite of such schemes, the proportion of Canada's GNP which is devoted to R. & D. of all types is still very small being about 1%. Further, if industrial R. & D., as opposed to that in government and university laboratories, is considered, Canada spends less in relation to GNP than any of these countries.

. . . .

8. Chemcell's experience has been that, in total, the various incentive schemes have been of relatively limited usefulness. A small IRAP activity has worked well at one laboratory with a minimum of administrative burdens, but has not been used at other R. & D. locations primarily because of the urgency of short term applied problems which were outside the scope of IRAP. It has not been possible to use PAIT because of the various qualifying restrictions which surround it. The IRDIA program has been and is being used but has limited quantitative effect on Chemcell's total R. & D. effort because of the moving base provision in an economic situation which does not encourage continually increasing R. & D. expenditure and the delay in determining benefits under its provisions.

BASIC NATIONAL DECISIONS WHICH MUST PRECEDE NEW R. & D. POLICIES

9. New policies for science in general in Canada and industrial R. & D., in particular, are obviously needed. Equally obvious is the fact that such changes should not result in an increase in Canada's already very heavy rate of taxation. It is submitted therefore that, in addition to the enunciation and elaboration of national science policy objectives, two other actions are required at the Federal level, namely;

(a) The setting of some national industrial guidelines or priorities which clearly indicate those industries or industrial sectors which are to receive increased R. & D. support, and

(b) Some re-allocation of funds to provide for such increases in support.

10. Implicit in the above is the assumption that national science goals and industrial priorities will, in part at least, complement each other and that in many areas general industrial R. & D. incentives will be supplemented by funds directed towards specific missions related to national science goals. We should recommend that such 'mission oriented' funds be allocated by a system of grants and contracts administered in the enlightened way that IRAP is today.

DISCUSSION

11. If Canada is to move towards an economy based more on creative ideas and less on raw material exploitation, two things are essential, namely, an incentive scheme which promotes idea generation in Canada (i.e. industrial R. & D. labs) and an attitude which encourages the flow of ideas into Canada from foreign laboratories. In addition, it must be recognized, as was pointed out recently by the Economic Council in its fifth annual

. . . .

review, that R. & D. which creates ideas must be complemented by 'innovation which is concerned with the crucial role of entrepreneurial decision making and risk taking in the "follow through" process which involves the coupling of the initial idea or the results of R. & D. with engineering, design, financing, tooling up, production and marketing. It is the innovation process ... which brings new products, processes and services into use and which contributes to growth.'

12. Most of Canada's technologically based industry is owned outside Canada. In our opinion the quality of Canadian research and research personnel is the equal of any in the world. Obviously therefore the most direct and effective way of interesting parent corporations in Canadian R. & D. laboratories is to ensure that doing research in Canada would cost less than doing it elsewhere, that the incentive schemes that resulted in lowering R. & D. costs in Canada were simple and long term in conception and that they did not impose unacceptable limitations on rapid passage of R. & D. reports between affiliates or on the initial location of facilities for exploiting new inventions. Given such a climate, it is our belief that industrial R. & D. labs in Canada would quickly become specialized in areas of expertise of prime interest to this country with consequent beneficial economic consequences.

13. What would be the cost of a simplified incentive scheme in which government and industry each would pay roughly half the cost of industrial R. & D. to give a significant economic advantage over doing the same research, say, in the United States? It is not possible to say with certainty, but at Appendix C, a calculation has been carried out based upon best estimates of present R. & D. expenditures which indicates that it would be of the order of 10% of current Federal R. & D. budgets.

14. This figure is too low, however, for if the whole process of innovation recommended so strongly by the Economic Council is to have more emphasis, it will be necessary to broaden the R. & D. incentive grant definitions to include certain fundamental innovative functions such as market research and commercial development expenditures not now classed as R. & D. and to assist companies in the very expensive final phase of innovation, that of starting up new plants. It seems to us that an investment tax credit, as now given in the U.S., would be applicable here.

RECOMMENDATIONS

15. 1. That there be a simple incentive scheme for R. & D. in selected industries.

2. That such a scheme be in the form of annual grants equal to 25% of all R. & D. capital and current expense outlays for that year.

. . . .

3. That the definition of R. & D. be simplified and broadened to recognize that Canada's need is to innovate, i.e., to get into commercial production ideas deriving from R. & D. regardless of their source.

4. That present 'Canada Only' restrictions on the reporting of research work and initial exploitation of its results be minimized.

5. That there be an investment tax credit on new production facilities.

TRANSITION PERIOD

16. If the R. & D. incentive grant proposal set out above must be implemented in stages, it is recommended that, in the transition period, NRC's IRAP be expanded without major change in its present method of administration and that the PAIT and IRDIA programs be revised to conform as closely as possible to the recommendations outlined above as regards a broadened definition of R. & D., less emphasis on 'Canada Only' restrictions and a simplification of their administrative procedures.

HISTORICAL SUMMARY OF FEDERAL R. & D. INCENTIVE PLANS

1959 - Defence Development Assistance Program (DDP)

Purpose was to sustain and improve the development capabilities of Canadian companies active in the military product field.

1961 - Defence Industrial Research Program (DRB)

Purpose was to improve the ability of Canadian companies to compete for R. & D. and ultimately production contracts in U.S. and NATO defence markets. DRB pays about half the cost of approved DIR projects.

1962 - Industrial Research Assistance Program (NRC)

Purpose was to create new R. & D. facilities in industry and to expand existing company facilities. NRC pays about half the cost of IRAP projects.

1962 - General Tax Incentive for R. & D. Increases

Corporations were allowed to deduct from taxable incomes a further 50% of those R. & D. expenditures which exceeded their 1961 expenditure base period; both expense and capital expenditures qualified for such treatment. The program was in effect between 1962 through 1966.

1967 - Industrial Research and Development Incentive Act (IRDIA) Department of Industry

This replaced the general tax incentive scheme above and provided for grants (or tax credits in lieu of grants) equal to 25% of capital expenditures made for industrial R. & D. purposes and similar 25% grants or tax credits for R. & D. expense outlays in excess of the average expenditures over a base period. Such base period consisted of the five immediately preceding years.

1965 - Program for the Advancement of Industrial Technology (PAIT) - Department of Industry

This underwrites specific projects for development and exploitation in Canada. PAIT will contribute up to 50% of the total cost of such projects. If successful and the results are commercialized, the company is required to repay the government funding with interest. If the project fails, repayment of the government's contribution is not required.

ESTIMATED COST OF A SIMPLIFIED
R. & D. TAX INCENTIVE SCHEME

	1963/64[1]	1965[2]	1968(est.)
Canada's R. & D. Outlay	$420 MM	$682 MM	$1,000 MM[3]
Spent in Industry	172 MM (41%)	284 MM (42%)	360 MM[4] (36%)
Spent by Industry	143 MM (34%)	234 MM (34%)	300 MM[4] (30%)

1. OECD Study 1 (Paris 1967).
2. Economic Council - Fifth Annual Review, p. 50.
3. Economic Council - Fifth Annual Review, p. 39.
4. NRC unofficial estimates, March 1967.

CALCULATION

If, in 1968, total expenditure on R. & D. is $1 MM and % spent in and by industry has declined slightly as indicated above, a grants incentive scheme which remitted 25% of industry expenditures on R. & D. would cost about $75 MM in 1968. If from this were subtracted IRDIA expenditures for 1968 which must be at least $25 MM, the cost of the simplified grants plan recommended is about 10% of a conservative estimate of Federal R. & D. expenditure for that year.[4]

APPENDIX 166

BRIEF TO THE SENATE OF CANADA

SPECIAL COMMITTEE ON

SCIENCE POLICY

by

LIONEL A. COX, Ph.D.

DIRECTOR OF RESEARCH

MacMILLAN BLOEDEL LIMITED

VANCOUVER, B.C.

February 14, 1969.

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INTRODUCTION

The principal reasons for doing research and producing technology are to enable Canada to compete in world markets (i.e., increase exports) and aid economic growth. If the basic objective of a science policy in Canada is to provide a stimulus to this economic growth, then the federal government, its agencies and department research laboratories must work closely with industrial research laboratories. This is because research itself does very little to enhance the economic growth until the results of successful research are used. This use involves translating successful research into improved and new products, improved and new processes, or new uses for existing products. So, the first fundamental step is to get a clear understanding of the part research plays in the so-called 'total innovation process', from which comes the real contribution to the economy of a company, an industry and a country.

Top management is often disappointed with successful research work until it has been exploited and commercialized, thus enabling the company to increase its profitability. This process takes time - usually six months to five years in industry, but occasionally longer. Similarly, knowledgeable Canadian citizens will be disappointed if the government puts many millions of dollars into research which only increases our basic knowledge and "know-how". What managers of Canadian research must do is to plan and set priorities so that the technical knowledge and "know-how" produced is used within a reasonable period of time, to fulfill human needs and wants and to increase Canada's ability to trade with other countries. There is too much research money wasted by universities and governments which produce knowledge that is either not used or of little value to mankind. A science policy must stress the need for the federal government to support mainly research programs and plans that produce something of value, firstly to all its citizens and then to the people of the world.

As a corporate citizen, MacMillan Bloedel Limited believes that the spending of government funds for research and development in Canada should be such as to make our country grow which, in turn, means that Canada must have successful primary and secondary industries. In order to explain how this can be done, it is necessary to clearly define what MacMillan Bloedel Limited means by the 'total innovation process' in industry.

INDUSTRIAL RESEARCH AND THE 'TOTAL INNOVATION PROCESS'

The 'total innovation process' is the chain of events or steps that lead from the adoption of an idea or an invention to an economically successful commercial venture. If these steps are clearly understood by the federal government, then it may be able to encourage industry, and thus enable Canada to achieve its science policy objective and key national goal -- economic progress. Unfortunately, many of the definitions for the spectrum of science activities now found in the Income Tax Act, the Dominion Bureau of Industry instructions and the regulations of the Department of Industry, indicate that a complete understanding of the 'total innovation process' has not been achieved by all government authorities. The Science Council of Canada's recent report(1) comes closest to our basic concept.

The 'total innovation process' in industry really rests on the initiative of two types of people -- a competent scientist or engineer and an entrepreneur.

What about top management's role in the innovation process? Company management must first establish corporate and divisional objectives and determine the general direction in which the company should go. Then, it must show interest in R&D and give it adequate financial support. Only in these circumstances can research and development projects and the 'total innovation process' be related to the needs of the business.

In most research laboratories, competent scientists and/or engineers will carry the project from the exploratory or

(1) "Towards a National Science Policy for Canada", Science Council of Canada's Report No. 4, October 1968, page 7.

background research stage through to the applied research stage. If the work is successful, it will then be moved along to the development stage, which often involves a pilot plant or prototypes. At this point, if the research and development work has been successful, the company usually must put up large amounts of "risk" capital and bring in the entrepreneur who can exploit the results of the R&D and bring it to a successful commercial conclusion. This 'total innovation process' or chain of events is illustrated in Figure 1, which clearly shows that industrial research does not directly produce increased employment or more exports or commerce for Canada, but produces technology. Thus, the research part of the innovation process is similar to exploration for mineral deposits or oil. Once the mineral deposits or oil have been found, then it is necessary for the company to put up capital in order to exploit the discovered natural resources. Similarly, R&D by itself may add nothing to the economic growth of a company, until top management decides to move from R&D into engineering, design and all the succeeding stages which bring new products, processes and services into use. It is the 'total innovation process' which contributes to the economic growth of a company. Dr. W. H. Gauvin, in reporting to this committee[(2)] outlined what he called "links" involved in bringing a research project to commercialization, but he did not emphasize enough the importance of the exploitation stage and the need for entrepreneurs.

A much quoted group of figures from a study undertaken in the United States in 1967[(3)] gives the following

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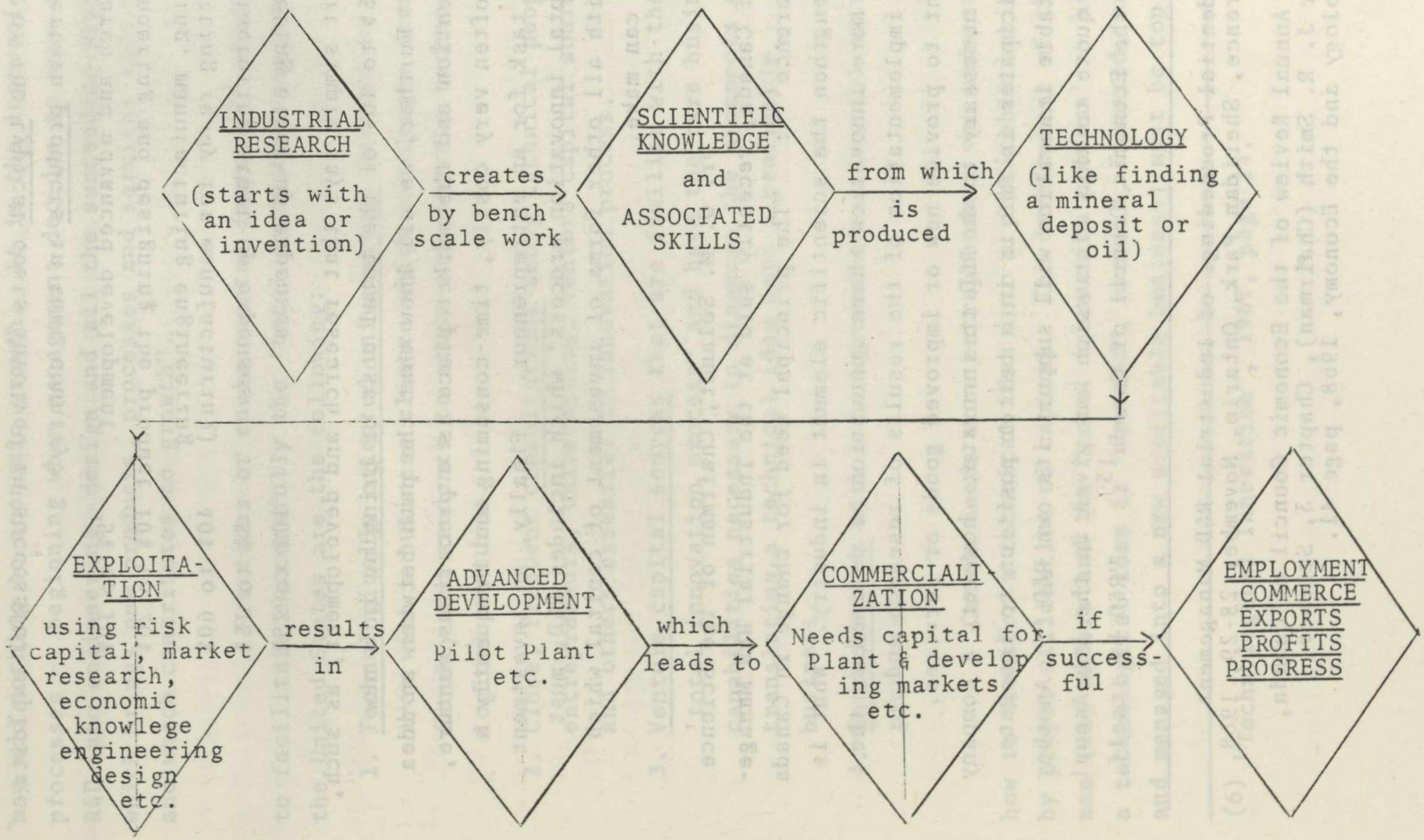
(2) W. H. Gauvin, Proceedings of Senator M. Lamontagne (Chairman) Special Committee on Science Policy, No. 2, Wednesday, October 23, 1968, page 61.

(3) "Technological Innovation: its Environment and Management", U.S. Department of Commerce, Washington, U.S. Government Printing Office, 1967, page 9.

FIGURE 1

THE 'TOTAL INNOVATION PROCESS' IN INDUSTRY

FROM AN IDEA TO THE MARKET PLACE



breakdown of the typical costs involved in successful exploitation of certain products in that country:

Research and advanced development	5% to 10%
Engineering and designing the product	10% to 20%
Tooling, manufacturing engineering (getting ready for manufacturing)	40% to 60%
Manufacturing start-up expenses	5% to 15%
Marketing start-up expenses	10% to 25%

This report simply says that research and development, as such, comprise 5% to 10% of the total cost of bringing in a new product. Further, we all know that the path between an idea or an invention and the market place is a precarious venture, which is often very costly, time-consuming and frequently a difficult task for an entrepreneur. Finally, an investment in the 'total innovation process' which includes R&D, must compete with all other forms of investment of capital which a company can make.

Dr. O. M. Solandt, Chairman of the Science Council of Canada, recently said at the Industrial R&D Management Conference[4]: "The principal need for change in Canada is to strengthen the scientific element in industry. What is needed is more innovation where innovation is defined as the practical implementation of the results of research and development to provide new or improved goods or services. It is not necessary to do R&D to innovate; however, a company that participates in R&D is in a better position to innovate and profitable innovation will support its own R&D." Another pertinent quote to this discussion was given in the 5th Annual Review of the Economic Council of Canada[5]: "R&D by itself

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(4) Confidential Proceedings of Industrial R&D Management Conference, Sheridan Park, Ontario, November 28-29, 1968.

(5) Fifth Annual Review of the Economic Council of Canada, Arthur J. R. Smith (Chairman), Chapter 3, Science Technology and the Economy, 1968, page 41.

may add nothing to economic growth. It is the innovation processes -- beginning when management decides to move from R&D into engineering, design and all the succeeding stages -- which brings new products, processes and services into use and which contributes to growth".

Practices or environmental factors[6] which appear to facilitate successfully the 'total innovation process' in the United States are the following:

1. Technologically oriented universities located in an area with a business climate which encourages staff, faculty and students to study and generate technological ventures.
2. Close, frequent consultations among technical people, entrepreneurs, universities, venture capital sources, and others essential to innovation process.
3. Venture capital sources that are familiar with the 'total innovation process' and have the rare business capabilities necessary to diagnose the prospects of translating a technical idea into a profitable business.
4. Entrepreneurs with a background of successful entrepreneurship.

Canada needs more entrepreneurs who understand how to transfer a technical idea into a profitable business by proper utilization of capital. The development of these men (who understand the 'total innovation process' -- how a technological idea is "spawned", evolved, financed, marketed and managed into a new profitable business) must be top on the

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(6) "Technological Innovation", 1967, page 14.

list of all university business education in Canada, and on all industrial and government training programs. On the other hand, perhaps the university and government atmosphere may not be conducive to developing entrepreneurs. In this case, industry must find, nurture and train these self-starters from their own ranks. This is one of the industrial challenges facing Canada.

At the present time, the government stresses too heavily the importance of R&D in improving our economic growth in Canada, instead of saying to industry: "We want to help you to improve your 'total innovation process' so that we can increase Canada's economic growth". Therefore, it is recommended that:

(a) Any incentive program for a Canadian Science Policy to assist industry must consider all the steps in the 'total innovation process' and not just the R&D segment of it, important as that is.

(b) The Government encourage and reward industrial entrepreneurship which assists companies through the critical, expensive and time-consuming steps of exploitation and commercialization of improved and new products and processes, just as they do for the mining industry.

There is no doubt that the economic climate in Canada must be made more favourable for the 'total innovation process' to work and the means by which this is done is much less important than the end result.

EXISTING FEDERAL GOVERNMENT RESEARCH AND DEVELOPMENT INCENTIVES

Industrial research and development is a valuable part of the 'total innovation process' that leads to continued economic growth in Canada. Realizing that this growth of R&D is desirable, certain government research and development incentives have been established. However, these incentives do not stimulate the conservative Canadian temperament and could be improved in a number of ways which we would like to discuss at this time.

1. The Industrial Research Assistance Program (IRAP)

   This is the best type of industrial research incentive that our company receives today. IRAP has helped us to increase our company's industrial research effort, especially in laboratory and high risk type research. However, the requirement that additional staff must be engaged to obtain this incentive is an undesirable limitation. It means that IRAP is not so useful for "mature" R&D laboratories because their staff is at, or near, its desirable capacity. Therefore, it is recommended that:

   The IRAP be modified so that companies can participate without increasing the size of their staff.

2. Industrial Research & Development Incentives Act (IRDIA)

   The IRDIA program, as related to operating research expenditures, is restricted to increasing R&D effort over a 5 year moving base. This is unsatisfactory, as there must be incentive to continue the expenditure of "risk" dollars, as all R&D, by its very nature, is risk. A tax grant which removes the base entirely would provide a better incentive for continuing and expanding R&D.

   The process for administration of IRDIA grants should be speeded up and simplified. This could be achieved by more verbal communications, thus reducing the amount of written information concerning projects. This method may also reduce the administrative costs of the IRDIA program. Another point is that the administrative costs for a company to prepare the IRDIA data are relatively high. Obviously, the government should help to keep these costs as low as possible. Finally, the IRDIA definitions of R&D are not sufficiently broad to be applicable to the experimental work carried out in the plants, and this is an important part of the 'innovation process' in many industries.

Tax free grants of 25% for capital R&D expenditures under IRDIA offer an excellent incentive. Here IRDIA provides industry with a clear policy in which capital research expenditures may be planned economically and effectively. It is therefore hoped that this excellent policy will be continued. In summary, it is recommended that:

- IRDIA be modified so that:
  a) all companies are eligible for tax free grants of 25% on capital and operating research and development expenditures, with no deductable base period;
  b) the process for administration of IRDIA be reviewed and simplified.

3. Program for the Advancement of Industrial Technology (PAIT)

The PAIT program offers loans for development of processes and products, but if the project is successful the loan is repayable. This program has been disappointing to industry and is now being revised by the government. The reason why this program has not been acceptable to industry is because it is not a real incentive; it limits the use of successful projects to Canada only; it is really of use only for high risk projects and on successful programs the true interest rate is higher than the simple 6% that the program indicates.

The PAIT program could be one of the government's most important incentive programs for the 'total innovation process', of which R&D is actually only a part. In other words, PAIT could be applied to the overall cost of exploiting and commercializing a new venture. This incentive would have to consider all economic factors which affect companies' decisions to 'risk' money, which includes not only R&D but market expansion, capitalization and so forth. It is recommended that the PAIT program be modified as follows:

a) Reduce or eliminate interest rates;

b) Broaden the Terms of Reference to include exploitation in foreign countries and free exchange of information with foreign parent companies. This means that by exploiting Canadian developments in other countries, a substantial profit could be obtained for the company through licensing, and for Canada. This concept is well recognized by many leading industrial countries such as the United States. In this connection, if patents are applied for in a foreign country and are not used, then the inventions can become public property in those countries or a compulsory licence can be obtained.

c) Simplify the administrative procedure in the handling of PAIT applications.

SUGGESTED NEW FEDERAL GOVERNMENT METHODS FOR STIMULATING THE TOTAL INNOVATION PROCESS.

1. Tax Relief

Tax relief could be given in the form of capital cost allowance for new plants and equipment invested, low interest loans and the like. The important criteria for government financial assistance to industry should be the industry's ability to compete in world markets, the impact of the work on defined national goals and benefits to the Canadian economy.

If we remember that ideas and inventions suffer from obsolescence, sometimes as fast as mines do from depletion, then a write-off analogous to mines and oil wells should be considered for all new technical ventures in Canada. Therefore, it is recommended that:

A so-called "tax holiday" be given for a limited time only to Canadian companies who have discovered and patented in Canada successful R&D work that will lead to new Canadian jobs or to increased exports and so forth.

2. National Technology Bank

In order to maximize the 'total innovation process' the federal government should encourage and help Canadian R&D management to seek out the required technical knowledge it needs, anywhere in the world. There is a tendency in Canada to have "scientific national pride" and a "not invented here" factor, which makes research people duplicate scientific and technological work that has already been done in other parts of the world. If the government is going to stress the 'total innovation process' to improve the economy of Canada, then technology should be obtained in the least expensive way. Therefore, it is recommended that:

A "National Technology Bank" be established by the National Research Council, to assist in obtaining needed technology from anywhere in the world which can be exploited and commercialized by Canadian industry.

3. Government Contract Research

In the U.S.A., industrial R&D is greatly stimulated by the assignment of government contracts to industry. In fact, contract research is one of the main methods in the United States for allocating government funds. Properly administered by the government, such contract research could be very good for Canada. For example, it could get Canadian companies into new technical areas.

Major Canadian national programs now under consideration by the Science Council(7), such as transportation, urban development, computer application and environmental pollution improvement to air, water and noise, should be carried out not only in government laboratories, but in industrial R&D centres. The government's role in this type of contract research could be one of initiating, coordinating and financing. In fact, the coordination of all major programs could be through the National Research Council. Therefore, it is recommended that:

a) The federal government establish a contract research system similar to the United States system for all major Canadian national programs.

b) The National Research Council be the government agency for coordinating this type of contract research.

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(7) "Towards a National Science Policy for Canada", 1968, pages 29-47.

RELATIONSHIPS BETWEEN FEDERAL AGENCIES AND DEPARTMENTS AND CANADIAN INDUSTRY.

There is a need for closer relationships and better liaison betwen government departments and agencies and industrial companies. Government R&D programs could be made more effective by closer interaction with industry. Duplication of research could be prevented and better use made of the research results obtained, if industry was permitted to have more say in the work done in government laboratories.

In the forest industry, the government maintains three laboratories, the Forest Research Laboratory in Victoria, B.C., and the two Forest Products Research Laboratories in Ottawa and Vancouver. Our company maintains a fairly close liaison with these three laboratories through visits and industrial committees. One of these committees, which has liaison with the Forest Industries Associations, is the Research Program Committee (RPC). It operates at the technical level with the primary function of reviewing existing programs as to their significance, to make recommendations regarding new problems, and to provide necessary background information related to their technical and economic significance. There are four Research Program Committees in Ottawa -- Lumber, Plywood, Wood Preservation and Engineering; and three in Vancouver -- Timber Engineering, Lumber and Plywood. Another committee in our industry is the National Advisory Committee (NAC) which was set up to advise the Deputy Minister of the Department of Fisheries and Forestry of the trends within the industry, to indicate where the emphasis is required on forest products research, to support industry's requests for assistance and to comment and advise broadly on the proposed program, policies and procedures of the Forest Products Laboratories. We have found this committee a useful means of getting closer to the people managing these government laboratories and to finding out what is really being done in these laboratories for the economic good of Canada.

Mission oriented government laboratories can be useful. Unfortunately, once they have fulfilled their task, it is sometimes difficult to switch them off their programs, even if these programs have outlived their usefulness. This is improving. Nevertheless, all government laboratories must continually assess the validity of their research programs and question the level of research expenditure. Parkinson's law frequently comes into play and seldom, if ever, is the number of scientists and engineers in a government laboratory reduced as is the case in industrial research laboratories, which are profit oriented.

It is recommended that:

- All government research laboratories have on their advisory boards appropriate industrial research managers with a strong voice at the policy-making level.

FEDERAL GOVERNMENT INTRAMURAL RESEARCH

A very large amount of research is done in Canada by the government. In 1963-64 only 13% of every research tax dollar in Canada was returned to industry[8], while in the United States the government returned to industry 67% of every research tax dollar[9].

At present, the government's intramural research, which is performed directly by government agencies and departments, is heavily oriented to basic research. This has been fully discussed in a report by the Engineering Institute of Canada[10], where it is shown that Canada is spending proportionately nearly twice as much on basic research as some of its industrial competitor nations, such as Sweden and the United States. It is apparent that Canada should either reduce its spending on basic research or should bring its relative R&D spending on development work more in line with its spending on basic research.

In the area of development work, it has been suggested that the government laboratories, such as the National Research Council, might be encouraged to carry out more development work and less basic and applied research. Government laboratories should not carry out development work themselves, since this is expensive in many cases, and cannot be done effectively without close cooperation with the manufacturing and marketing people in the industry in which the product or

(8) Dominion Bureau of Statistics report, 1965.

(9) U.S. Nat. Acad. Sciences, "Basic Research and National Goals", Report to Committee on "Science and Astronautics", U.S. House of Representatives, March 1965, p. 15.

(10) The Engineering Institute of Canada, "A Canadian Policy for Research and Development", March 1967, p.7 to 10 and p. 25.

process will eventually be exploited and applied. Therefore, it is recommended that:

Advanced development work be done by industry and sponsored by the government under a 'contract research system'.

The government and university laboratories could give a great deal of technical back-up assistance, but when one gets into project development, exploitation and commercialization, this is best done in the industry concerned. Of course, certain national science work, such as that associated with atomic energy, should be developed by the government, but not technical work which industry can do better.

It is well known that institutes or industry association laboratories, such as the Pulp and Paper Research Institute, have not been as productive as they might have been in the 'total innovation process' because of their inability to get their applied research work used by the various member companies. The transferring of the development work from a government research laboratory or an industry association laboratory is most critical and requires a special type of entrepreneur and government encouragement by some type of financial incentives.

The government laboratories are doing the bulk of their applied research in the areas where there is an opportunity to gain larger markets through exports. This type of research eventually has to be transferred to the export industries concerned, if the technology is going to be used for the economic good of Canada. Do the government laboratories have the mechanism for transferring this technology to industry effectively and efficiently?

SOME REASONS WHY THE RETURN ON INVESTMENT ON RESEARCH IS LOW IN CANADA.

The most realistic index of a nation's technological status is undoubtedly its international balance of payments for patents, royalty licensing fees for "know-how" and the like. Approximate research returns on investment from these sources in 1963/4 on research expenditures made 8 years previously(10) are as follows: Canada 1%; Sweden 9.1%; U.S.A. 14.3%. Canadian returns are low partly because Canadian industry is not investing as much in technology as industry in these other countries is doing, partly because some Canadian industries have not learned how to use the 'total innovation process', and partly because Canadian companies have not learned how to sell inventions or license them to foreign companies. In case anyone thinks this is not a profitable concept, let us cite, for example, the case of Syntex-Internacionel ATSA, with its headquarters in Mexico, which has made millions of dollars by simply licensing its oral contraceptive "know-how" to several American drug companies.

Canadian companies need to learn more about how to obtain financial benefits by properly organizing their patent systems. It is felt that the government agency, Canadian Development and Patents Limited, could assist industry in this area by making sure that good ideas are patented and that valuable patents are being exploited. Therefore, it is recommended that:

- All Canadian industries place more emphasis on their patent polices and systems, in order to protect their inventions and to obtain improved profits from licensing "know-how".

(10) The Engineering Institute of Canada, "A Canadian Policy for Research and Development", March 1967, p. 7 to 10 and p. 25.

RELATIONSHIPS BETWEEN UNIVERSITIES AND INDUSTRY

The link between universities and industry in Canada is weak and not very effective. This situation can only be rectified if both the universities and industry learn how to collaborate on technical problems of value to the nation.

The recent IRAP financial support of Canadian university professors, on approved IRAP industry projects, is one of the best techniques that the government has come up with to bring the universities in closer touch with industry. MacMillan Bloedel Research Limited has retained three outstanding Canadian professors as consultants through IRAP support. These men are not only providing ideas and assisting our R&D work, but they themselves are learning more about industry and how industrial research laboratories operate. Obviously, this will help these professors in training students for industrial research laboratories. Therefore, it is recommended:

- That the government consider other methods of encouraging university scientists and engineers to collaborate with industrial scientists and engineers, if only for the purpose of developing a two-way educational process which is so necessary in the development of technical people of value to industry and to Canada.

APPENDIX 167

Brief to Special Committee on Science Policy,

Senate of Canada.

Abitibi Paper Company Ltd.

BRIEF TO SPECIAL COMMITTEE ON SCIENCE POLICY,

SENATE OF CANADA.

The purpose of this brief is to present to the Special Committee on Science Policy of the Senate of Canada the specific views of Abitibi Paper Company Ltd. Our answers to specific questions posed by the Special Committee are given in an appendix.

The Company

Abitibi is a diversified forest products company with over 37,000 shareholders of whom more than 35,000 are registered in Canada. The Company owns 12 pulp, paper and board mills and 13 converting plants in Canada and the United States.

Abitibi's 1968 sales reached $256 million. Of these sales 43% were in Canada, 49% in the United States and 8% to overseas markets. The dominant product is newsprint with 6 mills in Canada and 1 in the United States. Abitibi is also an important factor in the fine and printing paper and in the building board markets. In addition, the Company ships kraft market pulp, paperboard and a variety of converted paper products.

While almost all of our mills carry on development work aimed at their specific needs, the bulk of the research and development program in which the Senate Committee will be interested is concentrated in two main areas:

a) Woodlands and logging R&D: a present annual rate of about $330,000.

b) The Central Research Division: present annual expenditures are at a rate of $1,330,000. This Division, previously situated at Sault Ste. Marie since 1947, is now located in a new modern laboratory, the Abitibi Research Centre, in the Sheridan Park Research Community near Toronto. It is this group which is most concerned with and affected by science policy of various governmental jurisdictions in Canada, and the bulk of the following comments are related to its past experience in this regard. These comments are also conditioned by the fact that research and development for our American subsidiaries are also centered in this Central Research Division. This occurred because the Division was in being and operating in these fields prior to the Company's expansion into the United States. It is not true to say that there is a particular economic advantage in this situation, for though salaries would be higher in the U.S.A., the other costs of operation would be less.

Summary

Of existing Federal Government programs applicable to Abitibi, the following can be said:

(a) I. R. A. -N. R. C. program: excellent and should be continued no matter what other decisions are made.

(b) I. R. D. I. A. - Capital Grants: good to the extent that it provides some recompense for the higher cost of capital equipment in Canada in comparison to the more favoured position of American laboratories.

Operating Grants: ineffective and confusing, have very little true incentive. Recommend elimination of the principle of a base expenditure.

For both types of grant the long delay in payments should be reduced.

(c) P. A. I. T.: One program, concerning logging machinery, is now in effect. Speaking generally, the P. A. I. T. program has little applicability.

Historically, growth in industrial power has followed from the exploitation of technology, not science. Most industrial R&D follows from the needs of the increased industrial power. It is an incorrect simplification to say that better Canadian science will automatically mean a higher G. N. P. But exploitation will, and it is this which needs encouragement. Bold management and bold financing must be rewarded commensurately with the risk involved, otherwise the timid and safe approach to progress and growth is the only logical one.

The Problems in Perspective

There are three main questions to be considered:

a) Shall the Federal Government provide incentives for the increase of research and development (essentially the present system)?

b) Shall the Federal Government subsidize R&D without such subsidy being contingent on increase?

c) Shall the Federal Government financially encourage the exploitation of R&D results to the end that new or expanded industry shall ensue?

The efficiency of present and recent programs, as they affect Abitibi, should first be considered. Since we have not shared in defence-related projects, there are just three applicable programs:

(a) The Committee for Industrial Research Assistance (operated by the National Research Council). This is an excellent program, well conceived and ably administered. It should definitely be retained and if possible broadened in its application. Its strong points are:

(i) The procedures for applying for project approval and grants and for yearly extensions of grants are simple and logical.

(ii) The concept that the grant covers salaries and fringe benefits of those directly involved in the program, while the company pays the remainder of the costs, is a very logical division. The grant covers, on the average, slightly less than half of the total cost. It is relatively simple to calculate the salary and fringe benefit cost, whereas to carry out detailed accounting for all other possible costs for each project each month would be extremely difficult. Few laboratories in Canada would have the necessary accounting assistance available.

(iii) The payments are immediate and therefore show up in the laboratory's monthly cost statements on a significant basis.

(iv) The program has promoted liaison between industrial and governmental laboratories to a marked degree, which is a result to be highly commended.

(v) The proprietary nature of industrial information has been well respected by the government representatives.

There are some weak points:

(i) The requirement that each project shall entail an increase in staff equivalent to the number of personnel supported by the grant is logical on the basis that the I.R.A.-N.R.C. program is intended to be an incentive for increase in

R&D. Nevertheless, it does mean a moving base upon which approval is contingent, and in times when business is slack it may be very difficult for a company to maintain even the status quo. Yet it is at these times that support of a company's R&D might be most critical. Also, at least in theory, any staff increase brought about by the requirements of non-supported projects does not qualify as satisfying the requirement of increased R&D, though indeed there is such an increase.

(ii) While basic research and longer-range applied research have benefitted because they readily fit the program, applied technology and development have not benefitted. Yet the latter are what lead directly to new industry, new employment and early return on investment. Part of this fault certainly lies with industry, which has tended to keep its more exciting prospects close to the chest through reluctance to divulge to outsiders. This attitude is hardly justified on the basis of projects which have been pursued.

(iii) The program does generate some inflexibility in the application of personnel. The Research Director is less free to assign staff to pressing needs.

On balance, the I.R.A.-N.R.C. program is excellent.

(b) Industrial Research and Development Incentives Act - Capital Grants: This is a good program because, although the grant itself is much delayed, it is definitely calculable at the start. It is a powerful incentive when new laboratory buildings are being considered, and indeed the predecessor act, section 72 of the Income Tax Act, was a significant factor in our decision to build the present Abitibi Research Centre at Sheridan Park. It is a good incentive for tooling-up the research facilities with the best and most modern equipment, since the man responsible for specifying and approving such capital additions can use the 25% rebate as a powerful argument.

Nevertheless it must be clearly understood that in respect to equipment, these capital grants serve only to bring the Canadian laboratory back to a par with its American counterpart. Almost all such equipment originates in the United States or other foreign countries, and present duties plus federal and provincial sales taxes imposed on these purchases place a severe burden on Canadian R&D budgets.

Operating Grants: This is an inadequate program for these reasons:

(i) It is applicable only to the increase over a moving base, and has an important effect only for rapidly-growing laboratories. For established laboratories there may be no benefit, certainly none during a status-quo period when help would be most beneficial.

(ii) Its administration is poorly conceived. The moving base should be eliminated. The cost of additional accounting required may easily outweigh the amount of grant involved.

(iii) From the time that a budget for a particular year is prepared to the time that the I.R.D.I.A. operating grant for that year is received, a period of at least three years elapses. The incentive angle becomes buried, and it plays no part in the cash flow of an operating budget.

(iv) At the very most it serves only to ameliorate the difficulties hampering Canadian industrial laboratories through the imposition of duties, federal and provincial sales taxes on operating expenditures, and municipal business taxes on R&D facilities. In many cases these taxes have increased in recent years, leaving less cash for the very essential support of the research function and personnel.

(c) Program for Advancement of Industrial Technology: The Central Research Division itself has had no occasion to participate in this program, though the Company does have one active project on the development of logging machinery. The essential weakness is that the P.A.I.T. program subsidizes failure, but Canada needs successes. A new commercial venture should be based on groundwork that indicates high probability of success. Yet success under P.A.I.T. entails repayment of grants at a very high true rate of interest.

The "exploit in Canada" provisions are politically logical, yet are distinct roadblocks in the application of P.A.I.T. A success must be protected by patents in other countries, yet these can lead to compulsory licenses which then become distinct contraventions of the agreement. This provision has particular effect on Abitibi, since it seems hardly right that a success arising from our Canadian research and development could not also be transferred to and exploited in our U.S. plants when it is otherwise logical to do so.

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The above comments refer to past history, and it is clearly realized that present dialogues are leading to modifications of government policy which will at least alleviate the undesirable or unproductive aspects. The mere existence of such dialogue is in itself exciting. Let us hope that it shall be productive.

We now return to the original questions and in particular what the government should hope to accomplish. Are the goals not new industry, particularly secondary industry, new employment, greater productivity and greater Canadian control of its own assets? How do these accord with promotion of scientific R&D or even technology?

We often hear comparisons of G.N.P. and expenditures on R&D as if the former follows from the latter. Yet the United States grew into a great power through entrepreneurship, bold management, bold financing, the exploitation of foreign science, the application of technology, and particularly the provision of reward to those who took the risk and succeeded. Great Britain's industrial revolution was based on technology, not science. Science in industry followed such growth, when the wellsprings of knowledge dried up and further technological development depended on having further basic knowledge before new advances could take place. The United States was a great industrial power before World War II but as a scientific power it was hardly significant -- as a simple illustration compare the Nobel awards in science. Only since World War II has it made the enormous strides in science.

If this argument has any validity, the goal of the government should be to encourage the uncommon man, to provide bold management with rewards commensurate with the risks and penalize the timid, safe, but unproductive approach to progress.

To relate this concept to the present argument, let us realize that money expended in basic and applied research, in development and in the initial exploitation of the technology which results is not equivalent to that spent for normal operating expenditures of a going concern. It is risk capital, and the payment, if any, lies well in the future. Incentive and taxation policies must recognize this prime fact.

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APPENDIX

Replies to Questions Posed by the Special Committee on Science Policy

A. Financing Industrial Research

1. How best can the federal government encourage fruitful R&D in Canadian industry? Are present schemes satisfactory?

This has been answered in our brief. Essentially: encourage the application of R&D results and the rest will follow.

2. What federal assistance would help stimulate more innovation in Canadian industry?

Innovation is risk. Encourage risk-taking by suitable rewards; a broader interpretation of P.A.I.T. and of I.R.D.I.A. and removal of the sliding base would be examples.

3. How can federal agencies and departments, N.R.C. for instance, more effectively assist Canadian industry?

The bulk of Canada's basic research must be carried out or underwritten by such agencies. The results must then be made known to those who can apply and develop them to best effect. It is our experience that there is a low level of success in this latter area. Personnel from these agencies must get out to industry, talk about their work, spark interest in its possible applications. Likewise industry must be encouraged to visit the agencies. Neither of these desirable occurrences happen, so research results lay fallow or the agencies themselves try to carry out the applied research and development. This is wrong!

4. Is there a proper balance between the support of the federal government given the three sectors: industry, universities and federal government.

No, there is too high a percentage of in-house research by the federal government and too little contracting-out to industry and perhaps to universities. A well-conceived contracting program could strengthen the non-government research organizations. N.R.C. has made large investments in the "pure science" of universities; does it perhaps have an equal obligation to "applied science" in industry?

Page 2, Appendix

5. On the basis of your experience what is the appropriate creation of and balance between basic research, applied research and development?

Within industry and on the basis of man-hours: 15% basic, 30% applied and 55% development. On the basis of cost: 10% basic 25% applied and 65% development.

This assumes that universities and federal and provincial agencies will do a higher percentage of basic research, and make it available.

6. What criteria should the federal government use in allocating funds to scientific activities such as the support of R&D in industry?

a) Ease of administrative procedures. I.R.A.P. is excellent, I.R.D.I.A. operating grant system is very poor. See brief.

b) Relevance to Canada's needs, with recognition of future needs as well as present.

c) Recognition of the very fundamental American-control problem in much of our industry. We cannot deny its importance in Canadian life, and must only apply legislative control where actions are inimical to the overall good of Canada.

d) Recognition of the much more minor, but nevertheless important problem of Canadian-owned American subsidiaries as in Abitibi's case.

7. What changes should be made in federal government financial support of Canadian scientific activities?

This has been covered in the brief and also in answers to above questions.

B. Industry and Its Environment

1. How can Canadian universities and industries more effectively collaborate in the field of science and technology?

We do collaborate but admittedly it could be much more effective. Temporary interchanges of personnel, cooperative programs on contracted research, access by improved technological means to information, and consulting are possible ways. In regard to the latter, however, university salaries are now higher than government salaries and much higher than industry salaries. University staffs are pricing themselves out of the market. We have a recent instance where $30. per hour was turned down.

Page 3, Appendix

2. Do Canadian universities graduate scientists and engineers able to perform effectively in Canadian industry?

Definitely yes. We need not be ashamed of the Canadian product in any way. But universities do imbue a fair percentage with the idea that business is unworthy, while at the same time failing to instil self-confidence in their graduates, particularly those with bachelor or master degrees.

3. What should the important long-term goals of Canadian science be?

Within government agencies and universities, to provide basic knowledge relevant to the country's needs, not just relevant to the researcher's interest. Within industry, to apply that knowledge for the present good and future growth of Canada; to back up production technology with the best information possible; and to show to the industrial production segment that innovation and bold application of knowledge is to its eventual good.

4. Is there an adequate supply of scientific manpower in Canada?

At present there is a super-abundance, though this may be a temporary situation. Many Ph.D.'s are looking for positions and quality is good. Immigration has flooded the country with inadequately-trained foreign graduates who suffer also from lack of adaptability to Canadian methods. The supply of technicians trained in post-secondary institutes is good, and growing perhaps into a surfeit.

5. Does foreign ownership hamper the development of innovation in Canadian industry?

Not generally. Foreign owners are generally bolder in their management concepts than Canadian, and they will generally innovate to ensure profits, stability and growth. But this is considerably different than doing their R&D in Canada. In toto there is little reason why they should.

6. Are the results of foreign science and technology available to Canadian industry in a timely and suitable manner?

There are few legal restrictions. However, dissemination of information is at its infancy in Canada, and bold imaginative steps, say under the auspices of the National Science Library, would be a fit subject for government subsidization.

The Queen's Printer, Ottawa, 1969

Page 3, Appendix

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First Session—Twenty-eighth Parliament

1968-69

THE SENATE OF CANADA

PROCEEDINGS

OF THE

SPECIAL COMMITTEE

ON

SCIENCE POLICY

The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*
The Honourable DONALD CAMERON, *Vice-Chairman*

No. 78

FRIDAY, JUNE 20th, 1969

WITNESSES:

The de Havilland Aircraft of Canada Limited: Mr. W. B. Boggs, President and Chief Executive Officer, Mr. J. P. Uffen, Director, Research and Technical Design, Mr. F. A. Stanley, Vice President (Finance) and Secretary-Treasurer; Orenda Limited: Mr. F. P. Mitchell, President and Chief Executive Officer, Mr. B. A. Avery, Director of Engineering; Computing Devices of Canada Limited: Mr. James F. Taylor, Chairman of the Board and President, Mr. Robert R. Hoge, Vice-President, Research and Development; Litton Systems (Canada) Limited: Mr. John D. Freitag, President and General Manager, Mr. L. A. Borth, President of Engineering, Mr. Robert E. Marcille, Vice-President, Marketing, Dr. J. J. Green, Director of Government Relations; Air Industries Association of Canada: Mr. David Golden, President.

APPENDICES:

168.—Brief submitted by Orenda Limited
169.—Brief submitted by Computing Devices of Canada Limited
170.—Brief submitted by Litton Systems (Canada) Limited

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5. [illegible]

6. [illegible]

7. [illegible]

8. [illegible]

First Session—Twenty-eighth Parliament

1968-69

THE SENATE OF CANADA

PROCEEDINGS OF THE SPECIAL COMMITTEE ON

SCIENCE POLICY

The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*
The Honourable DONALD CAMERON, *Vice-Chairman*

No. 70

FRIDAY, JUNE 20th, 1969

WITNESSES:

The de Havilland Aircraft of Canada Limited: Mr. W. B. Boggs, President and Chief Executive Officer, Mr. J. P. Uffen, Director, Research and Technical Design, Mr. F. A. Stanley, Vice President (Finance) and Secretary-Treasurer; Orenda Limited: Mr. F. P. Mitchell, President and Chief Executive Officer, Mr. B. A. Avery, Director of Engineering: Computing Devices of Canada Limited: Mr. James F. Taylor, Chairman of the Board and President, Mr. Robert R. Hoge, Vice-President, Research and Development; Litton Systems (Canada) Limited: Mr. John D. Freitag, President and General Manager, Mr. L. A. Borth, President of Engineering, Mr. Robert E. Marcille, Vice-President, Marketing, Dr. J. J. Green, Director of Government Relations; Air Industries Association of Canada: Mr. David Golden, President.

APPENDICES:

168.—Brief submitted by Orenda Limited
169.—Brief submitted by Computing Devices of Canada Limited
170.—Brief submitted by Litton Systems (Canada) Limited

20664—1

MEMBERS OF THE SPECIAL COMMITTEE

ON

SCIENCE POLICY

The Honourable Maurice Lamontagne, *Chairman*

The Honourable Donald Cameron, *Vice-Chairman*

The Honourable Senators:

Aird	Grosart	Nichol
Belisle	Haig	O'Leary (*Carleton*)
Blois	Hays	Phillips (*Prince*)
Bourget	Kinnear	Robichaud
Cameron	Lamontagne	Sullivan
Carter	Lang	Thompson
Desruisseaux	Leonard	Yuzyk
Giguère	McGrand	

Patrick J. Savoie,
Clerk of the Committee.

ORDERS OF REFERENCE

Extract from the Minutes of the Proceedings of the Senate, Tuesday, September 17th, 1968:

"The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That a Special Committee of the Senate be appointed to consider and report on the science policy of the Federal Government with the object of appraising its priorities, its budget and its efficiency in the light of the experience of other industrialized countries and of the requirements of the new scientific age and, without restricting the generality of the foregoing, to inquire into and report upon the following:

(*a*) recent trends in research and development expenditures in Canada as compared with those in other industrialized countries;

(*b*) research and development activities carried out by the Federal Government in the fields of physical, life and human sciences;

(*c*) federal assistance to research and development activities carried out by individuals, universities, industry and other groups in the three scientific fields mentioned above; and

(*d*) the broad principles, the long-term financial requirements and the structural organization of a dynamic and efficient science policy for Canada.

That the Committee have power to engage the services of such counsel, staff and technical advisers as may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to examine witnesses, to report from time to time, to print such papers and evidence from day to day as may be ordered by the Committee, to sit during sittings and adjournments of the Senate, and to adjourn from place to place;

That the papers and evidence received and taken on the subject in the preceding session be referred to the Committee; and

That the Committee be composed of the Honourable Senators Aird, Argue, Bélisle, Bourget, Cameron, Desruisseaux, Grosart, Hays, Kinnear, Lamontagne, Lang, Leonard, MacKenzie O'Leary (*Carleton*), Phillips (*Prince*), Sullivan, Thompson and Yuzyk.

After debate, and—

The question being put on the motion, it was—

Resolved in the affirmative."

Extract from the Minutes of the Proceedings of the Senate, Thursday, September 19th, 1968:

"With leave of the Senate,

The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That the name of the Honourable Senator Robichaud be substituted for that of the Honourable Senator Argue on the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—
Resolved in the affirmative."

Extract from the Minutes of the Proceedings of the Senate, Wednesday, February 5th, 1969:

"With leave of the Senate,

The Honourable Senator McDonald moved, seconded by the Honourable Senator Macdonald (*Cape Breton*):

That the names of the Honourable Senators Blois, Carter, Giguère, Haig, McGrand and Nichol be added to the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—
Resolved in the affirmative."

ROBERT FORTIER,
Clerk of the Senate.

MINUTES OF PROCEEDINGS

FRIDAY, June 20, 1969.

Pursuant to adjournment and notice the Special Committee on Science Policy met this day at 10.00 a.m.

Present: The Honourable Senators Lamontagne (*Chairman*), Blois, Carter, Grosart, Haig, Kinnear and Robichaud—7.

Present but not on the Committee: The Honourable Senator Denis—1.

In attendance: Philip J. Pocock, Director of Research (*Physical Science*).

The following witnesses were heard:

THE de HAVILLAND AIRCRAFT OF CANADA LIMITED

Mr. W. G. Boggs, President and Chief Executive Officer.
Mr. J. P. Uffen, Director, Research and Technical Design.
Mr. F. A. Stanley, Vice-President (Finance) and Secretary-Treasurer.

ORENDA LIMITED

Mr. F. P. Mitchell, President and Chief Executive Officer.
Mr. B. A. Avery, Director of Engineering.

COMPUTING DEVICES OF CANADA LIMITED

Mr. James F. Taylor, Chairman of the Board and President.
Mr. Robert R. Hoge, Vice-President, Research Development.

LITTON SYSTEMS (CANADA) LIMITED

Mr. John D. Freitag, President and General Manager.
Mr. L. A. Borth, President of Engineering.
Mr. Robert E. Marcille, Vice-President, Marketing.
Dr. J. J. Green, Director of Government Relations.

AID INDUSTRIES ASSOCIATION OF CANADA

Mr. David Golden, President.

(*A curriculum vitae of each witness follows these Minutes*)

The following are printed as Appendices:

No. 168—Brief submitted by Orenda Limited.
No. 169—Brief submitted by Computing Devices of Canada Limited.
No. 170—Brief submitted by Litton Systems (Canada) Limited.

At 12.30 p.m. the Committee adjourned to the call of the Chairman.

ATTEST:

Patrick J. Savoie,
Clerk of the Committee.

CURRICULUM VITAE

Avery, B. A.: Personal: Born April 28, 1922, at Kincardine, Ontario; Married in 1949, one son, one daughter; Director of Engineering Orenda Limited; B.A.Sc., Mechanical Engineering, University of Toronto, 1946; Registered Professional Engineer of Ontario; Fellow, Canadian Aeronautics and Space Institute; Member, American Society of Mechanical Engineers; Member, Society of Automotive Engineers; Director, The Canadian Nuclear Association; Past Director, Air Industries Association of Canada; Member, Board of Trade of Metropolitan Toronto; Vice President, Humber Memorial Hospital. 25 years' experience in engineering and general management positions in the jet engine, gas turbine and nuclear industries.

Boggs, W. B. (Bill): Title: President and Chief Executive Officer. Birth date: December 18, 1918. Education: Noranda High School, McGill University—B. Engineering—Mechanical. Previous employment: 1940-45, RCAF Service, Squadron Leader; 1945-50, Air Canada, Asst. Supt. of Maintenance; 1950-57, Canadair, Manager, Production Control; 1957-62, Canadian Car Division of A. V. Roe Canada Limited, General Manager; 1962-65, Vice-President, Transportation Equipment Hawker Siddeley Canada Ltd. Positions held at DHC: 1965, President. Family status: Married, three children. Hobbies, Sports, etc.: Skiing, boating.

Borth, Laurence Alan (B.Sc., M.A.Sc.): Born 8 July 1927, Kitchener, Ontario. 1945-1948 attended Queen's University and obtained B.Sc. (Hon.) in Electrical Engineering; 1949-1950 attended University of Toronto and obtained M.A.Sc. in Electrical Engineering. 1948-1949 Junior Research Engineer, National Research Council; 1950-1952 Research Engineer, Ontario Hydro Electric Commission, Toronto, Ontario. From 1952 to 1956 he was Senior Test Engineer and Laboratory Supervisor with Avro Aircraft Limited, Malton, Ontario, in charge of instrumentation for experimental flight testing, telemetering systems, radar and armament flight testing and ground tests of missile launchers. In 1956 he was appointed a Section Head at Raytheon Canada Limited, in charge of circuit design for radar indicators, video transmission equipment, symbolic displays and marine radar equipment. From 1958 to 1961 he was Chief Development Engineer with Canadian Applied Research Limited, responsible for operation of the Environmental Test Laboratory and for various research and development projects including:—ice detectors, displays, the Airborne Profile Recorder, de-icing controllers, temperature sensors, aircraft nose-wheel steering unit, command signal converter, aircraft instruments, portable and stationary magnetometers, etc. He joined Litton Systems (Canada) Limited as Director of Engineering in 1961 with responsibility for managing the Engineering Division which has engaged in development and engineering projects including gyroscopes, stable platforms, airborne analogue and digital computers, tape programmed automatic test equipment, and an automatic money dispenser. The Division also provides support for a large scale production of military and civil avionics equipment, principally inertial guidance systems, weapon release computers, aerospace ground equipment and command and control systems. Research programs in the Division are concerned with gas bearing technology, signal processing, pattern recognition, the automation of design, error detection techniques, etc. Other activities include product improvement programs; the design, manufacture and maintenance of factory test equipment; the operation and maintenance of calibration laboratories; and technical publications. In 1969 Mr. Borth was appointed Vice-President Engineering.

Freitag, John D. (B.Sc.): Born in New York, U.S.A. in 1928 and was educated at the University of Miami from which he received a B.Sc. degree in Electrical Engineering. From 1954 to 1966 he was with the Sperry Gyroscope Division of Sperry Rand and was appointed to various engineering and management positions in the field of navigation and radio propagation systems. The last position he held was Director of Marketing. In 1966 he joined Litton Systems Inc. as Vice-President of the Litcom Division, responsible for Advanced Programs and Technology Development. He was appointed President and General Manager of Litton Systems (Canada) Limited early in 1969. Mr. Freitag is the author and co-author of various technical papers on low-frequency radio propagation systems for long-range navigation and nuclear detection. He is a retired officer of the U.S.A.F.

Hoge, Robert R.: Vice-President, Research and Engineering Computing Devices of Canada Limited. B.S. (E.E.) Ohio State University, 1951; S.M. Massachusetts Institute of Technology, 1955; M.Sc. University of Birmingham, England, 1957. Mr. Hoge has served in his present position since June 1966. He is responsible for managing a 360-man R&D staff, of which 130 are graduate engineers and scientists, including 25 with advanced degrees. Mr. Hoge has been employed by Bendix Corporation, the major stockholder in Computing Devices, since 1957. At the Bendix Research Laboratories his responsibilities included development of control instrumentation for nuclear propulsion power plants, development of numerical controls for machine tools, and early application of micro-integrated circuits. He was Director—Advanced Technology Applications in the Bendix Executive Offices from 1964 until his appointment at Computing Devices. During the period 1951-56 Mr. Hoge was employed by Battelle Memorial Institute, The U.S. Army Signal Corps Engineering Laboratories, and the Electronics Systems Laboratory at M.I.T. He briefly served in the U.S. Navy during World War II and in the U.S. Army during the Korean War. He is a member of the Institute of Electrical and Electronic Engineers, (IEEE), The American Management Association, The Canadian Research Management Association, The Electronic Industries Association of Canada, The Air Industries Association of Canada, and the Associate Committee for Avionics —NAE/NRC.

