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First Session-Twenty-eighth Parliament 1968-69

## THE SENATE OF CANADA

## PROCEEDINGS

OF THE

# SPECIAL COMMITTEE <br> ON <br> <br> SCIENCE POLICY 

 <br> <br> SCIENCE POLICY}

# The Honourable MAURICE LAMONTAGNE, P.C., Chairman <br> The Honourable DONALD CAMERON, Vice-Chairman 

No. 41

THURSDAY, APRIL 24th, 1969

## WITNESSES:

Canada Council: Me Jean Martineau, Q.C., Chairman; Dr. David W. Slater, member and Dean, School of Graduate Studies, Queen's University; Jean Boucher, Director; and Frank A. Milligan, Assistant-Director and Head, Social Sciences and Humanities Division.

## APPENDICES:

No. 49-Brief submitted by Canada Council.
No. 50 - Brief submitted by the National Film Board.
No. 51 -Brief submitted by the Canadian Wheat Board.
No. 52-Brief submitted by Farm Credit Corporation.


## 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, April 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), Aird, Blois