Golden, David A.: Mr. Golden was born in Sinclair, Manitoba on February 22, 1920. He graduated from the University of Manitoba Law School with the degree of LL.B., in 1941, and received the Honourable Alexander Morris Exhibition for highest standing in all four years of the University law course. He was appointed Rhodes Scholar in 1940. Mr. Golden enlisted in May, 1941 in the 1st Battalion, The Winnipeg Grenadiers, and served in Canada, Jamaica and Hong Kong. He was a prisoner of war in Hong Kong from December 1941 until September 1945 and was discharged from the army in December, 1945, with the rank of captain and adjutant. In January, 1946, he started the practice of law in Winnipeg with Mr. Samuel (now the Honourable Mr. Justice) Freedman, under the firm name of Freedman and Golden. He attended The Queen's College, Oxford, from October, 1946 until June, 1947. On his return to Winnipeg he resumed the practice of law and also lectured at the Manitoba Law School. In May, 1951 Mr. Golden joined the Department of Defence Production as Director of the Legal Branch and a year later assumed the additional post of Associate General Counsel. In February, 1953 Mr. Golden was made Assistant Deputy Minister and General Counsel of that department. Mr. Golden was appointed Deputy Minister of Defence Production on September 30, 1954, and became President of the Northern Ontario Pipeline Crown Corporation in June, 1956. Appointment to his present position, President of Air Industries Association of Canada came on July 1, 1962. Mr. Golden also serves as a Governor of Carleton University, Vice-President of National Capital Arts Alliance, Vice-President of Ottawa Canadian Club, and a Director of Atomic Energy of Canada Limited. He is married to the former Molly Berger of Estevan, Saskatchewan, and has three children; two sons and one daughter.

Green, Dr. John Joseph, M.B.E., Ph.D., B.Sc., A.R.C.S., D.I.C., F.R.Ae.S., F.A.I.A.A., F.C.A.S.I., Born Nov. 9, 1905, Portsmouth, England. 1926-30 attended London University, The Imperial College of Science and Technology, Royal College of Science. Graduated in 1928 in honours Physics, awarded Imperial College Governors' Prize in Physics. 1928-29 Busk Studentship in Aeronautics for graduate study and research. 1929-30 Beit Fellowship for scientific research. Diploma of Membership of the Imperial College (DIC) in 1929, Ph.D. Aeronautics, London University 1930. 1930-43 National Research Council of Canada, Head of Aerodynamics Laboratory. M.B.E. (Civil) 1943. 1943-45 commissioned in RCAF and served as Chief Research Engineer, RCAF Test and Development Establishment. 1945 received King's Commendation for valuable service in the air. 1945-49 Chief Research Aeronautical Engineer, Air Transport Board. 1949-55 Chief Division 'B', Defence Research Board and Scientific Adviser to the Chief of the Air Staff, RCAF. 1955-59 Defence Research Member, Canadian Joint Staff and Defence Research Attache, Canadian Embassy, Washington, D.C. 1959-63 Chief Superintendent Canadian Armament Research and Development Establishment. 1963-69 Director of Research, Litton Systems (Canada) Limited. 1969—Director of Government Relations, Litton Systems (Canada) Limited. 1954 first President, Canadian Aeronautical Institute (now the Aeronautics and Space Institute). 1962 President, Canadian Aeronautics and Space Institute. Member, International Council of the Aeronautical Sciences and Chairman of its Executive Board. Honorary Life Member, American Association of Airport Executives; Member, Institute of Navigation; Member, Society of Automotive Engineers; Senior Member, American Astronautical Society; Editor-in-Chief, C.A.S.I. Journal; Member, Boards of Award, Laura Taber Barbour Flight Safety and Daniel Guggenheim Medal; Member, Industrial Advisory Committee, Flight Safety Foundation; 1967 Vice-Chairman, Canadian Research Management Association; Chairman, Associate Committee on National Museums of Science and Engineering, NRC; Member, Associate Committee on Avionics, NRC; 1954 Eleventh Commonwealth and Empire Lecturer before the Royal Aeronautical Society.

Marcille, Robert E.: (B.S., M.E.), Born 29 January 1928, Bridgeport, Connecticut. Educated at Rhode Island State University, B.S. (Electrical Engineering) 1949 and Yale University, M.E. (Electrical Engineering) 1951. In May 1951 he was appointed Assistant Project Engineer at Sperry Gyroscope Division, Sperry Rand but was commissioned in the U.S. Army Signal Corps in June and served therein until January 1953. From January 1953 to June 1956 he was Assistant Chief—Navigation and Flight Aids Section of the Signals

Corps Engineering Laboratories. In June 1956 he was appointed Head of the Technical Planning Staff and Engineering Systems for Melpar Inc. He joined the Guidance and Control Systems Division of Litton Industries, Inc. in July 1959 as a Senior Staff Engineer. In 1960 he became Project Manager and, in 1964, Applications Engineering Manager. He joined Litton Systems (Canada) Limited as Director of Marketing in January 1968 and was appointed Vice-President of Marketing in May 1969.

Mitchell, F. P.: Personal: Born December 5, 1922 in Stratford, Ontario; Married with three sons; President and Chief Executive Officer Orenda Limited; Director of Hawker Siddeley Canada Ltd; Registered Professional Engineer of Ontario; Fellow of the Canadian Aeronautics and Space Institute; Past Director of Air Industries Association of Canada, and The Canadian Nuclear Association; 25 years' experience in Senior Engineering and Management positions in the Canadian Aerospace Industry.

Stanley, F. A. (Frank): Title: Director, Vice-President, Finance & Secretary-Treasurer. Birth Date: January 29, 1911. Education: University of Toronto—B.Comm. 1932. C.A. (Ontario) 1935. Previous Employment: 1932-43, Thorne, Mulholland, Howson & MacPherson, C.A.'s; 1946-48, C.A.; 1943-46, Canadian Army; 1948-49, Loblaws Groceterias Co.—Assistant to General Manager; 1949-54, Regent Refining (Canada) Ltd.—Secretary and Treasurer. Positions held at DHC: 4-1-54, Comptroller; 2-6-61, Director and Comptroller; 8-1-62, Director and Vice-President Finance; 8-1-65, Director, V.P. Finance and Treasurer; 5-3-66, Director, V.P. Finance and Secretary-Treasurer. Family Status: Married—1 son. Hobbies, Sports, Etc.: Golf, Curling.

Taylor, James Frederick: Chairman of the Board, and President. J. F. Taylor was elected Chairman of the Board in January, 1968. He has been associated with Computing Devices since 1959, when he was elected to the Board of Directors. He was named Vice President and General Manager in 1966, and President in 1967. His association with Bendix in Canada goes back to 1952 when he was appointed general manager of the Aircraft Products Division of Bendix Eclipse of Canada, Limited in Toronto. Prior to his joining the Bendix Corporation, he had held a number of senior executive positions in the Canadian Government and aerospace industry. Mr. Taylor is also a director of Aviation Electric Limited, a Bendix affiliate in Montreal, and of Fleet Manufacturing Limited in Fort Erie, Ontario. He is a director of Canadian Industrial Preparedness Association.

Uffen, J. P. (Jack): Director of Research & Technical Design; born March 2nd, 1919. Education: University of Toronto—BASc. 1944. Previous Employment: 1945-49, National Research Council, Structures Lab.; 1949-51, National Research Council, Asst. Research Officer. Positions held at DHC: 3-1-51, Design Engineer; 2-52, Aerodynamics and Flight Test; 6-55, Chief Aerodynamicist; 9-1-66, Deputy Director of Research and Future Projects; 3-1-69, Director of Research and Technical Design. Family Status: Married, 4 children (1 daughter and 3 sons). Hobbies, Sports, etc.: Music, sailing.

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THE SENATE

SPECIAL COMMITTEE ON SCIENCE POLICY

EVIDENCE

Ottawa, Friday, June 20, 1969.

The Special Committee on Science Policy met this day at 10 a.m.

Senator Maurice Lamontagne (*Chairman*) in the Chair.

The Chairman: Honourable senators, we have representatives this morning of four different companies—The de Havilland Aircraft of Canada Limited, Orenda Limited, Computing Devices of Canada Limited, and Litton Systems (Canada).

As usual, those who are on my two sides will each make an opening statement. Then we will have a discussion period. I would ask each spokesman, before starting his remarks, to introduce the names of his associates so that we will have their names and titles in our record.

When the discussion period begins, you are always free to refer to any of your associates to offer comments or to add to your answers.

Mr. W. B. Boggs, The de Havilland Aircraft of Canada Limited: Mr. Chairman and honourable senators, I am glad to be here representing The de Havilland Aircraft Company of Canada Limited. The other two gentlemen with me are Mr. F. A. Stanley, Vice-President, Finance and Secretary-Treasurer, and Mr. J. P. Uiffen, who is our Director of Research and Technical Design.

I do not have a prepared statement. As you are undoubtedly aware, we did not submit a brief. Our position was that the Air Industries Association of Canada brief reflected our views and that we were prepared to support this. We worked quite actively in assisting them on the presentation of the brief.

The existing government programs for support of research and development in the aircraft industry and other industries, and for supporting innovation beyond R and D, are very good, very imaginative. I think it is safe to say that the industry, as presently constituted—and we think it is successful and has made a major contribution—would not be anything like as large, as viable, or make as significant a contribution to the economy, if these support programs had not been available.

Senator Grosart: Would you indicate the area of the programs you are referring to?

The Chairman: Defence contracts, I would presume.

Mr. Boggs: I am referring to the kind of support we received from the defence industry research programs, national research programs and Votes 5 and 20, referring to both commercial and military aricraft. These four programs we have found useful materially to the industry. We have not used PAIT and we do not think PAIT as at present constituted is particularly a good type of program.

Senator Grosart: Or IRDIA?

Mr. Boggs: IRDIA has not been of advantage to us, simply because of the base, which in our case has been very high. I might just give some specifics, to show why I think these programs are sueful and essential.

Our company has, in the last nine years, done roughly \$600 million worth of business, of which about \$80 million has been exported. To support that, we have spent \$100 million out of the \$600 million in research and development and in launching costs for new projects, that is, 20 per cent of the sales dollar; and Government support programs have contributed \$20 million, or about 6 per cent of the total. After we are through all this, there is 2.4 per cent of the sales dollar left as profit after tax, or \$15 million.

Senator Grosart: How does the 6 relate to the 20? Are they both percentages of the same thing?

Mr. Boggs: The \$600 million sales, of which the Government contribution has been \$20 million or 3 per cent. And we have spent $80 million. The sum total of the two is $100 million, or 20 per cent total sales, which has been required in R and D and launching costs. So, that $20 million—which does not look like a very major factor—really is the essential seed money from which most of this business grows.

The Chairman: You would not say "what is $20 million?", though, would you?

Mr. Boggs: You mean, too much or too little? All I am saying is that the history in the past has been good. We think the present programs need summary examination as outlined in the Air Industry Association brief.

Mr. Chairman, we would be happy to answer any questions.

The Chairman: Thank you, Mr. Boggs, thank you very much.

We now have Mr. F. P. Mitchell, President and Chief Executive Officer of Orenda Limited.

Mr. F. P. Mitchell, President and Chief Executive Officer, Orenda Limited: Mr. Chairman, honourable senators, ladies and gentlemen, before proceeding, may I introduce the chap I have with me, Mr. B.A. Avery, Director of Engineering. We appreciate the opportunity of being here today. We submitted a brief several months ago. It better contains anything I might say, and such remarks that I might make today a cally about Orenda and how research and development affects Orenda.

I am not an expert on over-all research and development in Canda and I should hate to make proposals about the over-all situation. But as it affects Orenda, I am, of course, very conversant.

One of the things in Orenda that I should like to discuss and tell you about is our industrial gas turbine engines. These were developed in the early 1960s, using technology developed in the military programs in the early fifties. In the early sixties we proceeded with our work and it went well. In fact, the whole program went so well that by the mid-1960s we ran out of technology. We continued development, but the basic tools in technology had gone on us in a very short number of years. This was certainly a strong illustration to us of the fact that technology was advancing very rapidly and we were just no keeping pace.

This is still the case, but we have rectified the situation somewhat by aligning ourselves with a big United States company, and this has given us access to technology which we really had to have in order to advance development.

We have had very little Government funding during this particular period of time.

Our programs that I am talking about are not aerospace programs. Orenda was very much in the aerospace business, but our prime research and development is not in that field. It is in the industrial area, and we do have a real challenge ahead of us in the industrial engine field.

Just to give you some examples, up to 1960 some one and a half million industrial engines had been sold worldwide. Between 1960 and 1967 some 15 million industrial turbines had been sold. The market is growing. Competition is growing. Technology is growing very rapidly. The problem of keeping up is certainly very severe to us. In fact, I don't think there is any question that we need as much assistance as we can get.

We are competing against giants who have continued in fully-funded government programs. We do not have that assistance.

The challenges are very severe. Whatever greater assistance the Government might give, as a result of your deliberations, would certainly have a very good return in terms of our development—both our economic development and our development of new products for worldwide sales.

Thank you.

The Chairman: Thank you very much, Mr. Mitchell.

Now we shall hear from Mr. Hoge, Vice-President, Research and Engineering, Computing Devices of Canada Limited.

Mr. Robert R. Hoge, Vice-President, Research and Engineering, Computing Devices of Canada Limited: Thank you, Mr. Chairman. Honourable senators, ladies and gentlemen, we were very pleased to receive your invitation to be here today. I should like to begin by introducing Mr. J. F. Taylor, our President and Chairman of the Board, Mr. Taylor and I are delighted to participate here today. We previously submitted a written brief. I have in addition a prepared opening statement to make. This statement will expand on our previous submission.

May I point out that I am an engineer in management, and do not profess to be an expert when discussing the economic aspects of science policy. However, I shall present my views, coloured as they are by our unique environment, in the hope that they will be of interest and value to you.

We are fully in agreement with Mr. Maxwell MacKenzie's view expressed at a previous hearing of this committee, with the Science Council of Canada Report No. 4 and with others who believe that Canada should adopt a policy of national priorities for mission-oriented research and development programs. Computing Devices would support the recommendation for two of the four program areas suggested for immediate planning in section 7(b) of the Science Council Report No. 4. These areas are transportation and computer applications and we have the capabilities to participate in these programs.

Our company endorses a policy of supplying federal funds to industrial research and development programs because we believe that government's investment in R & D pays big dividends. For example, an article in the March 1, 1969, *Financial Post* estimated that the ultimate dollar value of sales due to investment by Ottawa and industry in R & D under the 50/50 shared-expense R & D programs was $2,500 mililon; or for every dollar invested in the Vote 5 program $25 sales will result.

Getting closer to home, Computing Devices of Canada probably would not exist today if it were not for federally-funded research and development, since the company's first project was a fully-funded program to develop a tactical trainer for the Royal Canadian Navy. Our subsequent experience supports the general conclusion drawn in the *Financial Post* article. Later I will outline some specific examples.

Canada currently has a policy wherein individual universities and companies have the initiative in choosing subjects and seeking federal grants for R and D projects which are not fully co-ordinated. We believe that the Canadian economy would be more beneficially influenced if the majority of these grants were available only for R and D which was applied to subtasks of the major national programs.

We agree with those who believe that less Government R & D money should be spent within Government laboratories and proportionally more in industry. Yet, as we mentioned in our earlier written submission, we believe that there are justifiable roles for Government laboratories, particularly in the fields of pure research. There are many fine examples of successful products which are based on work of the National Research Council laboratories. But we contend that the development of competitive products from basic proven concepts is best accomplished by industry. The transfer interface between product development and production within a company like ours is difficult at the best of times. Attempting to produce a product which was developed by an outside agency makes the transfer problem even less tractable.

It is generally known that the United States spends a considerably smaller percentage of its federal R and D funds within government laboratories than does Canada. In an article in *Canadian Business* magazine for April, 1968, Dean D. L. Mordell of the faculty of engineering at McGill University pointed out that Canada spent 78 per cent of the total Government research dollars in Government laboratories in the period 1963-64, whereas the equivalent figure for the United States was 27 per cent. The United States approach results in a vigorous industry competition for the 73 per cent of public funds allocated to competitive R & D contracts. Competition instills motivation which in turn fosters higher productivity.

Canada should consider a system whereby NRC laboratories would compete with industrial firms for R & D contracts in the applied research areas. Of course, in this type of competition, NRC would be required to follow the same accounting and costing procedures as are required in industry. Perhaps this method will be used more extensively if national priority programs are established.

The 50/50 sharing of defence development expense through "Vote 5" is not a very generous arrangement, but I think it is helpful when a company such as ours wishes to pursue the development of a proprietary idea, product or system.

Our contracts are audited under DDP-30, 26A, and 26B, and as a result certain legitimate costs are disallowed. An example is bank interest, which is now a major item of cost. I would also like to draw your attention to the fact that: (a) we must earn profits on other contracts in order to generate sufficient funds to pay our 50 per cent share of Vote 5 projects, and (b) that we may have to terminate a project due to lack of funds just when we are about to achieve success. Therefore we believe that there should be a flexible arrangement on the ratio of development expense-sharing rather than a fixed 50/50 ratio.

Now I have some specific company examples I would like to cite of how we have used government R & D funds and what the outcome has been. My first example is the development under Vote 5 of a digital computer referred to as the ADC, which stands for Airborne Digital Computer. At first glance one might rate this program as a failure because our goal of selling the computer in quantities was never realized, the ADC development program was started in 1961 and, after a series of evolutionary steps, in 1968 we had delivered a total of 8 military computers as parts of systems. Typically, these computers consisted of 4 boxes, each measuring about 5 x 8 x 1 inches and collectively weighing about 100 pounds. The computers were designed to operate in adverse military environments and they could be used in a variety of applications, since they are the programable general-purpose digital type. The design philosophy and logic organization of this machine was outstanding and has received much praise from independent United States technical consultants.

This computer development program might also be considered a technical disappointment because, by the time the design was qualified to meet the military environments the machine was out-dated and competitors' machines using more advanced electronic components were on the market. You might say it lost its sex appeal. We lost the opportunity to develop an ADC with micro-integrated circuits because the company could no longer afford to invest the 50 per cent required, due to substantial losses on other development contracts. We requested 80 per cent funding from the government but were refused.

But that isn't the end of the story. As a manufacturer of computers it was logical for us to enter the computer systems market, and we proceeded to design systems around our airborne digital computer. This work has subsequently grown to the point where it represents roughly 50 per cent of our research and development activity. Most of this systems-work has been in the classified anti-submarine warfare field under contracts with the Canadian and United States Governments. Today we are recognized as specialists in the field and we have a capability which is unique in the western world. Both the Canadian and United States defence departments have high regard for this capability. It would not exist today if we had not embarked on a program to develop an airborne digital computer with the financial participation of the Canadian Government. Our most recent contract in this field is valued in excess of $3 million.

The computer has also been used in a military sound ranging system, which is used to locate the originating point of a sound, based on the fact that sound travels at a known velocity. By determination of the time taken for a sound-wave front to travel between microphones at known locations, it is possible to compute the location of the source of the sound by hyperbolic intersection. The military application of this technique is to locate the co-ordinates of enemy weapons firings.

A sound ranging system has recently been delivered to the United States Army for extensive trials at Fort Sill, Oklahoma. The future of this system is largely dependent upon the performance in these trials and a successful trial could result in sales in excess of $5 million.

A total of $1.85 million federal government R & D funds was spent on the ADC computer development. As an indirect result, we have already obtained $17,744,746 in sales of military computer systems which we might never have obtained if we had not embarked on developing the ADC. Additional computer systems business is expected to continue for several years, so we consider the ADC venture an indirect success.

Coming to projected map systems, a second more clearly successful development program in which we obtained federal support is the projected map system. This is a cockpit display device which provides the aircraft pilot with an automatic map projection of his present position together with a number of other features. To date $1 million federal funds have been expended on this project and we have received firm contract bookings totalling $9,534,516 for map products which are directly derived from our shared-expense development program. We believe this projected map product has an excellent future, including the commercial aviation field, and that the sales volume in world-wide markets will exceed PHI sales to date, and I will talk about that now.

My next example of a product which we developed with Government financial help is the position and homing indicator, or PHI for short. The PHI is a military aircraft navigation instrument which displays aircraft range and bearing to several pre-selected destinations. This product has been largely responsible for the rapid and successful growth of Computing Devices. The PHI was originally developed under a fully-funded development program for the Department of National Defence.

Since its inception, PHI sales of various configurations have totalled $56 millions and have resulted in our payment of $1 million to the Crown in royalties. We understand that Canadian Patents and Development Limited has earned approximately $3.4 million in royalties since its inception in 1947 although it handles the bulk of Crown patents. Therefore our PHI royalties have accounted for slightly more than 30 per cent of the CPDL earnings.

Now, what about the effect of foreigh ownership? It is frequently suggested that Canadian subsidiaries of major United States companies are not good Canadian citizens. We believe that Computing Devices has been a very good Canadian citizen. Although our major shareholder is a United States firm in a business area similar to our, we develop products for sale in world-wide markets. We are expected to live and grow through sale of products developed by our own engineering organization. Bendix Corporation does not market products which compete with ours in the United States. They have not gone into the fields of (a) Sound Ranging (b) ASW Research, (c) Photo-Reconnaissance Camera Control Systems, (d) Position and Homing Indicators, (e) Projected Map Systems. In fact, Bendix helps us sell our products in the United States and in the world markets.

Dealing with company investment in R & D, we believe that the management and shareholders of Computing Devices have also permitted liberal investment of disposable income in R & D. To illustrate, for the five-year period ending September 30, 1948, our sales were $97 million, and from this we had a disposable income of $6.8 million. Now this disposable income was used as follows; company funded R & D, $5.6 million, income taxes $400 thousand and dividends paid to shareholders $800 thousand.

Senator Grosart: Excuse me. How do you define disponsable income in the corporate sense if you include taxes? This seems to be a somewhat different definition from that in the income sector.

The Chairman: It would correspond to profit before taxes.

Mr. Hoge: Yes, profit before taxes, if you wish.

Senator Grosart: Oh, I see; but what is your income tax in your distribution?

Mr. Hoge: It was $400,000 over this five-year period; and this period spans a period in which we sustained substantial losses, in 1966.

Senator Grosart: But, if you define "corporate disposable income" as "profit before taxes," I do not understand why you have a tax item in the distribution of your disposable income.

Mr. Hoge: Maybe I should ask Mr. Taylor to explain that.

Mr. James F. Taylor, Chairman of the Board and President, Computing Devices of Canada Limited: That is the money we had available after all other charges.

Mr. Hoge: After we paid for the cost of our sales, but not including the company's contribution to R & D.

Senator Grosart: I am only questioning, if corporate disposable income is profits before taxes, I do not understand why you have a tax item of $400,000 in there.

Mr. Hoge: I did not call it that, but "disposable income". I got the data from our financial man, and I will not argue about why he did it that way. I checked it out against the financial statements of the company, and it fits; but I am not an accountant. At any rate, we have invested seven times as much of our income in R & D as has been paid to shareholders in dividends.

The following data corresponds to the year ending 30 September, 1968:

Net Profit before Research and Engineering Expense $1,406,000.
Research and Engineering Expense $780,000.
Profit on Canadian Operations $626,000.

Thus, in 1968 we spent more for R & D than we had left as profit on our Canadian operations. Fortunately, we had some additional profit from our U.K. subsidiary.

In conclusion, I believe our company situation may also help illustrate the importance of full-funded R & D programs.

Previously I indicated that in the last five years our cumulative investment in R & D has been $5.6 million. Last year it was actually $780,661. Limits on these levels are set by the profitability of our manufacturing business. If the only kind of R & D funding support available were the 50-50 sharing arrangement under Vote 5, then our gross level of R & D activity would be reduced to a very low level indeed. However, we are able to get significant fully-paid R & D programs, mainly from the U.S., so our actual level of engineering this year will be slightly over $6.8 million. Thank you, gentlemen.

The Chairman: Thank you very much.

Now, Mr. John D. Freitag, President and General Manager, Litton Systems (Canada).

Mr. John D. Freitag, President and General Manager, Litton Systems (Canada): Thank you, Mr. Chairman. Honourable senators, ladies and gentlemen, I am grateful for the opportunity to appear before you this morning. Before I make some comments on the brief we have submitted, I would like to introduce to you the other members of our organization who are here today: Mr. L. A. Borth, our Vice-President of Engineering; Mr. R. E. Marcille, our Vice-President of Marketing; and Dr. John J. Green, our Director of Government relations.

Litton Systems Canada is a wholly owned subsidiary of Litton Industries Incorporated, an international company with 219 plants in 35 countries. Our Canadian company manufactures modern, advanced electronic equipment for ground, airborne and shipboard applications. In the nine years of our existence this Canadian company has exported more than $250 million-worth of such equipment. Although the defence market for this type of equipment has declined in Canada and in other parts of the world to some extent, Litton Systems has been able to maintain its production levels in the export market because of our competitive costs and ability to produce in quantity to a very high standard of quality.

The policy of our parent company has always been to encourage us to exploit new markets wherever possible, based on product improvement and innovation derived from the technology we have acquired. I know that from time to time there have arisen in Canada some doubts about foreign ownership within the technologically advanced secondary industries. The view is sometimes expressed that the subsidiary company enjoys fewer opportunities for enterprise than the domestically owned company. In the case of our own company our experience has shown that this criticism is not valid. In one recent example, our parent company in California developed an inertial navigation system for commercial aricraft. The corporation has now decided that the exclusive manufacture and further development of this system, for the world-wide market, will be undertaken by Litton Systems. This system, the Litton LTN-51, which eliminates the need to carry a human navigator, was chosen to equip the several aircraft used by the President of the United States. It was selected for installation on the Anglo-French Concorde supersonic aircraft, and has been chosen by such major carriers as Air France and American Airlines for carrier personnel and freight transportation. The market for this equipment is rapidly expanding and promises to create a multi-million dollar production demand. We are cautiously looking forward to this.

Our engineers have developed a good capacity for innovation using a combination of imported and indigenous technology. This has been particularly noteworthy in the area of specialized electronic test equipment as required in the factory, at service depots and at the aircraft flight line. We have developed in Canada an export market for this type of equipment and are receiving multi-million dollar production contracts—just recently, a new contract with the U.S. Navy, for flight line test equipment for the check-out of systems in the P-3B Orion anti-submarine patrol aircraft.

I do not wish to comment on the Canadian Government financial support programs for research and development in industry in Canada, except to remark that we have had experience with the defence industrial research program of the Defence Research Board and also with Vote 5, the defence development sharing program of the Department of Industry, Trade and Commerce. We attribute to this support from the Canadian Government some of our success in capturing new production programs representing advanced technology. Specifically, this was a factor in the decision to put the LTN-51 production into Canada.

This support has also enabled us to engage in several important research programs. One of these is in the field of pattern recognition and utilizes techniques derived from holography. Another is concerned with the automation of the design of digital computers. We believe that in both of these areas we are on the brink of the state of the art and are pushing it constantly.

In the light of these accomplishments, and addressing ourselves to the questions raised by your committee, we believe that development, not research, is the prime need at this time, since it offers the more immediate return in marketable products, and therefore increasing labour opportunities.

We agree with previous witnesses who have pointed out the disproportionately low level of development in relation to the amount of research done in Canada as compared with other countries with progressive technologies. The development expenditure in Canada needs to be increased significantly.

In comparing research with development, we are very cognizant of the different manner in which the results of the two activities are handled. Research results are normally published as soon as possible and broadcast to the international scientific community. Aggressive entrepreneurs in other nations have access to such results and can apply them for some innovation on almost the same footing as in the country of origin. On the other hand, development, and applied research results, are almost always protected by not being published until they have been commercially exploited to the benefit of the country of origin. An additional comment is that the pay-off from basic research is usually a long term proposition whereas the returns from applied research and development are potentially more immediate.

In our opinion the best way for the federal Government to encourage fruitful research and development in Canadian industry is to create a climate of opportunity. In the same way that the technological goals of the United States space and military programs have provided a favourable climate for industrial developments in that country, national programs in Canada of adequate magnitude and challenge could react similarly on our industries. The national programs need not be as "far out" as the United States space program which contained goals more suited to their size, posture and state of technical advance than to ours. On the contrary, suitable programs here should be more directly oriented to our current national needs and aspirations yet would contain scope for the application of modern science and technology.

Across the spectrum of research and development, scientific activity is characterized by a varying degree of mission orientation which is meaningful for economic development in our technologically based society. The dialogue between government and industry which is now under way in Canada appears to be bringing out the pont that the expenditure of public funds necessitates a decision as to where in the spectrum the major support should be given. The answer to this question must surely lie in the immediate needs and aspirations of a country; and as these may change with time so too the emphases on research within each branch of science or engineering will shift in response thereto. We believe that at the present time Canada has a long term need for national economic development based on accelerating the growth of technology within its industries to retain or improve their competitive position in world markets.

An improvement in the collaboration between universities and industries would make the university more responsive to the specific manpower requirements of industry. Our own experience is that it is difficult to find specialists in some of the areas in which we are interested.

In conclusion, as a subsidiary Canadian company of a United States parent, we believe that foreign ownership can be most beneficial in that it allows the importation of technology as a base for further innovation and motivation of personnel. Because the pace of development is so rapid, if Canada does not import advanced technology we are not generally in a position to develop it ourselves on any reasonably competitive time scale and with any reasonable expenditure of Canadian funds. It is our opinion that foreign technology is only available to Canadian industries in a timely and suitable manner through the subsidiaries of foreign firms. This establishes a base from which a lesser amount of Canadian resources can be applied to achieve product goals that would otherwise be unattainable.

The Chairman: Thank you, Mr. Freitag. Reference has been made to the brief of the Air Industries Association of Canada. This reference was made, in particular, by Mr. Mitchell. I see that in our audience this morning we have the President of this association, Mr. David Golden. Mr. Golden, as your brief has already been mentioned will you please feel free to participate as you wish in the discussion?

Senator Grosart: I suggest, Mr. Chairman, that you have Mr. Golden come up to the front.

Mr. David Golden, President, Air Industries Association of Canada: Mr. Chairman, I thought I was appearing on the 24th. I am just sort of scouting today. We are due to appear before you on June 24 at 3 o'clock.

The Chairman: Yes, next Tuesday.

Senator Grosart: I was suggesting a sneak preview.

My first question, Mr. Chairman, will be a general one. We have heard a good many complaints about the existing government incentive programs, generally with the suggestion that a tax incentive type of program would be preferable to those that we have. Another general statement that seems to have come out is that the defence industry support is more effective than that in the civilian sector.

My first question is: What is industry as a whole doing to get these messages through to the Government? I ask the question because here we are, a committee of the Senate, hearing these same complaints over and over again, yet we have had no evidence that there is an overall industry effort directed towards bringing these matters to the attention of the Government.

In a brief yesterday we had the statement that there was no such overall industry R & D grouping. It is all very well to complain about the Government not co-operating, not co-ordinating, and not consulting, but what is industry doing as a whole? Would anybody care to comment on that? Is there a need for this, or would you prefer everybody to go his own way and get as much for his particular industry as he can out of the Government. and let the devil take the hindmost?

Mr. Mitchell: R & D, as it cuts across industries such as the pulp and paper industry, the aerospace industry and the electronics industry, is so different that there is really no basis for discussion between the various types of industries.

The Chairman: We see a lot of common interests when we read these briefs.

Senator Grosart: I find this a most amazing statement, because almost everybody else with just a diverse components in their marketing and their development of products has done this. All the farmers do not grow wheat—some of them grow sugar beet—yet they manage to get together. All the labour unions are fighting each other, they have jurisdictional disputes, but they manage to get together. What I am suggesting is that surely it would be helpful to the Government if industry as a whole came up and said: "Here is a better distribution of your funding of R & D as between the performance sectors, if you like, or as between the categories of R & D." Everybody comes up with a different figure. The Litton brief on page 6 quotes the now well known OECD comparison between the United States and Canada. Would it not make sense for industry to take the one we are discussing, the development component, where in the United States federal funding is 65.6 per cent and in Canada 37.0, come up with something helpful to the Government and say it should be 50 per cent in Canada? I am sure that anybody in government would look at these figures and say that they are not very different. Development and applied research together are 87 per cent in the United States and 77 per cent in Canada; it does not look a great disparity, although maybe it is. These are the kind of questions, it seems to me, industry could usefully do its share in asking. Industry could say that all government departments should somehow be got together and coordinate their funding. Surely industry can contribute something.

Mr. Boggs: Speaking from one segment of industry—although I may be pre-empting Mr. Golden on Tuesday—I was chairman of the Aerospace Association last year, which represents a significant segment of Canadian industry, particularly the one that has been through and had access to these problems. I can assure you that that segment of industry speaks with one voice. We have been involved in many direct representations to appropriate government officials on exactly the same basis as that discussed in the brief. So, whatever you are getting here, where you may have 20 separate companies in the aerospace industry submitting briefs, I do not think it is fair to say that that segment of industry has never spoken. We have spoken with one voice, and spoken very loudly. Mr. Golden can be heard from here to his office without using the telephone. We have spoken very loudly and firmly on all these matters. Just by virtue of having this meeting you are not reaching a whole new set of circumstances. I think the position has been made clear, but unfortunately we have not always been listened to.

Senator Grosart: I am sure you mean that your suggestions have not always been taken, not that you have not always been listened to.

Mr. Boggs: I beg your pardon, we have been listened to. To the extent that the philosophy is that there is an instrument in Canadian business that could speak for all business collectively in the same manner, it is something I find a little difficult to assume could happen. Maybe it should, but I think there are some tremendous disparities of problems and requirements between industries. I am not sure that you can get them to speak with one voice.

Just as an example, in the systems industry we are always having thrown in our teeth the idea that an automotive type industry is somehow the solution to our problems. The automotive industry is structured completely differently from any other industry in Canada, so is the aerospace industry, so is the oil industry and every other industry. There is a commonality, but to get them all together to speak with one voice frankly boggles my imagination. Maybe we could, but I agree with Mr. Mitchell that it would be very difficult to make it happen. I do not think labour speaks with one voice really. I think that is an over-simplification, if I may say so.

Senator Grosart: Yes, it is bound to be; if you take the chronology of the labour voice it is an over-simplification. I can remember, as I am sure you can, when every union came in separately, which gave the decision-makers the excuse to say, "everybody is giving us different advice. How can we satisfy everybody?" The ING decision is an almost perfect example of this. One of the two main reasons the Government gave for abandoning—temporarily we hope—ING was that the advice it was getting from the science community was conflicting. I do not particularly blame the Government for that decision in view of the very conflicting advice that was suddenly thrown in the face of the Government when they had to make the decision.

All I am suggesting is that industry itself might find some R if not D project on national science policy as it affects industry. Why do you not do some research, put out some papers? Private planning associations and various other people do. Industry itself is always saying to the Government, "Why don't you do it?" I have been guilty of that. Before I was in my present position I have come down here with delegations, and it was always the same, we said to the Government, "You do something". I am not being critical in saying this. I am really just wondering. Could you make any suggestions?

Mr. Mitchell: We know what you are saying. R & D is one rather small facet of the strains imposed on Canadian business. These strains are very, very severe on Canadian business. Things are changing, moving from the domestic to international markets; all kinds of things affect our industry, and there are all kinds of strains. R & D is only one of these strains, so it is putting a little pressure on to say that we must get together all the specific elements when there may be more important things with which we have to concern ourselves.

Senator Grosart: I do not say you must. In the Orenda brief we are told that relative to world-wide competition the scale of technological advancement—in Canada I presume—is slipping downwards. That statement is repeated. If the whole country is slipping downwards relative to other countries in technological development, this is a pretty important strain for industry to take a look at.

Mr. Mitchell: I agree 100 per cent. I am merely illustrating that there are other strains that are equally important and equally pressing.

Senator Grosart: That is part of the business of private enterprise, to look at the strains and say what should be done about it. I only make this as a suggestion. It is an aspect that concerns me, because I know there is some resistance in the science community generally, and there seems to be the same resistance in industry. It is perhaps understandable. I merely suggest that it would be very useful if there were a Canadian industry research and development association that came up with some figure. I think we would all agree that the evidence before us from all sectors is so conflicting that it would be very difficult for us in this committee at this moment to say to government, "All right, next year here is a balance". The universities say there should be more funding in the universities and you say no, more should be going into industry. I am quite sure that if we sat down with the in-house people, as a group, they would say, "Do not be very careful about moving any of your funding out of our laboratories." It is the reconciliation of these conflicts that, if I know anything about Government, is the way to get action from Government.

The Chairman: I think Dr. Green wanted to make a comment.

Dr. John J. Green, Director of Government Relations, Litton Systems (Canada): I am John Green of Litton Systems. I did want to add a word to what Mr. Boggs said and point out that the Electronic Association of Canada which already appeared last week before this committee did put a submission to the Government on the problem of increasing the technological capability of Canadian industry. In that document we did discuss the support schemes of the Government for industrial research and development. We hinted at what might be a good figure by saying no other western country spends less than 50 per cent of its Government money in industry. I should also like to remind Senator Grosart that there is an association, to which I referred last week, called the Canadian Research Management Association, which is composed of research directors and managers primarily from industry, but also representative to a lesser extent of both government and university.

As I have said, we have tried to steer clear of being a pressure group or a lobby, but I think we must re-examine our terms of reference in the light of Senator Grosart's comments to see whether or not we could perform a very useful function by discussing some of the things that he said, particularly his very last and interesting suggestion that industry itself might initiate a research, if not a development program, to study this problem of funding from government for research and development in industry.

Senator Grosart: If I could follow up with another question. It is really a specific area where this kind of research might yleld some results. I am speaking now of the comments that have been made on foreign control. We all know the public concern about this and the concern in government. We have had evidence from some industries of a specific industry policy between the parent company and the subsidiary where there is an allocation of specific fields of research and development to the Canadian company and an allocation of a specific percentage of sales. Perhaps this is not an allocation in terms of percentage, but it works out at a percentage. The figures I have seen would tend to support the statement that has been made here that foreign owership has far more pluses than minuses in the R & D field. The kind of thing that I feel industry might do, if it was interested in this suggestion, would be to bring this together and give us the figures for R & D for all Canadian subsidiaries.

Someone sent out a questionnaire. We have this and that seems to have a very good record. We want to ask, is this applicable to the whole industry picture? This is the kind of thing that I feel could be done and I think industry can make out a first-class case for itelf, but I do not think it is going to be done on an individual basis where individual companies are going to a whole group of separate individuals in the Government and dealing really only with a specific. What kind of support can we get for project "Y"?

My final question, which really leads out of this, is why is it that the defence support program DIR, and the National Research program, seems to be so much more acceptable than those in the civilian sectors? What are the differences that lie between the two types?

Mr. Mitchell: Are you talking about Vote 5 versus, say, PAIT?

Senator Grosart: I prefer to take the two sectors as a whole rather than get into individual programs, because there does seem to be a different Government philosophy in the funding between the defence side and the civilian side.

The Chairman: There are defence contracts too.

Senator Grosart: That is that I am asking, what are the approach differences and why are they more acceptable and why do they exist?

Mr. Mitchell: If we talk about PAIT, for instance, which is strictly a commercial program to help commercial development in R & D, financially it is not a good program. It required the pay-back and compound interest from the pay-back. We can prove that using PAIT costs us more money than taking it out of our own company.

Senator Grosart: I do not want to go over that argument; we have had it twice in a row.

The Chairman: Even if you are not successful?

Mr. Mitchell: It is a risk-sharing basis and this is the element that comes into the thing.

Senator Grosart: Nobody has yet explained to me why anyone would complain too much about interest if you are going to get either 100 per cent of your money back if you are unsuccessful or 50 per cent back if you are successful.

Mr. Mitchell: It is a question of corporation taxes.

Senator Grosart: I will take money tomorrow from anybody at twice the commercial rate if they will give me back half of it free if my project is successful and give all of it back to me if it is unsuccessful. I would not worry about interest rates.

Mr. Mitchell: I am afraid I do not follow that.

The Chairman: In what way?

Mr. Mitchell: What do you mean by giving it back when you say you get 50 per cent back or 100 per cent back?

Senator Grosart: This is what is called, in all the briefs, the pay-back. This is the Government funding of your expenditure on the particular project.

Mr. Mitchell: They put up 50 per cent of the fund and then you go ahead and spend this and start getting it back and pay back the 50 per cent and in the meantime you pay compound interest.

The Chairman: If you are successful.

Mr. Mitchell: If you are not the whole thing goes down the drain. If you take a look at this thing and write it off against profits, which reduces your corporation tax, you pay less. Therefore, really the effect of financial assistance is just about non-existent.

Senator Robichaud: Would you take a risk of going ahead with a certain project if that 50 per cent was not available?

Mr. Mitchell: In my particular case the risk involved—we feel satisfied with the risk. We are willing to take the risk and spend the money. What we really need, as far as we are concerned, is to stretch our research dollars. I do not need financial assistance nor do I want risk-sharing. I just need to stretch that dollar as big as I can in order to get more out of it. It comes down to that. If there are programs that allow me to stretch my research dollar in size this is going to help.

Senator Grosart: I do not want to pursue that argument. What is the major difference between the two types of funding?

Mr. Boggs: I think there is an oversimplification here. The DIR, NRC type of support is really not defence oriented. DIR has been used as an instrument and in my opinion it has not been defence research. It has been a 50 per cent on the dollar grant to assist more fundable R & D. Is that not correct, Mr. Uiffen?

Mr. J. P. Uiffen, Director Research and Technical Design, The de Havilland Aircraft of Canada Limited: In defence of the administering of that program when one takes a long view, it is typical to say that any phase of research is not defence oriented. I do not want to have any implication from us here in the committee in that regard.

Mr. Boggs: It is not defence research on one side and on the other side the Vote 20 and Vote 5 and PAIT being strictly commercial. I think it is going too much as a black and white situation. I do not think that is really true.

Mr. Uiffen: I do not think it is true either.

Mr. Boggs: The money is tended to be spent for more fundamental research, 50 cents on the dollar, and this has been the real money from which the defence technology grows.

Senator Grosart: Let us take DIP as an example.

Mr. Boggs: DIP is both viable and it was levied originally as defence, but in actual practice the money has been used on both defence and civil projects. I do not think there is a delineation between the two. In the three cases DIP, DIR and NRC funding, our objection is that we are trying to stretch our own research and development dollars as far as we can. These have been historically 57 per cent of the dollar programs.

We say we have only so much money for research. We would like, if possible, these programs to be more flexible. In some cases, to get the 75 cents on the dollar. Or, if possible, we would like 100 per cent funding of research program—of which there are very few in Canadian industry, whereas in the United States you get a great many 100 per cent funded programs—mostly, military. In other words, we cannot compete, we do not think, with an industry that has 100 per cent research dollars where we have 50 per cent research dollars. That is our objection in that area, but that is not civil versus defence type of funding.

In the Votes 5 and 20, those are DIM and DIP programs, and they have done a lot for Canadian industry.

Our view there, further, is that it is feasible, if the funds are available, we think these programs should be broadened, where the present definition of development money takes you through engineering and through it and pre-production.

We are competing in the world markets in many cases with programs that are supported with the same kind of funding, only the funding goes to 50 per cent on the dollar, or more, up to the point of production of the program.

In other words, they get a higher Government start than 50 per cent on a bigger base. They take the total launching costs of an aeroplane, for example, and put 50 per cent on that.

To be specific, in the case—as I think about our company's history—we have spent roughly $60 million on R and D, but the classical definition—and in addition we have spent $40 million more in the launching costs on these programs and making them commercially viable. So we spend $100 million and the Government pays $20 million for the dual purpose.

I can give a comparable situation where, in another country, another company, that $100 million would have been supported 50 per cent in total by the Government. So they would have put $50 million in, instead of the $20 million.

We are not saying that the country can afford it, but we are saying that that kind of thing should be looked at. It is a situation, a climate in which we are living, in competing with that kind of situation, and have been reasonably successful so far.

Senator Grosart: Are you really saying that the risk factor in an R & D expenditure by Canadian industry in marketwise higher than in the United States and therefore it it were to have industry funded or cost shared on R & D, there must be a higher level of Government support?

Mr. Boggs: Than in the United States?

Senator Grosart: Yes?

Mr. Boggs: If you pool defence and civil together, there is far greater Government supported percentagewise in the United States than there is here, because a high percentage of the United States business is military business, with the high percentage of United States funded research programs.

But proportionately we are not asking for more than that. We are getting specifically less. I do not think we want to try to compete with that . . .

Senator Grosart: Are you saying that if the risk is higher in Canada, the necessity for Government funding is actually higher than it is in the United States, if we are really to develop an indigenous technology?

Mr. Boggs: Yes, we think so.

Senator Carter: Following along the line introduced by Senator Grosart, there is a wide area of agreement in the brief we have before us this morning and the plain areas of agreement in all the briefs we have had from industry.

They have all agreed, for example, that the NRC program and the defence research programs are for some reason more suitable, more acceptable. They agreed that PAIT is practically useless to have. They agreed that our tax system is disincentive rather than an incentive. They agreed that there is a big gap in communications and relationship between industry and the universities, an almost unbridgable gap, according to some.

One cannot help feeling that they are all saying the same thing and it would be more forceful if they would say it...

The Chairman: Together. You could go on and say they all agreed also that there should be, relatively speaking, more development, as opposed to research. They all agreed that there should be more R & D in industry rather than in government.

Senator Carter: And that the concept of R & D should be expanded to include innovation?

This is in all these briefs that we have had from industry. It is amazing that they cannot say it together, rather than one at a time.

I would like to follow that, because the representatives of Computing Devices made the point that research and development programs are too short-range, mostly under three years and some of the shortest are twelve months—instead of what he considered should be a long-range program, from seven to 15 years or possibly even up to 20 years. That brief also makes the point that our present tax system is a distinctive instead of being an incentive.

On page 3 of the appendix to that brief, he says:

> The pathway out of this impasse is clear and simple and likely to have tremendous economic results to any country that has the courage to try it—within 10-15 years. Nor need it cost the Government anything in the present for this

potential future return. It merely involves shifting the ground rules so the serious disincentive, which faces all corporations, to engage in longer range R & D directed to economic growth, is changed to an incentive.

Then he asks how it could be done and he goes on to give his view, and I should like to read these two short paragraphs into the record:

> How to do it? There seem to be two essential changes in the Corporation tax rules as they pertain to R & D, and two safeguards and one rule.
> The two changes are:
> 1. Special tax treatment for the expense of all R & D programs in a corporation which are aimed at goals like 3-6 above—such that all of these costs plus a small incentive margin (say 10 per cent) are deductible from the corporate tax in the current year. This would have the immediate result that the corporation could not afford this year to be without a long range R & D program.

And then paragraph 2:

> Special tax treatment for any new business, new product or process issuing from such an R & D effort, during the first 5-10 years of its 'business' existence. This could be absolution of earnings from *all* corporate tax for the first 5 years, tax at half rate for the next 5 years, and thereafter the tax reverts to regular rates. This would have the immediate result that the corporation would energetically try to manage its longer term R & D *so as to obtain* the special profits from these tax concessions.

I should like to get the opinions of the other witnesses on these proposals as a way of improving our present research programs and encouraging longer range programs instead of short-range programs.

Mr. Hoge: I should like to make one comment, senator. I did not realize that the cover page was not on this appendix. I should not take credit for it. It came to me from Dr. Les Cook who is an assistant to Dr. Schneider at the National Research Council. I asked one of my assistants, "Can you pick any holes in this? Does it create a beneficial situation?", and he confirmed that it would but he was not convinced that it would be better for our company in the military business in the kinds of support we have now. He says that he believes that it would probably be better than the kind of program such as PAIT is in the commercial side of the market.

I wanted to be sure that you knew this was not my work. Dr. Les Cook deserves any credit that might come from this.

Senator Carter: I just wanted to see the reaction to it.

Mr. Mitchell: I should have to study it really in order to see what the impact is. Any tax incentives, of course, are extremely important. We pay very high corporation taxes now and a lot of money goes out that way. If some money could be retained for research investment, it would be bound to have a beneficial effect.

The Chairman: Are we not more and more going to the suggestion that, irrespective of the programs, provided you have more money from the Government you will do more research?

Mr. Mitchell: That is right. It does not really matter where it comes from.

The Chairman: Why have four or five different programs, then?

Senator Grosart: I don't understand that remark. You say it does not really matter where it comes from. According to the evidence we have had it does matter very much whether it comes by way of a grant or a pay-back allowance or from a tax incentive. Your remark may have been just off-hand. Nevertheless, this raises the question whether it would disturb anybody if there was a very significant change in Government policy to do practically all of its funding by tax incentives. But this might distort our public accounts. Everybody is interested in the level of Government revenues and expenditures. You distort these accounts very greatly, if you have a substantial part of your expenditures, which is what this is, not showing in your public accounts.

Mr. Boggs: Do you have any comment on that, Mr. Stanley.

Mr. F. A. Stanley, Vice-President, Finance, and Secretary-Treasurer, The de Havilland Aircraft of Canada Limited: Mr. Chairman, in De Havilland we would much prefer the funding system to the tax incentive system, owing to our experiences of having had losses two or three years in a row in funding the kinds of expenses we are really not talking about here, namely, launching costs. In respect of that, tax incentives for research and development would be useless to us for perhaps two or three years in a row. Therefore, we really would prefer the funding.

Mr. Boggs: I should think a straight tax incentive program would tend to create a situation that would be more difficult to control. That is just my observation.

Now, people sit down and look at a specific program or a specific project and it is agreed or not agreed that it will be supported. However, a lot of people resent Government interference in business. Certainly, there are times when it goes too far, but in the present technique of administering Vote 5 and Vote 20 the Government tries to sell the fact that a program is good and that it should get support. So there is a control factor in there that might be lost if the system was simply one of tax incentives. As I said, that is just my observation, and I might be quite wrong in saying that.

Senator Grosart: I gather you would not recommend an across-the-board tax concession for all research and development in industry?

Mr. Boggs: Not without a lot more study than we have given the matter.

Mr. Mitchell: The advantage in the suggestion of having an over-all tax incentive program would be the great reduction in administration costs. You would probably get more out of the dollar that way than by going through the channels and then back to industry again. Because of that advantage, therefore, it is worthwhile contemplating.

Senator Robichaud: On page 11 of the Orenda brief it says clearly that tax incentives should apply to all research and development carried out in industry and should not be restrictive as now constituted.

Mr. Mitchell: That was in relation to IRDIA. That was a comment against those particular incentive programs. Our position has been that we have not been able to take advantage of IRDIA because of the associated company aspect, which means that we get no advantage from it because of the base year calculation. If it were broadened to reflect all research and development, then it would definitely be a real advantage.

I think there is a lot to be said for tax incentives as a method of pushing research and development, and the prime reason for it would be because it reduces government administration costs.

Senator Grosart: Actually, what we are talking about is a form of government control. We are told by the people in the Treasury Board that this philosophy is very important to them and that they must maintain this kind of control over the expenditures of public funds.

Mr. Mitchell: In other words, if it is a tax incentive, it is still public funds. That is the point you are making.

Senator Grosart: Yes. There is a responsibility on the political decision-maker to be able to say why he took so much money out of the taxpayer's pocket—and it does not matter how he does it. He must be able to point to the benefit to the taxpayer or to the nation as a whole.

Senator Carter: Mr. Chairman, practically all of the witnesses we have had before this committee—I can think of no exceptions—have agreed that transportation should be one of Canada's national science goals. The Engineering Institute, particularly, called specifically for the development of a short take-off aircraft. Now, De Havilland has specialized in that field; we are all aware of the great contribution De Havilland has made in the field of aviation developmental aircraft. Have De Havilland STOL aircraft been fully studied as to their use in Canada, for example, to interconnect towns which have no airports?

Mr. Boggs: That is a very good question, senator. To be quite honest, the answer is no.

I don't think this has any bearing on the science policy discussion, but you would perhaps be interested to know that the reason I will not be here on Tuesday is that we have a major briefing in our plant with the Department of Transport and the Canadian Transportation Commission, aided and abetted by the Department of Industry, Trade and Commerce. This is to try to stimulate interest on a national basis to utilize the abilities of STOL aircraft to service the needs of other transportation systems in Canada. To answer your question specifically there is a lot of work to be done there and we are trying to take the initiative in doing so and we are getting indications of positive support from appropriate government departments.

Senator Carter: You are getting together with the Canadian Government on Tuesday in connection with solutions to transportation problems generally.

Mr. Boggs: Related to our expertise in STOL aircraft.

Senator Carter: Is DeHavilland following up the possibilities of the use of this new technology in other countries or exporting it to them?

Mr. Boggs: We would far rather export the product of the technology. Ninety per cent of our product last year was exported to other countries throughout the world. To answer your question, we are not trying to export technology we are trying to use the technology to export products.

The Chairman: Senator Kinnear.

Senator Kinnear: I want to direct a question to Mr. Freitag. One page 3, in the first sentence, a company program in "pattern recognition" is mentioned. This, as the witnesses know better than we do, is a very important subject in relation to the computer field—for example, in-putting data without having to key-punch it on cards—especially to banking, to post offices and so forth. What aspects of this field does the firm work on? What are their long-term objectives, for example, for exports of computer peripheral equpiment? What is the world-wide picture in this research field? For example Cognitronics and Recognition Equipment in the United States are producing some visual recognition equipment. How does a company such as yours adjust its strategy in relation to work being done elsewhere?

Mr. Freitag: I will answer part of that question and then direct your question to our vice-president of engineering. We are doing work associated with the military applications for the United States in communications and pattern recognition. We are expanding this technology into applications other than military. Perhaps Larry has something to say on this.

Mr. L. A. Borth, President of Engineering, Litton Systems (Canada): Perhaps I can say in a little more detail the specific things we are now pursuing in this field. We are pursuing certain U.S. Army requirements for page-reading equipment for input to military communications systems, and we have enjoyed some Canadian Government support in this area in the past. Two programs in particular are the DIR program in pattern recognition which is partially funded and a program under project Mallard which is a communications system shared by Canada, United States, United Kingdom and Australia, and we have some full funded work on the Canadian portion of that which relates to this pattern recognition page-reading machine. The possible non-military use of this equipment, of course, is evident in every large scale data processing system wherein the present in-put methods and the peripheral views tend predominantly to use punched cards which are still largely punched by human operators. We believe this kind of equipment offers the prospect of ultimately displacing the human operators in this area resulting in substantial cost savings. I don't know if that answers your question.

Senator Kinnear: I will go on and ask another one. This firm is a very capable subsidiary of the United States firm and the witness could help this committee by answering this question; what national science policy elements should we have to encourage the Canadian manufacture and export of technologically advanced products by subsidiaries of international corporations?

Mr. Freitag: That is a very complex and compound problem we are struggling with. It is in our opinion a question not relegated solely to monetary support. We find that our pushing of technology requires the constant influx of young technically-trained people to be the innovators and developers. It is not enough to have company-sponsored programs that are partially funded or quarterly funded, or tax incentive-type programs to have these people motivated. We have a flow of goods university-trained scientists and engineers constantly leaving for large romatic-type programs which we cannot offer them. Besides a financial program we need a nationalized effort that has the stimulus to keep these people motivated.

Senator Kinnear: I was hoping you were going to say that you could use all these people, but you are in fact saying the same as all the others that these well-trained Canadians have to leave because you haven't the work for them.

Mr. Freitag: It is a combination of things; we do have work for them, but unfortunately it is not only salaries that will keep them. It is not that we do not pay them enough or that we do not have the work for them. There are certain strata in the scientific and technological community who need more than that to be motivated.

Senator Kinnear: Are you so specialized that they are not suitable for your work, or are you not sufficiently specialized for them?

Mr. Freitag: It is probably a combination of both.

The Chairman: But we have heard up to now a list of advantages of Canada to have foreign-owned subsidiaries in the field of technology and the use of technology, so we are pretty well versed in the advantages. Are there any disadvantages?

Mr. Freitag: May I pass on the question?

Mr. Boggs: Are there disadvantages as well as advantages to having a foreign owner?

The Chairman: Yes, in so far as the interests of Canada are concerned in the field of R & D and, of course, the application of that technology in Canada to increase our production here and, hopefully, also our exports.

Mr. Boggs: I do not think there is a simple answer to that. I think it depends on the type of industry and ownership structure. Take, for example, the automotive industry. I think there is not much chance of getting R & D in the automotive industry in Canada—I hope there is nobody here from that industry! In our case, we have an owner who has made us totally responsible for our future, including decisions as to what we are going to design, hiring engineers, getting resources; and we are even allowed to compete with our owner.

The Chairman: In the United States?

Mr. Boggs: In the U.K. Personally, I have run into no disadvantages. There could well be situations where there are enormous disadvantages, where, by direction, the Canadian subsidiary is not allowed to do anything other than build a product. Mr. Freitag gave an example where they have been assigned a product for world-wide distribution. Mr. Mitchell, as partial owner, may have views on this.

Mr. Mitchell: The structure of my company is very complex, because we have 40 per cent ownership by the U.S. company and 60 per cent by the Canadian company, but the Canadian company, in turn, is 59 per cent owned by a U.K. company.

The Chairman: It is difficult to recognize your parents!

Mr. Mitchell: Well, I know who the boss is. But from my point of view, there has been no disadvantage to this type of ownership; it has all been an advantage. The source of technology has been vital to us from the U.S. company, and I cannot praise that too much or too strongly. The U.K. company aids us in our international sales programs, which we need. We are a young company and a young country, and we are trying to establish ourselves in world-wide markets, and we need assistance. So, I get nothing but help; I do not get any problems. Whether that is general or not, I could not answer.

Mr. Hoge: I can think of no real disadvantages. I can say that once in a while we have some employees, particularly those who have emigrated from England, worrying about the big owner south of the border, but there are no real manifestations as a result of it. With the kind of things we do, the kind of technology available to us, there are no disadvantages.

Senator Grosart: In that field, I think what worries us is the Canadian General Electric vis-à-vis General Electric story, in connection with the heavy water nuclear reactor. We have never had the full facts on that, but here was a case where it was obvious that the parent company was in competition in the world market with the Canadian company. Does this situation arise with any of your companies? It may be an isolated case.

Mr. Mitchell: We do compete.

Mr. Boggs: We compete too.

Mr. Mitchell: Openly, and with everybody's blessing.

Senator Grosart: In the same products?

Mr. Mitchell: Yes.

Mr. Boggs: There is an aircraft being sold actively by our company in Canada—or, rather, by an agency they have selected; and it is in quite severe conflict with some of the airplanes we make. We are looking at a design of a next generation airplane which will compete with some airplanes in England, and there has been no restriction on our activity. If we think it is a sound business proposition, with the Government supporting us on these present programs, we will go ahead. Whether ours is an isolated case or whether G.E.'s is isolated the other way, I do not know.

Senator Grosart: This is the kind of thing I would like to see industry come up with in defence of its position.

The Chairman: The case is very complicated, and I am sure that Mr. Golden, in his other capacity as a member of the Board of AECL, could perhaps participate in this too. But, Senator Grosart, in your case it is not...

Senator Grosart: Not my case.

The Chairman: No, the case you cited—it is not a problem of competition, but one of the absence of competition, the parent company paying, presumably, its Canadian subsidiary not to do certain things.

Senator Grosart: I did not go that far.

The Chairman: It is not a case of competition.

Senator Grosart: I did not go that far, because I do not think we have before us evidence that would support a statement that G.E. told C.G.E. to get out of that field.

The Chairman: On the contrary, we have the evidence, I think, from Dr. Grey, that this did not happen.

Senator Grosart: But I am suggesting it is the kind of broad information on this and other important subjects that industry might collect, because Government is not going to undertake the job of defending the industry position.

Mr. Boggs: With due respect, sir, is this not the kind of industry analysis and data that the Department of Industry, Trade and Commerce would consider one of its responsibilities?

Senator Grosart: I agree, but if anybody was doing an assessment of my own worth, I would prefer to do it myself than have anybody I know, including my wife, do it.

Mr. Boggs: A very good point.

Senator Kinnear: We are told in practically all the briefs also that the Government should select national goals, but how should they go about it? How should they select them for science and technology? Is the present science policy mechanism satisfactory for this, and how should the capabilities from the various sectors, university and industry, be obtained? What are your views on this? Well, you have argued that back and forth, so I could leave that last question out. Is the present science policy mechanism satisfactory, and how should the capabilities from various sectors play a part?

Mr. Mitchell: There is general silence on that!

Mr. Boggs: That is a very good question.

Dr. Green: I will attempt to answer the senator's question, as far as I heard it. It talked about national goals in science policy. I think the kind of suggestion we are putting forward is that these are national objectives.

Let us take what was a national objective some years ago, the construction of the St. Lawrence Seaway. That was a goal of national importance and significance that captured the imagination of Canadian youth and involved a lot of technology.

We have been talking about the mid-Canada corridor. The Acres company has proposed the possibility of large-scale developments stretching across the mid-Canada corridor.

The Chairman: In mid-vision.

Dr. Green: Yes. They warned people not to lean too heavily on the technology, but we are talking about pollution. There is the problem of pollution of the air and water, and particularly of water, which is of significance to us and which would be a national problem.

The Government of Canada is interested in oceanology. It has no less than 13 establishments strung out from coast to coast, each of which is dealing with some aspect of the problems of oceanology. From what has been said about this we know that it is the next frontier. It has great potential in respect of off-shore resources at the bottom of the ocean, and there is evidence of other matters that are very interesting. The Government might give leadership at the political level by saying: "These are the sorts of things on which we want to start programs." These programs can be handled on the Government's part through departments such as the Department of Fisheries, the Department of Mines, Energy and Resources, the Department of Northern Development, the National Research Council, and so on. The Government could co-operate with industry, and let contracts for the part that would be played by industry.

I think that this is the concept of national objectives and national goals of which industry is thinking.

Mr. Boggs: Did you mention transportation, sir?

The Chairman: It has already been mentioned. You will solve this next Tuesday.

Senator Grosart: Of course, Mr. Chairman, with all due respect, this does not answer the question. I sat down to make up a list of priorities that have been given us. I got up to a hundred, and I was not through the briefs. The question that Senator Kinnear asked was: "How do you decide which priorities are prior priorities?", and there is no obvious answer to it. Dr. Green used the phrase "new frontier". Well, the last new frontier I heard of was Telesat. Everything is a new frontier. Senator Kinnear used the word "mechanism". She asked: "How do you get the mechanism to decide what is the priority for this years' estimates?" That is a political decision that has to be made once a year, and if it is not made once a year adequately and efficiently you have what one of our witnesses called national science policy by accident.

Senator Kinnear: I asked whether they were satisfied with the goals, and they did not say Yes or No.

Mr. Mitchell: We have just witnessed one of the problems in mentioning goals. Bill Boggs said that you did not include transportation. I will say that you did not include something else. This is exactly...

Senator Grosart: But the National Science Council's report on transportation left out communications.

Mr. Mitchell: This is an extremely difficult thing, and it is a dangerous thing to some extent, because it may eliminate or ignore a whole segment of our economy which is important. It is a very difficult question.

Senator Grosart: Suddenly—and I say "suddenly" because it seems to have happened over a period of one or two years—we have an expenditure of $100 million and a statement that it is a national priority for Canada to be the first country in the world to have a domestic satellite system. I do not say that the decision is wrong, but I do not see any evidence of this being fitted in any way into an overall science policy. ING was one, the Arrow was one, HARP was one, ISIS was one...

The Chairman: And the telescope.

Senator Grosart: Yes, and the B.C. telescope. These are all new frontiers. These were all priorities. The rug has been pulled out from under a lot of these. This is one thing that worries me about Telesat. I wonder whether the rug is going to be pulled out from under it.

Dr. Green: I apologize to Mr. Boggs for not mentioning transportation, but I have been eating and sleeping with it, and reading about it. I am a member of the Green Committee of the Science Council, which studied transportation.

We all realize that this decision regarding national programs is really, and must be, a political decision. We are already getting some decisions in this area because, after all, money gets allocated for various programs and projects, but this is done in a haphazard manner. I feel that if some planning was done in this, and some assessment were made by someone at the top, then it would be better than the present situation. This is what the Electronic Industries' Association was suggesting, that the claims of different groups of specialists should go before an expert scientist who could then interface with the political level.

Through the Science Council you are trying to tackle the decisions that are necessary in arriving at some priorities. It may not be perfect, but it is better than having no system at all other than one in which it is the squeaky wheel that gets most of the oil.

The Chairman: How would you fill that gap at the top that you are talking of?

Dr. Green: I do not want to take this too far because it is a Government decision, but one could imagine that a minister...

The Chairman: You are advising the Government.

Dr. Green: I am thinking of a minister, a member of the cabinet, not responsible for a department. I am thinking of a minister who will be responsible for considering and bringing before the cabinet recommendations from the scientific community which have been screened, say, by the Science Council in conjunction with Dr. Uffen in the Science Secretariat, and who would be prepared to assess the programs and perhaps recommend pilot projects which could be tackled first before plunging completely into major programs. This would be a very satisfactory method. The Science Council and the Science Secretariat presumably are supposed to be advising the Prime Minister directly, but he is obviously much too busy. There must be some cabinet minister whose full responsibility will be in this area and who will listen to this advice from the experts, and who can make up his own mind in conjunction with advice also from the financial side of the

Government, and put up some rough priorities to the cabinet in these areas.

The Chairman: Let us come back to a problem that has been mentioned earlier—the transportation problem. At present there is research being carried out by the CNR, and also presumably by the CPR, by Air Canada, the Department of Transport, and the National Research Council. The Canadian Transportation Commission is now building up a supposedly new research arm. How is all this going to be co-ordinated? What about the proposal that is being circulated these days that we should have a kind of national research institute on transportation so as to have some kind of integration of priorities in this field of transportation, because we cannot cover it all? And what about trying also to get better co-ordination within the Government itself, and also between the Government, industry, and the universities?

Mr. Boggs: Does this not really amount to trying to put everything into one great ball of wax, and if it is too big nothing is going to happen?

The Chairman: I am not speaking of an institute like this that would eliminate all of the research that is going on in these various places—quite the contrary. It seems to me that it would be very difficult indeed to have a co-ordinated and integrated serious research program carried on in transportation having regard to the way these agencies are now ignoring each other.

Mr. Boggs: I agree that it is a problem.

The Chairman: How would you solve it?

Mr. Boggs: It seems to me that the way to eliminate this competition for funds, which is really what we are talking about, is to establish some agency through which all of the government support funds are channelled so that somebody can look at the totality and say, "All right, we have got $300 million to spend. Let the universities, government agencies and industry put down once a year what they want and we will use our best judgment to sort out where to spend the money". One problem is that it is not looked at as a total package. We have discussed the fact that at the moment most of the programs we talk about are administered through the Department of Industry, Trade and Commerce, but there are NRC, DIR and a lot of other people administering smaller pots of money. Maybe you start with the money. Have so much money with a central financial authority, and out of that allocate the resources. Somebody will need the wisdom of Solomon to decide who gets how much money. Do you not start with the money? Is that not where you start?

Senator Grosart: This is, of course, an important question. The OECD comparisons indicate that you must start here and ask whether there is a figure, whether there is a relationship between total funding of R & D or government funding of R & D in any one country and its technological capabilities. There must be a relationship. Is it a money relationship? Is it a GNP percentage relationship? Assuming you have the money decision, as you suggest, would you go so far as to say that the political decision should break down the total funding between, say, basic and applied research?

The Chairman: And development.

Senator Grosart: And development. Across the whole spectrum. Should it go as far as to allocate this percentagewise between the performing sectors once a year? I agree with those who say that we cannot have a fixed amount going on for ever, but would it make sense for the political decision-maker to take that responsibility once a year?

Mr. Boggs: I would not mind having it done that way and have the various elements competing within a fairly broad framework.

Senator Grosart: This is assuming there is a complete input of the maximum advice from the science community, industry and universities.

Dr. Green: Does not Parliament do this already in the estimates of each department? Is it not gone through in detail, so that when it comes back and the project gets going and you need a development project, it has to be signed by the minister and go before the Treasury Board? Is not this the way it is already done by Parliament in the Estimates?

Senator Grosart: Far from it. It adds up to this kind of a decision, but there is no decision to add it up to this.

The Chairman: It happens at the end rather than the beginning.

Mr. Boggs: It is done in pieces; fisheries comes in for so much, commerce for so much and so on.

Senator Grosart: We have asked many departments whether when they make up their estimates and decide, to fund project X through university Y they know at that moment what other departments are recommending and the answer is invariably "No".

Mr. Robert E. Marcille, Vice-President, (Marketing) Litton Systems (Canada): When there is a limited amount of funds available in some long-term goals can be established, like solving polution control, transportation or problems of the Arctic. We realize these goals as programs go further and further on, and more and more work will have to be put into the development aspect; there will be less available for research and there will be a natural reduction in the research portion of the expenditure. A long range program takes lots and lots of money with lots and lots of people involved.

Mr. Boggs: The annual plan has to look forward to a five or ten year eventual commitment.

Mr. Marcille: There must be a long range goal and the short range takes care of itself.

Mr. Boggs: An annual budget is useless.

The Chairman: I am sure Senator Grosart, as he implied, is not so short-minded as to restrict his decision-making basis to one year. It has to be done each year, but presumably with a longer period as background.

Senator Grosart: Yes, because even the money decision, the totality of money available, will change every year.

Mr. Hoge: I support what Mr. Marcille has just said. We should inaugurate some project programs and put them on a competitive tender basis so that various companies have to bid. The companies successful in getting contracts should have to perform the mix of research, development and innovation required to reach the objective, rather than the articial approach of saying each year that so many millions will be spent for pure research, so many for applied research, so many for development.

Senator Grosart: The difficulty about that is that it is exactly what we are doing now, yet over and over again we encounter the criticism that we have an imbalance in industry. The very process you are mentioning has been going on, but it has resulted in an imbalance. You complain that there is not enough funding of industry.

Mr. Boggs: The missing link is that it has not been looked at as a totality on the government side.

Senator Grosart: That is my point.

The Chairman: The gap is at the top.

Mr. Boggs: Once that is looked at, let competition enter. If we are against Fred Mitchell for funding, let the best program get it. Let us not lose that.

Senator Grosart: I am only thinking of the science policy of the Government. I am not at the moment discussing the operative aspects. That is an entirely different question; it is structure four, whereas I am discussing structure two.

The Chairman: Is it your view that there has not been enough contractual arrangement, or that the contractual method has not been used enough on the civilian side in government?

Mr. Hoge: My thought was that a very large percentage of Canadian expenditure for technological work is not available for funding competitive industry work; a very large chunk of it is assigned year after year to major government laboratories.

Senator Kinnear: Three of the questions I intended to ask have already been answered. In the Computing Devices brief, in paragraph 4 on page 1 you say:

> Our company has been successful in some team effort with Government agencies in the development of new products.

You add

> We are prepared to discuss in detail the factors that made these projects successful and to also examine in detail our experience relating to projects that were not successful.

Would you describe this experience and tell us about your general experience with government laboratories? Does this firm make use of the facilities offered by NRC?

Mr. Hoge: To answer the last question first, we do use the National Research Council on occasions for consulting type service. We have recently completed a consulting arrangement with them on the PHI, which I mentioned in my prepared statement. We have work on contract with the Aeronautical Establishment at Uplands, which I believe is part of the N.R.C., on two pending contracts we are competing on, wherein they would act as our technical consultants and advisers in some areas they specialize in. If you wanted to discuss the factors that contributed to success, have you got all day?

Senator Kinnear: I was certainly interested when you talked about the Position and Homing Indicator. I did not think that was a failure when you talked about the ADC computer system. I thought that was the best thing that happened to you and, of course, you admitted that.

Mr. Hoge: We feel that, all things considered, it is a very definite success.

Senator Kinnear: Because it made you do something else and look around.

Mr. Hoge: Yes, but we have been subject to a fair amount of criticism in my short time, which is about three years, because of the supposed failure which this SDC computer was. When I suggested putting this together, I began to look at all the factors which were generated out of our computer activities and came to the conviction myself that you get a much finer picture if you just look at how many computers you saw. Perhaps Mr. Taylor would like to comment on some of the factors which have led us into unsuccessful programs. He has been in the Canadian industry for a long time; I have been here three years.

Mr. Taylor: In one horrible incident we underestimated the technical complexities of the product that we undertook to do under a fixed price. After we lost about $1 million we began to understand that we were pushing it too far. We have been a little more careful in doing it. The second thing we have to do now is to make sure that we have enough funding to take it right through for the three-, four- or five-year period it will take. We cannot start in without knowing that we are going to be able to finish it.

Another thing that was extremely important, which we missed on one project, was that our market survey was falling. The market was not there. We developed it, but could not sell it. There was nothing wrong with the product, but nobody wanted it, or at least, I should say we incorrectly estimated. We had 100 to sell and our orders came in at five, 15 or 20. We missed the market on it. We have some pretty severe criteria now to judge a product with. I think the hardest thing for the management of a company like ours to do is to decide when something is not going to be successful and put the axe to it, because the engineers, with due respect, such as Mr. Hoge, always want to continue.

Senator Grosart: I would like to comment on this point. We have broken new ground in this committee and the area of frank discussion we have now had with an employee of a firm asking his President to get up in the public and discuss the failures...

Mr. Boggs: There could be an ex-employee.

Mr. Hoge: I am not worried, sir.

Senator Grosart: I was complimenting you on that; I was not being critical.

Mr. Marcille: I think a very important factor associated with any failure in perhaps the fact of any decision to move forward, and move forward fast enough, and this was not taken. When there is an opportunity it has to be capitalized on with appropriate expenditures from your company or from government funds. You cannot drag out development too long with technology advancing so fast in other parts of the world. By the time you have the product, someone is already producing it on your prototype.

Senator Kinnear: I was going to ask where you obtain your qualified staff, and whether you contract out any of your research to universities?

Mr. Hoge: Again, I shall answer the last question first. No, we do not contract out any of our research to universities. Our staff is a mixture of about 50-50 second generation Canadian citizens and the other 50 per cent is from the UK.

Senator Kinnear: Your professional staff?

Mr. Hoge: Yes, our professional staff.

Senator Grosart: I should like to ask a supplementary. Are any of the firms here contracting research or development or both to provincial research institutes?

Mr. Mitchell: We are. Possibly Mr. Avery, Director of Engineering for Orenda Limited, would like to answer that question.

Mr. B. A. Avery, Director of Engineering, Orenda Limited: We were working with the university first, not particularly subcontracting work, but we were using university professors and associate professors working with us as consultatnts. They were actually working full time during the summer on an area of specialty. This is combustion. We feel by so doing we will gain and get to understand the industry and learn its point of view and do some down-to-earth practical development and go back and train students to like and appreciate this kind of work.

We use part of the Ontario Research Foundation for specialty engineering, but we are not large enough to carry a full staff of capable people. We use the specialty areas. Supporting and helping is their largest business. A great many companies are much smaller than ours.

Senator Grosart: A suggestion has been made that, as part of the national science policy, there should also be research institutes funded by the federal Government and attached to universities. Would this be an unnecessary duplication of the work of the provincial institutes?

Mr. Mitchell: I would not suggest it being so in the case of the Ontario Research Foundation. It is an excellent foundation and has a lot of these facilities that you are talking about. It could be a duplication.

Mr. Boggs: Mr. Uiffen, do you have any views on that?

Mr. Uiffen: I do not have strong views. I have a personal view, if I may express it. There is over-concern in Canada with this bogey of duplication. I happen to have a personal feeling that research, especially in the purer forms, is a very private thing and with the people concerned it is a very individualistic thing. You are talking here of the gross, but you will only get it by assembling all of these individuals and considering a way in which you might assemble them. You can only afford a certain amount of duplication if you find it is happening in any one place, but I am personally afraid of a concentration of direction in research that could result from having it channeled into organized groups. As far as the Ontario Research Foundation is concerned, I do not have a strong view. They are a good organization and my personal view is that we need more research activity in industry. I might also say that I think the distribution of firms in Canada is such, considering their size, that there are not really very many of them that can have big research organizations. Therefore, activity such as the Ontario Research Foundation is engaged in is a good thing.

I am also afraid, as I watch government organizations of which I was once a member, that they do not get close to the problems of industry. This is in the area where you were using the word innovation I believe. I think you are going to have to try and generate research minded people who are in small industries and will have to afford production people. To concentrate the research in these areas of excellence or expanding on things which the Ontario Research Foundation represents is not necessarily the right thing. This is a bit of a trick, but as I see the distribution of Canadian industry it really is necessary.

I might use this point in time to put a plea in for the mechanism by which research is supported in industry. There has been a view expressed that in the promotion of research in industry we should try and get industry to have research divisions, if you like.

I submit that that only belongs to the largish firms and there are not very many of them in Canada.

I would entreat that, at the close of your deliberations, when you make recommendations to the Government, that research should be supported, that you should not make it a condition that the research or the personnel so supported be devoted wholly and solely to research.

I admit there are many administrative problems in this. But I think it is the better way for Canadian industry at large. As an example, of the size, I may be permitted to use the firm I work for. We can afford a few people only on research, pure and simple. I feel that a firm of our size should have the bulk of its research people also actively engaged in production problems. We offered that at the outset. Have I contributed usefully to the conversation? I feel I have swung into a personal plea, but I use it as an example and I am rather pleased to have it on the record.

Senator Grosart: This is a problem that has come up over and over again. It is really a problem of telescoping the spectrum from R to technological innovation.

It also raises another problem on that line. We have been told by witnesses from industry that some of the best people in universities shy away from the production end. The solution has been offered—and I think yours is a solution in that area—that if they are brought into industry and shown that there is glamour in the output end as well as in the research end, we will all benefit.

Senator Kinnear: My first question is probably to Mr. Mitchell, as it is referred to in his brief. At page 10, you state, in paragraph 4-9:

> The wholly Canadian-owned company and the foreign owned subsidiary, given sensible support and incentives, can continue to find sensible niches in the world marketplace, not only through saleable lines of products and services, but by becoming specialists in the design and development and production of certain portions of major product lines.

You suggest that the finding of such sensible niches in the world marketplace is an essential part in the provision of more industrial jobs.

Do the witnesses think that Canadian companies are as effective in this process as they might be?

I have one other question. What assistance does industry now obtain from Government departments regarding the search or research for these sensible niches?

Mr. Mitchell: First of all, since it is in our brief, we agree that these sensible niches do exist and that we as a company can root them out and exploit them. I think that where this is applied, industry in Canada is well served. So obviously, we agree on that point.

On your second question, does this refer to marketing?

Senator Kinnear: Yes, what assistance does industry get from government departments on marketing?

Mr. Mitchell: I would say we get a fair amount of assistance in marketing from government, particularly from the Department of Trade and Commerce and the Department of Industry. They do extensive market studies. They assist us in terms of personnel, in the trade commissioners' offices throughout the world. We get a considerable amount of assistance from government people in regard to marketing service, marketing information, marketing intelligence, particularly in foreign countries.

Senator Kinnear: Thank you. Perhaps some other representatives would wish to reply also, as it is a general question.

Mr. Taylor: I would like to add to that that we get a tremendous amount of money from all our Government people.

The Chairman: I hope that the marketing survey you referred to a moment ago did not come from the Government.

Mr. Taylor: We did it ourselves.

Mr. Boggs: I also confirm that we get a great amount of assistance from the Department of Trade and Commerce, more on marketing issues, but on marketing research also, where opportunities are thrown up and brought to our attention.

Senator Grosart: Domestically as well as in the export market?

Mr. Boggs: I would say generally, more domestic. Since we live in the export market, our experience is rather different.

Senator Carter: In the brief by Computing Devices, on pages 4 and 5, there is reference to a data bank of scientific and technological information. I would like to know a little more. Where do you feel this bank should be located—in the NRC, or a Government department, or an institute?

Mr. Hoge: I see it operated as a national utility, sir. It can be operated by the National Research Council. I do not think there is anything approaching that existing now, although they do have a very good library at the National Research Council. There are means for searching the catalogues and quickly assessing the texts. But these are really not much different from what they might have been five or ten years ago. If you have to drive to the east end of town, if you live in Ottawa, it is difficult enough but if you are away from Ottawa it is much more difficult.

There are two precedents I can think of for the kind of computers' communication network library access scheme. One of them exists as a research and development program now at the Massachusetts Institute of Technology in Cambridge, in a project called INTREX. I was told yesterday that a similar arrangement is under construction and possibly operating at the University of Toronto.

As to the thing I described, I visualize it as being available as a national service. I can only see it as being operated as a utility as well. It would necessarily use communication lines, possibly some communication lines that would be used for the check system. It would not be in demand 100 per cent of the time on those lines. Perhaps Mr. Taylor could add something.

Mr. Taylor: One point we are thinking about in this is that supposing someone wants information on a particular subject, we would like him to be able to go to some place where he could ask for it and have the information provided, with the question translated and have the answers back in English, French, Italian or other languages. In that way they would have access to whatever was going on in the world. If he has to do it on computing devices, it would be almost impossible, especially the translation. We say this would be a worthwhile objective and if it is something that is in regard to aircraft and everyone else is doing it, what is wrong with having it as a national service?

The Chairman: You are undoubtedly aware of the duty which was published just a few weeks ago and which recommends something along that line. They also recommend that this new service should be under the responsibility of the "gap at the top".

Thank you very much, gentlemen, for having been with us this morning. This concludes our week of sittings, honourable senators. The committee is adjourned.

The committee adjourned.

APPENDIX 168

BRIEF

TO

THE SENATE OF CANADA

SPECIAL COMMITTEE

ON

SCIENCE POLICY

February 1969

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INTRODUCTION

Canada has arrived at that point in history where it must develop and expand its secondary industries if it is to grow and prosper as a great industrial nation. The secondary industry in Canada is growing and becoming one of the largest employers in the country. However, the amount of research and development performed in this country by the secondary manufacturing industry is very much below the level of the successful industrial nations. Canadians in all sectors of the economy are aware of this situation and we are pleased to see the Senate taking an active part by acting as a forum for all to be heard and to contribute to an improving research and development environment in our country.

SUMMARY

We maintain that, although we are advancing technically, we are advancing at a much slower rate than other countries. In other words, relative to world-wide competition, the scale of technological advancement is slipping downwards.

This arises from the fact that the super powers are directing an enormous amount of money and talent into defence and space programs. The fall-out of technical data and know-how will in due time have an enormous effect on all secondary industry manufactured goods. Fully funded and profitable R & D programs obtained by U.S. industry from Government funds allows that industry to advance R & D facilities, management and technical staffs at an unprecedented rate.

In contrast to the situation in the U.S.A., the Canadian Government has very little fully funded military or space programs placed in Canadian industry. The Canadian Government has instituted cost sharing programs which, although helpful to industry, have neither the scope nor the incentive so necessary to create an environment in which R & D will flourish and prosper.

This is a serious disparity between U.S. and Canadian industry, but we must also recognize that Canada is a medium sized nation; relative to the U.S., we have very limited financial resources and technical strengths.

CONCLUSIONS

- Military expenditures should be channeled into Canadian industry, not only as a means of creating a military readiness capability, but also as a means of fostering R & D in industry.

- Canadian Government cost sharing programs and tax incentives or grants should be reviewed with the objective of increasing the incentive to Canadian industry.

- Canadian Government funding of R & D in Government establishments and in the universities should be measured very firmly as to its usefulness to Canadian industry and thus to the economy.

- Canadian industry must create alignments or arrangements with U.S. industry to allow access to their technology. The flow of American capital into Canada should be encouraged.

- The trend to reduced tariffs and barriers should be continued so that Canadian industry can develop a broader base to support R & D.

1- THE TECHNOLOGICAL CHALLENGE

1-1 There is much discussion and concern in Canada, both in industry and government, regarding our efforts in research and development. There is no doubt that the Canadian economy has been changing its role from being a supplier of raw materials to a supplier of finished goods. Before I go further, I would like to say that our natural resources and the exploitation of these resources form our basic wealth, and close attention must always be accorded this important segment of our industry. It is equally clear, however, that the development of our secondary industry is vital if we are to maintain and improve our standard of living with a low level of unemployment. It is in this area where we have our most challenging technological problems.

1-2 I maintain that, although we are advancing technically, we are advancing at a much slower rate than other countries. In other words, relative to world-wide competition, the scale of technological advancement is slipping downwards.

1-3 There are two reasons for this slippage. Firstly, in countries that have far less natural resources than Canada, there is a stronger incentive towards R & D since their success in these endeavours has a greater effect on their standard of living. Secondly, and certainly the most important, is the large sums of money that the super powers, the U.S.A. and the U.S.S.R., are directing into all types of research and development. Their efforts in defence and space programs are very advanced and the fall-out of knowledge from these programs alone will have a spectacular effect on practically all commercial goods and services. Canada could very easily find herself badly outdistanced amid tremendous world-wide advancement. The danger is very real and the impact on our secondary industries could be catastrophic.

1-4 Much has been said about the percentage of gross national product that each country spends on R & D. This is a very poor yardstick since it is the total dollars that really tell the story. Canada could very well spend as much on a percentage basis as does the U.S., and this would not significantly alter the problem.

1-5 The Committee Members no doubt know that R & D spending in the U.S.A. should reach $26 Billion in 1969 and nearly $18 Billion (70%) of this will be performed in industry. Canada, by comparison, probably will spend $0.8 Billion, with only $0.3 Billion (38%) being performed in industry.

1-6 No attempt is being made to condone the relatively poor performance by industry and Government in R & D expenditures during the past ten years; but it is important to realize that, even if Canadians strain their financial budgets, they would still fall far short of competing with the super powers. Canada does not spend enough effort and money on R & D, but the problem goes much deeper and cannot be solved simply by increasing our expenditures.

2- THE SOCIAL CHALLENGE

2-1 The Canadian economy will continue at a good level in 1969 but there are signs now that all is not well. Canadian industry is finding it more difficult each year to absorb the young graduate engineers and scientists from our universities and colleges, and yet we face unprecedented technological challenges. This situation is explosive and dangerous. There is an immediate demand to establish an environment in which science will flourish.

2-2 This is an immediate and pressing problem - the brunt of which will have to be taken by Canadian secondary industry. The challenges are great but so are the rewards. If we can put these young people into constructive jobs today, we will go a long way to resolving the technological problems of to-morrow.

3- THE STRENGTHS AND WEAKNESSES OF CANADIAN SECONDARY INDUSTRY

3-1 It is impossible to establish a clear blueprint for success against such formidable challenges but, to more clearly assess our position as Canadians, it is necessary that our strengths and weaknesses be reviewed:

a) Our main assets are our natural resources and our people.

b) The fact that raw materials are close at hand gives us a competitive edge.

c) Our skilled work force is second to none in the world.

d) The Canadian engineer is outstanding in one major aspect - he has a well established grounding in basic principles and, with this, a high degree of ingenuity. Ingenuity without a good knowledge of basic principles can be very dangerous, and a good knowledge of basic principles without ingenuity can be unproductive. The Canadian engineer has attained an excellent balance.

e) Our R & D facilities in Canada are certainly adequate if compared to our R & D spending; they are obviously grossly inadequate as compared to U.S. facilities.

f) Our world-wide marketing capability is probably not as good as more established exporting nations. The fact is, however, that we have done very well and our marketing and sales people are quite capable of meeting new challenges.

g) A major strength is our proximity to the U.S.A., and the resulting flow of data that enters Canada, either through industrial or Government co-operation.

h) Our home market is too small to support R & D programs alone.

j) Our financial strength is very limited as compared to the large U.S. corporations who perform the bulk of the U.S. R & D.

3-2 In assessing the above strengths and weaknesses, it is clear that we have some assets which need to be nurtured and developed. On the other hand, we have very limited financial strengths and a small domestic market which are major restraining factors.

3-3 Our future success will depend on how effectively we use our very limited assets.

4- USEFULNESS OF CANADIAN GOVERNMENT PROGRAMS

4-1 The various Canadian incentive and support programs have been helpful, but they are diminutive compared with the size of the fully funded Military research and development programs carried out by Industry on behalf of the Canadian Government during the 1950's. A program of expansion and improvement certainly is necessary.

4-2 The Department of Industry Program for the Advancement of Industrial Technology (PAIT) is in reality a form of R & D risk sharing by the Government. Industry obtaining PAIT support must repay the loan with compound interest if the product or service resulting from the R & D is carried successfully through the innovative process to a profitable conclusion. PAIT probably has been of assistance to small companies with little or no risk capital availability. However, we doubt that it has brought much research and development effort to the Canadian subsidiaries of foreign companies, or that it has been helpful to the larger Canadian companies where the risk capital is available once Management has decided that the project has the required probability of overall success.

4-3 The Industrial Research and Development Incentives Act (IRDIA) has assisted in increasing the level of industrial R & D and the amount of facilities available. The program has not been available to Orenda Limited since one of our associated companies had performed considerable research and development during the base year. The program probably will continue attracting companies to commence R & D for the first time, while its assistance in maintaining a continuing level is doubtful.

4-4 Defence Industry Research (DIR) programs have been quite successful in assisting companies with research programs in areas beyond the present state of the art, and in attracting R & D to Canada from foreign parents.

4-5 There are a few comparatively small fully Government funded R & D programs being carried out by Canadian industry. The majority of these are supporting the development of a part of a U.S. Military or Space program requirement. In this way, Canadian industry is gradually being given the opportunity to take part in these large U.S. programs in the research and development field as well as in production. There has been sufficient experience now to indicate that the Canadian economy and Canadian industry would benefit greatly from a continuing and increasing effort on the part of the Canadian Government to offer full Canadian Government funding support of parts of planned U.S. Military and Space programs, provided that the R & D effort is carried out by Canadian industry with the support of Canadian Universities and Government establishments.

4-6 The red tape and delays of many Government departments in dealing with R & D proposals have discouraged, particularly, the small companies who do not have the high level of overhead staff required to meet the reporting desires of the large staffs of Government employees set up to monitor the various support and incentive programs. There has been a steady increase in the number of Government employees monitoring and controlling Government support programs. This requires a higher level of overhead effort on the part of industry, per dollar of support received, compared to the 1950's when, particularly in the Military area, Canada was carrying out several major state of the art research and development programs. Surely, it is the scientific and engineering managers of industry, whose very jobs depend on successful R & D efforts, that can best control the expenditure of R & D funds within reasonably broad and readily monitored limits set by the Government.

4-7 The Canadian Government allocates a lower percentage of its available R & D funds to industry than does any other major industrial nation, in spite of the fact that our very size and capability can least afford this type of approach. The Canadian Government must change this balance of support since it is through viable tax paying industry that we obtain our funds for R & D. The Government and educational organizations should perform the pure research and the applied research requiring expensive and considerable facilities, but all carefully controlled to be in support of the applied research and development being performed in Canadian industry. Government support of University research programs can also be monitored to be sure that research in that sector is in harmony with the fields of endeavour of Canadian industry or is being planned to attract more R & D to Canada.

4-8 It is encouraging to note that the Department of Industry and the National Research Council, to our direct knowledge, are now inviting Engineering-Managers from industry to participate in the choosing and approval of compatible research programs to be supported by Government funds in Universities. This type of communication among the three sectors will be most helpful and should be strongly encouraged and nourished. The overall result could well be a sensible re-alignment of research and development effort between Government, Industry and higher educational sectors, and in such a way that each will be more productive and more directly applied as a team effort to the overall benefit of Canada. From the educational standpoint the result could well be a proper concentration on certain centres of excellence, attracting high quality staff, performing research helpful to the Canadian economy, and producing engineers and scientists trained to want to work at the type and kinds of research and development programs available to them in Canada.

4-9 Let us, as Canadians, recognize our financial capability and resist our inner desires to partake of the large sophisticated and expensive prestige programs which can only be financed by the very largest economies. The wholly Canadian owned company and the foreign owned subsidiary, given sensible support and incentives, can continue to find sensible niches in the world marketplace, not only through saleable lines of products and services, but by becoming specialists in the design and development and production of certain portions of major product lines. In this way, our research and development expenditures, on the three sectors of the economy will have a higher effective productivity in their effect on the Canadian economy and the standard of living of the average Canadian citizen.

5- DISCUSSION OF CONCLUSIONS

5-1 Military expenditures should be channeled into Canadian industry, not only as a means of creating a military readiness capability, but also as a means of fostering R & D in industry -

Historically, military requirements have created an environment in which science has flourished. Canada should not abandon this area entirely. Defence equipment quickly becomes obsolete but the technology created remains permanent and has a very beneficial effect on the economy.

5-2 Canadian Government cost sharing programs and tax incentives or grants should be reviewed with the objective of increasing the incentive to Canadian Industry -

The low level of military funded R & D will dictate the continuation and improvement of Government funded programs to create an incentive for R & D in industry.

Tax incentives should apply to all R & D carried out in industry and not be restrictive as it is now constituted.

Cost sharing industrial research programs should remove the compound interest pay-back clauses which are now included. R & D costs are usually a small part of the costs incurred in launching a new project. The Government should, therefore, consider a more favourable sharing of R & D costs with industry.

A more favourable sharing of costs and removal of interest charges would make the industrial research programs a very major factor in improving incentives for industry.

5-3 Canadian Government funding of R & D in Government establishments and in the universities should be measured very firmly as to its usefulness to Canadian industry and thus to the economy -

An examination of our strengths and weaknesses clearly shows the need for careful allocation of our very limited resources. Government and universities have an important role to play, but Government expenditures in Government facilities and universities should be measured very firmly as to the usefulness to industry.

If such expenditures were to be carefully examined as to the usefulness to Canadian industry, I believe there would be drastic realignment of programs. I believe it would show: that less money should be spent on basic research and more on applied research;

less with Government facilities and more with industry; less on prestige projects and more on the mundane type of project.

Many people recognize the need to carefully expend our limited resources. Some suggest that R & D in Government should be limited to a few large projects so that we could better compete. This view would not stand up to close scrutiny from an industrial viewpoint. Our industry is broad ranging and must remain so.

5-4 Canadian industry must create alignments or arrangements with U.S. industry to allow access to their technology. The flow of American capital into Canada should be encouraged -

Even if we strain our financial resources and direct our R & D efforts very efficiently, we would still be in danger of failing in the technological race. The flow of American capital into Canada will be accompanied by a flow of technological data. It is imperative that this flow of capital should be encouraged, particularly in the manufacturing industry where technology is so important. We, as Canadians, lose something in the process, particularly if we lose control, or our export markets are restricted. I believe we gain more than we lose but, in any event, I believe this trend is unavoidable if we are to maintain and improve our standard of living.

5-5 The trend to reduced tariffs and barriers should be continued so that Canadian industry can develop a broader base to support R & D -

The reduction of tariffs resulting from the Kennedy round of negotiations is having, and will have, a beneficial effect on R & D in Canada. The domestic market in Canada, in most cases, is not large enough to support significant R & D projects. Canadian industry must look to world-wide markets and, with the reductions in tariffs already negotiated, this now appears possible. The strain on Canadian industry required to take advantage of this new opportunity will be formidable and, in some cases, particularly with the smaller companies, it may not be manageable. The trend, however, is encouraging and challenging to Canadian industry.

6- THE POSITION OF ORENDA LIMITED

It is important that the reader understands in general terms the position of Orenda Limited.

6-1 Orenda is a designer and manufacturer of gas turbine engines for defence and commercial applications. We have extensive facilities for both production and R & D which were initially created for defence work.

6-2 Orenda Limited is situated near the Toronto International Airport. It presently employs 2,000 people - including about 100 engineers of various disciplines - on the design, development and production of industrial gas turbines, and the production of aircraft engines and parts, all for both domestic and foreign customers.

6-3 Orenda's 1968 sales were just over 50 million dollars of which just about one-third was exported.

6-4 Orenda is owned 60% by Hawker Siddeley Canada Ltd., and 40% by United Aircraft Corp. of East Hartford, Conn., U.S.A. Hawker Siddeley Canada, in turn, is 57% owned by the Hawker Siddeley Group in the U.K. Although control is with the Hawker Siddeley Group, our alignment through 40% ownership by United Aircraft is very much with the U.S. jet engine company of Pratt & Whitney - a subsidiary of United Aircraft. This alignment with a U.S. company was established two and one-half years ago, and was considered essential, both from a production and technological point of view.

6-5 In 1958 the growth and flow of technology into Orenda ceased with the cancellation of Canadian military engine development programs. Of particular interest to the Senate Committee is our experience in the industrial gas turbine business. The technology established with Orenda from military programs did allow us to diversify into a new product line of industrial gas turbines. This program has been successful to date and shows good potential for growth, both for domestic and export markets.

6-6 Since initial production started in 1962, Orenda has sold some $50 million of industrial gas turbines with 69% for domestic use, and 31% for export. It is now 30% of the Company's business. The success of this program was entirely due to the level of engineering competence established by Military R & D programs. However, by 1965 we found ourselves running seriously behind in technology due to the very low level of Government R & D funds available to us during the intervening years. The only solution available to us was to establish an alignment with a large U.S. corporation that was able to retain a large R & D program, both in the military and commercial areas of business. The result is a revitalization of our product development program, with a greatly improved confidence on the part of management which is so essential in evaluating and accepting the innovative business risks.

6-7 Improved Government incentives for R & D, either by tax methods, or cost sharing industrial research programs, or both, would have an immediate effect on Orenda and would substantially increase both applied research and product development.

6-8 We at Orenda are well constituted to market our products world-wide. We are not restricted by foreign ownership. We have a good product line in a growth market, but because of our size and the competition, particularly from large U.S. Corporations, we need all the help and assistance we can get in the applied research and product development field. It is interesting to note that almost all our competitors in the world's industrial turbine marketplace are large companies which receive considerable and continuous funding from their Governments for military and space projects and, in some cases, Government purchase orders for commercial type products to support the period of innovation. These companies, such as General Electric, Westinghouse, and the Solar Division of International Harvester in the U.S., and Rolls Royce in the U.K., are most certainly goliaths compared to Orenda Limited, and the funds supplied by their Governments in a great many forms, including fully funded profit bearing research and development programs, make Orenda's position particularly difficult and challenging.

APPENDIX 169

SUBMISSION OF

COMPUTING DEVICES OF CANADA LIMITED

TO

THE SPECIAL COMMITTEE OF THE SENATE OF CANADA

ON SCIENCE POLICY

May 30, 1969

SCIENCE POLICY IN CANADA

PART I

SOME GENERAL OBSERVATIONS

1. We believe that Canada's resources are too limited to participate in a broad spectrum of Research and Development. We therefore should direct Canadian efforts to certain specialized areas. We are prepared to assist in the formation of Government-policy by providing information and making recommendations.

2. We believe the resource industries will not provide sufficient growth to absorb the numbers of scientifically-trained personnel graduating annually from our educational system. Therefore an increasing number of jobs must be provided in the high technology area of the manufacturing industries if Canada is to fully benefit from its educational investment.

3. We believe Canada could obtain better value for the large amounts of R&D money spent in Government laboratories when related to the requirements of industry. For example, we have become critically aware of certain areas where work is funded to keep up with developments by industry.

   Too frequently work in Government laboratories is not (in the main) directed to assist in the development of selected areas of the economy. And usually industry must perform much additional and expensive development work to adapt Government lab inventions to the industrial requirements which were not considered in the first instance.

4. Our Company has been successful in some team effort with Government agencies in development of new products. These products have proved to be very successful in export markets and have returned substantial sums in the form of royalties to the Canadian Government. We believe this arrangement should be expanded and encouraged. We are prepared to discuss in detail the factors that made these projects successful and to also examine in detail our experience relating to projects that were not successful. We believe there is something to be learned through such a critical examination.

5. We are presently expected to match Government R&D money on a 50/50 basis. At the same time we are not allowed any profit on these development projects, so funds for re-investment in R&D must come from current profits on production. Since the pay-off period is

Science Policy in Canada

typically 5 to 7 years after the initial R&D expenditure, the company in effect carries the costs for several years before it becomes clear whether it was an expense or an investment.

By way of comparison, the development work which we do for USA agencies is usually fully-funded and allows a fee or profit. However, in recent contract negotiations with US agencies they have shown reluctance to continue funding R&D in Canada on better financial terms than the Canadian Government would provide.

6. A system of priorities should be established for allocating total Canadian funds for Research and Development programs so that the percentages of the total are in proportion to the desired relative impact on Canadian economic growth, gross national product, and social problems. We believe, for example, that adoption of this policy would substantially reduce our annual investment in agricultural research and drastically increase our annual investment in research beneficial to the housing and construction industry.

SCIENCE POLICY IN CANADA

PART II

ANSWERS TO THE SENATE'S "APPENDIX I"

SOME CURRENT QUESTIONS REGARDING CANADIAN SCIENCE POLICY

A. FINANCING INDUSTRIAL RESEARCH

1. How best can the federal government encourage fruitful R and D in Canadian industry? Are present schemes satisfactory?

   Answer: The operative work here is "fruitful". Canada Should:-

   a) define and establish national goals for product or industry areas where Canada can support a substantial home market,

   b) authorize a "tax-holiday" incentive to nurture manufacturing capacity and productivity which would make our output competitive on a world-wide basis in these adopted product or industry areas.

2. What federal assistance would help stimulate more innovation in Canadian industry?

   Answer: Adopt or authorize tax-relief profit incentive on new products which are derived from Canadian research and development. See, for example, the formula suggested by Dr. Les Cook in his paper entitled "Some thoughts on how to get increased economic and business growth". (Copy attached)

3. How can federal agencies and departments, NRC, for instance, more effectively assist Canadian industry?

   Answer: By acquiescing to a planned reduction in the level of their automatic annual funding, so that this automatic funding covers only those areas which can't readily be handled by industry. An example of the latter is the development and dissemination of National frequency, time, weights and measures standards -- like the function of the National Bureau of Standards in the United States. The funds so released could be used to pay for the programs suggested in 6 and 7 below. Some of their redundant staff could go into industry and some could serve in that government agency which technically monitor the programs in 6 and 7 below.

Science Policy in Canada Part II

4. Is there a proper balance between the support of the federal government given the three sectors: industry, universities and federal government?

Answer: No. The annual percentage of federal R&D funds which are spent within federally-operated laboratories is much too high. Even if this money spent in fèderal laboratories results in "pushing back the frontiers of science", the know-how is not within the brains and walls of the industries which need the know-how to contribute to Canadian economic growth. And the coefficient of transfer between government laboratories and industrial firms is poor in many countries.

5. On the basis of your experience what is the appropriate creation of and balance between basic research, applied research and development?

Answer: Create a Canadian environment of profit incentive for high-technology secondary industry manufacturing. With adequate profit incentives the science and technology will take care of itself.

6. What criteria should the federal government use in allocating funds to scientific activities such as the support of R&D in industry?

Answer: In allocating funds to scientific activities, the federal government should:-

a) decide what kinds of technology-based missions and programs would best promote growth of Canadian high-technology industries

b) write up the requirements and issue them as requests for proposals from industry

c) evaluate proposals submitted

d) spend most of the available funds on the contract awards to industry, keeping only enough within the government to technically monitor and administer the programs.

e) in implementing these programs, let the industrial competitors and successful contractors decide what kind and how much applied research and development is required to achieve the program objectives.

7. What changes should be made in federal government financial support of Canadian scientific activities?

Answer: Spend more of the federal R&D budget by competitive awards to qualified Canadian companies to undertake R&D in subject areas which support previously agreed-to national product or specialist-industry objectives.

B. INDUSTRY AND ITS ENVIRONMENT

1. How can Canadian universities and industry more effectively collaborate in the field of science and technology?

Answer: Establish more programs in graduate schools of engineering colleges wherein major projects are undertaken to solve problems which are of long standing and which currently set the upper limit on Canadian industrial productivity. A Canadian example of which we are aware is a program at McMaster University for simulating entire chemical processing plants on large scale digital computers. The McMaster program has two purposes:

a) to discover through laboratory simulation and (therefore) non-destructive experiments the true dynamics of a complex system like a refinery, and

b) having successfully established a computer simulation model of a plant, they are able to synthesize Direct Digital Control systems for these plants which enable them to optimize plant output economics for various given conditions.

In a related vein, the Electronics System Laboratory at Massachusetts Institute of Technology have been operating a development program for a number of years on computer-aided design. This program pertains to the numerical-control-of-machining industry. It was originally sponsored by the USAF out of Wright Field. At any rate, this computer-aided design research program is staffed in part by technical employees of firms who are interested in the results of the program. That is, machine toolmakers like Cincinnati Milling Machine Company, Giddings and Lewis, Warner and Swasey, Kearney and Trecker, have had people on assignment to MIT for periods of one year. Similarly, we believe both Boeing and Lockheed Aircraft companies have had some of their staff assigned to this program at MIT.

The above are examples of excellent collaboration between universities and industry.

2. Do Canadian universities graduate scientists and engineers able to perform effectively in Canadian industry?

Answer: Yes, Canada probably produces more scientists and engineers than currently can find employment in Canada. We believe that a great many emigrate to the United States.

Science Policy in Canada PART II

3. What should the important long term goals of Canadian Science be?

Answer: To make Canada pre-eminent in one or two product areas in the way Japanese have become specialists in entertainment-grade electronics. (Transistor radios, tape recorders, television sets, etc.). For those who say, "yes, but Japan has a low-cost labour market", I would point to Philips of Eindhoven, Netherlands, who are a major international electrical machinery and electronics firm.

4. Is there an adequate supply of scientific manpower in Canada?

Answer: Probably, assuming the output of scientists and engineers presently in government institutions can be more effectively coupled to Canada's production capabilities.

5. Does foreign ownership hamper the development of innovation in Canadian industry?

Answer: In our case it doesn't. In some cases it may. But for unique developments for which there are both Canadian and world-wide markets foreign ownership should not hamper development of innovation in Canadian industry.

6. Are the results of foreign science and technology available to Canadian industry in a timely and suitable manner?

Answer: We believe that most of the technological data and reports which are published in the world are probably available in Canada somewhere.

But we are not aware of any central Canadian agency which systematically collects and catalogues world-wide scientific reports in a manner which permits:

a) convenient search of the cumulative index for material of possible interest

b) quick reaction availability of selected reports for detailed study

c) translation of reports originated in German, Italian, Swedish, Norwegian, or Russian into English and/or French to facilitate evaluation by Canadians.

We believe the economics of operating such a Canadian Scientific Data Bank service should be evaluated. If this service can be justified, its operation could be one of the responsibilities of the National Research Council.

Canada might both (a) establish a model next-generation Scientific Data Bank and (b) provide a vehicle for developing and strengthening Canadian capabilities in computer-based data communications by associating the Scientific Data Bank with a nation-wide computer-terminal network which would permit remote access to the Data Bank indexes and library of reports. The remote terminals could provide picture-tube and keyboard scanning of the indices, followed by facsimile-printer production of report copies.

Possibly the computerized access network for the Scientific Data Bank Service should be set up as a crown-corporation utility which charged a service fee in proportion to subscriber terminal equipment installed and a computer access-time actually used. In this manner the beneficiaries of the computerized access service would defray the cost, thereby sparing the national budget.

COMPUTING DEVICES OF CANADA LIMITED

R R Hoge

RRH/em R.R.Hoge
30/5/69 Vice-President, Research and Engineering

SOME THOUGHTS ON
HOW TO GET INCREASED ECONOMIC AND BUSINESS GROWTH
through Technological Innovation
by more effective Research & Development in Industry

Research and Development programs in industry tend generally to be very short term and pedestrian in outlook. Active work aimed at goals beyond three years out is so rare as to be refreshing when you find it. The bulk of so-called "R&D" in industry is aimed at "results" within 12 months or less.

This is both disturbing and peculiar in countries where the economies are clearly resting on a technology base, and strongly oriented toward "growth." Even a cursory look at the R&D work lying at the base of most technological products and processes shows that it extended over much longer time periods than 1-3 years - in fact 7-15 years from initiation of the R&D until the results were "earning money" is much more the rule, and often the "real profits" are being reaped 20 years later - or even more!

This cannot be a good or wise situation from a national point of view and it seems that a prudent government seriously concerned to encourage healthy economic growth over the 10-20 year pull, would be well advised to examine the causes and take steps to correct them.

The causes are clear to every business man - under present business ground rules it simply doesn't pay to act otherwise - the risks are not worth the cost!

What are these ground rules? They are three:

1. that "R&D" expense is treated for tax purposes as a current cost of doing current business.

2. that - consequently - every $1 spent <u>this year</u> on R&D means ~ 48¢ out of the shareholder's pocket "this year" (for the larger on-going businesses) - just like every other $1 spent this year.

3. that there is no extra or special reward in the 5-15 year future for foregoing these earnings, running the risk, and producing a technical innovation. Only if it is clear that the current business is seriously threatened is there the possibility of a "fear" incentive - and that is not usually very effective 5-15 years ahead.

Clearly any "R&D" expense <u>directly</u> concerned with <u>this year's</u> or next year's earnings <u>must</u> be spent (like any other such cost). This leads to R&D programs of two sorts:

1. Technical "trouble shooting" on technical problems threatening this year's profits.

2. Technical "support" in the design of a new or improved product line - or the application or sale of products (sales support).

But there is a strong dis-incentive <u>this year</u> to spend out of <u>this year's</u> earnings on R&D aimed at high risk 5-15 year out goals for which neither the need nor potential return look to be unusual.

These R&D programs are exactly the ones the "economy" needs for they concern:

3. Examining and searching for new technologies or changes in present technologies which may beneficially obsolete, extend, or add to present technologies.

4. Exploring for entirely new products, processes, businesses, and business areas.

5. Investigating technical problems of "social" significance and "need."

6. The attraction and development of promising technical talent into this whole game.

The pathway out of this impasse is clear and simple and likely to have tremendous economic results to any country that has the courage to try it - within 10-15 years. Nor need it cost the government anything in the present for this potential future return. It merely involves shifting the ground rules so the serious disincentive, which faces all corporations, to engage in longer range R&D directed to economic growth, is changed to an incentive.

How to do it?

There seem to be two essential changes in the Corporation tax rules as they pertain to R&D, and two safeguards and one rule.

The two changes are:

1. Special tax treatment for the expense of all R&D programs in a corporation which are aimed at goals like 3-6 above - such that all of these costs plus a small incentive margin (say 10%) are deductible from the Corporate Tax in the current year. This would have the immediate result that the corporation could not afford this year to be without a long range R&D program.

2. Special tax treatment for any new business, new product or process issuing from such an R&D effort, during the first 5-10 years of its "business" existence. This could be absolution of earnings from all corporate tax for the first 5 years, tax at half rate for the next 5 years, and thereafter the tax reverts to regular rates. This would have the immediate result that the corporation would energetically try to manage its longer term R&D so as to obtain the special profits from these tax concessions.

The two safeguards are:

1. That the annual R&D costs subject to this special treatment may not exceed some limit - which might be say 3% of sales, or 20% of pretax earnings.

2. That to obtain these benefits a statement of the nature of the programs, new products, etc. must be filed with the Corporate Tax report - and that the allowance of these special tax incentives is subject to audit and approval by the Tax Authorities who evidently must have competent technical help to verify the authenticity of the statements.

The one rule is:

That a corporation may elect to use as the basis of its R&D costs "limit calculation" for <u>any given year</u> - the sales and/or earnings figures for <u>any one</u> of its last 5 years. This would provide a "smoothing" effect so that the R&D budget in the Corporation would not be exposed to annual fluctuations in sales and earnings - but would naturally grow or contract in a smoothed way with the Corporation's longer term growth.

An example will illustrate how this would work.

Let us assume a corporation with -

Current sales of ---------------------- $100 million
Current earnings of --------------------- $ 15 "
Current Corporate tax of ------------------$ 8 "
Current after tax earnings of ----------- $ 7 "

Under present rules if this corporation were to operate an R&D facility directed to longer range technical innovation costing $3 million a year, the picture would become:

Current earnings--------------------------- $ 12 million
Current Corporate Tax -------------------- $ 6.4 "
Current after tax earnings -------------- $ 5.6 "

which shows a <u>disincentive</u> of $1.4 million to the shareholders
and a loss of $1.6 million in tax revenue.

Under the proposed rules the operation of the same R&D facility would have the following result:

Current earnings	$12 million	
Current Corporate tax ---------	$ 4.7 "	(i.e. $3.3 million deductible due to 10% incentive)
Current after tax earnings ----	$ 7.3 "	

The Corporation could <u>not</u> afford <u>not</u> to have such a long range R&D facility <u>this</u> year! Perhaps initially it might be felt that so large a potential loss of tax revenue is frightening. The "limit" could be set lower - say at 10% - in the first instance as an experiment. That would still make a fine long range R&D facility.

Now let us look at the other end of the affair:

Although it is hard to speak of a "typical" technological innovation, the following data do refer to one which did actually happen.

Expenditure on "long range" R&D over 7 years totalled	$2 million
Pretax earnings during 1st 5 years of business	$6 "
" " " 2nd " " " "	$15 "
" " " 3rd " " " "	$45 "

Hence, <u>the Corporation</u> would get an "after tax" return

between 7 and 12 years after initiation of the R&D program of $6 million (being "forgiven" ~ $3 million of tax)

between 12 and 17 years after initiation of the R&D program of $11 million (being "forgiven" ~ $4 million of tax)

and thereafter have a growing profitable business at regular tax rates.

The Government would "give up" ~ \$1 million of tax during the 7 year R&D period (as incentive).

Then "give up" ~ \$7 million of tax during the first 10 business years (tax which it however would not have had if the R&D had not been done).

Collect ~ \$4 million of tax in the 6th to 10th business years (tax which it would not have had if the R&D had not been done)

And thereafter collect ~ \$24 million in tax in the 11th-15th business years alone, and so on for the future.

Perhaps not all the long range R&D expenditures can be expected to have this sort of issue - but if only 20% of it does it, it still provides the economic boost to the Company, the Government and the economy. Over a 15-20 year period everybody wins - which as we know - has been the nature of technological economies.

It seems as if a nation and a government which really wants to encourage major technological innovation to build a strong technically based growth economy must give its businesses the necessary leadership by showing that it (the government) is willing to forego a portion of current revenue, providing this is really devoted to building the economy of 10-20 years hence.

It seems as if the corporate shareholders and management are peculiarly able to do this effectively providing the present disincentives are removed and replaced by some modest incentives.

Under present ground rules, a corporation has a disincentive to innovate in any way that would change or obsolete its present businesses unless those businesses are threatened in some way.

Under the proposed ground rules a corporation would have a positive incentive to try to improve, change, and innovate, even obsolete its present products.

Undoubtedly there would be some marginal skull duggery - there always is - but the benefits over 10-20 years should be so great as to far outweigh the marginal skull duggery.

L. G. Cook
Manager - Program Planning Operation
PROGRAMS AND SYSTEMS

EGC;mlb
May 9, 1968

APPENDIX 170

BRIEF to the

SPECIAL COMMITTEE OF THE SENATE ON SCIENCE POLICY

Litton Systems (Canada) Limited.

Brief to the Special Committee of the Senate
on Science Policy

LITTON SYSTEMS (CANADA) LIMITED

Company Background

Litton Systems (Canada) Limited is a wholly owned subsidiary of Litton Industries, Inc., of California, an internationally oriented company with 219 plants and laboratories in 35 countries. Litton, Canada manufactures and exports highly sophisticated electronic equipment for ground, airborne and ship-board applications. In the relatively brief period we have been in existence we have exported roughly 250 million dollars worth of such equipment.

The company was established in 1960 in response to the requirement of the Canadian government for Canadian content in the Litton LN-3 Inertial Navigation Systems which the government was procuring for the RCAF's CF-104 Starfighters. The company rapidly expanded its capabilities to encompass the production of the complete inertial navigation systems. At the same time, we provided direct field support to the RCAF in the introduction and maintenance of these most modern and complex electro-mechanical systems.

The success of this program led to similar support responsibilities for the company in the case of the Air Forces of the Netherlands, Denmark, Norway and Spain, which also include the LN-3 system in their Starfighters. Our ability to produce this type of equipment in quantity, to a very high level of quality and at a competitive price led to export orders for later types of inertial navigation systems for such aircraft as the U.S.A.F.'s McDonnell F-4 Phantom and General Dynamics F-111. We are now in production of portions of still other navigation systems which are representative of the very latest technology, for both military and civil aircraft applications.

Another major export program at Litton Canada has been the production of special computer equipment for the F-4 Phantom aircraft in service with the U.S.A.F. The company has the full responsibility for the engineering aspects of this system, and we have introduced a number of design improvements.

The experience and capability of our engineering personnel has enabled us to develop and produce a variety of specialized electronic test equipment for inertial navigation systems as required at factory, service depot and aircraft flight line levels. We have developed an export market for such equipment and we are currently negotiating with the U.S. Navy for the production of a number of flight line test equipments for the check-out of the inertial systems in the P-3B Orion ASW patrol aircraft.

With the award to us of a contract to supply Command and Control Systems (CCS-280) for use on board the Canadian Forces new fleet of helicopter-equipped destroyers (DDH-280 class) we again imported from the United States the very latest technology to meet Canadian requirements. Litton Canada, through production and engineering has assimilated this technology and we are actively endeavouring to establish an export market for this technology, as was the case of inertial navigation system technology. This general type of equipment, adaptable to the display of tactical military situations on board ship, in the air or on the ground can also find civilian applications in many areas of activity as, for instance, traffic control in the St. Lawrence Seaway or computer aided instruction in our education facilities.

The company has also undertaken a number of applied research programs on a shared cost basis with the government. A number of these programs have been concerned with airborne navigation systems, aimed primarily at expanding in breadth and depth our capabilities in the electro-mechanical and electronic technologies involved.

One program, which is concerned with pattern recognition, promises to have very broad applications, not only in defence, but in many areas of business and government operations.

The challenge to a company such as ours is to be able to adapt both the imported and the internally developed technologies to new market possibilities in order to sustain at least the level of our production activities and personnel headcount, and hence our business strength, in times when defence production orders are nearing completion and are not being replaced by new program opportunities of appropriate nature.

Questions of Current Interest and Discussion

The Company believes that the best way to present our material is to direct our remarks to "Some Current Questions Regarding Canadian Science Policy" contained in Appendix 1 to Senator Lamontagne's letter of 20 January, 1969.

A. Financing Industrial Research

1. In our opinion the best way for the federal government to encourage fruitful research and development in Canadian industry is to create a climate of opportunity. In the same way that the technological goals of the U.S. space and military programs have provided a favourable climate for industrial developments in that country, national programs in Canada of adequate magnitude and challenge could react similarly on our industries. The national programs need not be as "far out" as the U.S. space program which contained goals more suited to their size, posture and state of technical advance than to ours. On the contrary, suitable programs here should be more directly oriented to our current national needs and aspirations yet would contain scope for the application of modern

science and technology.

It is believed that present schemes for encouraging R and D in industry are now being reviewed in order to improve them. Our comments will therefore be brief. The I.R.A.P. administered by the N.R.C. does not fit Litton's requirements. It appears to be oriented to the encouragement of basic research in industry whereas our objectives lie much closer to applied research and development. The cost sharing is less attractive to us than other schemes since the government share under I.R.A.P. is typically less than 50%, and the basic research nature of the work makes the company contribution an extremely long term, speculative investment.

We have found the DIR scheme operated by DRB to be the most attractive on both financial and administrative grounds. The DIR program does not call for repayment of the government's share of costs and is otherwise more favourable than other schemes on an overall financial basis.

There is less administrative "red tape" with the D.I.R. scheme. In our experience, the DRB personnel assigned to monitor our DIR projects are professionals and have provided useful advice and assistance.

To date we have had DIR assistance for six separate projects which have represented a substantial part of the research activity of the Company during the last five years. In this period, however, our design-development activities have always been considerably greater in scope than our research work. We can nevertheless point to specific examples of useful results stemming from the DIR support. In one case the capability engendered by the DIR project in our engineering staff has led already to several commercial programs for hardware with a total value of about $1 million. Two of these are pilot programs with significant follow-on potential.

In addition, this capability has been of value in connection with the $8.5 million contract awarded to our Company for the digital command and control systems on the Canadian 280 series destroyers. In a second case, the expertise we developed in gas bearing technology as a result of a DIR project enabled us in the latter part of 1968 to begin deliveries of gas bearings for precision gyroscope applications. This business, which is all export, is now proceeding at a rate approaching half a million dollars per annum. In a third case an early and direct result of a DIR project was the receipt by the company of an initial contract in excess of a quarter of a million dollars for work on Project Mallard -- a large quadripartite military communication system. Finally, we should add that at the present time certain of our company-funded development and marketing activities are based, in part, on technology and capability acquired under past DIR projects.

2. The stimulation of more innovation in Canadian industry would result from assitance of the DIR type, but extended to include development programs. Development, not research, is the national need at this time, as it offers the more immediate return in regard to providing marketable products, and therefore increasing labour opportunities. As pointed out by several witnesses who have appeared before the Senate Committee there is a disproportionately low level of development in relation to the amount of research being done in Canada as compared with other countries with progressive technologies. The percentage of development expenditure in Canada needs to be increased significantly.

Report No. 1 (1967) of the Organization for Economic Co-operation and Development on the overall level and structure of R and D in OECD member countries showed that in a comparison of five years (1963-1967) averages for the United States and Canada, almost two thirds of the U.S. expenditure was for development while only slightly over one third was spent in Canada in this category. The exact figures for this and other R & D categories are as follows:

	U.S.	Canada
Development	65.5%	37.0%
Applied Research	22.1%	40.6%
Basic Research	12.4%	22.4%

What is needed is a number of fully funded development contracts emanating from a national science policy. Partially funded development programs should also be encouraged for some projects in which individual companies have objectives which would be of some more limited national interest. In deserving cases, the funding arrangements for these projects should be more flexible than a 50/50 basis. The government should also be prepared to give more support for preliminary development work, or a more liberal interpretation of "research" within the present DIR context.

3. Federal agencies, and particularly NRC, could more effectively assist Canadian industry if their in-house research programs were undertaken deliberately to complement the developmental interests of industry and of the nation. Government in-house programs are often of no or minimal interest to industry or they "dabble" in development, an area unsuited to a government agency and traditionally appropriate to the private sector.

4. It is tempting, but not really defensible, to argue that there is an ideal balance attainable between the proportion of government support given to university, industry and in-house programs. The division of the funds surely depends on the situation within a country at any given time rather than a strict adherence to what might be the case in some other country. For a developing country, it is initially desirable for research support to go to government agencies.

At a later time the emphasis might be given to university requirements and, still later, to industry.

At the present time and in the immediate past, far too great a proportion of the available Canadian government funding for R and D has been spent in maintaining and expanding government R and D establishments. It has now become urgent not only to increase the total expenditures on R and D but to divert a substantially greater portion to accomplish a rapid growth in industrial technological capability. The Fifth Annual Review of the Economic Council of Canada indicates that in 1965 of $351 million of government funded research, $242 million was spent in government R and D laboratories, $50 million was spent in industry, and $57 million was spent in university and the like research. In terms of percentages this indicates 69% in Government, 16.5% in University and 14.5% in Industry. No other western nation has less than 50% of its expenditures for R and D allocated to industry. This remains one of the basic problems we face to-day. It is noted that the total Canadian R and D effort is 1.3% of the GNP as compared with 3.4% of GNP for U.S.A. and 2.3% of GNP in Great Britain.

5. As a rough estimate of the division of R and D funds required in Canada to-day, it is suggested that basic research should be allocated only up to 5%, applied research 10% to 20% and the remainder should go to development. It must be borne in mind that development programs, even of modest size, take very large sums of money in comparison with either basic or applied research. It is worthwhile to examine this more closely. A common assumption to-day in Canada is that all we have to do is to increase our research effort, with more money and bigger teams of researchers in university, government or industry. The best source of new ideas is often the fertile imagination of one man, whereas a lot of research work undertaken by teams of scientists is not necessarily productive or cost-effective. On the

other hand, teams of men <u>are</u> required for development. This activity often requires extensive tooling and test equipment which can be a significant portion of the expense.

In comparing research and development and in trying to decide between them as to which can now yield more timely returns to the economy there is another fact worthy of mention. This is that science knows no national boundaries. Research results are normally published as soon as possible and broadcast to the international scientific community; 'publish or perish' has become almost a creed among scientists engaged in basic research. This means that other nations with aggressive entrepreneurs have immediate access to such results and can apply them to some innovation on at least the same footing as in the country of origin. On the other hand, development, and to a lesser extent applied research, is almost always protected, by not being published until it has been commercially exploited and is thereby normally retained for the benefit of the country of origin. One further point is that the pay-off from basic research is usually long term whereas the returns from applied research and development are potentially more immediate.

6. The sort of criteria which the government should establish or utilize in part in allocating funds to technology are the following:

a. Is the program identifiable with Canadian objectives?

b. What has the agency or company done in the past to innovate and benefit the economy? Too often, political or other factors lead to the government almost subsidizing activities long beyond the point where by normal commercial standards, they should have become self-sufficient and thereby contributed themselves to the nation's economy.

c. Is the project an extension to new technological areas that would merit exploitation?

d. What is the marketability of the end product? In this connection it usually takes a superior product to capture an export market opportunity. The availability of such products within Canada will also, of course, provide a double advantage of reducing the need for Canada to import these products to satisfy our own requirements.

B. Industry and its Environment

1. More effective collaboration in science and technology between university and industry would come from a freer flow of people and information between the two environments. Summer work in industry and much more frequent visits by university staff to industry would help in this regard. Professorial emoluments coupled with the consultant fees available to them, seem to militate against the attractions of summer work in industry.

2. The scientists and engineers now graduating from Canadian universities are much better trained than they used to be and are able to perform effectively in industry.

3. The important long term goal of Canadian science should be national economic development. Science is a means to an end not an end in itself; this is particularly true at our stage of development.

4. There is certainly a quite adequate supply of junior scientific manpower in Canada at the present time. In specialized fields, however, there is a definite imbalance. For instance, if one is interested in acquiring specialists in nuclear physics there are plenty available. Specialists in optics are scarce and if one is looking for personnel specialized in mechanics, to work in the field of advanced gyroscope technology, they are virtually non-existent.

5. Foreign ownership certainly doesn't hamper the development of innovation in Canadian industry. On the contrary, it is fundamentally

beneficial in that it permits the importation of technology which can be used as the base for further innovation. We believe that it is fallacious to assume that Canada need not import advanced technology because it can develop it itself. The pace of development is so rapid that if we do not import a great deal of really advanced technology, we are in an impossible position to do it ourselves on any reasonably competitive time scale, and with any reasonable expenditure of Canadian funds.

The importation of technology to Canada via foreign owned Canadian firms provides a unique avenue to acquire proprietary industrial data and thereby to establish a high level base of technology. From this base, a lesser amount of Canadian resources can be applied to achieve product goals that would otherwise be unattainable.

6. The results of foreign science are usually available promptly to Canadians since, as mentioned above, the results of research are published in the various scientific journals. Foreign technology is only available to Canadian industries in a timely and suitable manner, however, in the case of subsidiaries of foreign firms, not otherwise. The articles which appear in publications devoted to applied science and technology (development) are usually so out of date that the transfer of technology by this means is not timely. The information released from foreign government applied science programs appears to have a deliberately built-in gap of from one to three years as a protection for the competitive position of the originating country.

First Session—Twenty-eighth Parliament

1968-69

THE SENATE OF CANADA

PROCEEDINGS OF THE SPECIAL COMMITTEE ON

SCIENCE POLICY

The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*

The Honourable DONALD CAMERON, *Vice-Chairman*

No. 71

TUESDAY, JUNE 24th, 1969

WITNESSES:

Dominion Foundries and Steel: Mr. Alan D. Laing, Assistant to Executive Vice-President (Financial), Mr. Noel Thomas, Manager of Research and Development; Steel Company of Canada Limited: Mr. A. D. Fisher, Vice-President, Planning, Engineering and Research Division, Mr. W. A. Darby, Tax Accountant, Mr. J. C. McKay, General Supervisor of Research; Falconbridge Nickel Mines Limited; Mr. P. G. Thornhill, Director; Aluminum Company of Canada Ltd.: Mr. G. M. Mason, Technical Director, Mr. Gilbert Proulx, Manager, Public Relations (Research)

APPENDICES:

171—Brief submitted by Dominion Foundries and Steel Limited

172—Brief submitted by The Steel Company of Canada Limited

173—Brief submitted by Aluminum Company of Canada Ltd.

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MEMBERS OF THE SPECIAL COMMITTEE

ON

SCIENCE POLICY

The Honourable Maurice Lamontagne, *Chairman*

The Honourable Donald Cameron, *Vice-Chairman*

The Honourable Senators:

Aird	Grosart	Nichol
Belisle	Haig	O'Leary (*Carleton*)
Blois	Hays	Phillips (*Prince*)
Bourget	Kinnear	Robichaud
Cameron	Lamontagne	Sullivan
Carter	Lang	Thompson
Desruisseaux	Leonard	Yuzyk
Giguère	McGrand	

Patrick J. Savoie,
Clerk of the Committee.

ORDERS OF REFERENCE

Extract from the Minutes of the Proceedings of the Senate, Tuesday, September 17th, 1968:

"The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That a Special Committee of the Senate be appointed to consider and report on the science policy of the Federal Government with the object of appraising its priorities, its budget and its efficiency in the light of the experience of other industrialized countries and of the requirements of the new scientific age and, without restricting the generality of the foregoing, to inquire into and report upon the following:

(*a*) recent trends in research and development expenditures in Canada as compared with those in other industrialized countries;

(*b*) research and development activities carried out by the Federal Government in the fields of physical, life and human sciences;

(*c*) federal assistance to research and development activities carried out by individuals, universities, industry and other groups in the three scientific fields mentioned above; and

(*d*) the broad principles, the long-term financial requirements and the structural organization of a dynamic and efficient science policy for Canada.

That the Committee have power to engage the services of such counsel, staff and technical advisers as may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to examine witnesses, to report from time to time, to print such papers and evidence from day to day as may be ordered by the Committee, to sit during sittings and adjournments of the Senate, and to adjourn from place to place;

That the papers and evidence received and taken on the subject in the preceding session be referred to the Committee; and

That the Committee be composed of the Honourable Senators Aird, Argue, Belisle, Bourget, Cameron, Desruisseaux, Grosart, Hays, Kinnear, Lamontagne, Lang, Leonard, MacKenzie, O'Leary (*Carleton*), Phillips (*Prince*), Sullivan, Thompson and Yuzyk.

After debate, and—

The question being put on the motion, it was—

Resolved in the affirmative."

Extract from the Minutes of the Proceedings of the Senate, Thursday, September 19th, 1968:

"With leave of the Senate,

The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That the name of the Honourable Senator Robichaud be substituted for that of the Honourable Senator Argue on the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—

Resolved in the affirmative."

Extract from the Minutes of the Proceedings of the Senate, Wednesday, February 5th, 1969:

"With leave of the Senate,

The Honourable Senator McDonald moved, seconded by the Honourable Senator Macdonald (*Cape Breton*):

That the names of the Honourable Senators Blois, Carter, Giguère, Haig, McGrand and Nichol be added to the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—

Resolved in the affirmative."

ROBERT FORTIER,
Clerk of the Senate.

MINUTES OF PROCEEDINGS

TUESDAY, June 24, 1969.

Pursuant to adjournment and notice the Special Committee on Science Policy met this day at 10.00 a.m.

Present: The Honourable Senators Lamontagne (*Chairman*), Belisle, Blois, Bourget, Carter, Grosart, Haig, Kinnear, Robichaud and Yuzyk—10.

In attendance: Philip J. Pocock, Director of Research (*Physical Science*).

The following witnesses were heard:

DOMINION FOUNDRIES AND STEEL

Mr. Alan D. Laing, Assistant to Executive Vice-President (Financial)

Mr. Noel Thomas, Manager of Research and Development

STEEL COMPANY OF CANADA LIMITED

Mr. A. D. Fisher, Vice-President
Planning Engineering and Research Division

Mr. W. A. Darby, Tax Accountant

Mr. J. C. McKay, General Supervisor of Research

FALCONBRIDGE NICKEL MINES LIMITED

Mr. P. G. Thornhill, Director

ALUMINUM COMPANY OF CANADA LTD.

Mr. G. M. Mason, Technical Director

Mr. Gilbert Proulx, Manager
Public Relations (Research)

(*A curriculum vitae of each witness follows these Minutes*)

The following are printed as Appendices:

No. 171—Brief submitted by Dominion Foundries and Steel Limited
No. 172—Brief submitted by The Steel Company of Canada Limited
No. 173—Brief submitted by Aluminum Company of Canada Ltd.

At 12.30 p.m. the Committee adjourned to the call of the Chairman.

ATTEST:

Patrick J. Savoie,
Clerk of the Committee.

CURRICULUM VITAE

Darby, Willford A.: born March 6th, 1922. Degree: Bachelor of Commerce—1949 Queen's University C.A. 1952. Joined Steel Company of Canada, Accounting Division on August 1st, 1955—appointed Tax Accountant October 21, 1959.

Fisher, A. D. was born in Calgary, Alberta on February 24, 1915: Graduated in 1937 in the University of Toronto with a B.A.Sc. Degree in Chemical Engineering. Commenced with Steel Company of Canada Limited in 1937 as a Metallurgist and advanced to the position of Superintendent—Coke Plant in 1943; General Superintendent—Hilton Works in 1951; Manager of Facilities Planning in 1963 and Vice-President, Planning Engineering and Research Division—1966.

Proulx, Gilbert, B.A.Sc., B.Eng. Consultant for special projects with the Aluminum Company of Canada Limited. Since 1942 has held various positions including that of Administrator of the $150,000,000 Chute-des-Passes Hydro Electric project in Northern Quebec and that of Vice-President, Operations, of an affiliated company. Member of several professional and social organizations.

Laing, Alan D.: born Winnipeg Manitoba. Graduated University of Manitoba with B. Comm, C.A. Degrees. Has position as Ontario Assistant to Executive Vice-President, Financial, Dominion Foundries and Steel Company.

Mason, George M., B.A.Sc.: Chemical Engineer and Technical Director with the Aluminum Company of Canada Limited since 1957. Previous to this has held various technical positions at Arvida works and that of General Purchasing Agent since joining the company in 1939. Member of several professional and social organizations.

McKay, John C.: Born February 27, 1931 at Rossland, British Columbia. Received B.A.Science in 1954 in Metallurgical Engineering from University of British Columbia. Joined Steel Company of Canada, Metallurgical Department in 1954. Appointed General Supervisor, Research and Development Department, 1961.

Thomas, Noel: Born Toronto, Ontario. Graduated University of Toronto with B.A.Sc. Degree. Has position as Manager of Research Development with Dominion Foundries and Steel Company.

Thornhill, Philip G.: Born 1918, Maidstone, England. Employed—Wendigo Gold Mines Ltd. 1937-40. Service—Canadian Armoured Corps, U.K. and C.M.F., 1941-46. B.A.Sc. Met. Eng.—University of Toronto, 1950. M.A.Sc. Met. Eng.—University of Toronto, 1951. Employed by Falconbridge Nickel Mines Limited 1951 to present as: Research Engineer, 1951-53; Research Metallurgist, 1954-59; Supervisor Metallurgical Research, 1960-67; Manager Process Metallurgy, 1968; Director Metallurgical Research, 1969. Member—APEO; CIMM; AIME; Electrochem Society.

THE SENATE

SPECIAL COMMITTEE ON SCIENCE POLICY

EVIDENCE

Ottawa, Tuesday, June 24, 1969

The Special Committee on Science Policy met this day at 10 a.m.

Senator Maurice Lamontagne (*Chairman*) in the Chair.

The Chairman: Honourable senators, this morning we have representatives from four different companies. As has been the practice in the past, the witnesses will make short statements followed by a question period.

I shall ask Mr. Laing to speak first. Mr. Laing is the Assistant to the Executive Vice President (Financial) of Dominion Foundries and Steel.

Mr. Alan D. Laing, Assistant to Executive Vice-President (Financial) Dominion Foundries and Steel: Mr. Chairman, ladies and gentlemen, our submission consisted of comments on the questions and the appendix to the letter in which we were invited to submit a brief to the committee. You have our submission and so we propose to comment on a few of the points without repeating our submission. We will attempt to answer any questions you may have on the submission.

There is one matter on which I should like to say something, and Mr. Thomas will speak on some other points.

In submitting claims for additional allowances for income tax purposes and in submitting our request for a grant under IRDIA, we found that many of the activities which we consider research did not fall within the definitions of research in the Income Tax Act and in the IRDIA Act. In our accounts, cost of development work which did not properly form part of the costs of production of operating departments was segregated and was charged to research. Our returns reporting research activities included the cost of all of these activities which had been recorded as research in our accounts.

The definition and interpretation which the Department of Industry publishes says that development work qualifies for financial assistance which uses the results of basic or applied research. Much of what we consider research and development does not proceed from our basic or applied research.

Two projects will illustrate the type of activity which we have considered research and which we have been advised by the Department of Industry may not, in their opinion, be research or development.

In making castings in our foundry the castings sometimes have defects because of non-metallic inclusions in the steel for castings. We did some tests to identify the composition and structure of inclusions. We attempted to relate the frequency of inclusion occurrence under different operating conditions. This was an investigation to determine on a trial and error basis what modifications would be required to reduce the proportion of defective castings, that is, to improve productivity. In the opinion of the Department of Industry, this was a routine metallurgical quality control problem. In our opinion, routine quality control can stop at making sure that customers do not receive defective products and ensuring that the processes are operating to the desired limits. This work went beyond that.

Another example is in connection with the annealing process. In a batch anneal process, coils of steel are set on a base, a cover is placed over them, the enclosure is filled with inert gases and the steel is heated to a temperature which will permit the irregularities in the grain structure of the steel to be reduced which result from cold rolling of the steel. We experimented with a base of different design. From an operating point of view, there clearly were uncertainties to be resolved before we could decide whether to use the new design. In the opinion of the Department of Industry the work appeared to be a verification trial of a newly-engineered device. They saw no evidence of previous scientific research and development to arrive at the new design.

The purpose of citing these examples is not to say that the representative of the Department of Industry erred in his assessment of our activities. It is rather to suggest that the limitation in the present definition and interpretation of the type of development work that qualifies for financial assistance is too narrow. We regard the cost of innovative activity as research and development whether or not it is preceded by basic or applied research and whether or not there is a significant element of scientific or technical novelty or innovation. The difference on the second point may be only one of what is significant. To us, the significance of the technological change is in the importance of the improvement measured by cost reduction or improvement in quality. Both of these are ways of saying improved productivity.

To summarize, we think some broadening of the interpretation of research and development presently used by the Department of Industry would result in financial assistance to increases in activities which result in improved productivity but which do not necessarily follow basic or applied research and where the significance of the improvement may take into account commercial significance as well as a degree of technical change in the process.

Thank you.

The Chairman: Mr. Noel Thomas, Manager of Research and Development, Dominion Foundries and Steel, would like to say a word in amplification.

Mr. Noel Thomas, Manager of Research and Development, Dominion Foundries and Steel: Mr. Chairman, honourable senators, our brief was in reply to the specific questions suggested to us as a guideline. A summation will perhaps make our feelings clearer.

We would point out that the benefit of research to Canada comes from the innovative side. This is the part usually carried on or promoted chiefly by industry. The recent Government tax concessions and grants towards industrial research have given greater incentive towards this end and are looked on favourably.

Unfortunately, for the large part, other research energies such as universities' research tends towards the fundamental and does not benefit Canada's economic position as well as if the time and energy was expended closer to the innovation side. The recent growth in the universities has demanded staff increases that in a large part have been made directly from post-graduate programs. Thus the educators and university researchers have become less and less familiar with Canada's industrial needs. Their research programs have been sponsored in large parts by government grants, which have also increased and carry no restrictions on areas of research, that is fundamental or applied. All in all, industry and universities have been widening in their relationships. The only sure-fire way to bring them together again is for the control over university grants to carry some means of control over the area of research either direct or through incentives.

The industrial links with government research laboratories are not uniformly strong in all areas. With the advent of the Department of Industry passing on industrial research claims perhaps the communications of applied research needs will be more evident. This, however, is too insecure, and better lines of communication could be established.

There is adequate research manpower available but it needs more incentive to work in innovation and conversely less incentive to work in fundamental research. Let us redirect it. We have good sources of the results of foreign science, so let us adapt to it and let us adapt to it quickly.

That is all I have to say in summation.

The Chairman: Thank you, Mr. Thomas. Now we have Mr. Fisher, Vice President of Planning Engineering and Research Division of the Steel Company Limited.

Mr. A. D. Fisher, Vice-President, Planning Engineering and Research Division, Steel Company Limited: Mr. Chairman and members of the Senate Special Committee on Science Policy, I would first of all like to express our appreciation for the opportunity of meeting with your committee and disseminating some of the thoughts and ideas we have in this particular area. I might say by way of introduction that we have confined our remarks and our suggestions to the area that has to do with the physical sciences and particularly as they relate to the private sector of the economy with specific reference to industry and its contribution to the economic development as far as the overall economy is concerned.

We have directed to the committee some recommendations, and I would like just to emphasize some of the recommendations we have made.

We have stated first of all that we believe that the aim of government science policy as it relates to industry and the private sector of the economy should be to maintain and also to increase economic development of industry and to release its efficiency and its ability to compete in the marketplace, and as a result to improve its productivity facilities, its capacity to meet demands placed on it, the quality of its products and the versatility of its products so that in the marketplace, in the development of the profitability of our enterprise, we can make the maximum contribution.

We have suggested that the Government should encourage business to maintain research and development because of the rather important contribution that research and development can make to these particular objectives I have just outlined. We feel that industry should be left very much to its own devices in determining its objectives in terms of research and development programs, because we feel that we are best equipped in this particular area to determine where the effort should be directed and where the maximum contribution will avail as far as our particular industry or segment of industry is concerned.

We believe that the government can exercise substantial influence in the achieving of these objectives by encouraging industry economically to engage in research and development programs so that there is some benefit through the Government to overcome some of the risk factors involved in the research and development activities which we carry on. We believe there should be some incentive program under the jurisdiction of government to industry to engage in research and development and to maximize the effort in this regard. We believe that these kinds of incentives should be geared to tax concessions rather than some kind of grant or subsidy, so that it is a reward for effort rather than just a stimulus to effort itself. I would like to see this kind of incentive geared to tax areas for the benefits that can accrue from concessions in this area.

We believe that tax incentives should apply to all research and development effort and the results arising therefrom, and we believe there should be a change in present policy so that the benefits that can accrue to industry are not minimized by some of the policies relating to the base period concept whereby industries that have developed a maximum effort in the past in research and development are not penalized by the fact that they have a successful program back of them and so cannot benefit in the future to the degree that they should. We believe the base period should be eliminated and tax incentives should be based on the effort being developed currently in research and development and its benefits. We believe that there should be some regard given not only to the research and development factor, in other words the development of the kind of information that can be applied to the development of processes and products, but it also should be geared to the area of changing research and development knowledge into practical application in a commercial way so that the very high risk involved in getting projects from the research area into commercial development can be minimized.

We believe then that the incentives should include probably the first commercial facility utilizing the results of the research and there should be some benefit in this area to the investment involved to support the effect of that investment.

We believe this also applies to the initial years of the operation of this kind of research and development findings and their application.

We believe that the government should give some recognition to the contributions that can be made through government agencies in centralizing, simplifying and standardizing the incentive programs so that we do not have the complexity in programs that we have at the present time. Then, not only as far as administration is concerned but also so far as the application of industry is concerned we would like to see a simplified approach made to the area of encouraging industry to meet with government programs.

Furthermore, there should be continuity; we should be sure that these programs will continue into the future so that we are not suddenly interrupted in our efforts on programs that will affect us economically. We believe too that the dissemination of information could be improved so far as these government incentive programs are concerned, and that they should be centralized and simplified through some administrative function within government. This should result in a simplification in the application and administration of these incentive programs. We have run into the difficulty of determining eligibility in many of the sectors that revolve around the application of government programs to the kind of research and development we are carrying on in the determination of eligibility to use this kind of incentive.

We believe there needs to be, and this is an important point, a greater liaison between government and industry in the development and research programs and in the utilization of research efforts. This can be carried on, of course, not only through the research agencies of government by closer liaison, but also in the academic sphere where universities and technical institutes can make their contribution, and closer liaison in this sector would be helpful to industry. This means co-operation not only on the part of these agencies and functions of government but also on the part of industry itself in making use of this source of information and assistance.

We believe too that the Government could be a factor in centralizing and contributing to knowledge, so that information could become more readily available and more simply applied to industry, so that we could have information on discoveries and the results of research made available to industry through various agencies, such as the Patent Office, the Technical Information Services, and so on, in the dissemination of technical information.

Finally, we feel that the Government could be better oriented, not only in its research institutes and organizations but also with respect to industry and the needs of industry, so that this liaison could be made more effective and programs carried on through the councils of government engaged in research and development could more effectively contribute to industry's effort. This, again, means closer liaison and a greater orientation towards applied research and development on the part of these agencies of Government involved in research and development.

Maybe with our tongue in our cheek, we have also suggested that people who are qualified in research and development are sometimes deterred from remaining in Canada by income tax policies that mitigate against their getting the full fruits of their effort.

Senator Grosart: Why do you say "tongue in cheek" for that recommendation?

Mr. Fisher: Well, I suppose we are all influenced to some degree by the income tax situation and its impact upon us personally.

The Chairman: Is it tax exemption for researchers?

Mr. Fisher: Yes, which kind of segregates researchers as a special group.

Senator Bourget: That is not easy.

Mr. Fisher: No, that is not easy; and that is where the "tongue in cheek" comes in.

The Chairman: I will do more research, if that is accepted!

Mr. Fisher: In summation, our recommendations really emphasize the need for industry itself to be encouraged and stimulated to a maximum research and development effort, and we feel that what has been carried on in the area of Government incentive in recent years has given encouragement in these areas. We feel that much more can be done to encourage industry to develop itself in the market place competitively, not just in the domestic market place but internationally, and that research and development and the fruits of research and development can be a major factor in making us more viable and effective in marketing our products and being more competitive world wide.

Thank you, Mr. Chairman.

The Chairman: Thank you, Mr. Fisher.

Now Mr. G. M. Mason, Technical Director at the Aluminum Company of Canada Limited.

Mr. G. M. Mason, Technical Director, Aluminum Company of Canada Limited: Mr. Chairman, ladies and gentlemen, when our company was invited to submit a brief to this committee, we were very grateful for the opportunity to present such thoughts as we have, and I wish to express my thanks to this committee this morning.

We have been engaged in research and development, of course, as long as the company has existed, and we have been much concerned, as have many other people, to establish goals for research and development, to decide what should be done and what should not be done, to devise means for eliminating obsolete research—and this is something we all fall into, I think, because we start a project sometimes which is very difficult to stop, even though it may be obsolete. We have also been concerned about the people engaged in research. We have to assure them they are making a contribution to the business, that they are part of the business, and that their efforts are appreciated and rewarded.

We are doing a relatively small volume of research business compared to Government, and we do not underestimate the fact that there are complex problems involved in co-ordinating Government research.

In this modern age science has an impact on virtually every area of our economy, whether it be agriculture, mines, industry, fisheries, and so on. Research and development are tools for the creation of scientific knowledge and the translation of science into practical activities. It seems clear that because of the great impact of science on our whole economy, there is a need to establish a central government agency with authority to direct Government spending in research and development into profitable channels and to ensure the maximum use of science throughout the country.

In view of these considerations, we have recommended the establishment of a co-ordinating authority for Canada's scientific efforts. This function could be undertaken either by an existing instrument or by a new one which might take the form of a department of science and technology. However, we believe it is important to ensure that this group be provided with the authority to take all necessary means to maximize the return from government expenditure on research.

In order that this group be provided with the necessary information from all segments of the scientific community, and from all the diverse areas of the economy, we recommend attaching to the co-ordinating centre a permanent advisory committee with broad representation across the country from the many areas where science is to be applied. An important function of this committee could be the setting of goals and objectives to be met. Furthermore, this committee would be the instrument of setting appropriate guidelines for expenditure on research and development by Government agencies and the assurance that these would be related to the needs of the country as a whole.

Our survival as an industrial nation calls not only for the formulation of an appropriate science policy, but also for its effective implementation. To achieve the latter goal, we believe that science and technology must be represented in our government at the government level by a person who would be fitted by training and experience to lead and represent the Canadian scientific community in an effective manner.

While we have in our brief made a number of other detailed recommendations, the above summarizes and states the essence of our recommendations, which are as follows: (1) the establishment of a co-ordinating authority; (2) the appointment of a permanent advisory committee; and, (3) representation of the scientific community at Cabinet level.

Thank you, Mr. Chairman.

The Chairman: Thank you, Mr. Mason.

Finally, Mr. P. G. Thornhill, Director, Metallurgical Research, Falconbridge Nickel Mines Limited. I understand that we have not received a brief from that company, but that Mr. Thornhill is going to read to us a brief statement which I believe is just now being made available to the members of the committee.

Mr. P. G. Thornhill, Director, Falconbridge Nickel Mines Limited: Thank you, Mr. Chairman. Ladies and gentlemen, I would like to thank you on behalf of Falconbridge for our being invited to this meeting.

Industry needs more incentive to do its own research and development via tax relief, not expanded research and development by government agencies. Thus we believe that the provisions of IRDIA should be amended to apply to all of our expenditure on research and development, so that we will not, in effect, be penalized for having the foresight to do research before some arbitrary date.

Construction and operation of new plants for the practice of new processes—that is, innovations—are subject to risks and expenses that deserve tax concessions and accelerated write-offs. For example, the Nickel Iron Refinery presently under construction at Falconbridge will cost $35 million. Because the process is new it is to be anticipated that start-up of the plant will involve flow-sheet changes and consequent losses in production. We believe that innovative risks of this type merit a depreciation rate at least as favourable as that applicable to other mining installations.

We believe that of the public funds spent on metallurgical process research and development an increased proportion should be directed to research and development on pollution abatement. We believe that public research and development on pollution abatement will benefit our industry, whether successful or not. Thus on the one hand if practical methods are developed by government research, the problem is overcome. If, on the other hand, the government cannot develop practical methods, it will at least have gained the insight which will help it to treat this particular problem of industry with more understanding.

Present Patent Office practice tends to result in the issue of a higher proportion of invalid patents to inventors using Canadian filing priority than to those using foreign priority. However, because of the unique minority position of the Canadian inventor in his own Patent Office, we believe that this injustice can be rectified with a correspondingly minor additional expense. The promise of a valid patent would greatly encourage Canadian research and development.

We believe further that the present patent system breeds procrastination and that Canadian research and development would be encouraged and accelerated if the chief recommendations of the Ilsley Report were followed.

Thank you, Mr. Chairman.

The Chairman: Thank you very much, Mr. Thornhill. We come now to the discussion period, and here I would point out that everybody is welcome to make a comment even though a particular question has been addressed to another member of the group.

Senator Bourget: At page 3 of the brief of the Aluminum Company of Canada, Ltd. I read:

> In this context, a Canadian science policy needs to have built-in mechanisms for adjustment and self-renewal...

Does that mean that there should be better collaboration, and constant collaboration, between these groups? What, in your view, would be the mechanism necessary to establish such collaboration and liaison between these groups?

Mr. Mason: Our view, sir, was that it would be the co-ordinating committee which would function in that way. We have made extensive use of the task force principle in some of our projects, and this means drawing people from several areas—areas of Government, areas of industry, and areas of the university. This could be done by using the central commit ee as a focal point for gathering these people together. This was our thought.

Senator Bourget: Then you mention that this advisory committee could be the Science Council, do you not?

Mr. Mason: We are not pretending to say who it should be, but it should be a senior group, possibly a science department of the Government headed by a cabinet representative. But, the advisory committee would be drawn from all segments, including industry, so that you would have available an activating group which would draw together all people from all areas of the community which would be involved in a specific problem.

Pollution has been mentioned. Pollution is a very broad problem. It involves very many segments of the community, and contributions could be made by many areas. The central committee would be in a position, in our thinking, to draw upon these areas, and give them responsibility and authority to do something even if it were only fact finding.

Senator Bourget: Do you think that the representation on the Science Council today is adequate? Are all segments represented on the Science Council?

Mr. Mason: In our view, sir, they are not.

Senator Bourget: They are not?

Mr. Mason: We feel there should be more representation from industry and from the working level of the community.

Senator Bourget: Mr. Chairman, I would like to have the views of the other members of the group on this co-ordinating authority. One gentleman here proposed that there be established a department of science and technology. On the other hand, the Steel Company is opposed to it. I would like to have your views.

Mr. Fisher: I can give you some background to the view that we have put forward which is somewhat opposed to that which has just been presented. We feel that industry itself, to a very major degree, can determine its own destiny. I think it is very difficult for some kind of a centralized committee to adequately define or promote the individual objectives of industry itself in a competitive environment, or to have some kind of a broad policy that can contribute to a major degree across the broad areas of industry itself, because the objectives of individual segments of industry, which relate to its particular function and facility, can be so diverse.

Pollution was mentioned as one area where a united effort could make some contribution, but there are many factors involved even in this area of scientific investigation that apply only to individual industries. Individual industries have their own individual problems and individual objectives. They are competing in different marketing environments, and they are certainly in a competitive environment. So, we feel that the major effort should be directed by the industry itself, or the individual companies involved in that industry, and we feel that we have individual objectives that have to be achieved.

A united effort does not really maximize the achievement of these objectives. Although some benefit can accrue from an overall effort, we feel that the maximum effort can only accrue by using the people, the facilities, and the skills of industry itself working in its own environment towards achieving its individual objectives. If our objective is air and water quality control then we feel we can maximize our effort in this area by endeavouring to correct our own problems in our own environment.

If there is going to be some kind of an incentive in the area of financial contribution then we can utilize that best, rather than having it flow to some kind of central agency where it is going to be, to a major degree, dissipated, and where the benefit is not going to be maximized.

Senator Bourget: Before you call upon other members of the committee, Mr. Chairman, could we hear the views of the other witnesses on this matter?

Mr. Thomas: I think I agree with Mr. Fisher. I cannot quite see how a committee can always work on some of the individual problems that we have. The problem of pollution, I grant you, is more universal among the steel industries, and a concerted effort from Government research institutions...

The Chairman: I think there is some confusion at this stage in that when you discuss a proposal you do not seem to discuss it at all in the same terms. I think that what Mr. Mason had in mind was a new central mechanism at the cabinet level. I am sure he was not favouring that new department, or that new ministry, doing all of the research in Canada.

Mr. Mason: I agree, sir.

Senator Bourget: The proposal is that there be a co-ordinating committee.

Senator Grosart: We are confusing the proposal because the suggestion that there should be a national science policy is very different from saying that the Government should try to run industry, or to tell industry what to do.

Mr. Fisher: Certainly we are not in any way arguing against the need for a national science policy. I think we emphasize the arguments in favour of this. What we are arguing against is the kind of centralized effort that we felt was being suggested, where effort in research and development would be concentrated through some kind of government agency, and to a degree withdrawn from the private sector.

Mr. Mason: I hope I did not give that impression. That was not my intention.

Mr. Fisher: Then we are not at variance. I think some co-ordination would be desirable, particularly in the dissemination of national research and development effort.

Mr. Mason: We have that in our brief.

Mr. Fisher: It must be realized that there are confidentiality aspects to this. We have invested substantial sums in our research and development effort, and from our point of view it would be undesirable to make this kind of information generally available so that we could not benefit from the fruits of our own efforts. There are some areas in which it would be desirable to disseminate our discovery or information, and at present our industry does disseminate this kind of information. However, where it can be a contributing factor to our own profitabilty it is desirable to keep it confidential, we would not want some kind of central agency disseminating such information.

The Chairman: There are people who want to arrive at the same conclusion as yourselves, for the Government to give a greater share of research effort in Canada to industry, but in arriving at that conclusion they say there must be in Canada a minister at the Cabinet table to make sure that it will be done. You can see where the confusion could arise when you start to argue that you are against a department of a minister in charge of these operations on the ground that you want industry to do more.

Mr. Fisher: I am not against the suggestion that we should give industry incentives to do more. I am, however, concerned about setting up a government agency under a minister who may really mitigate against our effort, who may begin to dictate what we should be doing, or where in his view our contribution might be more effective. We feel that industry is in a better position, knowing its industry, knowing its competitive environment, knowing the impact on the marketplace, whether domestic or international, and we feel we should be left to determine in a major degree our own destiny in this regard. If incentive is necessary it should be through some type of tax concession so that we can then use our own thinking, our own initiative and our own objectives as the stimulus to the effort we put forth in research and development, and not be governed by some kind of central agency that might not be particularly sympathetic to our segment of industry and might actually mitigate against our effort.

The Chairman: As Senator Grosart used to say when we were receiving representations from the universities, you want more public money and less public control!

Senator Grosart: A quite legitimate objective for anybody. Again I think there is some confusion. I believe that most of us in this committee believe that you can have national policy without nationalization and without having socialism.

The Chairman: We will probably come back to that later on.

Senator Haig: There seems to be some contradiction between Mr. Mason's proposal and what we have heard here from NRC. On January 29 this year NRC said:

> The fatigue failure of engineering materials is now the most widespread and intractable problem of engineering design.

The problem of aircraft fatigue is one that is mentioned. NRC said they had been working on this problem for about 20 years, and at page 3060 of our report Senator Grosart asked:

> How much of this research work on metal fatiguing is being done in industry in Canada?

The NRC director in charge of this work gave a very short answer, which was:

> The answer is very simple, sir: It is, effectively, zero.

On the basis of our record, NRC are doing research on this very material problem but industry is not. On page 11 of their brief, the Aluminum Company of Canada state:

> There is little spin-off from NRC research that can be used in the aluminum industry in particular.

What is your comment, Mr. Mason, on this seeming contradiction between NRC saying that nothing is being done and you saying in your brief that there is little spin-off from NRC research that can be used by your industry?

Mr. Mason: I can only say that I am astonished, because we have done a fair amount of work on aluminum properties, on corrosion, on structures and strength of structures. We have a structural laboratory at Kingston. I think it is more a question that we have not got together than that we are not using NRC.

Senator Haig: In other words, NRC does not know what you are doing and you do not know what NRC is doing.

Mr. Mason: I fear that is the case. I am rather astonished at this.

Senator Haig: Again on page 14...

The Chairman: Perhaps we might have some comments on this from the steel people.

Mr. Mason: It is an interesting point.

The Chairman: Perhaps we might hear from the steel people whether they are doing some research in this field.

Senator Grosart: On metal fatigue particularly.

Mr. Fisher: I think I would agree with Mr. Mason, that NRC are not aware of what is going on, and I do not know exactly how they would be aware unless it were through some kind of publication, because we do not work with them intimately in this area. Certainly we in the steel industry have put forth a major effort to make steel more acceptable for use and to overcome some of the problems to do with metal fatigue. Mr. McKay, who is in charge of our research and development effort, can corroborate that we have put a lot of effort into this, on the metallurgical and other aspects, to overcome some of the problems of metal fatigue. I believe that a lot of basic work has been done by industry generally on this problem.

Senator Haig: Do you mean to say that for 20 years NRC has been doing work and the industry does not know about it?

Mr. Fisher: We are aware of the information disseminated by NRC.

Senator Haig: Why have a government agency doing one thing and industry doing another? Why have this duplication?

Mr. Fisher: I do not think there is necessarily duplication. There are basic problems that I believe we are both endeavouring to resolve. We are both working in this area, although I do not think it is a closely collaborative effort.

Senator Carter: The lines of communication have broken down.

Mr. Fisher: Certainly I am as astounded as Mr. Mason that NRC is not aware of this, or has propounded the theory that industry is not doing anything. I think they must be aware that we would not be long in the marketplace if we were not.

Senator Grosart: In fairness, if I remember my question it was related to aeronautics.

Mr. Fisher: We are making very little contribution in this area.

The Chairman: What about yau, Mr. Mason?

Mr. Mason: I can only say I am astonished that the work we are doing at Kingston was not known to NRC. Aircraft is not a major tonnage outlet for aluminum today, as it was in the time of war. We are probably working in other areas of transportation, such as aluminum overhead conductors and other types of structures not associated with aircraft. If they have been working in the aircraft area, again I am surprised, because we have not been aware of it.

Senator Haig: On page 14 you mention developing single family aluminum housing of good quality at a cost more within the reach of wage earners than that of housing constructed by standard methods. Could you give specific comparisons between the two types of housing and how government agencies assist in this program, and what is the role of CMHC or the NRC division of building research?

Mr. Mason: These housing projects which are referred to here are prefabricated homes built in a factory and shipped to a site. The aluminum is not necessarily a major portion of the buildings. It is an effort to produce low-cost housing as a contribution to the general housing shortage. It is not necessarily aluminum application. Aluminum is used where possible, but these are prefabricated houses, equipped and furnished and they can be installed on a prepared site within three days. This effort is more in the housing effort than in the aluminum application effort.

Senator Haig: Is NRC a division of building research? Do you get any assistance from them?

Mr. Mason: I am sorry, I do not know. We are using Central Mortgage in the financing of these homes.

Senator Bourget: Was it fully developed by your own company?

Mr. Mason: Yes.

Senator Bourget: What has been your experience regarding the cost?

Mr. Mason: It has cost more than we had expected.

Senator Phillips (Prince): What about CMHC regulations? I think at one time they only allowed one of four of your units.

Mr. Mason: I do not know the answer, sir.

Mr. Gilbert Proulx, Manager, Public Relations (Research), Aluminum Company of Canada Ltd.: I am not familiar with that field. I do know that these houses were gradually developed by our company with the co-operation of CMHC. Quite a number of features had to be gradually adapted until there was acceptance of our design. That was the first effort that led to what we call the Alcan designed homes. Following that, in the second phase, we went into these factory-built houses to the extent that someone has said we are supposed to be the largest house builder in Canada. That is something we have been gradually developing throughout the years.

Senator Phillips (Prince): I did not make my question specific enough. If you are opening up a subdivision I understand CMHC regulations permit only 25 per cent of the homes in the subdivision to be prefabricated. Does that regulation still exist?

Mr. Mason: I do not know the answer; I am sorry. It could well be.

Mr. Proulx: I know that we have some housing developments where all the homes are built by our company. To what extent the percentage of prefabricated houses on a particular site is, I am unable to say.

Senator Bourget: Coming back to the question of aluminum, it says on page 6, paragraph 6:

> Encourage the reapportionment of research activities in order to lower the national investment in basic or pure research and to correspondingly increase that portion allocated to applied and developmental research...

Do you mean by this that there is too much basic or pure research done today? In your view, what should be the role of universities and research? Should it be limited to pure research and leave development and innovation to Government agencies and industry?

Mr. Mason: Certainly the universities can make a valuable contribution and we have worked very closely with some universities. We have given them some projects to work on for us. In other words, in a sense we have subcontracted specific projects to university research. This has been very fruitful, because we are forming an association with the university. Their people meet with ours and there is a stimulation between the two which we find very beneficial. We hope to increase this. There is the question of how much pure research should be done. We feel that the government agencies are highly oriented towards pure research whereas they could be more strongly oriented to applied research.

Senator Robichaud: Mr. Chairman, could I be permitted, later on, to ask a couple of questions?

The Chairman: By all means. I think Senator Kinnear was waiting, and also Senator Haig.

Senator Haig: I will pass.

Senator Kinnear: I think most of the questions I had marked have been answered. Would you like to give a table on the percentage of basic and applied research and so on? How much of the basic research would you say should be used in Canada and how much on applied and development research, because the small end goes to research and development. How would you like it divided?

The Chairman: To development as opposed to pure and applied research?

Senator Kinnear: That is right.

Mr. Mason: It goes without saying that there must be pure research going on. This is an important contribution to the on-going of the scientific community and the industry and also to the development of the country as a whole. We have found that the government agencies are inclined to do more fundamental research or pure research than applied research and we should like to see the proportion changed. I am sorry that I cannot suggest an ideal arrangement. I do not think anyone knows of an ideal arrangement.

Senator Kinnear: But, you would like it changed from basic to another?

Mr. Mason: To more of an applied research.

Senator Kinnear: Now, I should like to switch to Dofasco, page 7 of the brief:

> While Canadian universities graduate scientists and engineers skilled in their respective disciplines, they lack a broad knowledge which would result from a well-rounded education. Graduates need improvement in the following areas:
>
> 1. Communications—the effective use of basic English—especially in written reports.
> 2. Problem-solving—the development of a good analytical approach to problems.
> 3. Economic realities—the need to relate scientific learning to dollar costs.

That is something that I have been interested in for a long time. I feel that our scientists are trained in such specific fields and that it is a very narrow field. I am wondering if this should not be changed and that, as this report suggests, they should have a little broader knowledge. Some scientists or engineers are no sooner out of college and into work than they are asked to go back and get some knowledge of business administration. It does seem to me that that might be a good thing to do. What is your idea in regard to this Dofasco?

Mr. Thomas: To enlarge on it, I think the problem, as I mentioned in our summation, is that the university, as well as the need for universities, has grown and you have had to staff it with just recent graduates. It is only natural to assume that these people would not have economic reality and would have not been exposed to the needs for industrial research. They have not been exposed to industrial needs, or to the needs for industrial research. They are graduate students and, in these days, it follows along logically that they will be a little short on economics.

We would like to see more industrially trained people in the university staff.

The problem of solving communications is probably more a curriculum detail in the university's approach to the problem and oftentimes it is quite theoretical and reflects the kind of tutors they get at the moment.

Senator Grosart: I take it you mean "fundamental English" and not "Basic English," which is a very different thing.

Mr. Thomas: I am sorry.

Senator Grosart: Basic English is a particular discipline, invented by a man named Ogden in Cambridge. I am sure you do not mean Basic English.

The Chairman: It was a kind of international language.

Mr. Thomas: I see.

The Chairman: But you want this one to be Canadian.

Senator Grosart: The "c" in Basic English is Chinese.

Senator Kinnear: The Steel Company says, on page 13 of their brief:

> The idea behind PAIT is sound, but this company, and presumably others, hesitate except as a last resort to use the program because of the administrative detail demanded in advance of project approval or in withdrawing from a project, the necessity for full disclosure of results to government employees, and the stipulation that results be exploited within a reasonable period of time in Canada.

All you say is that you do not like PAIT and prefer a tax concession.

Mr. Fisher: I think that is a very broad statement, to say that we do not like PAIT. We have benefited to some degree from the use of PAIT in research programs, but we feel the inconvenience engendered by the regulations under PAIT make it very difficult for industry to apply it.

For one thing, we have to make disclosure of all of the information, much of which is confidential in a broad area of research, both before and also after PAIT.

As the results of the research program are developed, we also find that there is a tremendous amount of administrative detail developed in trying to keep a PAIT project.

We have to provide the kind of information which it is very difficult to provide, and which some say they would prefer to maintain as confidential, and cannot.

I think Mr. McKay, who is in charge of our research development effort, has been involved very intimately in the work with the Department of Industry, relative to the application of PAIT, and I would like him to comment on it.

Mr. J. C. McKay, General Supervisor of Research, Steel Company Limited: PAIT is a very useful scheme where the particular projects have a high reward, a very high risk, and are continuing on despite a high possibility of failure.

This is a place where you would be justified in going through administrative detail to seek PAIT. On a normal project of research, there usually is a high reward and there is a low risk. This would not justify the effort to apply for PAIT.

Senator Grosart: May I ask a general question, arising out of the discussion on PAIT and IRDIA and the other programs? There seems to be a consensus among the industrial firms that have been before us, that there is quite a bit wrong with these programs. To your knowledge, have these deficiencies in the planning of these programs been brought to the attention of the Department of Industry, Trade and Commerce?

Mr. Fisher: Yes. Certainly in our application, for example, for PAIT, we have objected to some of the requirements. In order to get the tax incentives under some of the other programs, we have had to provide a tremendous amount of detailed information, and all of this encompasses us in a rather major effort and a lot of time in providing the kind of information.

Mr. Darby, our tax accountant, has been involved in trying to get approval of the financing under the various government schemes and he has been involved in the detail in trying to get approval. I think he might comment on this and speak of the difficulty of securing approval, and on some of the objections we have raised to the provision of information.

Senator Grosart: I was not concerned with the specific objections at the moment. I take it there are objections, because we have had them in every brief from industry.

My question really is, what has industry done to try to correct this? Do you just complain individually to the Government that you do not like this or that? Did it ever occur to industry to get together all the people interested in these programs and give your view to the Government as industry's view about the programs?

Mr. Fisher: I would like Mr. Darby to comment on that.

Mr. W. A. Darby, Tax Accountant, Steel Company Limited: Mr. Chairman, I believe the Canadian Manufacturers' Association in their brief have indicated to the Government that this PAIT problem more or less punishes those people who have made a substantial investment in research and development, in the earlier stages. A company which invested a substantial amount in earlier years in research may not, and as a result did not benefit from the programs to any extent.

In regard to the so-called inequity—if you would call it that—it was accentuated when they brought in PAIT.

I sit on the CMA tax committee and at least on two or three occasions this whole matter has been brought up. The Government wants an ever-increasing return compiled on the research and if it does not show a compound growth every year you do not get a tax benefit.

I filed a recent tax return and with an expenditure this year of between $2 million and $3 million, the amount of tax relief we are getting is measured in tens of thousands of dollars, because in effect we spent such a substantial amount in the previous three to five years. This has been indicated to the revenue department.

Senator Grosart: This is an interesting problem. We have the base period problem at both ends—termination, and the early cutoff, and so on. We have all these problems; but the last witness said. "I know it has been brought to the attention of National Revenue". Anyone who understands the political process must know that National Revenue are not going to become crusaders for industry with the Department of Industry, Trade and Commerce.

My question is, what has industry done as a whole to get this changed? It is all very well to say the Government should do this, the Government should consult us, the Government should co-ordinate. What about having it the other way around?

Mr. Mason: I think you have made a good point. I think we have complained to each other.

Mr. Laing: May I talk from experience, from the point of view of STELCO? As I understand, we dealt with the Department of National Revenue, trying to explain to them what we thought was research. They agreed they could not assess it and asked if we would gather information together in tremendous quantities to be sent off to Ottawa for assessment by the National Research Council. They did the assessment. There were some debateable items and some were sent over to the Department of Energy, Mines and Resources for a further assessment. Again they gave a different opinion, and it came back to us through the Department of National Revenue.

The current submission by CMHC has been through the Department of Industry, because there is some doubt about the effectiveness of PAIT.

One of the problems is that we are trying to get information together on what happened in the past on PAIT type programs. Another problem—and I don't know if it is the Department of Industry's problem or just industry's problem—is trying to define what industry is trying to do in a specific project.

As I mentioned previously, sometimes our understanding differs somewhat from the definitions in the regulations. We have had some trouble in that respect in trying to describe what we intend to do.

Senator Belisle: Mr. Chairman, may I say how much the people of Sudbury and district have appreciated the excellent public co-operation and public relations they have had with and under the leadership of the management of Falconbridge Nickel Mines Limited. May I also add that your new refinery at Falconbridge, Mr. Thornhill, is not only a boost to the district but is an act of faith in the potential of Sudbury and district.

I am also pleased to say, Mr. Chairman, that had it not been for the generosity of International Nickel Company and Falconbridge Nickel Company, the Sudbury university complex would never have been possible, and I am pleased to make note of that.

Now, in your brief you suggest that, of the public funds spent on research and development for metallurgical processes, an increased proportion should be directed to research and development on pollution abatement.

Of course, pollution also consists of air pollution. How much money are you presently spending on research and development on air pollution by sulphur dioxide? I might say that this is of vital concern to all of northern Ontario.

Incidentally, I just read that International Nickel, which has three chimneys the highest of which is approximately 660 feet, now wishes to put up a new chimney of 1,200 feet.

Mr. Thornhill: It is 1,250 feet.

Senator Belisle: What will be the height of your stack at the new smelter? Have you made research regarding that?

Mr. Thornhill: Yes, and we have been very sharply told by the Department of Transport that we cannot increase the height of our chimneys one foot higher than they are now. We have the misfortune of being in the cone of approach to Sudbury airport. This is a matter with which Falconbridge is very deeply concerned, because we are under very high pressure from all sides.

I cannot tell you exactly how much we are spending this year, but certainly it is many times more than in any previous year.

Senator Carter: Does the height of the chimney have any other effect than dispersal of the gases? It takes them up into a higher air current and that sort of thing, I suppose.

Mr. Thornhill: It simply dilutes the atmosphere. You cannot make the sulphur disappear.

Senator Belisle: But you can extract the sulphur from the smoke content before putting the smoke into the atmosphere. How much are you extracting, or how much sulphur is going through your chimney? Is it 90 per cent clear?

Mr. Laing: The Government has published information on this aspect of pollution to the effect that the additional height is, with respect to sulphur content in smoke, a valid anti-pollution measure.

Senator Belisle: I have read that particular publication more than once, and with what I have read and with what I have been told I conclude that it is left to the discretion or direction of the company, according to how much sulphur they might be able to sell, just how much they are willing to extract.

Mr. Thornhill: I am afraid you are not up to date on the legislation which the Ontario government is now making us feel.

Senator Belisle: What percentage do they permit you to let out?

Mr. Thornhill: It is not a question of percentage. It is a question of the number of parts per million of sulphur dioxide in the air at ground level in the vicinity of the operation. If you have an operation which puts out one pound a day of sulphur dioxide and, if this one pound gives a concentration of above .3 parts per million, or whatever the figure is, the operator will be in violation of the law. If, on the other hand, the operation puts up 1,000 tons a day but manages to keep the concentration level as measured below .3, the operation is not in violation of the law.

In other words, you can pollute Canada but you cannot pollute one square inch or one square foot of Canada.

Senator Belisle: Then just what is the reason for the high chimneys?

Mr. Thornhill: Not in order to avoid polluting Canada but to avoid breaking the law.

Senator Belisle: How much is being done by other companies to control their pollution?

Mr. Fisher: We are under Government regulation, too, and there are also incentives for us to minimize pollution both in air and water. The Steel Company of Canada in its operation in Hamilton has spent in the last six or seven years approximately $18 million in control of air and water pollution. There has been a very substantial effort on its part to try to minimize the effluent going into the surrounding waters and air, or simply the environment.

Certainly, in all our new installations we do our utmost to so control the effects on environment. For example, in our new plant which could possibly affect Lake Erie we will be able to maximize efforts to control the effect of the effluents by putting in the latest devices and using the latest technology for both water and air control, because we are putting in completely self-contained systems so that we do not discharge effluents into the lake. If there is any pollution it might be of a thermal nature.

The same is true with dissemination into the atmosphere. We are using the best electrical equipment, electrostatic or other devices, to maximize removal of contaminants.

In Hamilton, where we have much older facilities, it is more difficult to apply the results of research in order to minimize the impact of environmental pollution. But again we are spending a tremendous amount of money in that respect.

We have a program going right now endeavouring to contribute to the cleaning up of Hamilton Bay. We have already spent $8½ million in the last six years in controlling discharge to the bay and cleaning up the effluent. We also have a program at the present time whereby we have approved $2½ million, and we have one amounting to $5 to $6 million in the engineering stage also designed to try to clear up the situation. But there are some serious problems that technically have not been overcome. There is the problem of how to remove certain contaminants from effluent in the water. There is at the moment no economic device for removing certain contaminants. So what do you do? Do you shut down the industry? Remember we are making a substantial contribution to the economy and viability of Hamilton. So what do you do to maximize your research and development to overcome these problems? We are working closely with O.W.R.C. and the Department of Health in endeavouring to bring some method of control or some degree of control to the situation. Furthermore our company is working with other industry to minimize the effects of pollution.

Senator Bourget: Is the government helping you financially in trying to solve the problem?

Mr. Fisher: We feel there is not too much incentive from government in the area of tax incentives. We would like tax incentives on the development of equipment to clear effluent so that the equipment for doing so would be tax free certainly from the point of view of sales tax. Where we are contributing with very little economic benefit to this effort to clean up the environmental pollution and to control air and water quality, we feel there should be some incentive given to industry in this particular problem area to spend more money and to maximize their efforts. Of course we are in a better position than some of the smaller industries. We can afford to spend more money to maximize our effort in this area. But when you consider the profitability of smaller industries and where they have old installations, it is rather difficult to justify the kind of expenditure involved.

Senator Bourget: Now, I am asking this question of all the witnesses. In general would industry prefer tax incentives to subsidies or grants from government? Am I right in thinking that they would prefer tax incentives?

Mr. Mason: I would say yes.

Mr. Laing: Definitely.

Mr. Fisher: We have emphasized that in our brief.

Senator Bourget: What kind of incentives would you suggest for the innovative parts of research? It appears that it costs a lot for any company to put a new product on the market. In fact it has been said that it can cost about 75 or 80 per cent of the total cost of the research done to put a new product on the market. Would you be better aided by tax incentives or would you be better aided by subsidies and grants?

Mr. Mason: If I may speak, I would say tax incentives.

Senator Bourget: Alone?

Mr. Mason: Alone.

Senator Grosart: Would you prefer tax incentives to contracts?

Mr. Mason: Yes.

Mr. Fisher: We would concur in that.

Mr. Laing: I think your words were research and development in relation to new products and getting them on the market, and with regard to contracts, I don't know how this would work out. It could work, I suppose, with incentives related to expenditure.

The Chairman: If you have tax incentives you can do research in the fields in which you are interested but if you get a contract from the government, that may not coincide with your own program. However, you are not opposed to contracts?

Mr. Thornhill: There is a point that has not been brought up as yet with respect to the comparison being made, and I think is something that all witnesses here have experienced if I can judge what they have said correctly. Not only does it take a tremendous amount of work on the part of the applicant in preparing his story for this begging procedure, and that is what it is, but there are tremendous numbers of government people involved too. They come and they go and you have their travelling expenses and you may get no for an answer, and many times you get maybe, and a lot of time is being spent in this way. So far as the scientist in industry is concerned, much of his time is taken up in dealing with people outside and trying to get the points across. This costs money; it all costs money.

Senator Grosart: Well, it takes a lot of time for your sales force to go out and sell things, but you do not consider that begging. It seems an extraordinary statement that when the government provides incentives you feel you are being asked to beg when in fact what you are doing is getting free money. I will beg at any time for free money.

Mr. Thornhill: There are some officials who tend to give that impression but there are some who don't.

Senator Bourget: Am I right in saying that what industry wants today is a simplied system of incentives program administered by a single agency so that you do not have to go around all the agencies. Would such a system be practicable and would it meet with your objections to dealing with several different agencies?

Mr. Fisher: If it is practicable in this particular area, we feel it should be done. We are not sure it is practicable, but we have not examined it because we are not too intimately involved in the process of government, but we feel a simplied system in dealing with a single person and a single agency would benefit us. Then we would know who we were dealing with and we would know the degree of justification to be applied to get the benefit of research and development through incentive programs. We feel it is necessary to minimize as much as possible the effort to justify our application, but it is a very difficult and complicated procedure. It is difficult to get your points across. There is a tremendous effort to be put forward in demonstrating justification while these efforts if applied to research and development could be most productive.

Mr. Mason: I would add another point concerning this, and that is the point of continuity. We have had these changes in programs and this has been difficult because we deal now with one government agency and then with another. If there could be some guarantee of continuity it would assist industry in dealing with government agencies and planning for whatever the incentive might be. It would also be of tremendous help if we were dealing with one government department.

Senator Bourget: But that is relative. Surely if you are doing some research and then you find that you are not going to achieve any results from it there has to be some mechanism to stop this particular program or research project.

The Chairman: To stop the particular research project but not to stop the incentive program.

Mr. Mason: A project may have become obsolete while we have been working on it; therefore, we must stop it. But there is an inclination to keep the thing going because the people working on it like it. This happens too. They say, "This is interesting. Let's keep on doing this." We must say, "No, the incentive has disappeared, and we must stop this."

Senator Grosart: On the question of tax incentives, I think we should be clear that it depends upon the characteristics of the particular industry, generally, the main characteristic being size, as to whether they prefer tax incentives or other methods of support.

The Chairman: Was your question related to this, Senator Carter?

Senator Carter: I was a bit confused. The reply to Senator Bourget's question was that they preferred tax incentives, and I gathered that they preferred tax incentives to the present program.

Senator Bourget: To grants and subsidies.

Senator Carter: Yes. Then, when asked whether they would prefer a simplified subsidy from one agency, they said "Yes". I did not know whether they preferred that to tax incentives or not.

Mr. Fisher: No, in collaboration with that—in other words, tax incentive programs administered through a single, central agency, if possible, and under a simplified set of rules and regulations.

Senator Carter: But you still want tax incentives?

Mr. Fisher: Yes, definitely.

Senator Haig: They want a central agency to which they can apply for the program and, if it is approved, they want a tax incentive to write off the expenditures.

Senator Carter: There is only place to go for a tax incentive, and you have another place for grants; so, that is two. When you are looking for tax incentives for research and development or innovation, how far are you going? Are you including market research and economic research in your innovation?

Mr. Fisher: I think this is worthy of some consideration, but our application of the grants up to the present time has been confined to the research and development in the technical areas. Certainly, effort involved in commercial research and other areas of research do not gain any Government support.

Senator Carter: But that is where your big expenditures are?

Mr. Fisher: Certainly, they are major, and on the international market some companies are to a greater degree than we are involved and the expenses have been greater to exploit these kinds of markets and to research them. Maybe it is good for the economy, and maybe some incentive in this area would be justified.

The Chairman: Your tax incentives program would not meet the situation of new industries or new products with a high technological content?

Mr. Fisher: Not necessarily.

Senator Carter: The problem I see with these new products is this, that I suppose you could get around it by limiting it to certain industries, but there are certain other industries where new products come out just to compete with another new product. Take the cereals industry. Every day somebody gets a new "Popsie" or something out which is a so-called new product but which, basically, is the same as the other one, and there is no innovation.

The Chairman: These are the innovations Senator Grosart used to make!

Senator Grosart: "Switch" research.

Senator Carter: When the consumers affairs committee met two years ago we found companies spending tremendous amounts of money just putting a new product on the market, and the same could be said for soaps and detergents which really were not new products but had some little gimmicks which made them different from the other ones. I grant that this is not true of the aluminum, steel or other kinds of industry.

Senator Grosart: Don't think it is not.

Mr. Mason: It would be more true of consumer products like breakfast foods.

Senator Carter: I would think so, but you have difficulty in drawing a line.

Mr. Laing: Our thinking in coming here is about scientific research and on product and process improvement. Our concern has been partly with the degree of process improvement. A lot of ours in the Dofasco part of the steel industry appears to have been involved in a great deal of development and not proportionate to the amount of applied research involved, and that part of innovation we think could be supported. You are suggesting that market research and commercial research are also research that may be worthy of support, but it is a problem of definition. It is a problem of definition now because it is difficult to see as to whether we think there are grounds for the support of commercial as well as technical research. I am not prepared to comment on that at the moment.

Senator Grosart: Are definitions and procedures easier in defence programs compared to civilian programs?

Mr. Laing: I do not know.

Mr. Fisher: We have not been involved in defence programs.

The Chairman: With National Research Council grants?

Mr. Fisher: No, we have not.

Senator Grosart: Most of the comment is on IRDIA and PAIT?

The Chairman: We are told that when these grants are administered by scientists rather than accountants, the administrative difficulties are much less great. I do not know if it is true, but you have no experience in that field?

Mr. Laing: No.

Senator Grosart: Do you think it would be possible for the Department of Industry, Trade and Commerce to write clearer definitions on research and eligibilities than they have? Is this a problem of semantics? Are they just bad definitions?

Mr. Laing: They become more detailed. First there is the act and then the regulations, and then there is interpretation. I think they are making an effort in that regard. Speaking again from my own experience in this area, it is a problem partly of description, and I think if we understand the limitations they are placing on what they consider eligible scientific research and development, the definition is too narrow, and that is the basis of our complaint.

Senator Grosart: Could any of the witnesses give an idea of the percentage of turn-downs you have had on applications to IRDIA and PAIT?

Mr. Darby: This is a "shotgun" figure, but I would estimate something from 5 to 10 per cent on those items we have applied for.

Mr. Fisher: We do a lot of screening ourselves before we go to the effort of making an application.

Mr. Darby: Another item is where the amounts we have spent are immaterial and would not warrant the amount of administrative effort to get them.

Senator Grosart: Would that be a high percentage?

Mr. Darby: Just a "shotgun" figure, around 10 per cent we would kick out on small items, but it would not a high dollars volume.

Senator Grosart: That makes it a total of 20 per cent of applications which, one way or another, you feel could qualify except for various red tape and other reasons?

Mr. Mason: They are good figures, 10 to 20 per cent.

Senator Grosart: That is not too bad.

Mr. Mason: This is the energy involved in convincing these people these are valid cases.

Mr. Laing: Our experience of this is that we do not bat as well as the opposition, apparently.

Senator Bourget: You do not have such good pinch hitters.

Mr. Thornhill: We have 100 per cent so far.

Senator Grosart: 100 per cent yeses?

Mr. Thornhill: There have been 100 per cent turndowns so far. Well, I will not say "one hundred per cent", because Falconbridge has never applied for PAIT as yet. We have never applied for PAIT in any way for anything, but we are attempting to get some money back now under IRDIA.

Senator Grosart: No runs, no hits, and maybe a few errors?

Senator Kinnear: I should like to ask a question with respect to the effects on human beings, animals, and vegetation of exposure to certain chemicals. You mention this on page 18. I am wondering whether you have noted any long term effects on the eyes and the ears. What side effects have you noted?

Mr. Mason: In any industry there are noisy operations, and we have used the regular commercial measurements for noise, and where there is a high noise level we provide the workers with protective devices. I feel that earlier on in industry the danger that might be done to hearing by high noise levels was not known, but it is very well defined. The Department of Health can give us specific levels that are tolerable, and if these levels are exceeded then we provide the men with protective devices, which are nothing but ear plugs, but which have the effect of lessening the possibility of damage to ears.

Senator Kinnear: Have you noted any deafness?

Mr. Mason: In our industry we have not that many operations of this kind. There are no cases that I know of in which deafness has occurred.

Senator Kinnear: What about side effects of working near chemicals? For instance, I come from a town which is quite different from the one Senator Belisle comes from, but there happens to be a nickel company there, and there are a great many who suffer side effects from the chemicals used. They have what is known as nickel itch, and they suffer greatly from it. Are there any side effects from the chemicals that you use at Alcan?

Mr. Mason: Many people are allergic to specific chemicals. An example I could mention is that of coal tar pitch, which we use in the preparation of electrodes, and which we handle in carload lots and sometimes in shipload lots. We have found that some men have to be protected from the effects of pitch on their skin. Usually, when we find a man who is susceptible, we put him on a different job. But, this is done only by trial and error, because it is very much a personal thing. These people are allergic to certain things. In our industry there are not very many of these people, but sometimes a man will develop hay fever or asthma because he is working in a certain environment, but in that same environment there will be other people working who have no difficulty whatever. But, such a man cannot work there, and we move him to some other job.

Senator Grosart: Do you report a case such as that to the Medical Research Council?

Mr. Mason: I cannot say that we do, senator, but certainly we have good internal records of people who are moved for reasons of allergy.

Senator Grosart: It would seem to me to be a very fit subject for research under a national science policy. If all these cases were brought together from various industries across the country somebody might be able to find the answers to these kinds of allergy.

Senator Kinnear: I notice from reading this that you own a farm in the Saguenay district. Have you found any difficulty there with the animals?

Mr. Mason: The animals in this case eat the fodder which absorbs the toxicological matter from the air. The animal is not affected if it does not eat the fodder. So, we bought this farm to determine precisely what the level of tolerance of farm animals was to the fodder. We have worked with several universities in developing the levels which can be tolerated. It has no effect on human life whatever, so far as we have been able to determine. The animals are not affected, but the fodder absorbs the undesirable elements, and when the animals eat it they are adversely affected.

Senator Kinnear: As Senator Grosart has said, it is important to report these effects, because now we are finding that there are toxic conditions from different plants. It has happened in Port Maitland, which is 20 miles from my home town, and it has happened in Newfoundland.

Mr. Mason: We have published everything that we have done. This has been published in various medical and other journals.

Senator Grosart: It would seem that you have an animal farm, but not a human farm.

Mr. Mason: We have many human farms. We have people working right in the environment, and they comprise the human farm.

The Chairman: Before Senator Kinnear proceeds to another line of questioning, does any member of the committee have a question on this particular topic?

Senator Belisle: Yes, Mr. Chairman.

Mr. Thornhill, in your opening statement you said:

> Present Patent Office practice tends to result in the issue of a higher proportion of invalid patents to inventors using Canadian filing priority than to those using foreign priority. However, because of the unique minority position of the Canadian inventor in his own Patent Office, we believe that this injustice can be rectified with a correspondingly minor additional expense.

Can you give us a more precise definition of that?

Mr. Thornhill: Yes. There is Rule 39 of the Patent Office Rules which gives the patent examiner power to demand that the results of a patent search in a corresponding application for that same invention in another country be made available to him. Since 70 per cent of all patents filed in Canada were filed first in the United States, and since the United States has a very efficient searching system for prior art, the use of this rule means that the Canadian Patent office does not have to do a very arduous search in that percentage of cases. In fact, it does not have to do it in 90 per cent of the cases, because 90 per cent of all patents filed in Canada are filed under a foreign priority date.

But, the Canadian scientist or inventor who files firstly in Canada does not get the benefit of this search done by others, so we have a relatively inexperienced staff of examiners in the Canadian Patent Office who, because they are able for the greatest proportion of their work to rely on others doing their searching, are somewhat at a loss when presented with such a case. You might say it is a unique problem, but it is our Patent Office.

Senator Grosart: Is not the answer that our Patent Act is so hopelessly out of date that it puts Canadians in an impossible position in respect of filing patents?

Mr. Thornhill: No, sir, I do not think that is it. I think the answer is that we are in a unique position in that 90 or more per cent of the filings are not done by Canadians. Here is a Canadian agency that is working 90 per cent for foreigners.

Senator Grosart: But the Patent and Trademark Institute of Canada told us one of the reasons is the obsolescence of our Patent Act, which has restrictions found in no other country in the world.

Mr. Thornhill: It also has rule 39, which I do not think every country has. Rule 39 gives at least good patents to those of us who know enough about it to file first in another country.

Senator Grosart: This in itself is an absurdity. It is absurd that the way to protect a Canadian invention is to file first in another country.

Mr. Thornhill: This is, in effect, the situation.

Senator Grosart: That is why I say it is an obsolete act. I do not think it has been revised or amended significantly in 40 or 50 years.

Senator Carter: We were talking about the stimulation of research and incentives. In the Aluminum Company of Canada brief, on page 6 in paragraph 8 you suggest that we should:

> Develop risk-reducing or risk-sharing mechanisms for research and development in potentially beneficial activities. Contribute, through a variety of well-tailored, flexible and appealing means, to the gradual increase of the overall national investment in these activities at least to the level reached in industrial competitor nations.

I wonder if you would elaborate a little on that, especially on what you consider "beneficial activities" and a "variety of... appealing means". We have mentioned tax incentives. Have you something else in mind?

Mr. Mason: Since we wrote that I think we have modified our views to the point where we feel that tax incentives are the real thing we would favour.

Senator Carter: I was wondering if you had other ideas.

Mr. Mason: No. On further thought we have come to the conclusion that we prefer the tax incentive method.

Mr. Proulx: For the smaller organizations there might be a system of grants and subsidies.

Senator Bourget: In your brief you mention collaboration between government and independent innovators. What would be the role of industry? Would it be to give financial help to independent innovators? We should be interested in having good products invented by some independent people. Or should it be the role of government to help independent innovators financially, by setting up a kind of crown corporation? I think industry itself should be interested in finding and hiring that kind of person, or helping him to develop a product from his invention.

Mr. Mason: I suppose he must find a sponsor.

Senator Bourget: That is it. There is that kind of organization in the United States, in Boston, under Mr. D'Iorio.

Mr. Mason: The independent innovator is a valuable man who needs encouragement. If he cannot find a sponsor, what does he do? Can he get help from the Government?

Senator Bourget: Do you not think that should be the role of industry? Surely industry is looking for such men, so why does industry not take an interest in hiring that kind of person? It is all very well for the Government to do a lot of things, such as giving tax incentives, but I think you would agree that industry should be ready to help that kind of person.

Mr. Mason: We have done.

Senator Bourget: I refer to people with brains, genius, whatever you call it.

Mr. Thornhill: How do you hire somebody independent and keep him independent? Once you hire him he is dependent on the industry.

Senator Grosart: How do you find a winner? That is the problem.

Senator Bourget: Help him financially.

Senator Grosart: There are 1,000 cranks for every winner.

Senator Bourget: I suppose everybody would like to help someone who is not a crank, someone who has a good product. Should it be the role of government to help such a man financially or should it be the role of industry?

Mr. Laing: I understand we are suggesting incentives, to the extent that industry decides what research should be undertaken. We are looking for some participation or encouragement, not to the extent of 100 per cent reimbursement plus a profit percentage. Our industry has to put its own money on the line and do the research. If an independent inventor has an idea with the appeareance of the possibility of commercial success, unless I misunderstand the attitude of this panel, industry would like, where possible, to think it is industry's function to work with that man. However, that means paying him a royalty, or assisting him with a patent application, or in a variety of ways. Industry still sees that as a valid effort, and I do not know that we are suggesting straight monetary encouragement to inventors by the Government. They could be assisted through things like the patent office mechanics.

Senator Bourget: The reason I asked my question was because of what was said in the brief of the Aluminum Company of Canada.

Mr. Laing: Then maybe I should shut up.

Mr. Mason: I agree with my colleague.

Senator Grosart: On page 13 of the Steel Company of Canada brief, in recommendation (ii) they speak of Government science policy overall and suggest that subsidies be granted

> ...only when such research is recommended by industry and is beyond the capacity of industry.

As a statement of overall government policy that seems a bit surprising. Did you mean to limit it to funding in industry?

Mr. Fisher: One of the points we are emphasizing is that there must be a closer collaboration between efforts through government agencies involved in research and development, that it should not be wasteful. If the fruit of the effort by government does not in some degree contribute to the effort we are making in the environment in which we are working, what really justifies the government effort, unless it is in the social or welfare areas, or in some other area? When it is confined to the contribution it can make to industry, then I think industry has to be involved. We feel that industry should have some voice in or some liaison over the kinds of programs that should be carried on. This means that the objectives we have established for ourselves should also become the objectives of the government agencies. This should arrive eventually at some kind of economic benefit to the industry or to the company the operation may be contributing to. This is why we feel the emphasis should lie in this area.

Senator Grosart: I take it what you are saying is that this statement refers only to funding of research efforts in industry?

Mr. Fisher: Yes, that will contribute to industry's effort.

Senator Grosart: As worded, your statement takes in all government funding.

Mr. Fisher: Oh no. We confine our submission to the physical science area where industry would be involved.

Senator Grosart: Are you then saying there should be no federal Government initiative in the industrial sector in national science policy?

Mr. Fisher: No, we are not saying that. We feel that industry should have more of a voice in the kind of contribution made.

Senator Grosart: You are not saying that. You are saying that subsidies should be granted only when such research is recommended by industry. That would suggest that there should be no Government initiative because the word "only" means nobody else. Are you saying there should be no Government initiative in the industry sector in our national science policy?

Mr. Fisher: We are basically saying that we should have the support of the industry.

Senator Grosart: You are not saying support.

Mr. Fisher: I mean support from the standpoint of recommendations.

Senator Bourget: Mr. Fisher, your company has had experience with foreign government agencies. Can you tell us what the difference is between your relations with foreign agencies and your relations with Canadian agencies?

Mr. Fisher: I have had varying experiences, of course, depending upon the foreign agency that we have been working with. Maybe we could give you some examples. We have worked with BISRA, British Iron and Steel Research Association and we have found that a great deal of their effort is confined to the more pure areas, almost an academic approach to research. We can see, arising out of the various programs they are involved in, very little practical applied benefit that industry can assimilate and make use of. Another thing is the tendency on the part of BISRA to engage in these programs and then not really allow too much co-operative effort on the part of industry. We should like to work in a co-operative way with people, such as BISRA, in an individual effort where we could work with them on a particular problem that faces us as a company. Then we would gain the fruits of our effort in this area. The tendency of these government-sponsored agencies is to make available to everyone the result of this kind of effort. You may have put your money into it, but you only share in a minor way from the benefits.

We have also worked with Institut de Recherches de la Siderurgie Francaise, the French equivalent of BISRA. Again, this is a government-sponsored agency. We have found a much more practical approach to the situation within this company, because we can work in a co-operative way and we can benefit from licence arrangements from many co-operative efforts that may be applied between ourselves and IDRSF. There has been a different approach. They are more practical and there is a more applied benefit arising from IDRSF, but also we can work co-operatively and benefit more materially. Again, we feel that this overall approach, using government agencies as the main fulcrum for research and development, is not the way it should be done. We feel industry should be generated by industry and with the co-operation of government agencies.

Senator Carter: Do any of the government agencies have a way of getting over this confidentiality problem?

Mr. Fisher: In case of IDRSF, they are prepared to grant us a licence within Canada, and this is the fruit of a co-operative effort. At least we have control. We can grant licences and benefit from the royalties that may arise out of this co-operative effort. We find less tendency, for example, on the part of BISRA, to give us this kind of benefit. They want the benefit to be dissipated or to use the benefit themselves, with BISRA acquiring the royalty benefit.

Senator Haig: That is the same as our own thinking here.

Mr. Fisher: I would say so.

Senator Haig: Do these licences give you very wide latitude or are they restrictive?

Mr. Fisher: They are usually rather restrictive. IDRSF again is responsible to the various companies and government agencies that support them. They have a responsibility to make this information available. We can only isolate it from the standpoint that we are in Canada, and isolate it from the European Common Market communities where IDRSF operates.

Senator Haig: It gives you a little advantage of a competitor.

Mr. Fisher: That is right.

Senator Grosart: Mr. Chairman, my French is bad this morning: What does "Institut de Recherche en Sidérurgie Française" mean?

Mr. Fisher: Institute of Iron and Steel.

Senator Grosart: You learn something every day.

Senator Bourget: It is a good day for you to learn a little French. I should be celebrating with the chairman.

Senator Grosart: May I ask you a question arising out of one of your recommendations on page 2, paragraph (n)? You do not recommend the establishment of government-sponsored industry-wide research associations. Are you referring to any particular kind of existing association there, the provincial research institutes or the suggestion of research institutes or campuses and so on?

Mr. McKay: This is in reference to a type of organization such as BISRA. We would not wish to sponsor such an organization or have such an organization in Canada.

Senator Grosart: But you like to deal with them in France? You would not want them here.

Mr. McKay: No, sir.

Mr. Fisher: We deal with them in France, because we can make a contribution. We feel a different approach would be much more effective in France as well as in Canada. In other words, we like industry to be involved directly rather than indirectly through the agency of IDRSF.

Mr. McKay: We have a choice in France. We can decide whether we will or will not associate with them, but in Canada would we have such a choice? You see the difficulty; it is a subtle one.

Senator Grosart: Would this rule out organizations such as the pulp and paper industry associations?

Mr. Fisher: That again is an industry association, not a government-sponsored agency. We say government-sponsored, industry-wide, the emphasis is on government-sponsored. We have the American Iron and Steel Institute which sponsors research and development programs and contributes to the overall effort and competitive situation of the industry. I think this is very desirable. We can concentrate on our own problems and give a better direction to the program, because we know more specifically where the maximum effort and priority should be.

Senator Grosart: In other words, you do not want cartels in Canada?

Mr. Fisher: No.

Senator Carter: Could I ask a question about relations with universities? They brought out this morning that communications between government and industry is not too good, particularly with reference to incentive programs. In both the Steel Company and the Aluminum Company briefs it is implied that there could be better relationships with the universities. Are you taking any initiative on your own to improve these relationships or are you just letting the universities go on "doing their thing" and you are "doing your thing" without either knowing what the other is doing or without there being very much interest in what the other one is doing?

Mr. Mason: We have had a number of examples, such as the chemical engineering staff visiting our big works. We invite them there for a symposium on some subject. In addition to that, we have given them specific projects in certain cases to work on. A third means is to invite them into our works for summer employment. We have had several professors come and spend the summer with us. We give them some jobs to do and ask them to give courses to our people. This means we are able to do some updating of our chemical engineering staff from the university people. At the same time, there is a cross fertilization, as I mentioned before, between the two, on ideas and techniques.

An example of that is that at McMaster they have been getting a whole section involved in the Bayer process for the extraction of aluminum from bauxite. This has been an extensive program, with 30 students and a number of members of the staff involved. They have spent several weeks on this problem and they have come back with what they feel is a good analysis of the process.

In doing this we feel we have sacrificed some confidentiality but we feel this is now probably worth the effort and we should not be too severe on this question of confidentiality.

We cannot have them work on the process without telling them how it works. We feel we must give them some precise detail, but they respect this. So far this has been very beneficial in working through the colleges at the present time, but I think there is room here for more activity in this regard.

Senator Carter: This has resulted from your own initiative?

Mr. Mason: Yes.

Senator Carter: I wonder if the other industries have felt the same way?

Mr. Fisher: To some extent our experience has been the same, but I do not think we have involved ourselves so much as Mr. Mason has. Industry has an increasing responsibility to involve itself more and more in the academic area. First of all, it is necessary to establish a better liaison, so that the universities and technical schools are more aware of the problems of industry and become engaged more and more in their effort, in the applied areas than in the pure areas. We think there is a need for a trend over to the applied areas.

We have been involved in specific problem areas, in going to the universities and establishing a co-operative program with the research facilities in the universities and engaging in the problem area.

We have done some, but we think we could do more and be a greater influence than we are, in endeavouring to exercise an influence in universities towards more applied effort in research programs. And in teaching methods, too, we feel there is too much of a theoretical approach and that we are generating people in the graduate area who are not well oriented on these problems of industry and who are not as well assimilated in industry, as a result.

Senator Belisle: I refer to the University of Sudbury.

We have many of their men who were in Falconbridge, and we have a director there at the university.

Mr. Mason: Yes.

The Chairman: That does not mean closer liaison in the field of research.

Mr. Mason: You must have technical people talking to technical people about technical problems. You cannot go through the top level of the university. It must be at the technical level. This is where the benefit will accrue to them, when they have the actual contact, first on the plan and then in dealing with the process.

In the field of computers, the universities are very well qualified. They have qualified staff and lots of ideas on the use of computers. We have found it beneficial to use their machines and their technicians as a means of updating ourselves in these newer techniques.

This is an area where a very great change is taking place, in the simulation of processes and applying mathematical analysis to chemical processes. It is an area of rapid change and one where we can benefit by using their experience and they can benefit by having practical problems to deal with.

Senator Carter: And in making the universities more oriented towards industry.

Mr. Mason: Mr. Fisher made that point.

Senator Carter: The question in my mind is, is this something you think you should be doing totally on your own, or should the Government have a role there as well, or should the Government stay out of it?

Mr. Fisher: We have academic institutes, and the universities and technical schools also have a responsibility in this area. They could do more with respect to knowing what is going on within industry.

For example, there is the experience at Waterloo, where they have actually geared their technical programs to involve their students in industry outside, for a period. During their academic career, this is good, because they can get a practical approach and can become actually involved in industrial problems, and they apply their theory in a more practical way.

We think the university and the technical schools could do more of this, have more involvement. At the same time, we feel an increasing responsibility ourselves to influence the academic environment and endeavour to encourage this kind of research.

Senator Carter: This is something fairly new on the part of industry?

Mr. Fisher: Yes.

Senator Carter: There has not been any similar initiative on the part of the university? This initiative has come from industry?

Mr. Fisher: I do not think all of the initiative has come from industry. We have had university initiative on the use of computers and in suggesting programs to us. But this has been confined to one or two specific areas—Waterloo was one and McMaster was another—where they come to us and feel they can make a contribution and ask us to work with them.

Senator Carter: How can this be spread out to get the idea across to more industry and more universities, that this is what should be done?

Mr. Thomas: If I may speak for Dofasco, we have done some work with universities and in particular with McMaster. If you talk to the professor, it is felt you are competing against a government grant for research, which he can get on the one hand and which carries no restriction on the work, rather than ask him to work a specific program. So we are in competition for the tax dollar and that creates some difficulty.

Senator Bourget: Do you employ many students during the summer holidays to stir their interest?

Mr. Fisher: We do, to the maximum degree that we can assimilate them, and this has been done over the years. We have taken a large number of students and given priority to university students, because they normally are becoming involved in industry and business.

Mr. Laing: We have taken about 500.

Mr. Fisher: We have taken about the same.

Mr. Mason: Ours also has been about the same. These people are very good potential employees. They get to know the people in industry and they know the business we have. There is a very high yield of return on these people who have worked for us in the vacation.

Senator Bourget: What about Falconbridge?

Mr. Thornhill: About the same.

Senator Bourget: That is good.

Senator Kinnear: In regard to Waterloo University, we heard of the graduate class this year. They have 11 in it and 10 went to the United States. I wish to point out this also in the brief, in the last sentence, where you say "that the Canadian tax climate should be made sufficiently attractive that highly qualified people will be induced to remain in Canada in spite of the fact that for the foreseeable future employment opportunities will be more attractive in the U.S.A."

Also, on page 27, in the first sentence you say that we are "competing for available personnel with the U.S.A." A few sentences later you say you are convinced that "there is a serious loss of such people to the U.S.A."

This would suggest we are not competing too successfully in retaining our best research personnel and no doubt this will become more serious as the war in Vietnam ends. How serious is the problem? If we lose the brightest researchers to the United States, how can we build a first class innovative industry, and what is the solution?

Mr. Fisher: I would emphasize again that we feel we are losing some of our better trained talent to the United States and elsewhere, and there should be some effort to retain these people who have such high qualifications and such high potential.

I mentioned earlier—with my tongue in cheek—that it may be we could incent them by putting less of a penalty on them with respect to income in the income tax arrangements; but this segregates a very select group for this kind of treatment and it is indicated that this is a very difficult thing to do.

Really, it is the fact that they can go to the United States and secure better job opportunities, better potential for the future, a higher remuneration, and they can establish a higher standard of living for themselves and they have a better opportunity for advancement and there is also a diversification in the research and technical areas, in the standpoint of utilization of their talents, and there is a larger market for this kind of people, with greater opportunity all the way through.

We should give some thought to this and should try to develop within Canada a better opportunity for those people and more incentive to retain them.

Senator Bourget: Is there much difference between the salaries paid to scientists in Canada and the salaries paid to scientists in the United States?

Mr. Fisher: The difference is rather substantial.

Senator Bourget: Would it be between 20 and 25 per cent?

Mr. Fisher: Certainly in that order.

Senator Grosart: Mr. Chairman, I was inclined to be impressed with the case that the representatives of subsidiary companies in Canada made out for their contribution to Canadian research and development. However, I find a rather alarming statement on that matter on page 6 of the Dofasco statement.

> A closer look should be taken at the research money grants which are made to research departments run by foreign subsidiaries. In some cases, research establishments and pilot plants have been put into operation in Canada by foreign controlled companies for the development of processes which appear to be aimed at non-Canadian markets for exploitation without benefit to Canada.

Have there really been cases of research funding of foreign subsidiaries where the use of the products of those funds was without benefit to Canada? Do you know of any cases, Mr. Thomas?

Mr. Thomas: Unfortunately, this is not my comment and I cannot say.

Mr. Laing: When I asked the author of that particular section of our brief, he mentioned one case.

Senator Grosart: There was only one case? However, if this is widespread, it is a very serious criticism of our whole funding of research. But you don't think it is a widespread criticism of the research funding?

Mr. Laing: No.

The Chairman: I suppose that these projects would not be eligible on most of our incentive programs, but perhaps they might be eligible for grants from NRC.

Mr. Laing: Do you mean that they would not be eligible because they would not be exploited in Canada? I cannot speak to that.

Mr. Darby: Mr. Chairman, that is why we suggest tax incentives. You have either to make capital investments in Canada or to generate taxable income in Canada. A foreign company could not do its research through Canadian subsidiaries and take benefit of that and exploit it in the United States, for example.

Senator Grosart: Well, the point I am getting at is that this is without benefit to Canada.

Mr. Darby: What I am saying, though, is the fact that, if you hang your incentive on tax incentives and have either a more rapid write-off of capital investment facilities in Canada or a lower tax rate on taxable income generated in this country, then Canadians and the Canadian economy will benefit. It does not prohibit the United States economy from benefitting at the same time. Of course, we get tremendous advantage from research done all through the world.

Senator Grosart: I am not objecting to the development of products that can be exploited in a foreign market. That is the name of the game.

Senator Kinnear: Mr. Chairman, this is an open question. Do you get many of your researchers from Europe?

Mr. Fisher: We do.

Mr. Thomas: Yes.

Mr. Thornhill: Yes, we do.

Senator Kinnear: So all of you do. In that case, there seems to be rather a paradox here, because on the one hand we are told that the situation in Canada is that there are highly-trained scientists and engineers graduating from our universities every year and yet we are told by the industrial companies that they cannot easily obtain the staffs they need. What is the cause of this shortage in the midst of plenty? For example, we heard the other day of somebody advertising for researchers or scientists, and out of 20 they could only use two. Do you people find any difficulty in this respect?

Mr. Fisher: One point I should emphasize is that we are not just looking for bodies; we are looking for people with talent and potential.

Senator Kinnear: That is what I am speaking of—very highly-trained scientists.

Mr. Fisher: We feel we are losing a tremendous number of the good people to the United States where, to some extent, opportunity is greater for these particular people with their peculiar talents.

Senator Kinnear: Do you mean you cannot use them here?

Mr. Fisher: We can and would like to, but we are losing them. We cannot establish sufficient incentives to retain them under our economy and with our income tax situation and other factors. Again, I mention the diversity of opportunity in the United States that we cannot possibly generate within the confinements of our economy.

The Chairman: So we import from Great Britain and export to the United States.

Mr. Fisher: We import not only from Great Britain but also from Europe.

Senator Kinnear: And are the people who come from Europe also going to the United States?

Mr. Fisher: We are more likely to retain them.

The Chairman: They go to the United States, if they are good enough.

Senator Kinnear: It seems to me that Canada is in the squeeze.

Senator Bourget: Are the scientists coming from Europe better qualified than those who are produced by our own universities?

Mr. Fisher: They are better than the ones we are able to retain from our own universities, otherwise we would not be hiring this particular element. But because they meet our requirements in the research area, which requires a very high degree of training and technical skill and potential from the standpoint of innovation, we do hire these Europeans. We are looking for a particular faculty within the individual. We may be a very energetic fellow, but he may not have the innovative approach and we may not be able to use the particular routine skills or training he has. It is a particular element in the technical community that we are looking for—the element that we can use in developing research and development programs, and the ideal people who can then take their ideas and begin a practical application of the ideas in the development and research programs are the ones we are looking for. If we find this element in a European and cannot get the equivalent skills in a Canadian, naturally we are going to hire the European.

Another thing is that the European is more likely to come to us based on what we can offer. The Canadian with similar skills can be offered something substantially higher in the United States.

The Chairman: What is the proportion of Europeans on your staff?

Mr. McKay: There are about 80 people in the research department. I would be rather hard pressed to say what the exact percentage is of European origin or Asiatic origin.

Senator Kinnear: How many Canadians do you have?

Mr. McKay: I don't know.

Senator Kinnear: That is odd.

Mr. McKay: I can say, though, that we have had a great influx of Czechoslovakians recently, much to our advantage. But you have to maintain a balance in your staff. I should like to think our staff was predominantly Canadian, and I should hate to think that some time in the future we would be of more foreign origin in our staff than of Canadian.

Senator Bourget: Are these scientists coming from industry or from universities?

Mr. McKay: From industry.

Senator Bourget: Should there be, then, some changes in our university courses? Because we have been told that there is too much basic research and that they are not prepared to face that kind of research that industry needs.

Mr. Fisher: There is a lot of truth in that. A lot of work going on in training and research work in universities is not in the applied areas, and we certainly take issue with that. I have a case in point. I visited Japan last fall and visited some of the research institutes within the university environment. They were doing a lot of research work there and I found that there was a closer liaison and a much higher proportion of research that could specifically be taken advantage of in industry itself. There was a very close-knit co-operative effort between the universities and industry and we see the fruits of that kind of effort in what the Japanese are doing today and the kinds of innovation they are coming up with. I think this same kind of approach if a co-operative effort which to some degree is engendered and encouraged by the Japanese government could be applied here.

First of all, the government itself on a broad basis is working very closely with the university and industrial environment to bring this co-operative effort towards certain national goals to encourage those in the export market area to come up with new and better products, more competitive products, and to produce them at a lower cost. This is almost the national objective. They encourage the universities to engage in applied research and to carry on a close liaison with industry in this regard. There you find there is a very close meshing of the university effort with the industry effort which does not exist here.

Senator Bourget: So that in Japan you have some kind of research institute on campus in the universities to encourage more practical experience in development and in innovation.

Mr. Fisher: The very fact that they have these programs going on in the university environment means that people engaged in it will have greater knowledge not only of the practical approach but also they will know what industry is doing and what their objects are. We think there is a need for more of this in our own academic environment.

Senator Bourget: They have more scientists working in industry?

Mr. Fisher: And they have more people with a university education in industry in Japan than we have here.

The Chairman: They have fewer in government labs than we have here proportionately.

Senator Blois: Mr. Chairman, there is one point I wish to raise which is clear to me but which I am afraid may not be clear to members of the committee. I am speaking now on the point of scientists coming to Canada from other countries. I rather feel that the proper answer to that is that the people they are bringing in are people that not only have knowledge and training but who also have considerable practical experience. These people can get better wages here in Canada and they have this considerable training and experience. Speaking now from some practical experience in have had in these matters, I think this should be made clear.

The Chairman: I think this point has been brought up by Mr. McKay a few minutes ago.

Senator Bourget: I have another question to ask, Mr. Chairman, in connection with information services. Do the witnesses recommend one centralized clearing house for scientific information or would they prefer the establishment of centres of information spread in different parts of Canada? I am directing this question to all of the witnesses.

Mr. Fisher: I do not see anything wrong with a central source of information as long as it functions well, is up to date and made readily available.

The Chairman: Have you seen the Tyas study published recently?

Mr. McKay: Yes, and I have discussed it with the people in the National Science Library and we have nothing but praise for what they are attempting to do. It is very impressive and we wish them the best of luck, and we hope the government will get behind them and make sure the programs they now have planned will come to fruition.

Senator Bourget: You are satisfied with that?

Mr. McKay: Very satisfied.

Mr. Mason: I would agree too.

Mr. Thornhill: I agree.

Mr. Thomas: I find it a very good service.

The Chairman: Honourable senators, on this note of unanimity we will adjourn. I thank our guests for this most interesting discussion we have had this morning.

The committee adjourned.

APPENDIX 171

BRIEF SUBMITTED TO

THE SENATE SPECIAL COMMITTEE ON

SCIENCE POLICY

BY

DOMINION FOUNDRIES AND STEEL LTD HAMILTON

SUBMISSION OF

DOMINION FOUNDRIES and STEEL, LIMITED
HAMILTON - ONTARIO

TO THE SPECIAL COMMITTEE ON SCIENCE POLICY

OF THE SENATE OF CANADA

The Special Committee was appointed to consider and report on the science policy of the Federal Government. This submission will deal with one of the points listed in the Order of Reference of the Special Committee, namely federal assistance to research and development activities carried out by industry in the field of physical sciences.

Dominion Foundries and Steel, Limited is a fully integrated steel mill with interests in two iron ore mines in Canada, and with blast furnaces, oxygen steel making furnaces, hot rolling mills, cold rolling mills, galvanizing lines, tinning lines, other flat rolled steel finishing facilities and a foundry. A subsidiary company, National Steel Car Corporation Limited, manufactures railway rolling stock. The number of employees of Dofasco and National is about 7, 800. The annual sales are about $280 million.

Our brief takes the form of comments on the list of questions received as Appendix I to the letter of January 20, 1969, from The Honourable Maurice Lamontagne, in which we were invited to submit a brief.

A. FINANCING INDUSTRIAL RESEARCH

Question 1 How best can the Federal Government encourage fruitful R and D in Canadian industry? Are present schemes satisfactory?

Comments on Question 1

The present schemes to encourage research in industry are:

(a) grants under the Industrial Research and Development Incentives Act;

(b) loans under the Program for Advancement of Industrial Technology;

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(c) grants under the Industrial Research Assistance Program administered by the National Research Council;

(d) sharing of development costs under the Defence Development Sharing Program administered by the Department of Industry;

(e) grants under the Defence Industrial Research Program administered by the Defence Research Board.

We have made applications for grants under the Industrial Research and Development Incentives Act for research expenditures for 1967 as a continuation of the claim for the additional allowance under the Income Tax Act. We have made one application for a loan under the Program for Advancement of Industrial Technology ourselves and participated in an application in another project with two other companies. We have not made application under any of the other programs.

We have found difficulty in attempting to explain the nature of what we consider to be our research and development activities to the Department of National Revenue and the National Research Council. The difficulty is that we regard the experimental aspect of any innovation in our production process to be research and development, whether it is something that results from our own basic or applied research or results from adaptation to our particular needs of a process in operation somewhere else.

Our attitude toward the Program for Advancement of Industrial Technology is that we might want to use it where there is a high degree of risk that a proposed research and development project will fail. We understand that the interaction of the grants under the Industrial Research and Development Incentives Act and the loans under the Program for Advancement of Industrial Technology results in an effective net cost to a company of 12-1/2¢ on the dollar for research and development that fails and of 25¢ on the dollar

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for successful research. The net cost of successful research where grants under only the Industrial Research and Development Incentives Act are received is also 25¢ on the dollar. This is the only reason that persuades us to use the Program for Advancement of Industrial Technology. The fact that funds are made available to finance half of the cost of the project while it is under way is not an inducement to us to use the program. We understand that a project which qualifies under the Program for Advancement of Industrial Technology qualifies also under the Industrial Research and Development Incentives Act. It is for this reason that the net cost to us of successful projects is the same whether or not we receive assistance under the Program for Advancement of Industrial Technology.

How the incentives are applied could be changed as follows:

During a recent review of our request for a grant under the Industrial Research and Development Incentives Act based on our 1967 expenditures, a representative of the Department of Industry told us that special purpose equipment imported for use on a research project the cost of which is included in current expenditures, does not qualify for a grant. If we purchased it through a resident company or a broker it would qualify and it is probable the purchase price would be higher than if we were to purchase it directly.

There is an illogical application of this rule. The rule applies to imported special purpose equipment, the cost of which is included in current expenditures. The rule does not apply to imported general purpose research equipment whose cost is included in capital expenditures. These capital expenditures qualify for a grant. The distinction of where the equipment is purchased is irrelevant as a criterion for deciding on government support for research in Canada. The relevant criterion is where the research is done for which the equipment is purchased. We suggest that this administrative rule be dropped.

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Question 2 What federal assistance would help stimulate more innovation in Canadian industry?

Comments on Question 2

The present kinds of programs are adequate for this purpose with one change. The assistance provided under the Industrial Research and Development Incentives Act could be broadened to include development work which is for the purpose of improving processes. We understand from the definitions and interpretation that development work qualifies that meets two tests: first, that it uses the results of basic or applied research and; second, that there must be present a significant element of scientific or technical novelty or innovation.

With regard to the first test, we think development work for process improvement should be encouraged whether or not it uses the results of basic or applied research. Such development work includes that originating with suggestions from employees under suggestion award programs. It includes development work undertaken by operating department personnel and development work done in quality control laboratories and in engineering departments. This development work is not preceded by basic or applied research. It does benefit industry. It is a source of innovation which merits stimulation as much as innovation which originates from basic and applied research.

Added incentive might be given to inventors with possibly some system being set up whereby an inventor could be put in direct contact with those who could best use his invention in Canada. This might be done under the Department of Industry.

Question 3 How can federal agencies and departments, National Research Council for instance, more effectively assist Canadian industry?

Comments on Question 3

There does not appear to be an easy way except by way of good example,

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or cases where federal agencies and National Research Council can be proven to have helped industry, the more mutual respect and interest will be generated.

Question 4 Is there a proper balance between the support of the federal government given the three sectors: industry, universities and federal government?

Comments on Question 4

The total of capital and current expenditures by the Federal Government on research and development and other scientific activities other than Department of National Defence was $373, 371, 000 in 1966-67. The current expenditures portion of this is $260, 069, 000. Of this, the part administered by the Department of Industry is $31 million. The part of the National Research Council expenditures for which industry is listed as the area of application is $11, 600, 000. An opinion of whether or not this proportion spent for industry ($42, 600, 000 of $260, 069, 000) is appropriate would depend on the benefits to Canada from the research done for the Departments of Agriculture, Fisheries and other departments and Atomic Energy compared with benefits to Canada from the research done for industry. If, to the amount spent directly for industry of $42, 600, 000 is added a benefit to industry from research in the Departments of Transport and in Atomic Energy, then the proportion spent for industry does not appear to be as high as it should be. It is likely that there would be earlier practical application from research work for industry which is a strong justification for allocating for industry a relatively high proportion of government financed research.

Federal Government current expenditures on research and development in 1966-67, including the Department of National Defence, were $328, 400, 000. An analysis of this shows that the performing organization is Canadian industry for $71, 600, 000 and educational institutions and individuals at such institutions for $50 million. The total includes spending by the Departments of Agriculture, Fisheries and other departments not related to industry. The proportion of federally financed research performed by industry by this

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Question 5 On the basis of your experience what is the appropriate creation of and balance between basic research, applied research and development?

Comments on Question 5

Generally speaking, it has been well established that far too much of the available scientific-minded time and effort is spent on basic research done in both the universities and government agencies. Direction should be given to ensure that more time is spent on applied research and development especially aimed at putting the new technologies to work in developing the manufacturing end of Canadian industry.

Question 6 What criteria should the federal government use in allocating funds to scientific activities such as the support of R and D in industry?

Comments on Question 6

Emphasis should be placed on devoting maximum interest and support to those projectswhich will increase our manufacturing of secondary goods which require higher skills and which produce a higher percentage return than we get in the exploitation of our primary resources. A closer look should be taken at the research money grants which are made to research departments run by foreign subsidiaries. In some cases, research establishments and pilot plants have been put into operation in Canada by foreign controlled companies for the development of processes which appear to be aimed at non-Canadian markets for exploitation without benefit to Canada.

Question 7 What changes should be made in federal government financial support of Canadian scientific activities?

Comments on Question 7

Perhaps requests for financial aid to Canadian scientific activities should be rated with a preferential lean towards those which will improve Canada's balance of payments by reducing Canada's dependence on imports and by generating foreign markets.

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B. INDUSTRY AND ITS ENVIRONMENT

Question 1 How can Canadian universities and industry more effectively collaborate in the field of science and technology?

Comments on Question 1

Serious attempts have been made by a number of engineering schools to improve communication between the university and industry. From industry's point of view, it appears that the universities lack a practical approach to the application of science to industry and overall scientific problems. It would be recommended that somehow the university scientific personnel must be exposed to industrial dollar and cents thinking and this can only be done with the co-operation of industry.

The universities and colleges must continue their efforts to make industrial people aware of what they have to offer and this will require a long hard sell.

Question 2 Do Canadian universities graduate scientists and engineers able to perform effectively in Canadian industry?

Comments on Question 2

While Canadian universities graduate scientists and engineers skilled in their respective disciplines, they lack a broad knowledge which would result from a well-rounded education. Graduates need improvement in the following areas:

1. Communications - the effective use of basic English - especially in written reports.
2. Problem-solving - the development of a good analytical approach to problems.
3. Economic realities - the need to relate scientific learning to dollar costs.

Question 3 What should the important long term goals of Canadian science be?

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of the Senate of Canada

Comments on Question 3

Simply stated, we must develop the best educational systems aimed at producing graduates in the scientific fields most requited by Canadian industry. Overall, there must be a shift towards applied research and development expenditures aimed at promoting Canada's secondary manufacturing industry. Increasingly, industry must assume its rightful burden of hiring and using more technical personnel following the example of the Japanese who have been extremely successful at applying and using new technology.

Question 4 Is there an adequate supply of scientific manpower in Canada?

Comments on Question 4

If it were not for the "exporting" of brains to the United States, we would probably have an adequate supply of scientific manpower. The challenge then is to provide meaningful work and incentive for Canadian engineering and scientific graduates.

Question 5 Does foreign ownership hamper the development of innovation in Canadian industry?

Comments on Question 5

In many cases, a Canadian subsidiary of an American company does no research in Canada, but still pays for its share of research carried out in the United States. One is probably safe in saying that in many cases the amount paid could support a very considerable Canadian research effort on the part of the subsidiary.

Question 6 Are the results of foreign science and technology available to Canadian industry in a timely and suitable manner?

Comments on Question 6

We think the answer to this is yes. We have good science libraries and through various Canadian and foreign technical societies, it is possible to get the latest up-to-date information on any subject which has in any way been made public.

APPENDIX 172

BRIEF

BY

THE STEEL COMPANY OF CANADA, LIMITED

TO

THE SENATE OF CANADA

SPECIAL COMMITTEE ON SCIENCE POLICY

I N D E X

1. Summary of Recommendations

(a) The aim of government science policy should be to encourage research and development in the private sector which will assist in maintaining or increasing the prosperity of the economy by making Canadian industry more efficient and competitive, for example, by improving its productivity and the quality of its products or by developing new products.

(b) Government should encourage business to engage in research and development along lines of its own choosing.

(c) Government should provide incentive programmes to encourage industry in Canada to engage in research and development.

(d) Government incentive programmes should, preferably, take the form of tax concessions rather than grants or subsidies.

(e) Tax incentives should apply to all research and development expenses and not merely the excess over some base period even if this involves lowering the percentage benefit.

(f) For tax incentive purposes, the definition of capital expenditures for research should include the first commercial facility utilizing the results of research.

(g) Consideration should be given to an additional incentive applicable in the initial years of operation of a new project.

(h) Administration of government incentive programmes should be centralized, simplified and standardized.

(i) Some reasonable assurance should be given of continuity in government incentive programmes.

(j) A single publication should be prepared outlining government incentive programmes and applicable administrative procedures.

(k) In government incentive programmes, the definition of eligible expenditures should be drafted in such a way as to minimize problems of determining eligibility and to avoid the necessity of disclosing confidential information.

(l) Government research agencies should consult with industry in choosing research programmes and scheduling the use of their facilities.

(m) Joint government-industry research projects should be conducted on a basis which will ensure that discoveries will be kept confidential if the participating businesses so require.

(n) The establishment of government-sponsored, industry-wide research associations is not recommended.

(o) The government should provide centralized clearing houses for scientific information.

(p) The facilities of the National Science Library should be expanded to provide broader service.

(q) The facilities and retrieval system of the Canadian Patent Office should be improved especially to facilitate the examination of Canadian patent art.

(r) The Technical Information Service should be improved along the lines of the United Kingdom Technical Information and Library Services Reports Centre of the Ministry of Technology and of the U.S. National Referral Centre for Science and Technology, Library of Congress.

(s) Government employees responsible for disseminating technical information should be given opportunities to study appropriate segments of Canadian industry.

(t) Governments and universities should encourage university staff to become more oriented toward Canadian industry.

(u) Government should revise its tax policy to establish a tax climate which would encourage highly qualified people to remain in Canada instead of emigrating to the U.S.A.

2. Terms of Reference

This brief is submitted to the Special Senate Committee on Science Policy in response to the invitation of the Chairman of the Committee contained in a letter dated January 20, 1969, and addressed to the President of this Company.

It is our understanding that the Committee is engaged in an extensive inquiry into science policy in Canada based on the Order of Reference under which it was appointed which directs the Committee to consider, and report on the science policy of the Federal Government with the object of appraising its priorities, its budget and its efficiency in the light of the experience of other industrialized countries and of the requirements of the new scientific age and, without restricting the generality of the foregoing, to inquire into and report upon the following:

(a) recent trends in research and development expenditures in Canada as compared with those in other industrialized countries;

(b) research and development activities carried out by the Federal Government in the fields of physical, life and human sciences;

(c) federal assistance to research and development activities carried out by individuals, universities, industry and other groups in the three scientific fields mentioned above; and

(d) the broad principles, the long-term financial requirements and the structural organization of a dynamic and efficient science policy for Canada.

While the Order of Reference includes within its scope the fields of "physical, life and human sciences", this brief will be restricted to the physical sciences.

3. The Company and its Research Activities

(a) Description of the Company

The Steel Company of Canada, Limited is the largest basic steel producer in Canada with over 40% of Canadian steelmaking capacity. The Company has eighteen plants located in four provinces and has sales officed located in every province except P.E.I. It has iron ore mines in Newfoundland, Quebec and Ontario. In 1968, the Company has sales of $589,612,742. It employed an average of 21,584 employees during 1968 and at the year-end had 52,520 shareholders approximately 95% of whom were Canadian. The Company is, therefore, one of the largest and most important industrial corporations in the country and represents a distinctively Canadian point of view.

(b) Description of the Company's Research Activities

The Company has for many years been active in research and development related to the steel industry and has endeavoured, we believe successfully, to keep in the forefront of technology and innovation in this field through its internal research programmes, utilization of facilities of government departments and agencies, both domestic and foreign, co-operation with other companies and close ties with the academic community.

(i) Internal

Internally, various department of the Company have been active in developing improved technology, equipment and products. The Company has been a world leader for many years in blast furnace technology; it was one of the first to make extensive use of oxygen in steelmaking; it invented the Stelmor Process for the production of wire rod which does not require special heat treating; it has been a leader in the direct reduction of iron ore and in a new approach to steelmaking based on the use of such reduced ore in electric arc furnaces; and it developed a unique process for making spiral nails without twisting. These are merely examples of the type of research and development in which the Company is continuously engaged.

By the 1960's the Company concluded that the accelerated rate of technological change in the iron and steel industry made desirable a more highly organized and sustained programme of investigation and research. Accordingly, a Research Department was set up in 1962 and a Research Centre was completed in 1967 at a cost of $4.5 million to be devoted to applied research in iron and steel manufacture and technology. This Centre compares favourable in the quality of its personnel and facilities with any in the world although its size is of necessity smaller than facilities operated by larger steel companies in countries such as the U.S.A. and Japan.

(ii) External

In addition to its internal research activities, the Company has engaged in co-operative research with a variety of public and private agencies both domestic and foreign and accordingly has considerable familiarity with the available opportunities for such work.

(aa) Relations with Canadian government agencies

The Company participated in research projects in co-operation with various government or government sponsored departments, agencies and associations including the following:

Department of Energy, Mines and Resources
Canadian Carbonization Research Association
Solids Pipeline Research and Development Association
Solids Pipeline Economic Study Association
Canadian Zinc and Lead Research Committee
Canadian Continuous Steel Casting Research Group
Eldorado Mining and Refining Corporation
and various industrial research institutes.

We are, therefore, familiar with the type of direct assistance which can be provided by government agencies in Canada.

(bb) Relations with foreign government agencies

The Company is also familiar with similar types of assistance available in other countries through its participation in research projects in co-opération with the following bodies:

British Iron and Steel Research Association
Institute de Recherches de la Siderurgie Francaise
Centre National de Recherches Metallurgiques (Belgium)
Association Internationale pour les Recherches de Base au Haut Fourneau d'Ougree
U.S. Bureau of Mines
Blast Furnace Research, Inc.

(cc) Relations with industry associations and other companies

The Company participates actively in the technical committees of numerous industry associations and has made use of various commercial research institutes including:

Ontario Research Foundation
Illinois Institute of Technology
Battelle Memorial Institute
American Iron and Steel Institute
and sundry similar trade organizations.

In addition, we have from time to time made arrangements with other companies for the joint development of promising projects. For example, we are the leading participant in a group of companies which is conducting research on the direct reduction of iron ore and other ores and the utilization of reduced ore in electric arc furnaces. This group includes U.S. and German participants.

(dd) Relations with universities

The Company appreciates the importance of close ties between industry and the academic community and the necessity of providing assistance to universities with a view to encouraging research and assisting worthy students. In this connection, we have established a Chair in Metallurgy at McMaster University, have contracted projects with the University of Waterloo Industrial Research Institute and have established a student aid programme which provides graduate research fellowships in metallurgy and a variety of scholarships, bursaries and awards in technology. In addition, the Company has sponsored various research projects at different universities.

(c) Expenditures on Research

The extent of the Company's interest in research is indicated by the fact that its direct expenditures for this purpose in the last seven years totalled $20,500,000. This, of course, does not include its student aid programme or expenditures on development which would be absorbed in operating expenses.

(d) Extent of Government Assistance

The importance of government assistance in carrying through this programme is indicated by the fact that for the same period deductions in determining taxable income totalling $26,200,000. were made in respect of research under Sections 72 and 72A of The Income Tax Act. In addition, grants totalling $79,000. will be claimed under the Industrial Research and Development Incentives Act by the end of the 1968 taxation year.

4. Aims of Government Science Policy

(a) Aims of Policy

Before any meaningful evaluation of present government policies can be made or any useful recommendations put forward, it is necessary to state the standpoint from which we view this problem. We must determine what the aims of science policy should be before attempting to decide what means are best calculated to achieve these ends. In attempting such a formulation, we recognize that it is impossible to achieve everything all at once. Priorites must be established. In a country like Canada with a small population, limited financial resources and very high levels of taxation, it is obvious that government support for research must be directed towards those areas which will produce tangible results without too long a delay.

Under these circumstances, we suggest that the aim of government science policy should be to encourage research and development in the private sector which will assist in maintaining or increasing the prosperity of the economy by making Canadian industry more efficient and competitive, for example, by improving its productivity and the quality of its products or by developing new products and processes.

(b) Means of Achieving this Aim

To achieve this aim, the means employed by government in implementing its science policy must,

(i) recognize the demands of the market in a manner flexible enough to meet the continuous changes in the market; and

(ii) encourage the utilization by industry of the results of research.

In our view the most effective government science policy is one which encourages industry to engage in research along lines of its own choosing with as little government direction or interference as possible. Direct government involvement in research should be directed primarily toward those broad areas such as energy resources and development of the north which may be beyond the capacity of any single industrial enterprise and in education and the dissemination of information. Accordingly, we would oppose the appointment of a minister responsible for science or technology or the formation of a department to deal with these matters. The problem will not be solved by direct government involvement in research except in specific areas as indicated above.

Perhaps the most important means which can be adopted by government for achieving the ends in view is an indirect one involving the creation of an economic climate which rewards initiative and risk-taking. It is often difficult to reduce promising discoveries to practice because of the risk involved and the amount of capital required. Government policy should, therefore, be directed toward creating a climate favourable to the entrepreneurial spirit, risk-taking and the formation of the necessary pools of venture capital.

In general, therefore, we recommend that government science policy should encourage research and development in Canada by the following means:

(i) encouraging business to engage in research by granting adequate tax concessions with respect to research expenditures;

(ii) providing government-owned research facilities and programmes and preferably granting subsidies only when such research is recommended by industry and is beyond the capacity of industry;

(iii) encouraging a closer relationship between the academic community and industry especially when research is being carried on under academic sponsorship; and

(iv) revising its taxation policies by making rates of personal income tax, gift tax and estate tax more attractive than those in the U.S.A. in order to encourage talented and experienced people to remain in Canada.

These recommendations will be developed in more detail hereunder.

5. Evaluation of Existing Government Programmes

(a) Government Incentive Programmes

(i) Outline of Existing Programmes

The five government incentive programmes currently available in respect of research and development are outlined in Schedule A hereto. This Company has had experience under PAIT and IRDIA as well as under Section 72A of the Income Tax Act. We have not made use of IRAP, DDSP and DIR and cannot comment on their effectiveness.

SUMMARY OF FIVE COMPLEMENTARY GOVERNMENT INCENTIVE PROGRAMS

Assistance Program	Objective	Program Administered by	Nature of Incentive	Date Introduced
Defence Development Sharing Program (DDSP)	"To sustain and improve the development capabilities of Canadian companies active in the military product field"	Dept. of Industry Trade and Commerce	Costs shared. Government share not repayable	1959
Defence Industrial Research Program (DIR)	"To improve the ability of Canadian companies to compete for research, development and ultimately production contracts in the United States and NATO defence markets"	Defence Research Board	Costs shared equally. Government retains royalty-free right of use	1961
Industrial Research Assistance Program (IRAP)	"To create new research facilities within industrial companies and to expand existing facilities" and "to improve communications between research workers in government and industrial laboratories"	National Research Council	Payment of the salaries of new research teams in companies where none previously existed, or for new research workers to be added to existing research staffs over and above a company's normal expansion of research effort. Support extends from 3 to 5 years by annual grant, subject only to satisfactory progress	1962
Program for the Advancement of Industrial Technology (PAIT)	"To help industry help itself to upgrade its technology and to expand its innovation activity by underwriting specific development projects which involve a significant technical advance and which offer good prospects for commercial exploitation"	Dept. of Industry Trade and Commerce	Cost of an improved development project shared equally by the Department and the company concerned. If the results of the development project are put into commercial use, the company must pay back within ten years the Department's contribution together with compound interest based on the government borrowing rate	1965
Industrial Research and Development Incentives Act (IRDIA)	"To provide general incentives to industry for the expansion of scientific research and development in Canada"	Dept. of Industry Trade and Commerce	Grants equal to 25 percent of the aggregate of a company's capital expenditures and any increase in current expenditures during the fiscal period over the average of the preceding five fiscal periods	1967

It may be that there are special considerations applicable to defence research which merit its being treated in a manner different from research in other fields. Accordingly, our discussion of government incentive programmes will exclude any reference to this area.

(ii) Comment on Existing Programmes and Recommendations

Our overriding comment on government incentive programmes is that such programmes provide the most effective means for the encouragement of research and development in Canada within the limits of available funds. Without such encouragement, for example, it is doubtful if this Company would have built its Research Centre or have carried through some of its more costly and effective research programmes.

This is not to say, however, that the present programmes constitute the best conceivable means of attaining the desired end. As noted above, the ultimate aim of government policy should be to encourage research and development work which will increase national prosperity. This implies that the results of such research should be commercially exploited. IRDIA proceeds on the assumption that, if industry is encouraged to spend money on research, the desired result should follow. This assumption is valid to the extent that industry is not interested in research for the sake of research and would not engage in it unless it anticipated that it could be commercially exploited. PAIT, however, goes further and recognizes that some additional encouragement may be necessary in order to ensure that research will be directed along exploitable lines. The idea behind PAIT is sound, but this Company, and presumably others, hesitate except as a last resort to use the programme because of the administrative detail demanded in advance of project approval or in withdrawing from a project, the necessity for full disclosure of results to government employees, and the stipulation that results be exploited within a reasonable period of time in Canada. Industry prefers to be flexible in its approach to research projects, to treat the results as confidential and to exploit them when and where the economic considerations dictate. The PAIT programme does not fit well into our view of how research should be conducted. It would be more desirable to encourage the exploitation of research findings by granting tax concessions in the manner recommended hereunder.

Somewhat the same comments apply to IRDIA to a more limited extent. We believe that tax incentives which encourage a taxpayer to increase his profits provide a more effective and flexible means of promoting the practical application of scientific knowledge than do grants or subsidies. Similarly in the case of research carried out in Canada by foreign-owned corporations, the benefit of tax incentives would be available only if there was accompanying commercial activity in Canada. For these reasons we consider that the scheme of Section 72A of the Income Tax Act was preferable to the IRDIA programme although there were objections to that legislation relating to the use of a base period.

We recognize that it is argued in some quarters that a system of grants or subsidies is preferable to one of tax incentives since it permits participation in the programme by companies which do not have profits sufficiently large to permit them to take advantage of such incentives. It is our impression that the number of such cases must be very small and we find it difficult to see how an unprofitable company could be expected to undertake an effective research programme in view of the large expense and high risk involved. This problem is mitigated by the present income tax provisions permitting a carry-over of business losses. In general, however, we submit that research and its commercial exploitation should be encouraged by making it more attractive taxwise rather than having government become a partner in research. In our view the only case where there is an argument for direct government participation in research programmes is in the case of very costly and risky programmes which are clearly of value to Canadian industry but are beyond the capacity of industry to carry out itself, such as research with respect to solids pipelines. Even in such cases, it is important that the government minimize the administrative difficulties involved in its participation in such programmes.

Our objection to both Section 72A of the Income Tax Act and the IRDIA programme is to the provisions of incentives only with respect to expenditures in excess of those in some base period. This system discriminates against those taxpayers who showed sufficient initiative to engage in research before incentives were available, who took early advantage of such incentives or who made large expenditures during the base period. We suggest that your Committee should be concerned that government incentives should be not merely effective but equitable and non-discriminatory. In fact, it may well be that the objectives of the legislation are not being achieved because of this discriminatory feature. For example, we believe that there could be cases in which research is discontinued or curtailed following high expense years so as to establish a lower base period for the future. It is unfortunate that government policy should produce such disruptions and distortions. We would recommend abandoning the base period even if this involved lowering the incentive rate.

In connection with any plan whether in the form of tax incentives or grants, we recommend that the definition of capital expenditures for research should include the first commercial facility utilizing the results of research as well as those capital items directly involved in research. Such a provision should shorten the time gap between discovery and exploitation. The final steps required to put into commercial operation discoveries made by research are frequently the most expensive and involve the greatest risk. A discovery may be allowed to remain at the applied research stage simply because of the financial risk involved in scaling-up a process or perfecting a product prior to commercial exploitation.

If the Canadian economy is to realize the maximum benefit from research and development, consideration should be given to an additional incentive in the initial years of operation of a new project. We have no precise formula to suggest but this might be in the nature of an easing of the tax rate for a limited period on profits derived from new products or processes resulting from research work performed in Canada.

Our experience also leads us to the opinion that the government incentive programme has been unnecessarily complicated by the creation of a number of plans to meet a variety of situations, their administration by a number of different departments and agencies, and their frequent revision or discontinuation. It is our view that optimum use of incentives by industry has been discouraged by administrative complications of information and uncertainty. In addition, the cost of administering the various programmes both in government and industry must be greater than if the system were simplified. While it may not be possible to devise a single incentive system, it should be possible to simplify and rationalize the present situation. In addition, because of risk involved in research programmes, businessmen are reluctant to commit themselves without some assurance of continuity. We would, therefore, recommend that, so far as possible, government incentive programmes be consolidated and administered through a single agency, or at least have common application and submission procedures. It might also be helpful if a single publication were available outlining the various programmes and the administrative procedures applicable to each. The definition of eligible expenditures should be drafted in such a way as to permit businessmen to determine the eligibility of projects with a minimum of difficulty, and particularly without having to disclose confidential information.

(b) Government Research Agencies

(i) List of Existing Agencies

A variety of governmental departments and agencies in Canada are engaged in research activities. These include:

Defence Research Board
Department of Energy, Mines and Resources
National Research Council
various provincial institutes or councils.

In addition, government bodies from time to time sponsor or participate with industry in associations of various kinds related to specific areas of research such as:

Canadian Carbonization Research Association
Solids Pipeline Research & Development Association.

(ii) Comment on these Agencies and Recommendations

In general, our relations with such bodies have been satisfactory. It is our view that, if the services of government agencies are to promote effectively the aims of science policy outlined above, it is important that they be aimed at objectives which may be exploited commercially and for this purpose that industry have a voice where practicable in the research programme to be pursued and the scheduling of the use of available equipment. This conclusion has been borne out in our relations with research associations sponsored by or using the facilities of foreign governments.

Another important consideration in any such co-operative ventures is that government bodies should appreciate the importance to industry of treating discoveries as confidential if government facilities are to be used to the best advantage by industry. In some cases, we have encountered situations, especially in the U.S.A., where the policy of government agencies seems to be directed to immediate publication of results and to making such discoveries available to all and sundry at nominal cost. Such policy is contrary to the interest of participating companies which may have made large contributions of money, time and know-how and discourages them from co-operation with government bodies.

(iii) Comment on Foreign Government Agencies

We do not favour the establishment in Canada of government-sponsored, industry-wide research associations like BISRA and IRSID. While they are very fine organizations, we consider them appropriate only in countries where industry is nationalized or government regulated. In a free enterprise economy like Canada's, we believe that such organizations would interfere with the spirit of competition and the prerogative of each firm in an industry to reach its own decisions as to whether it wishes to engage in research and the type of programme which it wishes to pursue. We prefer to carry on our own programmes either alone or in voluntary association with other companies or government agencies which have a compatible interest in a particular subject.

(c) Government Information Services

(i) List of Existing Services

One of the greatest problems of the modern scientist is to keep abreast of the vast flow of information which is being produced today. The steel industry has traditionally been very open in the exchange of technological information. However, government can assist in this area by providing centralized clearing houses for scientific information.

In Canada, the following agencies are designed to serve this function:

National Research Council Technical
Information Service
National Science Library
Canadian Patent Office.

(ii) Comment on their Services and Recommendations

We have from time to time made use of the National Science Library and have found the service to be first rate. We would recommend, however, that its facilities should be expanded and steps taken to enable the staff to provide an expanded service, especially as regards a "retrospective search", that is, obtaining relevant information on a given subject, as requested.

The Canadian Patent Office is a storehouse of technology which should be readily accessible to industry as is the case with the U.S. Patent Office. While the staff is courteous and co-operative, we find that the lack of facilities and archaic system of patent retrieval of Canadian patent art forces us to use the U.S. patent art.

With respect to the Technical Information Service, we would recommend that its services should be re-organized, possibly along the lines of the Technical Information and Library Services Reports Centre of the Ministry of Technology of the United Kingdom and of the U.S. National Referral Centre for

Science and Technology, Library of Congress. A summary of the former service is attached hereto as Schedule B.

In addition, we recommend that government employees responsible for disseminating technical information should be given opportunities to study segments of Canadian industry so as to become better acquainted with the information needs of industry through a programme organized with the co-operation of industry. This might be accomplished by a system of sabbatical leaves or assignments.

6. Motivation of Research Personnel

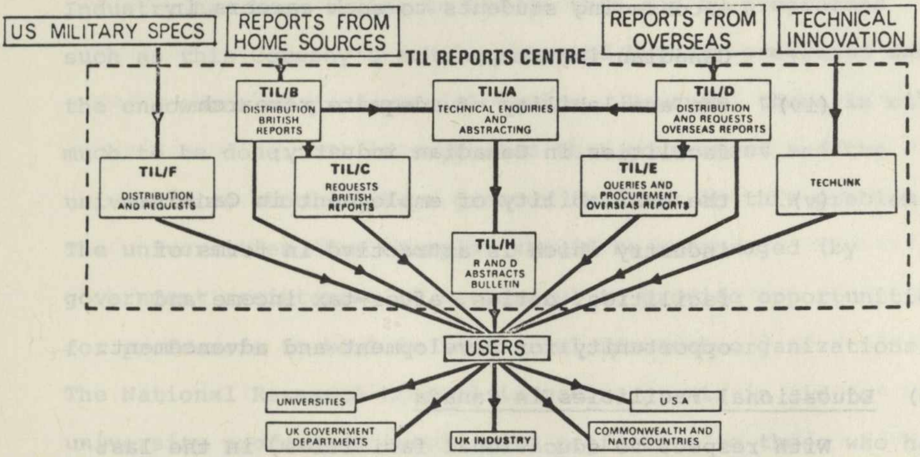
(a) General

In order for a country to have an effective research programme, it is essential to attract, develop and retain highly qualified research personnel. In our view the ability to meet these objectives depends largely on the following factors:

(i) the availability of high-calibre educational facilities in Canada;

(ii) the availability of courses in applied research in the curriculum of our educational institutions and the encouragement of students to enroll in these courses;

Dip into Mintech's TIL—for R & D information



Each year a substantial flow of technical reports pours out from UK government research and development establishments and government sources in Commonwealth and NATO countries. Such reports contain a great deal of information on processes, materials, instruments and systems. For anyone in industry or elsewhere to discover what useful information is available in this mass of material, and to obtain access to it, would be a more than formidable task were it not for the services provided by the Technical Information and Library Services (TIL) Reports Centre of the Ministry of Technology.

The aim of the TIL Reports Centre is to collect all such reports likely to be of interest, and to make them as widely available as possible. This is done through three basic services: regular publication of abstracts and lists of material collected, distribution of a series of leaflets on specific items of technical innovation under the title *Techlink*, and a technical inquiry service which includes the compiling of bibliographies to customer's requirements.

Abstracts are presented as a bulletin, *R & D Abstracts*, published twice a month. They are compiled from the 35,000 new technical reports which the Centre acquires each year. The total stock consists of over half-a-million titles. So massive is the involvement in R & D by the countries represented and so extensive is the subject coverage that almost any interest can be catered for. The subjects include aeronautics; astronomy; atmospheric and earth sciences; behavioural, biological and medical sciences; chemistry; electronics and electrical engineering; energy conversion; materials; mathematics; mechanical, industrial, civil and marine engineering; methods and equipment; military sciences; navigation and communication; nuclear science and technology; ordnance; physics; propulsion and fuels; and space technology. *R & D Abstracts* is obtainable on subscription of £12 per year, which includes free loan of the reports listed. Copies of the reports can be purchased at printing cost. A complimentary copy of *R & D Abstracts* can be obtained from the Centre.

Among the reports from NATO countries are those issued by the US National Aeronautics and Space Administration and certain reports issued by the US Department of Defense. US Military Specifications are also received by the Centre, whose library of these documents currently amounts to 50,000 titles. Apart from their military role, 'Milspecs' are being increasingly used as the basis of commercial specifications, especially by overseas buyers. Of particular interest are the MIL Standards and Handbooks which are comprehensive guides to specialist subjects such as micro-electronics, semiconductor devices, and sampling procedures for inspection and quality control. Lists of newly received US Military Specifications and NASA reports are included as supplements, usually monthly, in *R & D Abstracts.*

Innovation data

The reports announcement service is complemented by the *Techlink* service which provides a rapid and selective communication of information on new ideas, equipment, processes and materials to individuals in industry. A one- or two-page leaflet, each *Techlink* contains the essentials of a particular technical innovation. The material is gathered from the Centre's collection of reports, from the United Kingdom Atomic Energy Authority, the National Research Development Corporation and from the Ministry's own research and development establishments. Each leaflet gives details of where and how further information can be obtained.

At present *Techlinks* are being provided without charge on an experimental basis. They are designed as a personal service to those in industry who are concerned with research, design and development and who can directly exploit the information presented. The subjects covered are classified under 52 headings and customers receive only those *Techlinks* that are relevant to their interests. Included in this service are *Report Announcement Techlinks* which summarise new reports of special technological interest. *Techlinks* or information about the service can be obtained through the Ministry of Technology's Regional Offices (listed on page eight) or a local Industrial Liaison Officer.

With the total literature resources of their library behind them, the scientific and technical staff of the Centre are able to provide an effective technical enquiry answering service. Continuing bibliographies on electronics reliability, microelectronics, fluidics, lasers and metal joining are compiled and published at intervals. Other bibliographies, based on report literature, can be prepared for a small charge.

More information: TIL Reports Centre (Ref NT), Ministry of Technology, Station Square, St. Mary Cray, Orpington, Kent, BR5 3RE. Telex 896866. Tel: Orpington (01-66) 32111, extns. 19 (Techlink); 20 (R & D Abstracts); 25 (technical enquiries); 45 (foreign reports); 102 (British reports); and 110 (US Military Specifications).

(iii) the orientation of university staff towards encouraging students to seek careers in Canadian industry;

(iv) the availability of adequate research facilities in Canadian industry;

(v) the availability of employment in Canadian industry which is attractive in terms of facilities, duties, after-tax income and opportunity for development and advancement.

(b) Educational Facilities in Canada

With respect to educational facilities, in the last twenty years provincial governments in Canada have devoted vast sums to the improvement of education. Industry has made large contributions for the same purpose. Higher education is available to any able student and facilities for scientific education are generally very good. It must be recognized that, because of the rapid expansion of our universities, there are problems in the area of instruction and that our newer institutions have not yet attained widespread recognition. However, these inevitable problems will be solved with time provided that staff of the necessary calibre can be attracted to and retained by our universities.

(c) Orientation of Academic Staff

The orientation of university staff, however, has not always been conducive to attaining the aims of a desirable science policy. Too often in the past there has been a great gulf fixed between business and the academic community. Industry has been trying to bridge this gap by programmes such as this Company's scholarship and bursary programme and the endowment of professorial chairs. However, there is still much to be done. It is suggested that government and the universities should take a greater interest in this problem. The universities, for example, should be encouraged (by government assistance, if necessary) to provide opportunities for professors to work in industrial research organizations. The National Research Council in making grants in aid to university professors should give preference to those who have industrial experience or who are interested in pursuing "oriented" fundamental research related to the national science policy. Professors might make an effort to direct the thesis work of graduate students towards studies of greater practical value to industry.

(d) Employment Opportunities in Canada

With respect to availability of industrial facilities and employment opportunities, we feel that government incentive programmes have contributed greatly to the ability of industry to offer attractive opportunities. We believe that our recommendations in this area would enhance the effectiveness of such programmes.

(e) Tax Policy and the Retention of Research Personnel

In spite of all these efforts and the progress which has been made in recent years, we must never forget that we are competing for available personnel with the U.S.A. which can offer longer established and better known universities with more extensive programmes and a greater number of attractive employment opportunities. Probably the most important factor in determining whether this country can maintain an effective research programme which will achieve the aims set out earlier in this brief is the ability of industry to retain highly trained, motivated, able and experienced research personnel. Research personnel are no more impervious than others to the attractions of higher salaries, larger laboratories and greater opportunities for development and advancement than can be provided in a relatively small country. In addition, these people are in short supply and are highly mobile. We are convinced that there is a serious loss of such people to the U.S.A. One of the most effective ways of making Canada attractive to able people would be to make our tax system attractive as compared with the U.S.A. At the present time, we believe the reverse to be true. Our personal income tax, particularly when combined with gift tax and estate tax, is too highly progressive and too heavily weighted against the able, the industrious and the thrifty. Research personnel tend to be in or working toward the salaried upper middle income brackets on which our tax system rests most heavily. We believe that one of the most important recommendations which we can offer is that the Canadian tax climate should be made sufficiently attractive that highly qualified people will be induced to remain in Canada in spite of the fact that for the foreseeable future employment opportunities will be more attractive in the U.S.A.

May 30, 1969.

APPENDIX 173

BRIEF TO THE

SENATE SPECIAL COMMITTEE ON SCIENCE POLICY

PRESENTED BY

ALUMINUM COMPANY OF CANADA, LTD.

Montreal March 1969

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GENERAL CONSIDERATIONS

Aluminum Company of Canada, Ltd. presents this brief to the Senate Special Committee on Science Policy from the dual standpoint of a corporate citizen and of a business enterprise.

This company, like its parent, Alcan Aluminium Limited - usually referred to as Alcan - is a Canadian enterprise with head office in Montreal which engages in all phases of the aluminum business. While Canada has the third largest per capita aluminum usage in the world, the basic fact remains that Aluminum Company of Canada, Ltd. has to look to export markets to consume some 85 percent of its domestic primary production.

The success of this company depends in large part on its ability to compete internationally as well as on the efficient performance of its personnel and the effective utilization of its assets.

As a corporate citizen, Aluminum Company of Canada, Ltd. believes that the general welfare and further progress of the country - through a sound national policy for research and development - should be built in great part upon the fundamental belief that international trade is a desirable and necessary pursuit for Canada and that this country should use its resources to produce those goods which it can produce most efficiently and - for that portion of these goods exceeding the needs of the domestic market - to exchange them in foreign trade for goods which it is less suited to produce.

As a business enterprise the primary objectives of this company are those of continual growth and increasing profitability by coping with, adapting to, and creating change. To meet these objectives this company relies not only on its extensive applied research and developmental facilities in physical science but also, to a large degree, on the promotion of managerial and inter-personal skills and capabilities, because they have a large influence on creativity, efficiency and productivity. It is felt by this company that these two types of activities cannot be divorced from one another and must instead go hand in hand to achieve optimal results. An overview of Alcan's research activities in these various fields is appended to this submission not because it is comprehensive, but rather because it is indicative of the company's own policy. This summary also is meant to bring to light the rationale behind the accompanying set of suggestions.

The recognition that major change impinges on each country and on each business enterprise with increasing force is continually reshaping the general policies which serve as guidelines for this company, and has had a strong impact on the content of this brief.

The new pervading environment - largely influenced by the computer - has set in motion an irreversible trend toward the "systems" approach for multiplying the effectiveness of human enterprise. It emphasizes such matters as connecting links, accessibility of information, awareness by any organization of the operation of its parts and of its innovating capabilities.

This view replaces static fragmentation by dynamic wholeness. Constant communication and participation thus become essential by-products of constant change. All organizations, to ensure their survival and progress, have to introduce more flexibility and mobility in their behaviour and become more readily responsive. They have to assess more critically and compare more extensively all courses of action and develop a greater awareness of current and emerging challenges, pressures and constraints.

In this context, a Canadian science policy needs to have built-in mechanisms for adjustment and self-renewal to ensure the constant review and improvement of all its facets, in a comprehensive fashion, by intimately involving all the segments of the scientific community - government, universities, industry and independent innovators. In this way this policy would remain adequate and relevant at all times and contribute to the efficient tapping and enhancement of the country's scientific technological resources and to the optimization of the activities deriving from their use.

Such a policy would be apt to accelerate economic growth, increase productivity, encourage employment, upgrade the standard of living, improve education, favour social and cultural development and, generally, make human life more satisfying for Canadians.

SUGGESTIONS FOR A SCIENCE POLICY

As an elaboration on the preceding considerations, it is hereby suggested that the following features be considered for inclusion in a national science policy for Canada.

1. A Coordinating Authority for Canada's Scientific Community

Establish a coordinating authority for Canada's scientific community. It could absorb some of the ongoing research agencies of government, create new ones, and integrate closely their activities with those of other agencies which for various reasons would continue to operate within the sphere of their current departments. This function could be readily undertaken either by an existing instrument or a new one which might take the form of a Department of Science and Technology, but what is of paramount importance in this age of increasing complexity is to make sure that it be provided with the authority to take all necessary means and steps to maximize the over-all return accruing from governmental agencies.

2. A Permanent Advisory Committee

Attach to the coordinating center a permanent advisory committee, representing appropriately all segments of the Canadian scientific community. This committee would review the adequacy and pertinancy of the science policy; evolve a set of national goals to be met by the development and stimulation of science and technology and the encouragement of innovation; propose social and economic objectives and priorities, taking into account the resources, capabilities, needs, characteristics, aspirations and limitations of the country; identify those areas where Canada can compete with advantage; and generally insist on the necessity of assuring greater profitability and more usable results from the government's spending by concentration on research intimately tied to social and economic objectives. This role could possibly be assigned to the Science Council of Canada provided it gave a better representation to all those involved.

3. Liaison Within the Scientific Community

Mostly through the permanent advisory committee, the science and technology center would ensure close and easy liaison between all segments, and the individuals therein, of the scientific community by disseminating information on its activities and through meetings, study sessions, polls and surveys and by facilitating and simplifying direct contacts. A balanced representation of all groups concerned would be maintained on all other advisory and planning committees.

4. Repository for Available Information

Set up, within the new science center, a national information pool which would collect, file, and disseminate all existing data as well as all data currently being generated by government agencies, university research centers and other non-proprietory sources throughout the country, and all other readily available data from foreign sources.

5. Computerized Retrieval of Information

Ensure fast and reliable retrieval of information from the masses of data stored in the national information pool by using a computerized system to permit effective and economical response to any valid request originating from the Canadian scientific community or from any other legitimate party.

6. Change of Emphasis in Research

Encourage the reapportionment of research activities in order to lower the national investment in basic or pure research and to correspondingly increase that portion allocated to applied and developmental research to bring the ratio between these two forms of research in line with that of industrial competitor nations who place a greater emphasis on short-term returns and tangible benefits.

7. Redistribution of Basic Research Activities

Review the allocation of government-sponsored basic research to allow a greater share to university centers and a smaller one to the government's laboratories in order to distribute these activities, and the scientists engaged therein, more evenly across the country.

8. Stimulation of National Research Investment

Develop risk-reducing or risk-sharing mechanisms for research and development in potentially beneficial activities. Contribute, through a variety of well-tailored, flexible and appealing means, to the gradual increase of the overall national investment in these activities at least to the level reached in industrial competitor nations. Such activities, when judiciously selected, play an important role in generating new technologies and improving current ones; in bringing about new products, processes and businesses and ameliorating those already in existence; in solving economic and social problems; in attracting, retaining and developing professional and technical talent; and, more generally, in contributing to the productivity and growth of the country and to its overall well-being.

9. The Initiation of Major Projects

Using a systems approach for selection, planning and implementation, initiate major research projects on problems and tasks exceeding the capabilities of any single party by favouring the joint participation of government, universities and industry. Carry out these projects with the most appropriate organization and in the most efficient manner to minimize the risk inherent in each phase. As was established in the U.S., such large undertakings often do set in motion a chain reaction which spins off scientific, technological, economic and social benefits of considerable and lasting value besides promoting a healthful spirit of collaboration between the participants.

10. Collaboration Between Government and Universities

Maintain federal support at an appropriate level to universities for their participation in basic research.

11. Collaboration Between Universities and Industry

Increase collaboration between the universities and industry by granting, in appropriate cases, a tax write-off for industry-sponsored projects carried out either in academic research centers or in industrial concerns involved.

12. Collaboration Between Government and Industry

For the major projects previously described, and other government initiated projects, award research and development contracts to industry on a competitive basis, except in specific instances where bidding would not be appropriate or practicable.

Support Canadian industry by simplifying, improving and expanding current research and development tax incentive programs such as outlined in Sections 72 and 72-A of the Income Tax Act and consider, in particular, the resumption of the bonus deduction, terminated in 1967, for expenditures over a "base" level. Tax incentives, based on success, are still the best way to stimulate innovation in the private sector of Canadian industry.

Direct federal grants to industry for research and development should be considered in special cases where there is substantial public interest, such as in promoting area development or particular activities.

13. Collaboration Between Government and Small or New Industry

In addition to the above suggestions, the smaller or new enterprise may call for more support, in the form of either generous contracts or of grants and technological help. These additional incentives would have to be weighed against the potential and validity of the claims.

14. Collaboration Between Government and the Independent Innovator

Adequate means have to be devised to encourage inventors and other independent innovators to remain within this country in order for it to benefit from their creativity by providing effective assistance in financing promising inventions through all stages leading to development.

15. Products and Processes

The encouragement of technical innovations should not be limited to products but should also extend to processes. Newness should not be the sole criterion as improvement of existing products and processes is often of prime importance.

16. Behavioural Research and Manpower Development

Innovative and technical proficiency does not by itself ensure success. Extensive studies must also be conducted in management science to increase the conceptual ability of management and to provide them with new tools, especially in regard to decision-making. Similar studies must be undertaken on the social and economic climate for the identification of developing patterns and trends and in behavioural science for the development of more adaptive organizational structures and behaviour, and to increase the personal skills of management and staff for better adjustment to a dynamic environment.

APPENDICES

OVERVIEW OF ALCAN'S RESEARCH EXPERIENCE

As stated previously, this company is continually engaged in a variety of research and development activities. The following description is not intended to cover all phases, rather it provides a short overview supported by a few typical examples of trends and innovations.

The Aluminum Company of Canada, Ltd. is unable to comment on whether foreign ownership is a hindrance to developmental research in Canadian industry. On the other hand, there is no evidence that foreign science and technology are not readily available.

The federal agencies appear to be highly oriented toward pure science. There is little spin-off from NRC research that can be used in the aluminum industry in particular. This may not apply to Canadian industry as a whole, but the question of whether NRC and other government agencies engaged in research relate their programs to the needs of industry in general may well be asked.

Physical Research and Development

Research outlays by this company in 1969 should exceed $15 million. Much of this spending will be concentrated on improvement in process efficiencies and operating techniques, thereby resulting in cost reduction, but attention is focusing increasingly on product-oriented research and related profit opportunities.

In its Kingston, Ontario, laboratory, the company investigates metallurgical problems connected with the fabrication of semi-finished products, and also studies casting, rolling, extruding, welding, finishing and other processes connected with the fabrication and utilization of aluminum.

In its Arvida, Quebec, laboratory, research and development is concentrated on improving processes in the raw material and smelting fields and on increasing production efficiency. Tolerances on trace impurities, alloy composition limits, metal cleanliness, gas content, grain size and metallurgical structures are being progressively reduced, as new applications are sought and customer requirements become more stringent. To meet these demands successfully, improvements are being sought in methods of handling molten metal during transfer, and in holding, remelting and casting the metal. Concurrently, the quest continues for greater refinement in analytical methods and quality control.

In the Montreal General Engineering Departments and in other research facilities the company is engaged in the design and improvement of various types of plants and processes for production and fabrication. Other developmental work is accomplished in plant laboratories and under actual production conditions. The task force approach is often used on major projects.

There is a continuing study and evaluation of methods for improving hydro-electric power production and transmission. For instance a patent has been granted for a unique self-damping cable for use in overhead transmission lines. Field testing has successfully proven the value of such a system in preventing aeolian vibration and several power utilities are currently making line installations.

The company's fabricating and manufacturing operations maintain developmental activities which give rise to new processes, equipment and products which contribute to increasing sales in existing markets and the penetration of new ones. In this respect, the marketing research function provides much useful data and guidance.

One interesting example is a new continuous electrochemical pre-treatment process for lacquered coiled sheet to be used in can making. The first commercial unit is now in operation, with three others being designed, one of which will run at speeds considerably faster than conventional chemical treatment lines.

Research conducted on lubricating oils has made possible the production of coiled sheet and foil at significantly increased speeds and with greatly improved surface appearance. Another phase of this broad process improvement program was the development of a continuous monitoring system for control of flatness during rolling. All of this work contributes to higher rolling productivity with improved quality.

A rolling mill under construction in Arvida represents in many respects a breakthrough in the production of re-roll sheet stock, for it will be the first installation of its kind in the world using the Hazelett ingot caster in tandem with a rolling mill to produce re-roll stock continuously, using molten aluminum direct from Alcan's Arvida smelter. This undertaking, supported by the Department of Industry and Commerce, will considerably reduce the need for high inventories and its flexibility will make possibble deliveries within several days, rather than weeks, in exceptionally urgent cases.

Another prime example of innovation is the method of construction designed to fill the need for single-family housing of good quality at a cost more within the reach of wage earners than that of housing constructed by standard methods. It consists of fully finished, factory-produced houses. This method was initiated early in 1968 at a new plant in Woodstock, Ontario.

Other important developmental work is pursued vigorously in a variety of fields extending from transportation to boating.

The company has cooperative programs underway with various chemical engineering academic groups - especially with the University of Windsor and with McMaster University. It also maintains close association, including summer employment, with professors of the University of New Brunswick, University of British Columbia, Ecole Polytechnique, Laval, etc. These contacts have been very beneficial to the company and it is planned to continue and expand them.

An interesting step in this connection was the inauguration, first in 1955, at the Universities of Toronto and McGill and, later, in 1960 at Ecole Polytechnique and the University of British Columbia, of a program of research fellowships. Enlargement of contacts with the teaching staffs and, with high calibre students who are also prospective employees, has provided a tangible return.

Behavioural Research and Manpower Development

To gear itself to the situation caused by strong environmental pressures, the company attempts to keep its finger on the pulse of society through its Public Relations Research Department. It thereby develops an awareness at all times of how the social situation of the organization is evolving with respect to its environment and deduces, from its studies, specific viewpoints and suggestions for keeping the company attuned to the times. Through such means as attitude surveys, this department measures the familiarity of the population with the firm, and its favourability, and also establishes its profile in regard to employer role, ethical reputation, product reputation, customer relations, plant community relations, civic responsibility and corporate vitality.

As the company's organizational structure and leadership patterns must remain adjusted to the rapid change in technologies and markets, the Staff Training and Research Division of the Personnel Department has developed, since 1961, a laboratory approach to organization development which has involved more than 1,000 supervisory personnel at levels ranging from foreman to president.

Throughout the years inter-personal competence has remained one of the primary goals of this program. It also encompasses an overriding concern with the inter-group relations problems, especially those arising from competitiveness and deals with intra-personal insight and inter-personal skill. This is particularly important because there are always many task forces at work, comprised of people with different departmental and functional identification, and representing different levels of authority. It has been found that such temporary groups benefit greatly from human laboratory experience.

Decisions have to be less routine and more innovative in a more complex environment, and this approach favours newer, more adaptive methods of making them. The organization is thus becoming better suited to constantly changing markets and industrial conditions.

Managers require not only inter-personal skill and sensitivity to human and social variables in the industrial complex, but also further theoretical knowledge and intellectual sophistication. Consequently, programs have been set up to deepen their concepts of the managerial role and assist them in acquiring greater understanding of the implications of changing technology and external environment.

Management development is a joint responsibility of the individual employee and of his superiors who play the key role in his day-to-day development. Central coordination is provided by the Staff Personnel Division. Various resource groups in the training and personnel areas offer essential services. For example, at installations distant from large centres, the company has helped technical employees to update their skills by employing university professors during the summer to give courses and conduct seminars and by using the VERB system to conduct long-range lectures during the winter months. Works staff enjoy fruitful interchanges with universities through co-op and technical exchange programs as well as contacts with individual professors.

Development through experience on the job is insured by a carefully coordinated program of job rotation and advancement, which seeks to provide the appropriate learning experience at crucial points in each employee's career.

In 1967 a variety of programs of educational assistance in force at the various installations were augmented by an integrated continuing education policy, in order to increase the effectiveness of the Company's program in this area. It is available to most staff employees, and is implemented at each location by means of a specific program adapted to local conditions.

The distinguishing features of this policy are emphasis on flexibility and adaptability, and reliance upon the judgement of employees and management. A request for assistance may be initiated by either an employee or the company. Any form of education - related to the needs of the company - may be considered, and no limit is set on the amount of assistance granted. An advisory committee has been set up to foster the development of the program and to keep it abreast of change in the relevance of education to the needs of industry. In other words, continuing education is thereby recognized as an integral part of the work situation. The emphasis is not on whether assistance should be given but rather on what kind of course is appropriate. The official statement on "Company Assistance for Administrative, Professional and Technical Employees for Continuing Education" is attached.

This policy also encompasses a centrally coordinated procedure which, since 1946, has provided for the annual selection of several employees to attend the one-year course of the company's Management Development Program in Geneva.

Health-Oriented Research and Development

Some of the programs undertaken by the Health Services of the Aluminum Company of Canada, Ltd. are mentioned briefly below.

The company has undertaken much research in ergonomics - that is, in human factors involving sensorimotor energy expenditure in productive work. This includes physiological studies conducted since 1944; equipment design related to human constraints, and the need to mechanize highly stressful elements of jobs; job design in conjunction with human factor considerations; and selective placement of personnel by matching physical demands of jobs with physical capabilities of individuals.

Toxicological research - into the effect of exposure to certain chemicals on human beings, animals and vegetation - and epidemiological research are pursued on a regular basis with the close participation of universities. New knowledge and original analytical techniques have evolved from this program. For the same purpose, Alcan owns and operates its own farm in the Saguenay District. The latter also serves to provide instruction in farm management to the local rural population.

Accident prevention research has brought into existence improved standards of illumination, noise levels, eye protection, safety clothing, etc.

Through continuous cooperation and collaboration with university researchers working in our installations, deleterious effects from the rapidly increasing pace of technological change on employees are being reduced. Finally, several company health centres - besides undertaking periodic voluntary examinations of employees - conduct statistical studies based on their records, disseminate health education information and initiate industrial hygiene programs.

Management Science Research and Development

The growing complexity of business has prompted the company to have its Systems Development Department review its information requirements in many areas, with the purpose of improving decision making.

An excellent example is the new computerized metal records system implemented in December 1967, which daily relates sales commitments to smelter inventories. It facilitates customer service, inventory management and production planning and scheduling. Tied in closely with it is an allocation and bookings control system which provides guidelines and additional data.

A goal which is being given much close attention is the development of an in-line system for tactical or short-range planning, as well as another for medium-range planning.

When analytical tools fail, the methods of model-building and simulation can still be used successfully. While requiring a large amount of computer programming, simulations are not necessarily mathematical in nature, but are logical and can therefore be applied to complex industrial problems, where good compromises replace best solutions. For instance, this approach has been used to design a system for preparing a weekly production schedule for the company's casting alloys production facilities. It is also paying off in analytical study to rationalize and improve the selection of products as part of a pre-production policy.

Another system has been designed to calculate sags and tensions in transmission lines subjected to a variety of loading conditions. It is used both for supplying tabulations on cable conditions and for the company's research purposes. A variation of this program presents the results in a graphical format.

A computer program has been written to simulate the hot metal production facilities existing in the company's smelters. It calculates the contribution from various outputs to determine which production level best satisfies the full range of the sales forecast.

The critical path and Pert techniques have contributed to the improvement of the control of several construction projects. Other studies involve structural engineering, electrical design, utilization of port facilities and other phases. Much progress has also been achieved in computer control of operations, particularly in smelters.

1st September 1967

ALUMINUM COMPANY OF CANADA

COMPANY ASSISTANCE TO ADMINISTRATIVE, PROFESSIONAL AND TECHNICAL EMPLOYEES FOR CONTINUING EDUCATION

Foreword

The Company, recognizing that its success depends on the abilities of its employees, has normally encouraged self-development by giving added or broader responsibilities to those who have increased their skills and knowledge. It has helped many to improve their qualifications and capabilities through continuing education and, to keep pace with the growth of knowledge, and technological, economic and social change, has decided to make more aid available and to broaden its scope. To this end, a more comprehensive programme of assistance for continuing education has been established.

The application of new knowledge is of mutual benefit to the individual employee and to the Company, and they have mutual responsibility for its acquisition. Every person in a supervisory position is called upon to identify education which would benefit the Company and to recommend it for qualified employees in his area of responsibility. The individual employee has a corresponding opportunity to propose appropriate education for himself.

The continuing education programme will assist employees to attend suitable formal courses, but the Company recognizes, and employees will recognize, that coaching and instruction received during the course of normal employment and experience gained through daily work are also a form of education and as such, augment the employee's personal, professional, and occupational qualifications.

I. Objectives of the Programme

This programme will help to assure the continued availability within the Company of the skilled and qualified employees necessary to its success:

1. By encouraging self-improvement and providing comparable educational opportunities at all Company locations.
2. By aiding administrative, professional, and technical employees who wish to supplement their employment experience and/or improve their academic qualifications by means of suitable courses of continuing education.

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II. Definitions

For the purpose of this statement, the following definitions shall apply:

1. "Continuing education" means education of an employee during his period of employment by the Company.

2. "Assistance" means financial aid given by the Company to employees continuing their education.

3. "Administrative, professional, and technical employees" are defined below:

(These classifications are neither mutually exclusive nor all-embracing).

(a) "Administrative Employees" are employees occupying administrative posts.

(b) "Professional Employees" are employees who possess university degrees or their equivalent.

(c) "Technical Employees" are other employees whose work requires a high degree of specialized knowledge in such fields as the physical sciences, finance, and personnel administration.

III. Terms of Assistance

1. The extent and type of assistance will be determined by the employee's present qualifications, the nature of the proposed course of studies, and the needs of the Company and the employee at the time at which the application is made.

2. Once approved by the Company, Assistance will vary from 50% to 100% of tuition costs, according to the circumstances of each case.

3. Where appropriate, a supplementary allowance will be provided to cover expenses related to either Company-initiated or employee-initiated courses.

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4. Assistance will be provided on evidence of registration in the course of study.

IV. Responsibilities of the Assisted Employee

The Company will rely on the good judgement and sense of responsibility of its employees, rather than formal obligations, to ensure that its expenditures on Continuing Education will benefit both the Company and the assisted employee. The employee may, however, be asked to give his opinion of a course for which he has been assisted. This measure is intended to provide information on courses, not on the achievements of the employees.

V. The Advisory Committee on Continuing Education

1. The Committee will be appointed by the Vice-President - Personnel.

2. The Committee will be composed of about five senior employees, representing insofar as possible a cross-section of disciplines and business functions.

3. A permanent secretary will be provided by the Personnel Department.

4. In order to assist Management in using this programme to compensate for differences in educational opportunity between locations, the Committee will assemble and make available information on continuing education programmes both within and outside the Company.

   (a) The Committee will record precedents for the granting of assistance and, drawing upon the opinions of participants, their superiors, and Company specialists, will evaluate courses. It will also maintain a listing of employees qualified to act as instructors for internal courses.

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(b) The Committee will advise Management on the implementation and development of the programme. It will recommend guidelines for setting rates of assistance and evaluating individual programmes and will keep Management informed of the costs of the Continuing Education Programme. It will give the Works Manager or Montreal Department Head information enabling him to compare his programme with the general practice in the Company and will supply him with other data or advice at his request.

5. The Committee will prepare information on the Company's Continuing Education Programme for potential applicants and their superiors and may interview some applicants.

VI. Implementation Procedures

1. Assistance may be initiated by the candidate himself, by Works or Montreal Departments.

2. The following procedure will be used:

(a) Application forms for assistance will be made available.

(b) The applicant who acts on his own initiative will apply through his immediate superior.

(c) The Works Manager or Department Head will consider the merits of the case and (except as provided for in Section VI-4 below) will decide what assistance will be offered.

(d) The particulars of all requests decided at the local level will be made known to the Advisory Committee. Where appropriate, (see for example, Section VI-4. (c) and (d)), the Committee may undertake to find an alternative source of assistance.

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(e) If the applicant is not granted the assistance requested, the reason for the decision will be discussed with him. He may submit an alternative request, or, after a suitable interval, repeat the original.

(f) Applications which are subject to central decision, (See Section VI-4 below), and others which the Works Manager or Montreal Department Head chooses to refer, will be forwarded with his recommendations to the Head of his Division and a copy will be sent to the Committee. After reviewing the request and, possibly, interviewing applicants, the Committee will offer its comments to the Head of the Division, or other appropriate authority, who will make the final decision.

3. Requests initiated by Management will be subject to the same procedure as requests initiated by applicants (i.e. certain categories of assistance will be awarded by central decision, and all awards made will be reported to the Advisory Committee for recording).

4. In the following cases, the final decision on assistance will be made centrally.

(a) All cases where the period of paid absence or the total expenditure for a single employee (tuition plus related expenses, exclusive of salary) exceeds that which a Works Manager or Department Head is permitted to authorize for other purposes.

(b) All cases involving a course of study for which Management decides to limit total Company expenditure or for which the number of Company employees who can attend is limited by the decision of Management or by other considerations.

(c) All cases where the Works or Montreal Department thinks that the Company may benefit by the expenditure but is unwilling to accept responsibility for the cost.

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(d) All cases where the Works or Montreal Department prefers to delegate the final decision.

VII. Budgeting of Expense

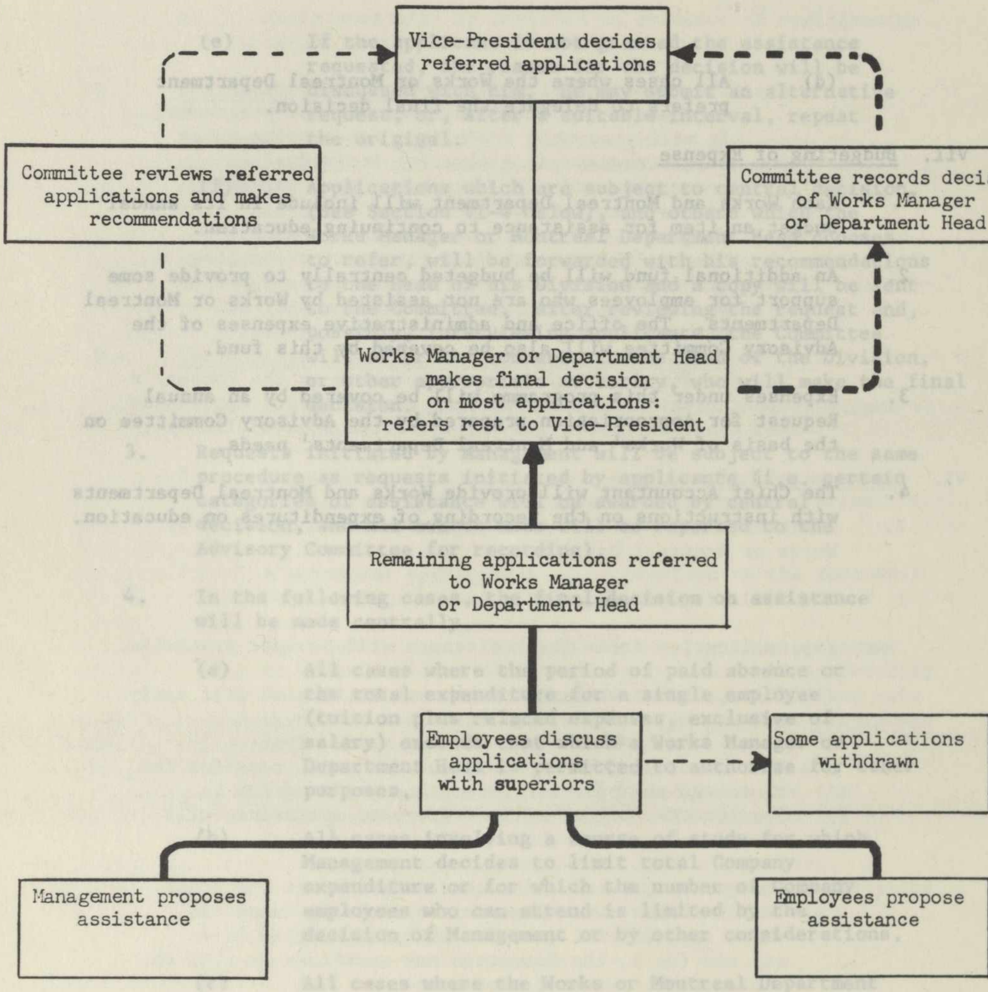
1. Each Works and Montreal Department will include in its annual budget an item for assistance to continuing education.

2. An additional fund will be budgeted centrally to provide some support for employees who are not assisted by Works or Montreal Departments. The office and administrative expenses of the Advisory Committee will also be covered by this fund.

3. Expenses under this programme will be covered by an annual Request for Appropriation prepared by the Advisory Committee on the basis of Works' and Montreal Departments' needs.

4. The Chief Accountant will provide Works and Montreal Departments with instructions on the recording of expenditures on education.

FLOW CHART FOR ASSISTANCE TO CONTINUING EDUCATION



First Session—Twenty-eighth Parliament
1968-69

THE SENATE OF CANADA

PROCEEDINGS
OF THE
SPECIAL COMMITTEE
ON

SCIENCE POLICY

The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*
The Honourable DONALD CAMERON, *Vice-Chairman*

No. 72

TUESDAY, JUNE 24th, 1969

WITNESSES:

The Bobtex Corporation Limited: Dr. Emilian Bobkowicz, President, Dr. A. J. Bobkowicz, Vice-President, Research and Development; Air Industries Association of Canada: Dr. D. A. Golden, President, Mr. S. Roth, Chairman, Research and Development; United Aircraft of Canada Limited: Mr. R. D. Richmond, Vice President (Operations) and Member of the Board of Directors, Mr. Elvie L. Smith, Vice-President (Engineering); Aviation Electric Limited: Mr. D. R. Taylor, President; Canadair Limited: Mr. R. J. Ross, Chief Development Engineer.

APPENDICES:

174—Brief submitted by The Bobtex Corporation Ltd.
175—Brief submitted by Air Industries Association of Canada
176—Brief submitted by United Aircraft of Canada Limited

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MEMBERS OF THE SPECIAL COMMITTEE
ON
SCIENCE POLICY

The Honourable Maurice Lamontagne, *Chairman*

The Honourable Donald Cameron, *Vice-Chairman*

The Honourable Senators:

Aird	Grosart	Nichol
Bélisle	Haig	O'Leary (*Carleton*)
Blois	Hays	Phillips (*Prince*)
Bourget	Kinnear	Robichaud
Cameron	Lamontagne	Sullivan
Carter	Lang	Thompson
Desruisseaux	Leonard	Yuzyk
Giguère	McGrand	

Patrick J. Savoie,
Clerk of the Committee.

ORDERS OF REFERENCE

Extract from the Minutes of the Proceedings of the Senate, Tuesday, September 17th, 1968:

"The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That a Special Committee of the Senate be appointed to consider and report on the science policy of the Federal Government with the object of appraising its priorities, its budget and its efficiency in the light of the experience of other industrialized countries and of the requirements of the new scientific age and, without restricting the generality of the foregoing, to inquire into and report upon the following:

(*a*) recent trends in research and development expenditures in Canada as compared with those in other industrialized countries;

(*b*) research and development activities carried out by the Federal Government in the fields of physical, life and human sciences;

(*c*) federal assistance to research and development activities carried out by individuals, universities, industry and other groups in the three scientific fields mentioned above; and

(*d*) the broad principles, the long-term financial requirements and the structural organization of a dynamic and efficient science policy for Canada.

That the Committee have power to engage the services of such counsel, staff and technical advisers as may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to examine witnesses, to report from time to time, to print such papers and evidence from day to day as may be ordered by the Committee, to sit during sittings and adjournments of the Senate, and to adjourn from place to place;

That the papers and evidence received and taken on the subject in the preceding session be referred to the Committee; and

That the Committee be composed of the Honourable Senators Aird, Argue, Bélisle, Bourget, Cameron, Desruisseaux, Grosart, Hays, Kinnear, Lamontagne, Lang, Leonard, MacKenzie, O'Leary (*Carleton*), Phillips (*Prince*), Sullivan, Thompson and Yuzyk.

After debate, and—

The question being put on the motion, it was—

Resolved in the affirmative."

Extract from the Minutes of the Proceedings of the Senate, Thursday, September 19th, 1968:

"With leave of the Senate,

The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That the name of the Honourable Senator Robichaud be substituted for that of the Honourable Senator Argue on the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—
Resolved in the affirmative."

Extract from the Minutes of the Proceedings of the Senate, Wednesday, February 5th, 1969:

"With leave of the Senate,

The Honourable Senator McDonald moved, seconded by the Honourable Senator Macdonald (*Cape Breton*):

That the names of the Honourable Senators Blois, Carter, Giguère, Haig, McGrand and Nichol be added to the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—
Resolved in the affirmative."

ROBERT FORTIER,
Clerk of the Senate.

MINUTES OF PROCEEDINGS

TUESDAY, June 24, 1969.

Pursuant to adjournment and notice the Special Committee on Science Policy met this day at 3.00 p.m.

Present: The Honourable Senators Lamontagne (*Chairman*), Blois, Bourget, Grosart, Haig, Kinnear, McGrand, Phillips (*Prince*), Robichaud and Yuzyk—10.

In attendance: Philip J. Pocock, Director of Research (*Physical Science*).

The following witnesses were heard:

THE BOBTEX CORPORATION LIMITED

Dr. Emilian Bobkowicz, President

Dr. A. J. Bobkowicz, Vice-President Research and Development

AIR INDUSTRIES ASSOCIATION OF CANADA

Dr. D. A. Golden, President

Mr. S. Roth, Chairman, Research and Development

UNITED AIRCRAFT OF CANADA LIMITED

Mr. R. D. Richmond, Vice-President (Operations) and Member of the Board of Directors

Mr. Elvie L. Smith, Vice-President (Engineering)

AVIATION ELECTRIC LIMITED

Mr. D. R. Taylor, President

CANADAIR LIMITED

Mr. R. J. Ross, Chief Development Engineer

(*A curriculum vitae of each witness follows these Minutes*)

The following are printed as Appendices:

No. 174—Brief submitted by The Bobtex Corporation Ltd.
No. 175—Brief submitted by Air Industries Association of Canada
No. 176—Brief submitted by United Aircraft of Canada Limited.

At 5.10 p.m. the Committee adjourned to the call of the Chairman.

ATTEST:

Patrick J. Savoie,
Clerk of the Committee.

CURRICULUM VITAE

Bobkowicz, Dr. Andrew J.: Born in 1936 in Lódz, Poland: Description: Canadian, Married, 5' 11", 180 lbs., 4 children. Languages Polish, French and English. Academic Background: Completed Public School in Poland. Completed one year out of a two year course leading to a degree in Commerce and Economics, in a commercial pre-university Licee (equivalent to the Canadian CEGEP) 1948. Left Poland and completed 1948-49 academic session in Ecole Primaire, Boulogne-Billancourt (Seine), in Paris, acquired a working knowledge of French and English languages. 1953—graduated from Westmount Senior High School, Montreal (cum laude). 1958—Bachelor of Engineering (Chemical), McGill University. 1963—Doctor of Philosophy (Chemical Engineering), McGill University under the auspices of the Pulp and Paper Research Institute of Canada. Title of Doctoral Dissertation: "The Effects of Turbulence on the Flow Characteristics of Model Fibre Suspensions" under the direction of Dr. W. H. Gauvin. Supplementary Education: High Polymers (special course) McGill University 1957. International Trade Course, Sir George Williams University and The Montreal Board of Trade 1960 (placed first). Structure and Mechanical Properties of Fibers and Crystalline Polymers, MIT, 1964. Structural Mechanics of Textile Materials, MIT, 1964. Dynamics of Textile Processes, MIT, 1964. Extrusion principles and practices, International Plastics Industry Consultants Inc., New York City 1967. PACER workship, Dartmouth College, Thayer School of Engineering, Hanover, New Hampshire 1967. Prizes, Honors, Scholarships and Awards: 1953—Westmount Senior High School citation for obtaining the highest scholastic standing in chemistry. 1953—Westmount Senior High School citation for obtaining the highest scholastic standing in physics. 1958—Chemical Institute of Canada, First Prize, student technical paper contest (paper entitled "Thermal Diffusion"). 1958-59—McGill University and National Research Council Summer Grants. 1959-60, 1960-61, 1961-62—McGill University, recipient of the D.S. and R.H. Gottesman Foundation Scholarship. 1960—Sir George Williams University and The Montreal Board of Trade citation for first standing in the International Trade Course. 1960-61, 1961-62—McGill University, Pulp and Paper Research Institute of Canada Summer Scholarships. Industrial Consultant and Lecturer on Digital Computer Applications: Special Lecturer in the Chemical Engineering Department, McGill University since 1963, "Digital Computers in Process Calculations". Special Consultant to the Noranda Research Centre on application of computers between 1963 and 1965.

PAPERS, PUBLICATIONS AND PATENTS

1. "THERMAL DIFFUSION, C.I.C. Student Paper Contest, Montreal, February 1958.
2. "THE TURBULENT FLOW OF MODEL FIBRE SUSPENSIONS", Joint A.I.Ch.E.-C.I.C. Chemical Engineering Conference, Cleveland, Ohio, May 1961. (Co-authored with Dr. W. H. Gauvin).
3. "THE NEW TREND IN FIBRE PROCESSING TECHNOLOGY", Twenty-First Annual Meeting of the Soil and Crop Science Society of Florida Proceedings, *21,* 148-170 (1961).

4. "NEW TRENDS IN FIBRE PROCESSING TECHNOLOGY", The Cotton Trade Journal, 30th International Edition, 26 (1962-63).
5. "THE TURBULENT FLOW CHARACTERISTICS OF MODEL FIBRE SUSPENSIONS", Paper presented at the 13th Annual Chemical Engineering Conference of the Chemical Institute of Canada, Montreal, Canada, October 1963. Bobkowicz, A. J. and Gauvin, W. H., Canadian Journal of Chemical Engineering *43*, 87-91 (April 1965).
6. "THE EFFECTS OF TURBULENCE ON THE FLOW CHARACTERISTICS OF MODEL FIBRE SUSPENSIONS", Paper presented at the 56th. Annual Meeting of the American Institute of Chemical Engineers, Houston, Texas, December 1963. Bobkowicz, A. J. and W. H. Gauvin, Chemical Engineering Science, *22*, 229-241 (1967).
7. "TEXTURED FILAMENT YARN" Patent filed in 22 countries (1963). (Co-authored with and assigned to Mr. Emilian Bobkowicz).
8. "PARALLELIZATION OF STAPLE FIBERS BY ELECTROSTATIC MEANS", patent in Canada and the U.S.A. (1965). (Co-authored with Mr. Emilian Bobkowicz).
9. "UNIVERVAL OPEN-END SPINNING METHOD OF MULTICOMPONENT YARNS PRODUCTION", patent filed in 29 countries (1967). (Co-authored with Mr. Emilian Bobkowicz).
10. "MANUFACTURE OF FIBERTAPES", patent filed in 29 countries (1967) (Co-authored with Mr. Emilian Bobkowicz).
11. "METHOD AND APPARATUS FOR RINGLESS SPINNING OF FIBER-POLYMER YARNS" patent filed in Canada and U.S.A. (1968). (Co-authored with Mr. Emilian Bobkowicz).

PROFESSIONAL SOCIETIES: Member: American Institute of Chemical Engineers, The Corporation of Professional Engineers of Quebec, The Engineering Institute of Canada, Canadian Society for Chemical Engineering, Association of Polish Engineers in Canada, Computer Society of Canada, Association for Computing Machinery, The Soil and Crop Science Society of Florida, Montreal Board of Trade, the post-graduate honourary Society of the Sigma Xi, The Fiber Society, Province of Quebec Chamber of Commerce, The Institute of Textile Science, Society of Plastics Engineers Inc. PREVIOUS EMPLOYMENT: Summer Employment: Belle Glade Experimental Station, Florida, U.S. Department of Agriculture (Ramie fiber decorticating) 1955; North American Cyanamid Limited, Niagara Falls, Ontario, (development—calcium carbide and cyanamide production) 1956; DuPont Company of Canada Ltd., Kingston (development—nylon textile fibre production) 1957; McGill University, Part-time demonstrator, 1958-59, 1960, 1961. TEXTILE BACKGROUND: Since his birth, Dr. Bobkowicz was practically constantly exposed to textile oriented matters. The city of his birth, Lódz, is the largest textile centre in Poland and is otherwise known as the "city of a thousand chimneys", the latter all stemming from textile mills. At home he was constantly aware of his father's textile materials and machines transactions and more recently of the textile inventions and new ideas. These were always discussed frequently and openly and with a great deal of father-son-participation. Dr. Bobkowicz's interest is therefore deeply rooted. Two of his Summer Technical Papers for McGill were on textile subjects, the first on "Ramie Fibers" and the second on "Nylon Yarn Production". His knowledge of Ramie cultivation, decortication and utilization stemmed from experience gained by spending part of the summer of 1955 at the Everglades Experiment Station in Bell Glade, Florida, where the U.S. Government is conducting research on Ramie cultivation under the direction of Dr. R. V. Allison. His know-how on nylon textile yarn production was gained while employed at the DuPont of Canada nylon plant in Kingston. The textile inventions of his father, Mr. Emilian Bobkowicz, further heightened his interest and encouraged him to absorb books and technical literature on all aspects of the textile industry on a continuous basis, which he has now been doing for a number of years. With the advent of the man-made fiber industry, dominated by the chemical corporations, and the revolutionary ideas encompassed in his father's inventions, Dr. Bobkowicz's Chemical Engineering training really became the necessary qualifications of the new generation of textile experts. The marriage of chemistry and conventional textile processing resulted in the chemical engineer being the new style textile engineer, particularly if one also considers the role played in these developments by the paper manufacturing process, traditionally the domain of the chemical engineer. In this respect, Dr. Bobkowicz's link with the Pulp and Paper Research Institute of Canada and the choice of thesis work performed for his doctorate was particularly fortunate and generated an exceedingly suitable background for his further work in the development and implementation of his father's textile inventions, in some of which Dr. Bobkowicz is a co-inventor himself. The more detailed interrelations involved are further discussed in Dr. Bobkowicz's paper on "The New Trend in Fiber Processing Technology". Current Position: Since 1963, Research Director and Vice President in charge of R.&D. of Emilian Bobkowicz Limited. Since 1967, Research Director, Vice President in charge of R.&D. Treasurer and Director of The Bobtex Corporation Limited.

Bobkowicz, Emilian: Born 1903 in Poland; immigrated into Canada 1949; obtained Canadian Citizenship 1955. Married with two children. Education: Master degree, Political/Economical Science, Warsaw Academy of Political and Economical Science. Languages: English, Polish, Russian, German.

Golden, David A. Mr. Golden was born in Sinclair, Manitoba on February 22, 1920. He graduated from the University of Manitoba Law School with the degree of LL.B., in 1941, and received the Honourable Alexander Morris Exhibition for highest standing in all four years of the University law course. He was appointed Rhodes Scholar in 1940. Mr. Golden enlisted in May, 1941 in the 1st Battalion, The Winnipeg Grenadiers, and served in Canada, Jamaica and Hong Kong. He was a prisoner of war in Hong Kong from December 1941 until September 1945 and was discharged from the army in December, 1945, with the rank of captain and adjutant. In January, 1946 he started the practice of law in Winnipeg with Mr. Samuel (now The Honourable Mr. Justice) Freedman, under the firm name of Freedman and Golden. He attended The Queen's College, Oxford, from October, 1946 until June, 1947. On his return to Winnipeg he resumed the practice of law and also lectured at the Manitoba Law School. In May, 1951 Mr. Golden joined the Department of Defence Production as Director of the Legal Branch and a year later assumed the additional post of Associate General Counsel. In February, 1953 Mr. Golden was made Assistant Deputy Minister and General Counsel of that department. Mr. Golden was appointed Deputy Minister of Defence Production on September 30, 1954, and became President of the Northern

Ontario Pipeline Crown Corporation in June, 1956. Appointment to his present position, President of Air Industries Association of Canada came on July 1, 1962. Mr. Golden also serves as a Governor of Carleton University, Vice-President of National Capital Arts Alliance, Vice-President of Ottawa Canadian Club, and a Director of Atomic Energy of Canada Limited. He is married to the former Molly Berger of Estevan, Saskatchewan, and has three children; two sons and one daughter.

Richmond, R. D.: Position: Vice President (Operations) and Member of the Board of Directors. Company: United Aircraft of Canada Limited, Longueuil, Quebec. Born: Winnipeg, Manitoba—1919. Education: University of Michigan BSE 1942 (Aeronautical Engineering). Career: National Research Council—Ottawa, Ontario 1942—Junior Aeronautical Engineer; Fairchild Aircraft Limited—Longueuil, Quebec 1942—Chief of Aerodynamics and Flight Test; Canadian Car and Foundry Ltd. (Aircraft Division) Montreal, Quebec; 1947—Senior Development Engineer; Canadair Ltd.—Montreal, Quebec; 1949—Chief of Aerodynamics; 1959—Vice President, Missiles and Systems Division; United Aircraft of Canada Limited—Longueuil, Quebec; 1960—Vice President (Operations). Associations: Fellow, Canadian Aeronautics and Space Institute; Associate Fellow, American Institute of Aeronautics and Astronautics; Member, The Engineering Institute of Canada; Member, Corporation of Professional Engineers of Quebec.

Ross, Robert James, D.C.Ae, M.I.Mech.E, A.F. C.A.S.I., C.Eng, P. Eng. Robert James Ross, Chief Development Engineer at Canadair, is a Canadian citizen, born at Farnham, England. He attended the Royal Aircraft Establishment Technical College, Farnborough, England, from 1941 to 1946, where he received Higher National Certificates in Mechanical & Aeronautical Engineering and the R.A.E. Diploma in Engineering. He then completed two years post graduate study at the College of Aeronautics, Cranfield, England, receiving his D.C.ae, in 1948. He began his career as a scientific officer with the Ministry of Supply in the Aerodynamics Flight Section at the Royal Aircraft Establishment Farnborough, engaged on aerodynamics research in flight. In 1952, he joined Canadair as an Aerodynamics Engineer. In the ensuing years, he has held various posts in the Engineering Division of Canadair, including those of Chief Dynamics & Flight Test Engineer and Director, Research & Development. He received his present appointment in May 1969. He was a member of the NRC Associate Committee on Aerodynamics for 3 years, and is currently a member of the Research & Development Committee of the Aircraft Industries Association.

Roth, Sam: Vice-President, Program Development CAE INDUSTRIES LTD. Sam Roth, 44, was born and educated in Montreal, where he received his B.Eng. Electrical degree from McGill University in 1948. He joined Canadair Ltd. in 1948 and was Section Chief, Electronics Research and Development, Aircraft Division when he left to join the Electronics Division of CAE Industries Ltd. in 1960 as Manager, Research and Development Department, Engineering Division. He was named Manager, Research and Development Programs in 1963, and was appointed to his present position as Vice-President, Program Development in 1967. Mr. Roth is a member of the Corporation of Professional Engineers of Quebec, and the Institute of Electrical and Electronic Engineers. Mr. Roth was on the Executive of the Air Industries Association's Research & Development Committee from 1966 to 1968 and is currently Chairman of Research & Development.

Smith, Elvie L.: Vice-President—Engineering, United Aircraft of Canada Limited. Mr. Smith joined United Aircraft of Canada Limited in 1957 as a Senior Analytical Engineer in charge of the performance section. He was appointed to increasingly responsible positions of Chief Project Engineer, Development Engineer and Engineering Manager to his present position of Vice-President—Engineering. Prior to joining this Company and following a short period of lecturing at Perdue University, Mr. Smith joined the Engine Laboratory, National Research Council, Ottawa, where he was active in Research on gas turbine anti-icing and thrust augmentation systems until 1954. For the period following and until joining the Company he worked with the Flight Research Section of the National Aeronautical Establishment on turbojet afterburners. Mr. Smith was graduated from the University of Saskatchewan with the degree of B.Eng. (Great Distinction) in Mechanical Engineering and obtained a Masters degree from Perdue University in 1949. He is the author of a number of research papers concerning gas turbine and anti-icing and turbojet thrust boosting by afterburning. He is an Associate Fellow of the Royal Aeronautical Society and a Fellow of the Canadian Aeronautics & Space Institute. His hobbies are skiing and gliding, and he is holder of Canadian Gold C No. 4.

Taylor, Dudley Robert, P.Eng.: Profession: Enginer (Electrical). Firm Name & Address: Aviation Electric Limited, 200 Laurentien Blvd., Montreal 379, Quebec. Firm's Business: Sale, manufacture and overhaul of aircraft instrument and accessory systems, supervisory control systems, fluidics, navigation systems. Birthplace: Montreal, Quebec. Date of Birth: September 21st, 1914. Education: West Hill High School, Montreal, McGill University, B.Eng. 1937. Career: Electrical Engineer, Air Canada, 1938-43; Tech. Asst. to Chief Engineer, Air Canada, 1944-51; Sales Manager, Aviation Electric, 1952-58; Vice-President, Aviation Electric, 1959-65; Executive Vice-President, Aviation Electric, 1966-67; President, Aviation Electric, 1968-.

THE SENATE

SPECIAL COMMITTEE ON SCIENCE POLICY

EVIDENCE

Ottawa, Tuesday, June 24, 1969.

The Special Committee on Science Policy met this day at 3 p.m.

Senator Maurice Lamontagne (*Chairman*) in the Chair.

The Chairman: Honourable senators, I understand that we have representatives of United Aircraft of Canada Limited, who are unable to attend the meeting this afternoon, probably because of the weather. This is a good industry or company to be the victim of weather. Thus, we only have two groups before us this afternoon.

I should first like to introduce Mr. Emilian Bobkowicz, President of The Bobtex Corporation Limited. He is accompanied by his son, Dr. A. J. Bobkowicz, Vice President of Research and Development, and Mr. Michael Boyd, who is a director of the company. I will ask Mr. Bobkowicz to make his opening statements now.

Mr. Emilian Bobkowicz (President, The Bobtex Corporation Limited): Mr. Chairman and honourable senators, we are honoured by the opportunity given to us to present a case in point of view of a group of Canadian inventors whose experiences during the last two decades, against the background of about 250 patents granted and pending on a world-wide basis in a major secondary industrial field, might well provide useful data and guidelines for shaping Canada's science policy of the future on a more pragmatic mission-oriented basis to make our R & D efforts and assistance programs more responsive to economical results thus to the needs of the market place, which is now the whole world, replacing to an ever greater degree national markets primarily due to the forces of the technological explosion the world is witnessing which defies any political and economical boundaries. No country or company, even the most powerful ones, can hope to become technologically self-sufficient in this age of rapid changes and no amount of money spent on research and development can achieve this goal either.

A major driving force behind this technological revolution is the creative minds of the inventors to which no country or company holds a monopoly. A study made in 1967 by 16 of the United States' leading research administrators for President Johnson on technological innovation came to the conclusion that major inventions, with some important exceptions, were made by little fellows of small companies or the lone "garage inventors type". They have apparently been more inventive than large companies or Government operated R & D institutions. The direct involvement of this inventive force with the future science policy planning should become a primary objective.

The trade in technology, in patents and licences, is the most rapidly growing area in international trade. The U.S.A. has an ever growing substantial net technological export balance. Japan with its about $250 million annual deficit on technological import belongs to the group of countries, including Canada, which has an ever widening net technological import balance of trade.

To gradually reverse this trend in Canada there is, against the background of these facts, but one solution, to create in Canada the proper environment to attract to an ever increasing degree: (a) inventors, the creators of new technologies from all over the world, including Canada to establish their basis of operation in Canada; (b) new industries, based on new technologies, to establish in Canada production facilities as a primary export base; and (c) to induce foreign parent companies to switch to their Canadian satellites the development, production and world wide commercialization of new technologies to their Canadian base.

Our brief to the Special Senate Committee on Science Policy suggests one possible way of adapting and channeling our present science policy towards the above desirable objectives.

The Chairman: Thank you very much, sir. Mr. David Golden has been with us before in another capacity. He is coming back with his main function in life now, as President of Air Industries Association of Canada.

Mr. D. A. Golden, President, Air Industries Asssociation of Canada: Thank you, Mr. Chairman and honourable senators. The Air Industries Association of Canada has already filed a brief and I do not propose to read it, but I would like to introduce the other members of the Air Industries Association who are with me today: Mr. Sam Roth, CAE Industries Electronics Division, Chairman of the Research and Development Committee of Air Industries Association of Canada; Mr. D. R. Taylor, President of Aviation Electric, and a director of Air Industries Association; Mr. E. L. Smith, Vice President (Engineering), United Aircraft of Canada Limited and Vice Chairman of the Research and Development Committee of Air Industries Association and Mr. R. J. Ross, Chief Development Engineer of Canadair Limited, and a member of the Research and Development Committee of Air Industries Association of Canada. I am happy to introduce the Vice President (Operations) United Aircraft of Canada Limited, Mr. R. D. Richmond.

We do not have any prepared statement, Mr. Chairman, other than the brief which we filed earlier. We are available for any questioning which honourable senators may like to direct our way.

The Chairman: I suppose it is a little bit too early, but I wonder if Mr. Richmond would be ready to make a brief opening statement to the committee before we go on with the discussion.

Mr. R. D. Richmond, Vice President (Operations), and Member of the Board of Directors, United Aircraft of Canada Limited: Yes, thank you. I apologize for interrupting your proceedings. There are, I am sure, several reasons why research and development is considered to be a good thing for the country. In our context I am going to speak directly to the one aspect of industrial development and confine myself to it.

Those of you who have had an opportunity to read our brief will see that we limited our discussion to one of the development of a particular small gas turbine engine, which is known as the PT 6. This is one of our activities, but it is also the major activity which absorbs most of our research and development talents. This engine is developed as an aircraft engine and when it was conceived in 1958 it was directed towards a market for utility and what are known now as business aircraft. At that time there was only one competitor in this particular power class, with about 500 horsepower. This was a company located in France.

Subsequent to our launching of the program, we picked up a United States competitor and latterly we now have one in the United Kingdom. I think that in spite of this we have been able to capture about 75 per cent of the market for this class of power plant and have produced about 3,050 of these engines.

This is just background information incidentally. I am not here to give a sales talk on either the engine or the company.

The Chairman: It is free advertising, but it is not very effective.

Mr. Richmond: I suspected as much. I am sure that we all appreciate that any successful enterprise has two basic ingredients in it, knowledge and resources. In the case of knowledge in our business it has to be on several different levels or disciplines. There is technical knowledge, marketing knowledge, manufacturing, and of course management knowledge. In this area we were greatly helped by our parent, United Aircraft Corporation of East Hartford, Connecticut, which initially licensed us to make some of their old engine parts. The relevance of this is that we had an opportunity to master some of these skills and techniques on their products prior to having to launch our own. Subsequently, we also had an opportunity of training a nucleus of technical people in the development business at their facilities.

In the marketing field we have also had the benefit of their experience and help on a world-wide basis. This is a continuing thing. It has not just been what you call a "one shot" but it has gone on and will continue we hope for some time. Also, a characteristic of our business is the fact that we require continuing assistance from not only our parent company, but also require the continuous use of resources to establish facilities and to continue to develop our product to meet an ever changing market condition. As an example, we not only find that our development cycle goes on past the point of the delivery of the engines to the customer. We have to continue to increase the reliability of the product and to meet the demands of competitors from these other countries in terms of ever increasing requirements for more horsepower and lower fuel consumption. We need the ability to be able to have some flexibility in our business and to be able to deplore these resources with a very quick response.

I am sure that I am not saying anything new when it is recognized that no business or company is a master of the particular environment in which they work. It is exceedingly important that there be some flexibility in the way funds are made available, both from the company's generation of these funds and also any that might become available through government assistance.

We have another characteristic in our activity which also has some bearing on the research and development aspect. We have to be in a position to produce what you might say is an excellent product, not just a good product. One of the reasons for this is that aircraft engines traditionally have been bought in the more highly industrialized countries from domestic suppliers and, specifically in our case, from France, the United Kingdom and the United States. These particular countries are also attracted to us for the marketing of our engine and particularly, of course, the United States. As an example, we currently are supplying engines to one major Canadian airplane manufacturer, De Havilland, for their successful airplane. If we did not have an export market to sell in we would be in a position where we would have to sell the engine at probably an uncompetitive price or perhaps, to put it another way, we might not have a market for our engine. Currently we are dependent on approximately 77 per cent of our outlet for these engines outside Canada and primarily in the United States.

I have made quite a long statement here. It is really to give some background for the type of thinking that we do by choice—or sometimes think we are forced into—in projecting why we are researching and developing aeronautical gas turbine products.

In closing, the point that I should like to leave with you is the very important one that businesses or companies cannot be rigid in their thinking. They have to be flexible and be able to respond to the ever changing market conditions. Consequently, in regard to sources of funds, government should also be flexible. There should not be so much concern about the basic conditions on these funds or rigid ideas about what the percentage of the shares should be between the government and the company. They should be flexible enough to take into account specific circumstances that might occur. Maybe it should only be 20 per cent funding in some cases but in others maybe it should be 100 per cent. If the risk is worth it in a particular company that can attract this business, which in turn means increase in gross national product to the country and an inflow, in our case, of United States or foreign exchange, then there should be a willingness to appreciate all of this and judge each case on its merits. I am not saying that our company in particular should have one level of funding and somebody else should have a lower level. What I am saying is there should be a broad band which should be used for judging these particular applications.

The Chairman: Thank you very much. Now we shall go into our question period. Who is going to be the first. Senator Robichaud?

Senator Robichaud: Thank you, Mr. Chairman. I can at least start the discussion. In that case I shall direct my first question to the representative of Bobtex Corporation. I notice in their brief it is stated on page 5, paragraph 8:

> This brief has been prepared by two inventors with a background of extensive experience in large-scale international invention industry.

I may also mention, as it is stated in the brief, that we have heard very little so far from inventors or people who call themselves innovators. This brief, in stating the situation in Canada, says something like this:

> Even in the case of Canadian inventions, under present conditions it would be against fundamental economic laws to choose Canada as the world base for such new industries...

Would the witness expand on his own experience? For example, what kind of invention is Bobtex involved in, and why did the principal of this company, notwithstanding what is said in the brief, that Canada should not be chosen as a special base for such operations, choose Canada for his operations?

Mr. Bobkowicz: I emigrated with my family to Canada about 20 years ago. I had a very large business in Europe in international trade in textiles, raw materials, machinery and chemicals. I did very well. I came to Canada with money. I travelled all over the world in order to decide where I should go and finally chose Canada, because of the reasons I mentioned in my brief. I wanted to come to a country where the future is more secure than other countries.

While in Canada we have been developing and pursuing our ideas in changing the 3,000-year old system of spinning. The technology of spinning was based on so-called cohesion forces and we came up with a new idea that could change entirely the system of forming a yarn and forming a weave. This started up in a small garage in Westmount in Montreal and under very difficult conditions. The question was, how do we proceed with the implementation of something which will be tackling one of the biggest problems, because textiles are the second important consumer item for man.

Right from the beginning we ran into one difficulty after another. An inventor experiences in the first years the feeling that he is crazy, cuckoo—that is the first reaction. This is after a certain period of time and particularly after hearing experts say that what he is trying to do is impossible. We have spoken with very top experts even within my family. I had spinning managers who said, "Why do you try to change 3,000 years of technology? It does not make sense." So what do we do? I had my money and I was willing to put in substantial amounts, start to develop prototypes, experiment with it and try to get some money to finance it. In the first period, from a cold idea to the hardware stage, the risk is usually the greatest. You cannot easily find someone who will want to venture or to finance such an idea, but we tried.

The Chairman: Especially when you are supposed to be crazy.

Mr. Bobkowicz: Anything which is new is particularly so to the expert, because what is an expert? An expert is an expert of the past. He cannot judge the future very well. He does not see and he has not the vision. Mind you, I do not speak about all experts and I do not want to offend anybody.

We had a difficult time to start out, but we were sure about what we were doing. The first thing that we did, of course, was to search patents and find out if someone had the same idea. We investigated patents all over the world.

Senator Yuzyk: How long did it take to get these patents?

Mr. Bobkowicz: Well, the patent; that is another story.

The Chairman: He has not reached that stage yet.

Mr. Bobkowicz: In the United States it takes approximately six or seven years to get the first reply from the Patent Office. In Canada it is faster, because it takes about three years. We had 26 countries covered with our patent. We have spent a fortune on the patents only. One patent alone will cost at least $1,000. We became our own patent lawyers in order to save money. We studied it and prepared it.

After our patent appeared we said, "Now it is time to find out who will finance us and help us." A great deal of money is needed to put through a technology of this importance. This is a typical case of how new inventions start. Where do we go? First of all we went to some of the large firms in Canada—I will not mention names—and we ended up with an American firm. The Canadian firms were not at all prepared to venture into such an idea. The next step was to file an application to the National Research Council, and there we found a response. It is only because of the National Research Council that we are still with our invention in Canada.

You ask why I wanted to do it in Canada. It is because I am a Canadian. Whatever I can do I want to do it in Canada. We progressed with our invention, and then we found open-minded investors. Mr. Michael Boyd took care of the financing. That was a very difficult job to do. We got enough money together to start our company. We were gradually able to prove that we had something worthwhile to offer. No one would believe us, even the biggest companies. The textile mills, as such, were more shortsighted or more conservative than any outsider. They could not believe that you could do the same work without all this complicated machinery and that it could be done in a simpler, cheaper and much better way. After we got the first money we developed further and then we had propositions. Standard Oil's first proposition was, "How much do you want for the invention?" We said the invention was not for sale, that we wanted to establish a joint venture. "No, we do not do joint ventures; this is not our policy." I said that my policy was not to sell the invention. We did not reach an agreement and so we realized that we almost had to depend on ourselves, our own means and ingenuity. It was a very hard time because I came to Canada with money and I allocated one-third of my holdings to this, which was quite a lot of money. Gradually we built up a first class scientific team in Montreal. We have succeeded in proving our process. We have built the first prototype machines and are showing them now on a test basis to various clients. We even have orders already, because some American firms of spinners walked in and asked about our patents. Now we are getting enquiries from all over the world almost, because people got intrigued with this.

At a certain stage the Aluminum Company of Canada was interested—of course, we might use more aluminum in our machines—but later on they realized that it isn't only the aluminum involved, so they said they wanted to be partners in it. They became partners and we have a very, very pleasant co-operation with Aluminum Company of Canada and we are now set to go.

The potential of what we are doing is so large, it involves not only putting up a factory for making the machines for export all over the world, but who will exploit the new technology first? We have no possible way of forcing Canadian textile mills to do it. It looks to me that probably foreign firms will jump on it first.

We showed it first of all to Canadian firms; they showed great interest, and so on, but nothing else. I believe that they would just like in this case to have some support from the government to go into such a venture. It is understandable; this is done in England, for instance. With a new process and technology in the trade the spinners have been very conservative there; they wait a long time to invest their own money. So the English government purchased ten machines or so and said all right, those machines we bought we will give to you for testing; find out about them, let us not be latecomers in the new age technology. It could be done here the same way, but it looks as though the first machine will start to operate in the States; that is except for the ones in our lab.

We have the yarn, we have the machines and there are other new developments involved, because once you start in one direction you go on the main avenue then you find side avenues. Very often the side avenue appears to be much more important later on than the main avenue. So we had to cancel almost all our achievement up to this date and go to the new avenue. It would be a fallacy not to go, because it would be a big short cut. So finally, who will benefit from a new invention? We have to serve world markets. That means that we have to be in the most competitive situation. Let us not fool ourselves, we have patents, we have many patents, but we have to be competitive enough at the same time to meet all these huge old-established textile machine manufacturers.

We were told in Canada that we cannot build a spinning machine of this type; we were told go to the States to build them, to the textile machinery manufacturers. We said we don't believe that we cannot build it here; we built it here in Canada with a team of engineers and anybody who wants to see them, please come and see them in operation.

The question now arises, where do you put up the first machine factory to serve the European market or the South American market? We have to get the support of tax incentive, because the technology is changing so fast and we have so much to reinvest. That is the reason why I propose two practical approaches: one is to help the inventor to get started in Canada. If we cannot help him to get started in Canada, we cannot get new technology into Canada, we can only get developed technology for which we have to pay heavily. When it comes developed it costs a lot of money, so we have to start. This has been proven in our case; we have started in Canada and we believe this is going to be arranged on a simple basis without government money by putting up an insurance plan which will cover part of the risk of an invention like it is covered in the export business. This will work and it is not complicated, it is simple. The private sector will then see the risk is taken away and be able to finance it. Capital will eventually be willing to take this gamble, but not 100 per cent.

The Chairman: What will be the impact of this new machine? Will it be in terms of reducing costs or reducing the labour input?

Mr. Bobkowicz: It will reduce the phases of processing yarn from bale to yarn. There are many, many phases involved in the present system. They are interrupted, which means a discontinuous process. In our case we start with the bale and we can end with the yarn fully automatically, and with only two machines. We convert the yarn at speeds which are ten times higher than are achievable at present. By virtue of this we have, of course, labour savings and raw material savings. Because we are not restricted to any particular type of fibre we are fibre-independent in respect to the machines. You have to have different types of machines to spin coarse wool, fire wool, fine cotton yarn, or coarse cotton yarn. To spin jute, you have to have a special kind of machine, and so on.

In our case we are independent from the fibre and we are following a trend that means we have arranged a marriage between the past commercial system and the advanced extrusion polymer system. We combined it. We have had advisers at our disposal. One of these, for instance, is Professor Mark, who is called the father of polymer science, to whom we went in Pittsburgh. By the way, we stumbled on him in the Expo Exhibition lecture and he told something of that. I said to my son and Mr. Hyland I would like to pick this fellow's brain. They said why don't you hire him? I said well, I cannot hire him, so they said all right, Alcan will pay. This cooperation started with Mr. Mark advising us closely and the team in our lab is on a very high level.

I do not think there is anything like it in the world. We attended an international scientific meeting in Princeton recently to find out whether there is something like this in our industry elsewhere. We found out that there is not.

The potential of this, the savings, the flexibility, the savings in the raw material, the savings in labour, in the flexibility, will make this process the leading system of processing of fibres into yarns. That is so large that we now have to keep it completely in Canada. Normally in our case the inventor would have to say all right, I will set up plants, one in the common market, one in the South American market and one maybe in the Far East or Europe. With the proper tax incentive which would pull back completely everything to be reinvested for expansion, Canada today could be the main base for the whole world. That would apply to many of such cases practically. We are proposing a very practical way of approach, which we have tested and know works. Why I say it will work, honourable senators, is that before the war I was very active in Poland. We had to build a new port from nothing. I was an adviser to the government and was decorated with the Distinguished Service Golden Cross for it. There was the Minister of Trade and Commerce and we worked out an incentive scheme. Within a period of five years we had one of the leading ports in being, not only in respect to shipping, but also in trading. What is the use of having only shipping without trade? This is the most profitable business, so this worked.

The Chairman: Here we have the contrary; we have trade without shipping.

Mr. E. Bobkowicz: Well, that is the same. We should stimulate. We should understand what is needed. When we know the problem in research we have 50 per cent of it solved. We have this problem all the time.

The Chairman: I suppose that we should come back to your more concrete proposals, but I think it was interesting to get the background of this for the moment.

Senator Robichaud: Mr. Chairman, while we have this background I notice that Mr. Bobkowicz has mentioned the patent end of it. There is no doubt that this is a time for industry where patents are very important. I have noticed that you have stated in your remarks that in your experience with the United States it would take as much as seven years to obtain a patent and you have given three years as being the case in Canada before you can get a reply.

Would you have any suggestions which would have the effect of improving our patent system in Canada?

Mr. E. Bobkowicz: To be very frank, in Canada particularly we have been called into the examiners from time to time and we found a very, very co-operative response. It goes much faster than in the States.

Of course I cannot propose any changes here with respect to the United States patent law, because there it is really very involved.

The Chairman: We will let them worry about it, but it is interesting to hear you this afternoon say this when this morning you were told that our patent system was probably one of the worst in the world.

Mr. E. Bobkowicz: Maybe from the legal side, there is another thing from the patent side. Actually our tax law and patent law, maybe not the patent law as such, is punishing the inventors.

To give you an example, when I created my own company, Emilian Bobkowicz Limited, which was later on joined with the Aluminum Company of Canada, there is a law that if any inventor sells his idea to an outsider he can sell it for $1 million and he does not pay any taxes. If I transferred my patents to my company where I am in control, this is called arm's length, so they say you cannot do this. That means that if I want to develop it myself I am punished, but if I give it to somebody else I am getting a premium. This is wrong, because this should not be the case. We should give the premium to the inventor, not to the buyer of the patents. I am actually encouraged to sell. But this is a minor point.

In respect to the patent law in general, I am not such an expert as to be able to say what should be done to accelerate it. It is too long. There is one thing, until you get a patent in Canada anybody can start to infringe it and then you have no redress against him. This is very bad.

Dr. A. J. Bobkowicz, Vice President, Research and Development, The Bobtex Corporation Limited: I want to add one point: in terms of international patent law, we had one case in Japan where we waited 13 years for a patent.

Senator Robichaud: And by the time you got the patent was it still effective, or was it too late?

Dr. A. J. Bobkowicz: Oh, yes, it was still effective.

Senator Robichaud: Mr. Chairman, before I shift to Air Industries, I have one remark to make in connection with paragraph 24 on page 14 of the Bobtex brief, where it says that, referring to direct lending through existing or new agencies:

> To encompass these aims, it is natural to wonder whether the research, talent and experience presently available in the Industrial Development Bank could not be specifically channelled into this area of credit insurance.

I would hope that Mr. Bobkowicz would have more influence with the Industrial Development Bank in this regard than any of us have had so far.

Mr. E. Bobkowicz: Actually, I went to the Industrial Development Bank in the very beginning for assistance. I presented my case and a description of our first year's development. I remember the name of the man, Mr. Noble. So I was told yes, we finance, of course we help people like you to put up a new industry, but you have to be developed already. So I said then why do you call yourselves the Development Bank? If I have already developed a project then I do not need you.

What we need is support when we are in the phase of development. Then we would attract outsiders, because there are many inventors who would come to Canada if there were an incentive. We could attract a lot of people to Canada just by giving them some incentive, at least the possibility of financing. This should not be through government, nor through the suggestion I made, not just to go from one institution to another and to be looked upon as a crank. The private market will take the rest of the risk. The insurance basis will cover any losses just as in the case of the export insurance credit. I could not export anywhere before the export insurance credit was introduced. An exporter is not a financier. He cannot afford to produce a product or to finance foreign markets. So the export insurance credit took out this risk and the exports started to move.

Senator Robichaud: Mr. Chairman, my first question to Dr. Golden would refer to page 2, referring to the background of the company, where it is stated that:

> The steady growth of the industry within this environment is due to its ability to compete in the international market. In 1967 and 1968 some 60 per cent of the total industry production was exported. This is the highest percentage export of any aero space industry in any country in the world and this industry is now Canada's third largest manufacturing exporter.

Could Dr. Golden give us an idea of what has been the average rate of growth in the export market of the production of this company in the last five years?

The Chairman: Of the total industry?

Senator Robichaud: Yes, of the industry?

Mr. Golden: Yes, senator. First of all I would like to correct the statement on page 2. We prepared this at a time when we only had the estimates for 1968. We now have the total figures. In fact, in 1968 not only did we export more than 60 per cent, we exported more than 70 per cent of our total production. At the time that we prepared this brief we only had an estimate. The actual figures turned out to be higher. We do have the figures for sales and exports.

In 1963 total sales of the industry, which we call the Canadian aerospace industry, were $550 million, of which exports represented $234 million. In 1964 total sales were $588 million, of which exports were $284 million. In 1965 total sales were $541 million, of which exports were $251 million. In 1966 total sales were $594 million, of which exports were $300 million. In 1967 total sales were $660 million, of which exports were $402 million. In 1968 total sales were $750 million, of which exports were $559 million.

Senator Haig: Mr. Chairman, may I ask Dr. Golden to explain what avionic products are?

Mr. Golden: It is a term which is becoming one more widely used than used to be the case. Airborne electronics used to be given the generic term avionics, but I am afraid it seems to be covering a lot more electronic products now.

In our industry when we talk about Canadian aerospace statistics we include aircraft, aircraft engines, components, accessories, ground support equipment and avionics, in which we include electronics as they relate to aircraft.

Senator Haig: Thank you.

Senator Robichaud: Regarding this increased production and also increased export, could you give us an idea of what percentage of this growth has ben commercially oriented, compared to the growth for military purposes?

Mr. Golden: I am sorry, senator, I cannot give you accurate statistics.

Senator Robichaud: No, just an estimate?

Mr. Golden: It is true to say that in recent years the increase in sales and the increase in exports has been concentrated more in the commercial area than in the defence area. The percentage of our total production and the percentage of our exports which is in the commercial area has been growing faster than the other.

Senator Robichaud: I also noted that your brief, which you stated yourself was purposely very brief, does not mention the relationship between government, industry and university in research. In comparison to the pulp and paper research institute, which really operates almost jointly with the government and the universities, could we have your comments regarding this type of co-operation?

The Chairman: You have a very different type of association. This is not a research association.

Mr. Golden: The Canadian Pulp and Paper Research Institute is actually an institute which does research. The Air Industries Association of Canada is a trade association, consisting of about 90 companies in the aerospace industry, but we do not perform any research or own any labs or do anything like that.

Senator Robichaud: But what are your comments on the relationship or co-ordination that does exist between industry, university and government in research?

Mr. Golden: We have got comments on that and I think I will pass. Perhaps Mr. Roth, the Chairman of our Research and Development Committee, will speak to it.

Mr. S. Roth, Chairman, Research and Development, Air Industries Association of Canada: We make reference on page 4 of our brief to the expenditures by government in R and D with respect to government, industry and universities. In particular we quote that of the $351 million in government R and D expenditures in fiscal 1968, the figure from the Fifth Annual Review of the Economic Council of Canada, 69 per cent was spent in government research laboratories, 16.5 per cent in universities and only 14.5 per cent in industry.

The point we are making here is that we believe that the industrial percentage in Canada is strikingly lower than in other countries. We quote as an example the 65 per cent of every tax dollar spent in industry in the U.S. We believe that there should be a substantial increase of government research and development expenditures in industry. It is this expenditure which provides the innovative product development which directly provides assistance to the economy of the country.

Senator Robichaud: I must apologize. You did cover that part of it.

The Chairman: I wonder if you could list for us the factors which you think were responsible for this increase in total sales, increase in exports in your industry and the part that research incentives have played?

Mr. Golden: Yes, we will mention some: there is no question that the government development votes have been extremely helpful in our industry. It would be quite wrong, despite the fact that we have some critical comments to make about these votes, to overlook the very great benefit that they have been. There is no question that the production sharing arrangement between Canada and the United States has been extremely helpful. Although initially these arrangements related only to military products, in may cases this has provided for the movement of technology into Canada based on a military product which is now being applied to a commercial, civil product. The operations of the Export Credit Insurance Corporation are, of course, extremely important in the expansion of exports. Then there are one or two very special cases. The very large subcontract orders placed by Macdonald, Douglas in the United States with its Canadian subsidiary in Malton, Douglas Aircraft of Canada Limited, where they had a very large piece of every DC-9 that was built and exported had a very great effect on the 1967 and 1968 figures. The tremendous surge in sales of Mr. Richmond's PT-6 engines in United Aircraft and the De Havilland Twin Otters are very largely commercial programs.

Would any of my colleagues care to fill in any of the points I have forgotten?

The Chairman: Perhaps Mr. Richmond will comment?

Mr. Richmond: With respect to our relationship between the commercial and military sales of the PT-6, it has been about 85 per cent commercial up to the end of 1968. There will be some change in this through 1970, but it will still be predominantly commercial customers who will take this engine.

The Chairman: How did your project develop? As a result, of course, of the experience that your parent company allowed you to take, but do you feel that these government incentive programs are very helpful in your case?

Mr. Richmond: There is no question, there would not have been a PT-6 program without the assitance of the federal government. I can say that categorically. We have spent on the development of this engine, this is total development costs through the end of 1968, about $42 million. During that period we got just under $13 million of direct assistance on the R and D phase, which is about 30 per cent. In addition to that, we received about $6 million under the defence industry modernization vote, of which, as you know, 50 per cent is repayable over a five year period. I think what perhaps we are all saying is that, at least I guess I should say what I am saying for the company here, I get a little mixed up with the industry...

The Chairman: You are part of it.

Mr. Richmond: ... is that although we have received this amount of assistance and without it there would not have been a program, we find that because we have been successful in attracting this amount of business and that is the reason I emphasize why we do research and development, there is no other reason we do it, we find that we have been in a position where there are new opportunities for us which we do not want to refuse. You never know if you opt out of a situation whether you may be putting yourself in a position where it is not just that business, but it is follow-on business that you may not be able to get. You try to handle everything that you might say comes your way. It is a little bit like doing an Indian rope trick to continue the development of this product or products as they are now turning out to be, and at the same time generate enough revenues to support them. It is perhaps an odd situation, in that the more business you get, the more difficult it is, because you cannot place this business just where you would like it. You have to take it or not take it, as the opportunity arises. This is what I meant when I said earlier that there should be a higher degree of flexibility in the way the government looks on this. I think particularly of this concern about repayment. The government really gets repaid if the program is successful in terms of employment, taxes that the personnel and the corporations pay, and so on. I don't have to go into this. There is a great multiplier factor which I am not really competent to speak about. It is a very difficult situation to say no to something and at the same time you do not want to say yes if it is going to get you into trouble.

Mr. Roth: Mr. Chairman, just to add some statistics to those that Mr. Richmond provided, if I could wear my company hat for a minute: CAE have sold some $23 million worth of simulators in the past years. These have all been commercial. The point I would like to make here is that the technology which allows us to compete in that international marketplace to sell these simulators stems from a military program which we were involved in earlier, in particular the F-104 business.

One other point I would like to make is that that training grant, if you like, and that ability to do non-recurring development for military' programs is tending to disappear, which is one of the reasons why we would like a reassessment of the direct government assistance.

Dr. A. J. Bobkowicz: I would like to comment on the question Senator Robichaud raised about university, industry and government co-operation. I could speak from experience in our company. We are participating in the National Research Council program which was initiated this year. They have provided a very effective tool for providing government money to industry. This then utilizes that money to pay professors who are in the universities and who are asked and paid to work in the laboratories of the companies. This is for the period of the summer or on a part time basis year round. This is particularly useful to small companies which are being supported by the National Research Council, which are in need of additional brain power and technological upgrading in the overall company staff. The source of these brains in the universities then is becoming available to industry where it needs it most, that is in the application of government money, utilization of university manpower as well as their facilities very frequently, and the exposure of university professors to industry where the industry benefits as a result. It is a two-way street and from our experience it is working very well.

Senator Haig: Do you take any graduate students, or near graduation, into your firm for summer periods, or for weekends, something like that?

Dr. A. J. Bobkowicz: As a company which has a total of approximately 25 employees, we have three summer students.

Senator Haig: That is a good percentage.

Dr. A. J. Bobkowicz: We are employing at present two professors as well as the consultant that we mentioned on a similar program basis. The American ones we pay for ourselves, of course.

Mr. Elvie L. Smith, Vice President (Engineering) United Aircraft of Canada Limited: I would like to express a concern that we have about the trend of university expenditure. We have been expending increasing amounts of our tax money in the country, of course, on education and we wonder now if perhaps some of this is not getting out of hand. I refer here to some data which was published in a document called Background Studies in Science Policy by Messrs. Jackson, Henderson and Long. There they examined the trends in expenditures in R and D in industry, government and universities. They assumed that the total country's expenditure might go from today's less than 1½ per cent of GNP spent on R and D to 2½ per cent by 1978. They further assumed that the trends which are evident now in university and government expenditure would continue and that the remainder of the money would be spent in industry. This leads to the result that between the years 1966 and 1978 university expenditure would go up from 24.6 per cent to 38.9 per cent of the total country's expenditure on R and D. Government would go down slightly, from 33 per cent to 31 per cent. Industry would drop sharply, from 39 per cent to 27 per cent. We consider that this is a quite wrong situation in a country that is saying it is seriously endeavouring to stimulate industry R and D and the production that goes with it. So we believe that this trend should be changed. Unless we build and augment substantially the total expenditure the only other option is to reduce the rate of expansion in the university expenditure and hand some of this money to industry to aid in new production.

The Chairman: Since Mr. Golden is a member of the Board of Carleton University, I am sure he has taken a good note of your comment.

Senator Robichaud: I have another question for Mr. Richmond: We were pleased to hear of the success of United Aircraft Corporation in innovation, manufacturing resulting in increased exports, also for giving us some suggestions such as a larger degree of flexibility in government program in order to assist in research. My question is a related one: Would the company have been able to successfully design, manufacture and develop the PT-6 engine without the import of technology from its parent company in the United States?

Mr. Richmond: That is a hard question to answer, of course it is a matter of timing, but I think the answer probably is no, in the time frame that we did it in.

Senator Robichaud: Did you get a major part of your assistance from the parent firm, or was the major work done in Canada?

Mr. Richmond: No; the development work on this engine was all done in Canada. The training of a nucleus of engineering people was carried out at United Aircraft's plant in East Hartford prior to the launching into the development of the PT-6. This was a matter of about a dozen people. Subsequent to that there have been and continue to be specific instances where we can get assistance on request on specific problems. In addition to that there is a great backlog of information and experience of things like materials as an example. These are very fundamental things which a company starting from scratch could not possibly accumulate in the time that is needed to bring forth a program successfully. Just to set the record straight, the development of the engine was all done in Canada in our facilities. I would like to belatedly introduce the two other members of the group here: Mr. Miles Beech, the comptroller of the company, and Dr. el Baroudi, manager of business planning.

Senator Kinnear: Here on your technological trends you say in the building of your new engines you are going to run into a great deal more pollution apparently. You give the reason for clearing up the pollution, the reasons why you cannot clear it up. Have you started to deal with that?

Mr. Richmond: I do not believe that we meant to imply that we were causing any pollution now.

Senator Kinnear: Do you mean to say that your engines are so good that there is no trouble pollutionwise?

Mr. Richmond: No; fortunately they are small enough that they really do not generate that much in the way of pollution. What is intended here is to indicate some of the areas where there needs to be continuing and further work, particularly if these engines are going to operate as many people think they will in the future in and around populated areas. This is a philosophy that is developing, where the larger airports will be set up outside the main population centres and smaller airplanes will be used to carry the people from the main distribution centres into the small fields near the areas. This is what is meant here. The word pollution also applies here to noise.

Senator Kinnear: Oh, yes; that is part of it. You say that here too. When are we going to get better transportation service from the larger airports we have today with smaller planes to various areas, like the Niagara district?

Mr. Richmond: I see Mr. Golden sitting here, maybe he will answer that.

Mr. Golden: It is the best solution in the world; there is no question about that.

Mr. Richmond: This is now taking place in certain of the major population centres in the U.S., particularly around Los Angeles. There is quite a lot of activity with this concept.

Senator Kinnear: Well, it is a serious transportation problem and I think we are into great trouble in Canada now needing that service. I was hoping that you would say you are going to get at it right away.

Mr. Richmond: The products are there. It is a matter of convincing people to use them and having the airports, of course.

Senator Kinnear: I hope you don't mean the very small aircraft that just carry four or five people.

Mr. Richmond: No, the airplanes that are currently in use for this type of operation carry about 18 passengers.

Senator Kinnear: I am still disappointed.

Senator Robichaud: You are prepared to supply the tools to do the job?

Mr. Richmond: That is correct.

Mr. Golden: I think, senator, that one of your witnesses on Friday was Mr. Boggs, the president of De Havilland. I do not know the details of the aircraft on which they are working, but the DHC-7, I think, which is the aircraft which presumably will be their next project, is designed to have four PT-6 engines and to carry 40 people.

Senator Kinnear: That is much better.

Senator Phillips (Prince): With respect to the transportation problem that Senator Kinnear brought up, what about the use of helicopters for this? I do not know whether or not your firm would include the new helicopter company opening up in Picton as part of your group.

Mr. Golden: I would hope so. Mr. Richmond knows more about helicopters than I do.

Senator Phillips (Prince): Are they not in operation in the United States for that very purpose?

Mr. Richmond: Yes. I hate to say this, because United Aircraft is also in the helicopter business. We sold several of them up here for the Royal Canadian Navy. The problem to date has been that the operating costs of helicopters are such that the commercial operator cannot attract passengers at the fare necessary to pay for the operating costs and some margin. Thus the ones in the U.S., to my knowledge, are operating under a direct subsidy from the federal government, although I think that is phasing out, and what is starting to take its place is the subsidy from the major airlines. The reason for this is that the airlines will underwrite the operation of these helicopters on the basis that the customers will use the helicopter to get off at the main terminal to get to a major trunk line. It does not appear that within the present state of the art helicopters will ever be as economical to operate as a fixed wing airplane.

Mr. Golden: In fact, recently some helicopter services in the United States have been suspended and replaced by airlines flying aircraft such as the De Havilland Twin Otter powered by PT-6's.

Mr. Richmond: That is right. New York Airways is one of them.

Mr. R. J. Ross, Chief Development Engineer, Canadair Limited: I would just like to add a few words to those mentioned by Mr. Richmond concerning the aircraft needed to meet the ever-increasing congestion in the urban areas. The short take-off and landing aircraft has already made very sizable inroads in this area. As the inter-urban areas become more crowded then the needs are going to become more difficult, the space available is going to become more difficult. We shall probably find ourselves in a situation where just short take-off and landing aircraft may not be the total answer to the problem. We may need eventually to include in our system aircraft which can land and take off vertically. I am not referring here just to helicopters. Helicopters in themselves do have limitations with respect to the speed at which they can operate and then accordingly the productivity which they can generate. I am referring here to aircraft which are somewhat faster but can still operate vertically. Canadair has been engaged in the development of this class of airplane for more than ten years. Now, this work has been going on with the support both of the company and assistance from the Canadian government. We are already at the point where we have a successfully flying vehicle. I would simply like to put on the record at this point that we believe that this is a two stage operation where we have short take-off airplanes and eventually we will need vertical take-off airplanes in order to meet the total needs which are developing, especially as the urban areas become more and more congested.

Senator Phillips (Prince): By vertical take-off you are referring to jets?

Mr. Ross: In our particular case we use propellers. We tilt the one wing, the engines and the propellers so that in a way it looks like a helicopter with some small sized rotors when it is vertical. In normal flight the wings tilt down and it operates and looks like a normal airplane.

Mr. Richmond: This opens up a whole new generation of aircraft which probably is best classed as hybrids. Some will have a configuration such as Mr. Ross has described, some will have rotors which look like helicopters but will have wings on them as well, and some will have jet engines which simply lift the aircraft vertically. The big disadvantage currently with the latter is how to deal with the noise problem in congested areas and the debris that gets thrown up.

Senator Blois: Mr. Bobkowicz, on your spinning equipment are you planning to put up a plant to do the spinning, or simply to manufacture the machinery?

Mr. E. Bobkowicz: Our purpose is to build the machinery and to make it available to everybody in the spinning business.

Senator Blois: I thought from what you said that one piece of your equipment would be too large for a small plant. You said something about it being a continuous operation.

Mr. E. Bobkowicz: Our process will actually for the first time in the textile industry enable—up to now the concentration in the industry was due to the size of the spinning mill which was not economical if it was, say, below 10,000 spindles. So only big companies could afford to have a spinning mill. Due to this factor the weavers were not able to have their own spinning mills. First of all they would have to have a variety of yarns. This was more and more creating a situation where big spinners either took over the weavers or big weavers started to go into the spinning business. Now with the new system anybody, a small weaver can become a spinner. We can have a spinning mill in this room. He can spin any fibres. He can be very flexible. He can make his own yarn. We provide the technical know-how. We provide what he can do, but the ingenuity of the user of the machine will be the master of what he does, because we provide a tool that is so flexible that there are no limitations actually on what he can make on it.

Senator Blois: Would the machinery be terribly expensive compared with frame spinning or mule spinning?

Mr. E. Bobkowicz: You cannot compare the conventional system with our system. If you compare it with one part of the spinning mill, the mule or spinning frame, this is just a section of it. We substitute a whole section. So we have to look rather at the overall benefits. In respect to the investment needed, our equipment will need maybe one-third of the investment needed now per pound of output.

Senator Blois: Yes, but you are doing away with carding of all types; it would be one machine?

Mr. E. Bobkowicz: Yes, he can start up high efficient production right from one machine, which is not now possible. Then we intend to rent the machine.

Senator Kinnear: What will that do to the cost of the finished yarn?

Mr. E. Bobkowicz: Of course you have coarse yarns, medium yarns, different types of fibre.

Senator Kinnear: Comparing them with your other machines, is it going to raise the price of yarn?

Mr. E. Bobkowicz: No, on the contrary it will reduce the price of yarn. That is exactly what our process is doing. The competitiveness of the textile industry can be improved considerably. I believe that if this were applied properly in Canada we could switch around and become exporters instead of importers of textiles.

The Chairman: Exporters to Japan?

Mr. E. Bobkowicz: Yes, even to Japan. Because you see the labour content in our machines is such that we can compete. It is only a fraction of what it is in the conventional system, therefore we are not labour-sensitive any more.

The Chairman: But with all these advantages and after having discussed all these things with the industry in Canada, still there is nobody yet that you know of who is interested enough in your machine to buy it?

Mr. E. Bobkowicz: Oh, yes; they are interested, but—

The Chairman: They will be too late?

Mr. E. Bobkowicz: Yes sir, but they are not in a hurry and they are looking to Ottawa and to Quebec for financing, and so on, which is actually the right way to do it.

The Chairman: Have they made applications to Ottawa to get grants?

Mr. E. Bobkowicz: I would not know, but I think some of them, yes. I understand that there is one firm in Quebec who made some application. We ourselves made approaches to Minister Pepin and to Quebec in respect to assisting the spinners. We are still in talks, but the results are very slow.

The Chairman: If we were able to further reduce our import subsidies it would be very interesting I think.

Mr. E. Bobkowicz: That is what I have in mind. I am not speaking about the textile people here. To me the competitiveness is rather to assist the textile mill to buy new equipment and to be competitive than to put on an import barrier which will induce them to stay conservative.

Senator Blois: It would have the tendency of putting a great many people out of work, would it not?

Mr. E. Bobkowicz: It would actually increase the work. If one man in the world, let us say in India, the millions of people in India would buy one shirt more, that is to say if they could not afford to have two shirts instead of one shirt, we would have much more. The consumption is actually growing fantastically due to the rising standard of living and the population explosion. The textile industry is facing a very large problem to be able to supply the future demand of the world markets. That is the reason why we believe that a new system must be introduced. The old system is out. It is not capable of further improvements.

Senator Blois: As far as the United States and Canada are concerned it would put a great many people out of work if they all adopted your system, thousands of people?

The Chairman: That would depend, of course, on the increase of demand both at home and abroad as a result of reduced costs.

Senator Blois: I can see that, but I am talking about directly.

The Chairman: For the same amount of production you mean?

Senator Blois: Yes, many, many people.

The Chairman: You said a moment ago that this would economize on labour.

Mr. E. Bobkowicz: To increase productivity.

Senator Blois: Oh, yes, I agree with that.

Mr. E. Bobkowicz: Increased productivity always leads to vast economic development. If we have lower productivity, we keep something which is stagnant.

Senator Blois: Take some of the cotton spinners in the province of Quebec. With your type of machine, as I understand it, the production for one unit of yours would be equal to perhaps 15 to 20 units that they are at present using. So that would cut out a great deal of labour.

Mr. E. Bobkowicz: No, that is one point I want to make. You see, a spinning mill of the present time which has, let us say a capacity of opening fibres, in our case if it has let us say 10,000 pounds of opening capacity it can produce 20,000 pounds of yarn. With the present process it would only produce 10,000. So the logical thing would be to apply our machines, not to reduce the labour force but to increase the productivity. We would put in these machines to increase the output of the factory without removing anybody from it.

Senator Blois: Yes, but we do not have the capacity to use it either here or in the United States.

Mr. E. Bobkowicz: I would disagree here, if I may, because in fact 50 per cent of the production in Canada is covered by import today. It is a tremendous field to eliminate many, many imports or, conversely, improve our export position in fine items. We could possibly not compete maybe with some of the imports, but we could increase our export in other items made by this process. So generally I rather think it will contribute more to increase employment than decreasing it, besides creating a new industry for making the machines. The machines will also have to be built by labour.

Senator Blois: Yes, but you are going to replace so many machines that have already been made by labour. I am not going to argue about that, it has no particular bearing on this, but I just fail to follow your argument altogether. You make one machine and say it is fairly simple and it would probably take, I think you said 25 men working, or something?

Mr. E. Bobkowicz: No.

Senator Blois: I understood you to say a small number of men. If you take the number of men who are employed in making the spinning and carding machinery in the United States, Great Britain, or other parts of Europe where that type of machinery is made, a tremendous number of men are used for that type of work.

The Chairman: I suppose we have no choice now that the invention has been made. If the invention is applied in other countries and not in Canada it will put more people out of work.

Senator Blois: That is right, it would help out the Indians and the underdeveloped countries.

Mr. E. Bobkowicz: The invention of the loom or of the mechanical system has not decreased, as was previously thought, the need for workers, on the contrary it has increased it considerably.

Senator Blois: It eased up a lot from when the women had to use the spinning wheel to make the garments.

Mr. E. Bobkowicz: In spite of this they have increased considerably.

Senator Phillips (Prince): If I may, Mr. Chairman, I would like to direct a couple of questions to Mr. Ross of Canadair. When the

Argus was in production I had the pleasure of visiting the plant on a couple of occasions. Their management mentioned the excellent co-operation they had received from NRC, particularly in meteorology, wind tunnels, and so on. Are you still receiving that co-operation?

Mr. Ross: Yes, Senator Phillips. This takes place whenever we have a particular need and we identify a particular problem that we are not able to solve with our own resources. We go to the National Research Council and if they happen to have expertise in that area then certainly they make it available to us. They assist us in the solution of our problems. However, these problems do not arise too often. There have been areas in the recent past where this has happened. We have a problem and the NRC has had a particular program and there has been a commonality of interest. We have been able to combine with them and they have done work which has led to benefits on our part. Certainly I would say that whenever they have something which is able to help us then they certainly offer it to us.

Senator Phillips (Prince): The second question, Mr. Ross, is that you were doing research on other types of manufacturing. I am thinking now of the machine for sorting mail, and so on. Its purpose was essentially to prevent the lay-off that occurs when a certain aircraft goes out of production. Are you still carrying on that type of research?

Mr. Ross: I was not involved with the program concerning the post office sorter. It did not come to a complete conclusion. I think the project was abandoned at some stage. We are not continuing in that particular area. We have not pursued other projects of a similar nature to that, although the people who were engaged on that have gone on into other product development areas.

The Chairman: I would like to ask a question of Mr. Richmond. You referred a moment ago to government incentive programs and asking for more flexibility. Since we have begun to receive representations from industry there has been one suggestion that we certainly make these programs quite flexible. That would be to go back to tax incentives rather than grants. Is this the kind of thing that you favour, or you support, or would you simply want to see the present programs being continued with more flexibility built in?

Mr. Richmond: I was really referring to the continuation of the same type of program that really had (a) more money available and (b) that it was allocated in a manner such that the consideration...

The Chairman: You are really asking for more discrimination in a sense?

Mr. Richmond: That is a way to put it, yes. Perhaps we could have a comment from Mr. Smith on this question. He attended a series of meetings in Ottawa where this question was aired.

Mr. Smith: We could make this as an industry comment in that, as Mr. Golden has said, the existing benefits have been very real. We have, however, as an industry been pumping so much of our profit into new product development that a tax incentive as such is not really adequate for the job. We hope to have increased continuous and direct assistance for research and development. This in fact is essential if we are going to take hold of the opportunities that are open to us since we are now trading effectively in the international market.

Mr. Golden: The development of major new products in the aero space field is an international matter. Consequently you have to see how these things are done in France, the United Kingdom and the United States. There is no such thing as a major new product in the aerospace field without very significant government support which cannot come only from tax incentives. They have their role to play, but there have to be real development grants as well if you are going to proceed in the field of a new major avionic system, aircraft or engine. That is the name of the game in the aerospace field. The advantages on the other hand are correspondingly very great. It is a high technology industry which can export and a successful product can stay in production for a very long time indeed.

Mr. Richmond: I might just add something to that. As I mentioned, we have three main competitors in this size of engine in the western world. Two of them we know receive a much higher level of assitance than we do directly. This means in effect that it is very difficult.

The Chairman: That is in Great Britain and France?

Mr. Richmond: Particularly. This makes it, of course, very difficult to be price competitive with these engines assuming that other things are equal.

The Chairman: Could you describe the differential or quantify it?

Mr. Richmond: In the case of one product in the U.K. it is a hundred per cent quantum right now. There is a reason for that. They have an in-country use for the engine. They are funding an airplane to use that engine as well and it will be used in a military application. The engines are really insensitive in the sense as to whether they are military or commercial in this power class. So they will, in fact, have a competitive product fully funded on the market in the next year and a half. In the United States it is a different situation. There is really no direct funding of commercial products, as you are probably aware. But the companies on the other hand enjoy a very large degree of military programs and, of course, there is a spill-over. There is a similar version of the engine competitive with ours which has been funded and there are families of engines in and around the power class which are under contract to the U.S. military. So that there is a continual interrelation of osmosis effect here on both overhead assistance and technology assistance that spills out from these programs.

Mr. Golden: Not only military, of course, but now NASA fully funded plus profit.

Senator Robichaud: Mr. Chairman, we have had evidence that there is no doubt that United Aircraft of Canada as a result of their innovation program have contributed largely in assisting Canada's balance of payments. This is particularly due to their large percentage of export. Can a company such as United Aircraft continue successfully to innovate regardless of development in other segments of the Canadian industry? For example, the materials industry? In other words, what other industrial sectors should receive encouragement to development in order to protect the development within United Aircraft?

Mr. Richmond: I would like to answer that in two parts. Firstly, I would like to reiterate what I was trying to make clear earlier, that there seems to be plenty of opportunity for these products, or variations of the products, or similar products of a more advanced nature. We have plenty of opportunities to sell in this market. It is a question of whether we can afford to continue to develop them at a sufficient rate, you might say, to attract business at the particular time it is there.

The second part of the question I would like Mr. Smith to answer, who runs our engineering organization.

Mr. Smith: The material area is one of the benefits of having a corporate parent. We have been able to get from our parent material knowledge as required, really, for the projects we have been on. We have planned and we do plan to continue to use that knowledge because it is available to us. We have specialized in our own research in terms of developing the aerodynamics of small scale components. We are now in a position to trade technology with our parent. This material question happens to be one where we do not anticipate doing any work, we do not anticipate needing to do work. The general answer to the question is that as far as small engines at United Aircraft are concerned we have in-house or in-corporation those researches going forward that are necessary for the next product.

Mr. Golden: What you also need for a successful exporting engine industry is a very good support industry, sub-contract, components, accessories. Mr. Taylor there can comment on that perhaps.

Mr. D. R. Taylor, President, Aviation Electric Limited: Mr. Chairman, I think this is an important point, because we all look upon these so-called large companies or prime contractors within the industry, which are relatively few in number, for the survival of the smaller companies in the industry which form a greater number of companies although smaller in total percentage of industry. Success stories like the PT-6 and the De Havilland Twin Otter are vital to the survival of many of the smaller companies who are active in the support accessories that go on to these prime products. Engines need pumps, fuel controls, ignition systems. Airplanes need electrical systems, hydraulic systems, wheels, brakes and under-carriages, and so on. Again it is the same type of technology. In this end of the business we need research and development. We must keep abreast of this state of the art. When the engine manufacturer comes along with his next generation of engine, or next sophistication, the accessory people must be in a position to respond. The saying is that the key to success is what the prime contractor is able to do.

Mr. Richmond: Mr. Chairman, I might enlarge a little bit on that. In the first few hundred engines which we built there was a so-called Canadian content of about 25 per cent. We currently are running between 70 and 75 per cent as a result of a program we have had to try and develop more and more of the Canadian suppliers. These are such as Mr. Taylor's company, as well as what we call just sub-contractors making parts for us to our drawings.

Senator Robichaud: So you are really getting some support in material?

Mr. Richmond: Yes, but I can give you an example of one place where we fail to get support, if you are interested. Many small companies, and I mean very small ones, of a hundred people or more, who are in the business of supplying parts are lacking in many of the management skills that are necessary if they are going to deliver these parts to the correct quality and on time when you need them.

Senator Robichaud: Are they lacking due to lack of financial support?

Mr. Richmond: I am sure there are some, yes, that are in that position. The point I am making now is that by management skills I mean the ability to control their operations when they are running a high volume of parts through. We made contact with the Department of Industry and suggested that as one way of being able to build up this base of small companies we would undertake to train them in the control techniques. They knew how to make parts, but they did not know how to make a lot of them and on a continuing basis where they were at a given time. We were received quite favourably on this to begin with. An arrangement was worked out whereby we would fund 50 per cent of this cost and the Department of Industry would fund the other 50 per cent. It was necessary for our people to go into their plants and run classrooms as well as setting up systems on how to control the operation. The first thing that they found when they went to get their funds was that this came under the heading of education. Then we were told that we had to go to the province; so we went to the province...

The Chairman: Or change the name.

Mr. Richmond: That was even thought of. We never did get this resolved so, quite frankly, we have done a lot of this on our own. We also, quite frankly, have not done as much as we would have had we had some support. This is really building an industrial base. It is just one example of the type of thing that is needed to develop more sophisticated industry.

The Chairman: I would like to come back to this proposal of an insurance scheme to finance the small innovator. How would it actually work? You explained a little bit in your brief, but would it work exactly like our export credit arrangement?

Mr. E. Bobkowicz: In a similar way. Actually I would visualize it in a way that an inventor who, like in my case, came with an idea. We already had some patents. He would come to this institution like the Export Insurance Corporation and say we would like to have insurance coverage of this. We might be able to get financing from some people but they do not want to take all the risk, only part of it. If you take, for instance, the insurance for export, you get only the guarantee, not the money. You are getting only the signature of the government, because the money is supplied by the private sector, or whatever means you have. It is not the government's responsibility to provide the money. So when I make such an application then, of course, this institution will check it, make an educated estimate as to whether this is a worthwhile invention. They might say that for the first year we are willing to give a guarantee of so and so and wait for the first year's results. That is often done also in the States on a contract basis, that the first year is the proof that the idea has merits. Then, having this guarantee, again the private investor who will finance it will also look into it, because he is involved in a 25 per cent or 20 per cent risk, so he also will investigate the feasibility. But all inventors at the early stage are rather fuzzy. It is very difficult to establish whether they have merits or not and to find out which one is good you have to go through a hundred. If several pay off, it becomes a profitable proposition anyhow. There is a gamble involved in every invention. Only experiment can show later to what extent it has merits.

The Chairman: In the United States there are companies like the American Research and Development Corporation which try to specialize in this sort of exercise. We have one apparently in Canada too, but it is not working very much. It does not want to take risks or it does not have enough money. We do not know.

Mr. E. Bobkowicz: Of course the risk has to be spread. At the moment there is a risk involved to you, you are dealing only with one party. Here in our scheme the risk is spread over many firms. It is more flexible. The inventor would then be responsible to find the money on the market himself, providing the government is willing to guarantee it.

The Chairman: Yes, but once he has a government guarantee it makes things much easier.

Mr. E. Bobkowicz: Yes, it will make it much easier, but still the private investor will look into it. If I go, for instance, with an export product to a bank and I have even the coverage—had that with Egypt, for instance. I exported some wheat and I had to find somebody who would take the rest of the risk, which I believe was 20 per cent. I was told, all right, we can insure this, but it is up to you to find the money. Our banks cannot provide you with the money. So we had to do it. So even at that time there was reluctance on the part of the bank in Canada. We could not find the money here so I found it in Amsterdam. We are providing a tool like a mortgage on a house. Supposing we had no mortgages now? Who would finance all these buildings? This is almost, let us say, mortgaging ideas. In my opinion this would be a very flexible instrument without involving government expenditure, only the risk. If our present government wants to spend, let us say in a certain field, $200 million or $100 million or $50 million, for $50 million you can only have $50 million of work or business covered. For $50 million of insurance you can have ten times higher output. This would be very practical. Those who finance such a scheme would have to pay an insurance premium. It could be 5 per cent of the amount. That would be the cost of the development of the idea. The government would get money back right away, building up a fund in case of a loss, in which case they recover from the fund. With the Export Insurance Company I understand those fears were exactly the same. What would happen if there were a loss? How can we then recover? Now it appears that they have an income, not a loss, despite the heavy risk.

The Chairman: The same thing applies with Central Mortgage. I think they have been able to reduce the premium on their insurance.

Mr. E. Bobkowicz: Yes; I had a Central Mortgage myself when I came to Canada. I bought one of the insurances; then I wanted to get out of this insurance because I wanted to take the risk myself, but I could not.

The Chairman: I have a final question. This has to do with the coordination of these various incentive programs, since you seem to advocate various incentive programs to fit different situations. It has been proposed to us that there should be much more co-ordination among these various programs. Centralization of their administration has been suggested, instead of having one in NRC, one in Defence Production, or two or three in industry. Do you have any comments to make on this, Mr. Golden?

Mr. Golden: It think perhaps some of my colleagues would like to comment. I should say, first of all, from our parochial point of view just thinking of the aerospace industry as such, this is not basically a major problem. Most of our activities in the development field relate to the Department of Industry, Trade and Commerce. They understand our problems. We would like more money and things like that, but they understand our problems and we do not on the whole feel that there is any real problem there. I think we would feel that research in the universities, that part of research in the universities which is funded by the federal government could probably be co-ordinated better by NRC. It may very well be that from time to time the various government agencies concerned should be talking to each other more than they do. Perhaps some of the in-house programs could be better related to what industry expects to achieve from them. My general reaction to that question would be that this is not a major problem in the aerospace industry. Now I will probably be contradicted by some of my colleagues here.

Mr. Roth: I think in general industry agrees that the existing administrative procedures are adequate. This does not mean that they are perfect. We have had complaints about the time it takes to get approval, which we would like improvement on. We believe, though, that because of the several different types of government programs, you mentioned NRC, there is DRB, DIR, and so on, there could be more co-ordination. We believe that this kind of co-ordination should be done by the Department of Industry, Trade and Commerce, who best understand our problem.

Senator Bourget: Should they be administered by a single agency? Do you recommend that? You, Mr. Golden, may have a different point of view because if you deal only with the Department of Industry, Trade and Commerce, that is different. For other industries who would be probably involved with some other departments or government agencies it may be that it would be better to have only one agency who would administer the incentive programs. I am not giving any details, but often we have been told that they are too complicated, paperasse as we say in French.

Mr. Richmond: There is probably some desirability in this. I do not consider this to be a major initiative. What I think perhaps does need some examination from the standpoint of co-ordination is firstly the distribution of the funds that may be available from the government, how they are going to be spent. If there is a serious interest in industrial development then quite frankly the industry is in a better position to spend this money to get a return. That is what they are interested in the return. A return for industry is a return for the country in terms of employment, exports, and so on.

The second point which I think needs some co-ordination is that which has been touched on, the various activities that are taking place within the different in-house activities in the government. It seems to me that although you cannot legislate research in any specific direction, or I do not think you should legislate all research into a specific direction, it is a question of priorities. Perhaps there should be a little more of the in-house activity directed towards supporting the industries' down-the-road activities, not what they are doing today, what they hope to be doing five years from now. I am sure this is not new. On the other hand, I think that you cannot be too rigid again and say that all in-house activity has to be in support of something. Nobody told Edison to invent the light bulb, for example. So it is a question of how you split it up. Right now I think it may be a little bit too heavy in the direction that it is not supporting industry's desires and wishes down the road.

Senator Bourget: Is it the same with the universities? That they are not conducting their work as much as industry would like them to to a certain extent?

Mr. Richmond: I guess we would answer yes to that.

Senator Bourget: I do not want to criticize the universities, but this has been said here, that they should work more closely with industry so that industry will get something out of their research work.

Mr. Richmond: There are two reasons for that. One is the benefit to industry. Secondly, they are training people presumably to go into industry. The majority of the people intend at one time or another, I would presume, to go into industry. If they are working in an environment in which there is no relationship to what industry is doing, it is quite a gap to bridge. The other reason, of course, is that industry needs these people.

Senator Bourget: The reason I am asking this question is that, as you know, the governments are helping the universities. In view of this we could in our report recommend that universities should do that kind of work that will help industry to put out some new projects or things like that.

The Chairman: I do not think we will be able to go very far in that direction of telling universities what they should do. You can perhaps adjust your incentive programs or your research programs so that they might be influenced that way.

Mr. Golden: Senator, it would be wrong to suggest that there is no such co-ordination, because it does of course exist. It is a question of degree.

Senator Bourget: What about the manpower? Do you find, or do you expect to find difficulty in finding qualified engineers and technologists to do that kind of research that you are doing?

Mr. Roth: We have not as a committee answered this question, but perhaps I will get the ball rolling. I do not think that the industry presently has a difficulty in acquiring qualified engineers and scientists. We recognize though that if we do not continue to have research and development programs to attract our graduates, then we are going to lose them. This again is an incentive to continue, an indirect incentive to continue research and development support. Graduates leaving university with bachelors or advanced degrees are looking to do engineering and scientific work. If we cannot find it for them, they are going to go where it is.

Mr. Richmond: That leaves a gap, it is a two-headed affair. You have to have levels of skill, just like a book with a whole lot of leaves in it. You cannot use all graduates and you cannot use all men with ten years experience. So if there is not some continuity of taking these people in and they leave the country, then it is very difficult to get something started. You have to go out and recruit outside the country.

Senator Bourget: What is the percentage of scientists in your industry who are Canadian-born?

Mr. Golden: There are no such Association or industry statistics. Maybe some of the companies have it.

Mr. Richmond: I really do not know. Would you know of that, Mr. Smith?

Mr. Smith: I would guess that 30 per cent of our engineers and scientists are Canadian-born.

Senator Bourget: Are you losing many to the United States?

Mr. Smith: No, talking for United Aircraft we have a sufficiently rapid growth in our activities that we have had relatively small attrition in recent years.

Mr. Richmond: It is a good example; if you can provide interesting work they will remain.

Mr. Smith: We have recruited a large number of people in the United Kingdom, I might say, on a fairly regular basis to fulfil the requirements.

The Chairman: We were told this morning that we are importing people from the U.K. and Europe and that we are exporting to the United States.

Mr. Golden: That did not start yesterday and it will not end tomorrow.

Mr. Taylor: This goes back to the university question. There is much discussion among people these days who are studying exactly what is going on here about so-called mission-oriented research and potentially more mission-oriented research in universities. This is so that those things that the universities are doing will be directly useful upon the graduation of the student. He is then better adapted to immediately fit into the needs of industry. I think we are all hoping that out of the various studies that are going on now we will see more industry, university co-operation and more direction on how the studies should go. In this way when graduates do become available we can immediately fit them into industry without any gaps in what is going on. I think this is a highly desirable direction to reach. Also, if we can establish our national goals as a country and we can orient ourselves, all of us, industry, universities, government laboratories alike, address ourselves to these goals specifically, then we can see a much better overall result coming out of it.

Mr. Ross: If I could add, Mr. Chairman, to what Mr. Taylor has just said. I am quoting numbers here that were given by Dr. Patterson at the Science Council. He estimated that in 1968 there were 5,500 R and D engineers in Canada. He said that it is expected that by 1975 there will be a total of 11,000 such engineers in Canada. The proportion of these engineers with advanced degrees will increase from 30 per cent at present to some 60 per cent in 1975. I think this doubling of the scientific and engineering population means that we have got to double the amount of work that we want to use these people for. If we do not have the economic growth which is going to absorb these people and utilize them effectively, then they are going to leave the country. The money that we have invested in their education will, of course, be lost to the economy.

Senator Bourget: Of course many of them will be absorbed by universities.

Mr. Ross: Some of them will go back into teaching, yes. Some of them are foreign students and they will return to the country of their origin. These numbers, the 5,500 and 11,000 are those that are expected to be available within the country in total. Perhaps what it means is that if universities are planning to produce that number of people there should be a proper relationship between the industry planning and the availability of scientists and engineers.

Senator Bourget: You are not afraid of an overproduction in scientists?

Mr. Ross: The point I am getting to is that maybe there could be an overproduction. I do not know. Unless the rate of economic growth matches the rate of increase in availability of scientists there may be an imbalance.

The Chairman: More and newer aircraft. Have you any additional comments before we adjourn? Thank you very much, gentlemen, for having been with us this afternoon.

The committee adjourned.

APPENDIX 174

BRIEF

TO

THE SENATE COMMITTEE ON SCIENCE POLICY

by

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of

THE BOBTEX CORPORATION LTD.

31 JANUARY 1969

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This BRIEF is in response to the public invitation of Dec. 17, 1968 by The Senate Committee on Science Policy relating to their Study of SCIENCE POLICY IN CANADA.

It is NOT FOR PUBLICATION, except by The Senate Committee, should the committee deem it advisable to make the brief's contents public.

It has been submitted as requested to:

Patric J. Savoie, Secretary
Special Committee on Science Policy
Room 369-E
The Senate, Ottawa

SUMMARY

1. Like capital, inventors and inventions are international in nature, moving to whatever climate will permit them best to prosper.

2. The world is witnessing a technical explosion, two manifestations of which are a battle for technical supremacy and a battle for trade supremacy. In both, technical superiority is the major weapon.

3. Industry nurtured by technical innovation and invention can successfully compete in international markets, in addition to fulfilling domestic needs, and so become export-oriented, to the great prosperity of the host country.

4. Canada with its two strengths of vast and growing primary industries based on unlimited natural resources on the one hand, and being one of the few remaining oases providing a sound basis for long-range investment in a world of economic instability and political unrest on the other hand, could become one of the most preferred locations for the setting up of numerous multinational innovation industries - provided a suitable climate is created through adequate incentives. Under present conditions we are losing out to other countries with a growing technical superiority over us.

5. It is of the utmost importance to Canada that the widening technological gap between our country and the agressive leaders in world trade be reversed. Present Research and Development (R. & D.) incentive and assistance programs, while a step in the right direction, are not effective in creating the proper climate for inventors to

prosper and to bring new inventions and innovations to commercial fruition.

6. Our brief contends that although late in the day, Canada can still acquire the technical competence required to create and support a healthy and expanding secondary industry based on innovation and the need to export dynamically, through implementation of the following two-part incentive program:

(a) a Federal Government-sponsored insurance plan to enable coverage of 75% to 85% of the inherent risk involved in the "idea to hardware" development phase of all inventions whose merits have been evaluated under the scheme as being worthy and capable of commercialization to help foster our national industrial and trade objectives as summarized herein.

(b) a specific income-tax credit plan, including a reinvestment in Canada provision, for industries manufacturing new products based on new technology, and primarily, or exclusively, export-oriented.

INTRODUCTION

7. Much has been heard on the subject of science in Canada and the need for innovation, from government leaders, economists, journalists, and representatives of big industry and of universities. On the other hand, very little has been heard to date from inventors and other innovators, who are often in the best position to judge the requirements of government policies in this area and the effectiveness of any measures designed to stimulate applied science.

8. This brief has been prepared by two inventors with a background of extensive experience in large-scale international

invention industry. It presents measures for the encouragement of Canadian invention and industry based thereon, which, if implemented, would reverse the widening "technology gap" in our vital secondary industry, a situation recognized as dangerous to the Canadian economy; and would enable Canade to participate agressively and successfully in the world's technological explosion.

PREMISES

9. It is essential to recognize the premises and objectives underlying our proposals which follow. The first two are fundamental truths about inventors and inventions. The remaining seven outline Canada's present strengths and weaknesses in reference to the need for our country to fundamentally improve its technological progress.

10. The premises are:

1) The world supply of creative and inventive minds is limited; possessed by few, it is a rare gift of nature. Technical innovation orbits around this inventive nucleus. No amount of money spent on Research and Development can create inventive minds. It is a recognized fact, however, that the most potent stimulants for such, often dormant, inventive minds to become creative are "need" and "reward", the latter in the form of material benefits and social recognition of achievement, primarily both.

2) Inventions, the products of inventive minds, like capital, are highly mobile and international in that technical progress respects no boundaries. They are attracted to where the highest rewards and best scientific environment and economic climates prevail. During the "idea to hardware" stage the availability of adequate

financial assistance offered on realistic and flexible terms for R. & D. work is of paramount importance. In the commercialization phase, tax incentives and easy access to venture capital are imperative. Most countries that have become leaders in the world's technological progress provide many such INCENTIVE PROGRAMS which have succeeded in attracting creative minds and invention industries from all over the world, to the benefit of their respective economies.

3) Canada enjoys an undisputed advantage and attraction for continued growth in its resource-based primary industry. Our enormous natural resources, both already known and as yet undiscovered, and a gradually expanding home market, constitute a great economic potential for investment and reinvestment of money earned for many generations to come. Large though our primary industry is, however, it is growing less fast than secondary industry, and has progressively declined to 10% of Gross Domestic Product (G.D.P.)in 1967.

4) Canada's secondary manufacturing industry, on the other hand - now accounting for about 25.1% of G.D.P. (1967) - is now highly vulnerable due to diminishing trade barriers (Kennedy Round) and inadequate technological progress; it is recognized that international trade is increasingly stimulated by technical superiority and to a lesser degree by a contest of prices.

5) Unfortunately, Canada does not yet provide adequate R. & D. and realistically oriented incentive programs. Creative minds from outside are not being widely attracted, the drain on our <u>best</u> brains has not been arrested, and increasing foreign ownership has not been checked. While the first two are contributing factors

to the latter, the effect is compounded by the well-documented subsidiary company characteristics prevalent in a large portion of Canada's industry. In the case of the brain drain, it is not the sheer numbers lost but the high quality of the exodus which hurts most.

6) The limited size of the Canadian market is a serious handicap in attracting new invention industries. Even in the case of Canadian inventions, under present conditions it would be against fundamental economic laws to chose Canada as the world base for such new industries, which are multinational by nature. This will remain true until Canada adapts and extends its current assistance programs and provides more effective incentives which could more than offset present handicaps and thus justify new industries setting up here.

7) In many fields Canada is a latecomer in joining the world-wide battle for technological supremacy. As such, in order to improve its chances of being successful, it must not only match but even excel in any incentive weapons it utilizes as compared to its competitors.

8) From the most fundamental point-of-view, Canada's most urgent need is an OFFENSIVE entrepreneurial new secondary industry based on new ideas, new inventions and novel technology effectively applied to the manufacture of new products and to a more agressive expansion of Canadian exports into world-wide markets. In contrast to this, DEFENSIVE innovations geared to improve old technologies of existing industries provide smaller advantages; moreover, they are inherently more vulnerable in this world of rapid technological change.

9) Given proper incentives, Canada can well become one of the most preferred locations for the setting-up of many multinational innovation industries, for the following reasons:

a) Canada is located at the doorstep of the world's largest consumer and capital market and at major crossroads of international East - West - South trade.

b) In a world of economic instability and political unrest, Canada is one of the few oases left which still provide a sound climate for long range investment.

c) The existence of abundant domestic natural resources referred to under item 3 above.

11. All this constitutes opportunities of great magnitude for Canada. If we are successful in attracting such innovation industries, it will enable us to mold to our own design an even greater future. This can only be done by creating an appropriately attractive climate in Canada.

12. Canada has nothing to lose but a great deal to gain by introducing special incentive programs to attract such new-invention industries, primarily and often exclusively export-oriented, producing new products and using new technology, not yet applied in Canada. On the other hand, without such programs, the enormous additional benefits which are possible to be gained for the Canadian economy of the future will be sacrificed.

OBJECTIVES

13. The above premises clearly infer two major objectives for the Canadian Government:

a) To provide adequate and flexible ways and means for effective assistance to inventors to enable R. & D. financing of inventions from the idea through to the hardware phase of development.

b) To provide more attractive and effective incentives to new-invention industries to stimulate their setting up of operations here, and to ensure reinvestment of part of their profits in Canada to enhance perpetual industrial growth and innovation.

PROPOSALS

I. Government-Sponsored Invention Risk Insurance

14. More often than not, inventors/innovators do not have adequate funds to embark on the long and costly road of R. & D. work to bring their invention from the idea to the hardware stage. At this initial and most crucial stage they will seldom qualify for any of the present R. & D. assistance programs within the Program for the Advancement of Industrial Technology (P.A.I.T.) or the National Research Council's (N.R.C.) Industrial Research Assistance (I.R.A.) which at best provide 50% of the costs involved. Many an invention has been abandoned or lost to mankind and to the Country of origin because the inventor failed to find the needed venture capital, willing to take a gamble with respect to the inherent risk involved in even the most promising inventions at their initial R. & D. stage. Independent inventors often do not even have adequate funds to secure proper patent coverage.

15. With some exceptions, to a significant degree large corporations have lost the risk-taking pioneering spirit which made America great. Now, many prefer to jump on the band wagon after the inventions have been developed and fully proven, even if this is always much more expensive and often too late. Well-known are such famous ideas as XEROX, POLAROID and many

others which failed to find backers at the early stage who were willing to take the risks involved. In these cases, many industrial giants who had the opportunity to assist and did not, badly missed the boat. By contrast, the Pittsburg Mellons' pioneering spirit laid the foundation to their industrial empire, including aluminum and carborundum, by practical implementation in the past of their motto: "Give us an inventor with a good idea but no money, and we shall provide the money and jointly exploit the idea."

16. A strong parallel can be drawn between the problems of exports and those of the invention industries. The invention industry, which is the mother of major exports, presently finds itself in Canada with the same financing problems as have beset and seriously handicapped product exports. The latter involve inherent and unavoidable export risks as well as financing demands because of deferred payment terms after the goods had been shipped. Country after country was thus forced to provide the exporter with up to 85% of the export value with a Government guaranteed export credit-risk insurance against payment of a reasonable premium. Canada's own Export Credits Insurance Corporation (E.C.I.C.) was initiated in 1945. On the basis of this insurance, exporters are now able to finance export transactions in private capital markets, primarily banks of their choice, because the export risk factor has been substantially eliminated. The result: exports, such as Canadian wheat for instance, started to move at an accelerated pace and apparently the overall losses to the Canadian Government are much below the insurance premiums collected, in spite of the often high financial and political risks involved.

17. A similar risk insurance plan could well be applied to enable coverage preferably of 85%, but not less than 75%, of

amounts advanced to an inventor by any financial source, preferably also including banks, the remaining 15 or 25% being absorbed by venture capital financing, which would thus be easier to acquire. Such financing would be confined to applied R. & D. work on specific patented or patents-pending inventions, covered by said Government risk insurance after proper educated evaluation of their merits, to carry the invention from the idea through to the commercialization stage. The risk insurance coverage involved would be limited to a total amount and term agreed to in advance in each individual case. The insurance premiums could be made payable by the financing medium on each amount advanced to the inventor. It could be extended into the commercialization stage by premium payments on the value of sales materialized from the respective invention until the total amount of premiums paid reaches the total amount of the insurance coverage. The aggregate insurance premiums collected should substantially exceed any losses incurred and provide a sound basis for perpetual extension of the scope of this insurance plan. For all practical purposes it would de facto constitute a backwards integration of the present product export insurance into the export product development and manufacturing phase, the primary source of all industrial exports.

18. In the broad context, the principle of credit insurance related to technically oriented secondary industry should be looked at in the light of the long term financial requirements of a dynamic and efficient science policy for Canada.

19. It is almost certain that the most effective step that could be taken in the area of innovative secondary industry financing in Canada at this time would be the further

development of the concept of industrial credit insurance. Thus, moneys could flow into small secondary industry not on the basis of the credit of the borrower, but on the credit of the insurer which would be unassailable.

20. Small business lending is usually considered risk lending, which is a bad concept. The effect is undesirable because the lender thinks or claims that the risk can be compensated by an increase in the rate of interest which is self-defeating as it increases the burden of fixed interest payments to the borrower. The business of insurance on the other hand is directly related to risk taking and the insurer has to accept the fact that he is being paid through premiums to accept risks.

21. For any private institution involved in direct lending activities, the effect of a loan going sour can be bad not only for the credit of the lender, but also in the inhibiting effect it has on future lending. On the other hand, a credit insurance company would not be performing its function properly if, over a period, it did not have to stand some underwriting losses; its reserve mechanisms are designed for this purpose.

22. As in any insurance activities the underwriting of risk would be the key, but as a practical matter there seems to be no reason why the talent of existing institutions whether government or private, could not be utilized for this purpose.

23. Industrial credit insurance would compete with nobody; it would harness and supplement the activities of the present institutions active in venture capital financing and would open the door to supplies of moneys from say pension funds and trust funds which are at present unavailable for this purpose.

It would enable a great central promotional effort to be made goading on business without treading on any toes, while the actions of the authorities would have a very much greater impact on the economy than could be achieved by additional direct lending through existing or new agencies.

24. To encompass these aims, it is natural to wonder whether the research, talent and experience presently available in the Industrial Development Bank could not be specifically channelled into this area of credit insurance. One of its main functions would be the underwriting of industrial credit risks and it could also offer certain services in the area of managerial assistance.

25. Its primary relationship would be with a limited number of approved lenders who could demonstrate certain specialized expertise and through whom insured loans would be made to developing corporations. Some of these approved lenders would be existing institutions with experience in this area.

26. Such a flexible program would be very attractive to inventors and industrialists of many countries in the world, including Canada. It would greatly enhance their interest in persuing their activities here, and at the same time they would be attracted to a lesser degree to go south of the border with the development and commercialization of their ideas.

27. Dilution of the risk factor (inherent in new idea development and implementation) among numerous parties involved would result. More importantly, the Canadian Government would not need to provide any allocations of funds in its budget for this purpose, assuming that on the average the losses should be well below the amount of insurance premiums collected.

28. The scope of such assistance would thus be considerably increased and widened. The invention risk insurance possibilities would no doubt enhance the importance as well as the effectiveness of all hitherto existing R. & D. assistance programs, such as Industrial Research and Development Incentive Act (I.R.D.I.A.), P.A.I.T. as well as N.R.C.'s I.R.A. Inventors would thus be able to operate within highly flexible assistance programs aimed at mission-oriented projects together with Canada's Universities, (already increasingly involved in cooperation with private industry) resulting in a better scientific environment.

II. Special Income-Tax Incentives for Export-Oriented New-Invention Industries.

29. To attract companies desirous of setting-up plants to exploit new processes or products, not being exploited in Canada, long range income-tax-credit incentives should be provided for a period of about ten years. By their very nature, such new products and processes based on technical advancements and innovation are multinational in character and in their commercialization. Multinational industrial corporations have to operate on the basis of long-range planning and thus would be reluctant to consider acceptable the present 3-year incentive programs. Nor would they agree to confinement to designated areas: the choice of location for setting up of such modern plants is governed by prevailing conditions most favourable from the economic, social and scientific points of view, and depends on the raw materials used, the type of product manufactured, markets to be served, the scientific-technological environment needed and labor sources available.

30. To prevent conflict with General Agreement on Tariffs and Trade (G.A.T.T.) provisions and to assure continuous growth of the Canadian economy, it is suggested that the income-tax-credit incentive should stipulate that the full prevailing

corporate income tax is payable every year into a special account of a Canadian bank of the respective company, with the provision that the company have unrestricted drawing rights from this account; however, only for the purpose of reinvestment in Canada for future defined expansion and innovation needs (such as plant and equipment), without any repayment obligations ever. Any amounts not withdrawn for this purpose within three years from the date of its deposit on this account would have to be transferred to the Government Income Tax Office. Such a tax-credit incentive scheme would not interfere with the restrictive provisions of G.A.T.T. - which consider export subsidies as an indirect devaluation - because de facto it would constitute an internal industrial growth and innovation stimulant, in contrast to the "added value" and other direct or indirect export subsidies used by many countries.

31. In a world of rapidly and continuously changing technologies and the consequent high risk factor involved, the return of capital invested must be accordingly accelerated in order to finance perpetual innovation and fast expansion to stay abreast of technological progress and competition. Therefore, full advantage should be taken of the initially high demand for new products, as it may well level off after a short time. From this stems the direct need for incentives in the form of income tax credits as outlined above.

32. If Canada wants to profit from the world's technological explosion to a larger degree than it has up to now, it must be progressive in its thinking; act agressively; and be timely in accord with the prevailing world trend.

33. Approval in principle of the two recommendations in this brief is sought from Ottawa at the present time.

34. As the recommendations go beyond the confines of what could be referred to as Science Policy and have a bearing on foreign affairs, Canadian and International trade, commerce, finance, taxes and tariff relations, it is recognized that immediate implementation may offer some difficulties. Nevertheless time has become an important factor; implementation of the Kennedy Round provisions entails the currently pending international negotiations. For the practicalities of setting up of multinational industries, any new incentive programs in Canada preferably should precede conclusion of these talks.

35. The authors are very encouraged by the Canadian Government's appeal to Canadians for their direct involvement in the economic affairs of the country and are appreciative of the opportunity to present this brief. It is our firm belief that a far-sighted expansion of the present Government Policy on Science can help Canada to advance its level of technological achievement to that which is needed for successful economic growth and expansion. We are willing to present our more specific viewpoints at any public hearing of the Senate Committee on Science Policy, if and when so desired.

36. Respectfully submitted this thirty-first day of January, the year one thousand, nine hundred and sixty-nine.

Emilian Bobkowicz

Dr. Andrew J. Bobkowicz

NOTES ON THE AUTHORS AND ON BOBTEX CORPORATION LTD.

37. The authors are respectively President, and Vice-President: Research and Development of The Bobtex Corporation Limited, described briefly hereunder. Their Curriculum Vitae are included as appendices A and B.

38. A co-author of this brief is Mr. Michael Boyd.

39. The Bobtex Corporation Ltd. is a company incorporated under the laws of Canada having its head office in Montreal. It is a technological company, comprised of engineers and scientists striving to bring to commercial fruition a new and revolutionary textile process based on world wide patents held by Mr. E. Bobkowicz and Dr. A. J. Bobkowicz, the founders of Bobtex. The inventors hold 245 Canadian and world wide patents, 146 granted and 99 pending, in 29 countries. Participating co-founders of The Bobtex Corporation are the Aluminum Company of Canada, Ltd. and the firm of Boyd, Stott, McDonald and Phillips Ltd., as is reflected in the composition of the Board of Directors of Bobtex:

Mr. Emilian Bobkowicz, President and Chairman

Dr. Andrew J. Bobkowicz, Vice President
(Research and Development)
and Treasurer

Mr. Paul H. Leman, Executive Vice-President
Aluminum Company of Canada, Ltd.

Mr. R. T. Hyland, Vice President
Alcan International Ltd.

Mr. Michael Boyd, Director of Fry & Company Ltd.

40. Financial support and technical assistance is being received by Bobtex from the Aluminum Company of Canada, Ltd. and from the Polymer Corporation in Sarnia. The extensive Bobtex R. & D. activities are also receiving considerable support from the National Research Council within their I.R.A. Program.

APPENDIX 175

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A BRIEF BY THE

AIR INDUSTRIES ASSOCIATION OF CANADA

TO THE

SENATE SPECIAL COMMITTEE ON SCIENCE POLICY

March, 1969

1. INTRODUCTION

The Air Industries Association of Canada is very pleased to respond to the request of the Senate Special Committee on Science Policy for an aerospace industry statement on this important subject.

Over the past few years an increasing awareness has developed as to the need to study and forecast Canada's future in respect to its economic, technological and industrial facets. The Economic Council and the Science Council have issued a series of reports which bear on these subjects. These reports have been based on a number of studies, reports and presentations, some of which have been specifically commissioned and others prepared voluntarily by interested parties. Of particular interest to the aerospace industry is the report being prepared by the Aerospace Marine and Rail Branch of the Department of Industry, Trade and Commerce. The first two volumes of this report which contain substantial quantitative data have been published and the third volume, which we understand is directed at developing recommendations as to future policy for the industry, is in course of preparation.

All the reports and studies illustrate clearly that Canada's future economic welfare is inextricably linked to its industrial growth. They also note that the speed of industrial growth of the most advanced countries is closely relatable to their level of technological competence. In most instances the aerospace industry is highlighted as a prime contributor to Canada's technological competence.

There would appear therefore, to be little argument today as to the advantages to be gained by Canada in maintaining a high level of technological capability. The problem is to establish directions of effort which will be most effective in achieving Canada's overall national goals of growth and improved social conditions.

2. BACKGROUND

The environment in which the Canadian aerospace industry exists is conditioned by the limitations of Canada's domestic and military aerospace requirements. The steady growth of the industry within this environment is due to its ability to compete in the international market. In 1967 and 1968 some 60% of the total industry production was exported. This is the highest percentage export of any aerospace industry in any country in the world and this industry is now Canada's third largest manufacturing exporter.

The domestic base although relatively small is significant and, in addition, it provides a proving ground for specialized equipment which is subsequently sold in the international market place.

The output of the industry is increasingly commercially oriented.

In 1968 the aerospace industry employment was approximately 50,000 with some 2,500 being engineers and scientists. It is clear that this technologically advanced industry plays a very important role in attracting and retaining high quality technical people for Canada.

The activities of the industry now encompass a broad spectrum which in addition to aircraft and aircraft engines include avionics, flight simulators, space products, accessories and ground support equipment. The avionics segement alone has now achieved 1/3 of the total annual sales of the aerospace industry and Canadian electronic and avionic products enjoy an international reputation for technical excellence in many specialized areas.

The development of most of the aerospace products which have generated current industry sales was commenced several years ago. New products that will be offered in future years and the acceptance of these products by both domestic and export markets will be determined by the research and development effort which goes into the Industry now.

3. THE NEED FOR INCREASED R & D SUPPORT

The aerospace industry is already a leader in demonstrating the effectiveness of concentrated, product oriented technological development. The industry is prepared to augment present efforts substantially but to do so, increased direct government funding is required. Other more general forms of support provide stimulation, but increased direct funding of research and development is essential. The Air Industries Association of Canada requests that serious consideration be given to expanding current Government R & D assistance programs by increasing the level of financial support for projects that lead to the development of internationally competitive products. In support of this straight-forward request the following comments are provided:

(a) Previous briefs presented to the Special Committee of the Senate On Science Policy have noted that the Canadian Government R & D expenditures as a percentage of G.N.P. was low compared to other Western Countries. Of even greater consequence is the small proportion of these expenditures that is available to industry. The Fifth Annual Review of the Economic Council of Canada quotes that of the $351,000,000 in Government R & D. expenditures, 69% spent in government research laboratories, 16.5% in universities and only 14.5% in industry. The industrial percentage in Canada is strikingly lower than other industrialized countries; for example in the United States about 65% of every research tax dollar is spent in industry.

In view of the facts that development and product design with ensuing production bring the most immediate benefits to the economy and that, to be effective, these phases must be conducted by industry, the Association believes that the total funding available for R & D should be increased substantially and that the bulk of this increase should be assigned to industry.

(b) The various government assistance programs have unquestionably been beneficial in promoting the R & D in the aerospace industry which has led to production and sales. However, these programs call for substantial cost-sharing with the government. Hence, the aerospace industry, in endeavouring to respond to growth opportunities, is currently generally investing almost all of its available funds in the innovation of products and services. Further acceleration in expansion rate requires increased R & D assistance.

(c) The principle is accepted that industry should participate in funding the research and development phase to ensure responsible product selection. It should be noted however, that the further costs of tooling, of prototypes, of production start-up and of market development, which are incurred in bringing a new product into successful production, are also very large. These costs also ensure the careful selection of products and in addition they represent a significant further financial burden.

In light of the foregoing the Association suggests that, as an alternative to substantially increased R & D support, consideration might be given to government sharing of the total non-recurring costs of bringing a specific new product to the market place.

(d) The terms covering some of the cost-sharing R & D programs administered by the government include a requirement for repayment to the Crown for financially successful programs. The Association believes that there should be a reassessment of the repayment requirement for research and development assistance funds. As noted above, research and development is only a portion of the costs associated with the innovation process in high technology industries. Hence, industry should assign available funds to any other unsupported costs incurred and to its share of further research and development rather than to repayment of past research and development assistance. The government will recover its investment from the increased corporation and private income taxes generated by successful programs. In this regard the Association would draw attention to the views of Professor V.W. Bladen in his appearance before the Senate Committee.

(e) The investments prior to payoff on aeronautical products are very large but the business and therefore the employment resulting from a successful product is large and enduring; for example a successful airplane or airplane engine stays in production for 10 to 20 years while a successful avionics product has a production life of 5 to 15 years. The very large early investments and the long payoff make increased direct assistance in the launching phase essential.

4. <u>SUMMARY</u>

To summarize, the aerospace industry is currently a pace setting industry in terms of successful exploitation of innovative technology. Its export record is outstanding and the R & D capability in the industry exists, it does not have to be created, it is today an effective, mobilized technical force. The industry is product oriented and is capable of immediate expansion. Existing government assistance programs have been effective but to accelerate growth and to continue to compete successfully in export markets, which it must do to stay viable, the aerospace industry must have increased direct R & D assistance from government.

The Association hopes that the views expressed herein will be of assistance to the Special Committee on Science Policy and that the endeavours of that Committee will lead to an increased awareness of the importance of industrial research and development in achieving national goals of economic growth and improved social conditions.

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Brief of United Aircraft of Canada Limited
to
the Senate Special Committee on Science Policy

12 MAY 1969

There is much discussion in Canada on Science Policy at the present time, so much so that I will not recite again the reasons for all these reviews. These are well known to this committee. Rather, I would like to make some specific comments on the operations of United Aircraft of Canada Limited.

The Company has a number of activities, which are described in general terms in a series of Appendices to this brief. I will discuss in the following our PT6 gas turbine engine program only, to illustrate how judicious Government support for development projects can produce worthwhile results.

By the end of 1968, the Government had contributed $12.6 million to this program, the full amount pledged by the Government being $15.8 million. The combined investment of the Government and the Company has produced the following cumulative employment, product and exchange volumes, expressed in millions of dollars:

Year	Cumulative Government Support	Cumulative Gross Payroll			Cumulative Total Sales	Cumulative U.S. Currency Sales *	Cumulative Net U.S. Currency Inflow *	Cumulative Canadian Content **
		Engrg.	Other	Total				
1962	3.5	7.2	0.8	8.0	-	-	-	-
1963	4.2	9.4	1.5	10.9	-	-	-	-
1964	5.6	11.9	4.1	16.0	2.6	2.5	1.6	1.7
1965	7.8	14.1	8.4	22.5	10.1	9.1	5.7	6.7
1966	10.9	17.1	14.6	31.7	27.1	23.2	14.3	18.2
1967	11.9	18.8	22.4	41.2	58.9	48.0	29.0	39.9
1968	12.6	20.3	30.9	51.2	92.0	71.3	42.1	62.8
1969	13.4	21.8	41.9	63.7	136.0	102.3	60.9	94.6
1970	13.9	23.1	54.5	77.6	188.0	142.3	87.9	133.6

* These are direct exports only. They do not include sales to Canadian customers for installation in aircraft to be exported.

** Recurring production content only. Excludes design, development and non-recurring production costs.

While forecasts beyond 1970 exist, data beyond that point have not been used lest they detract from the validity of the figures. This table indicates that a relatively small investment on the part of the Government to enable the Company to proceed with a program in time to meet market requirements has fostered a contribution to our country's GNP and foreign exchange out of all proportion to the amount invested. By the end of 1970, a $13.9 million investment of Government funds will have fostered $133.6 million additional GNP with increasing annual increments ($22.9 mn, $31.8 mn and $39.0 mn in 1968, 1969 and 1970), such that the addition to GNP in 1970 alone will be three times the cumulative gross Government investment.

The investment has also helped to develop a capability which has made it possible for Canada to take advantage of further opportunities to increase the GNP through additional products in the small gas turbine engine category, where Canada has developed a fairly unique prowess.

I hope the example of the PT6 will serve to illustrate that:

(1) Effective exploitation of development projects is best undertaken by industry.

(2) Government support to development can result in very beneficial effects on employment, our balance of payments, and our technological capabilities.

In closing, I should mention that we have a continuing program of applied research in collaboration with the Defence Research Board. This has been an effective program, results of which have been embodied in development projects such as the PT6.

T E Stephenson

jsc
att.
29 April, 1969

T. E. Stephenson,
President.

APPENDIX A

A SHORT COMPANY HISTORY

United Aircraft of Canada Limited (UACL) was created as a sales, service and overhaul organization in 1928 to handle the products of Pratt & Whitney Aircraft, a division of United Aircraft Corporation of East Hartford, Connecticut. *

During World War II, UACL branched into manufacturing when it produced Hamilton Standard constant speed propellers and Pratt & Whitney Wasp engines. The Company now manufactures in Montreal, for world-wide markets, all Pratt & Whitney piston engines and spare parts.

In 1958, the Company created the nucleus of a design and development organization. After orientation at Pratt & Whitney Aircraft of East Hartford, and the completion of preliminary design of the 3,000 lb. thrust JT12 gas turbine engine, this team designed its first Canadian aero engine, the PT6 gas turbine. The first production engine of this program was delivered in 1963 and at this date over 2900 engines have been delivered to customers. Current manufacturing plans call for a substantial level of production of this engine over the next ten years. Based on the market acceptance of the PT6 engine, UACL has embarked on a new engine project, an advanced turbo-fan or fan-jet engine, which will go into production for the General Aviation market in 1971 and for which orders have been won from two major manufacturers in the U. S. A. and France.

In 1962, UACL entered into the helicopter field. The Company is currently involved in detail design and manufacture of components for the Sikorsky CH-53 primarily for the U. S. market.

In 1966, the Company formed an Industrial and Marine Division to handle all projects not connected with the aircraft industry. PT6 engines are now being used in Turbo-Trains in the U.S. and Canada, wood chippers in the pulp and paper industry, sea-going boats and hovercraft, fracturing units in the oil industry, power generation and gas pumping systems, high speed snow plows and in highway trucks.

United Aircraft of Canada Limited currently employs more than 5,000 people in the Montreal area in seven plants occupying over 1-1/2 million square feet of area. Over 900 members of our technical staff are employed in engineering and management tasks.

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* The following are divisions of United Aircraft Corporation, East Hartford: Pratt & Whitney Aircraft, Hamilton Standard, Sikorsky Aircraft, Norden, Electronic Components, United Technology Center and Research Laboratories.

APPENDIX B

UACL'S BUSINESS ENVIRONMENT

United Aircraft of Canada Limited develops, manufactures, markets and supports in the field a proprietary line of products that is complementary to that of United Aircraft Corporation (UAC) of East Hartford. More precisely, UACL produces small gas turbine engines aimed at the General Aviation market. UAC, on the other hand, produces large gas turbines that power over 70% of the aircraft operated by the major airlines of the world.

From the time of the Korean War, UAC has given UACL rights to produce under license spare parts for all existing Pratt & Whitney piston engines and to support their operators around the world. This business has provided the production base and the profits for the development of a Canadian line of gas turbine engines. UAC sponsorship in the activity has ensured UACL access to the U.S. market and in particular to the U.S. Military market. In transferring this piston engine business to UACL, UAC has made a long range investment in Canada while concentrating on its large gas turbine engine business in East Hartford.

UACL has received financial aid from the Federal Government for the PT6 and JT15D engine programs. As a direct result of this support on the PT6 engine program it is estimated that in 1983, or 20 years after the start of production, the cumulative sales on this program will be over $1.6 billion with 90% of our production being exported to the U.S. We estimate sales of over $2-1/4 billion over the life of the program. We anticipate the JT15D engine program sales to be in excess of those of the PT6.

Sales in the U.S. will continue to be possible because of the excellence of our specialized products and their competitive prices and because of UAC's sponsorship, particularly in the U.S. Military market.

Successful Canadian aircraft products such as the PT6 engine which is in operation around the world, have helped to establish Canada in the international market place for quality goods and have paved the way for other exports. Canada's place in the market is doubly reinforced when Canadian engines are selected for U.S.-manufactured aircraft in use around the world.

APPENDIX C

UACL'S MARKET

The following table presents the forecast activity mix at UACL as exemplified by sales:

UACL SALES BY ACTIVITY

	1968 Actual %	1973 Forecast %	1978 Forecast %
Proprietary Products	23.6	59.7	62.4
Licensee Products	43.8	10.6	3.1
Overhaul Activity	8.4	5.5	6.9
Industrial & Marine Products	9.7	15.2	20.9
Helicopter & Systems Products	4.3	3.7	2.3
Agency Products	10.2	5.3	4.4
TOTAL	100.0	100.0	100.0

As indicated in the preceding table, nearly 2/3 of our forecast sales in 1978 will be generated by our proprietary line of products tailored to the General Aviation market. The users of our products are:

(i) commuter airlines - transportation of commercial passengers and freight,

(ii) business corporations and government agencies - executive transportation and utility applications,

(iii) air taxi operators - charter service, and

(iv) flying schools - training of professional and private pilots.

This market is forecast to grow rapidly as indicated in the following table: *

U.S. GENERAL AVIATION TOTAL AIRCRAFT PRODUCTION

	1967	1975	1980
Unit Production	10,850	17,900	21,560
U.S. $ Production (Millions)	475.3	1,108.5	1,660.6
Increase in $ Production over 1967 - %	100	233	350

One rapidly growing segment of the U.S. General Aviation market served nearly exclusively by UACL's PT6 engine is that for turboprop aircraft. This can be seen from the following table:

U.S. GENERAL AVIATION TURBOPROP AIRCRAFT PRODUCTION

	1964	1965	1966	1967	1968
Increase in Unit Production over 1964 - %	100	277	444	475	750

This growth trend is forecast to be maintained.

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* This data was obtained from a study recently published by the Utility Aircraft Council of the U.S. Aerospace Industry Association.

The Industrial and Marine market which is forecast to generate 20% of our sales in 1978, is in a developing market; a measure of its growth rate is presented below:

U.S. INDUSTRIAL & MARINE MARKET
1,000 - 6,000 SHP GAS TURBINES

	1965	1967	1972	1977
Increase in Unit Demand. over 1965 - %	100	107	146	180

UACL guarantees customer product support services for the lifetime of an engine. This can exceed 40 years. Currently, UACL provides technical field support, overhaul and parts service to over 520 operators in 47 countries.

APPENDIX D

UACL'S PRODUCT

ENGINE DEVELOPMENT

UACL produces small, lightweight gas turbine engines that are economic and reliable to operate over a wide range of conditions.

In a successful engine program as many as ten different models may be produced in quantity over a 25 year period with the last model having well over twice the power of the first model. This increase in power must be achieved for:

(i) small increases in cost and weight,

(ii) decreases in fuel consumption rate, and

(iii) an ever increasing reliability.

To cope with the demands of the market, a great deal of development effort must be invested over the engine program life, and particularly at the early stages of the program, to:

(i) "build in" a portion of the anticipated growth potential of the engine, and

(ii) ensure low production costs right from the very first engine.

The balance of the development effort must be invested over the life of the entire program for:

(i) the refinement and support of each existing model, and

(ii) the development of each successive engine model.

It is noted that the cumulative non-recurring expenses associated with engineering, design and production start-up at the end of an engine program, can be of the order of six times the cumulative non-recurring costs incurred to the start of production on the first engine model of the line.

TECHNOLOGY TRENDS

In the future, advances in gas turbine engine performance are likely to be achieved through increases in heat addition during combustion (with engine volumes and weights per unit of output power lower than today's engines). Hand-in-hand with this, higher compression pressure ratios will be required for the maintenance of optimum engine cycle efficiency.

Increases in heat addition imply higher turbine inlet temperatures which require new materials and blade cooling to prevent deterioration of engine component strength.

Higher compression pressures imply greater aerodynamic sophistication and higher engine rotational speeds; these must be achieved with simple designs.

Pollution of the environment due to propeller, fan, combustion, compressor, bearing and jet efflux noise as well as gaseous and particle by-products of combustion, will have to be rigorously controlled at the design stage.

Improvements in manufacturing productivity will be achieved through:

(i) simplicity of design - simpler air flow paths, fewer engine components,

(ii) the use of materials with better machinability and formability - which still satisfy the needs of higher engine performance.

(iii) improvements in manufacturing processes and machines, and

(iv) increased automation in production.

Further automation of the production process is most likely to occur through:

(i) the slaving of large quantities of machine tools and production processes to a master computer with sensible multiplexing for low down-times,

(ii) the integration of inspection routines with machining operations, and

(iii) the use of on-line systems for production management information, collection, synthesis, distribution and analysis with real time diagnostics.

The Queen's Printer, Ottawa, 1969

UACL'S PRODUCT

[illegible]

ENGINE DEVELOPMENT

UACL produces small, lightweight gas turbine engines that are economic and reliable [illegible]

In a successful engine program as many as ten different models may be produced in quantity over a 25 year period with the last model having well over [illegible] the first model. [illegible] must be achieved for:

(i) small increases in cost and weight

(ii) [illegible]

(iii) [illegible]

To cope with the demands of the market, a great deal of development effort must be [illegible] particularly at the early stages of the program:

(i) "build in" a portion of the anticipated growth potential of [illegible]

(ii) ensure low production costs right from the very first engine.

The balance of the development effort must be invested over the life of [illegible]:

(i) the refinement and support of each existing model, and

(ii) [illegible] model.

It is noted that the cumulative non-recurring expenses associated with [illegible] engine program, can be of the order of six times the cumulative non-recurring costs incurred to the start of production on the first engine model of the [illegible]

TECHNOLOGY TRENDS

In the future, advances in gas turbine engine performance are likely to be achieved through increases in heat addition during combustion (with engine volumes and weights per unit of output power lower than today's engines). Hand-in-hand with this, higher compression pressure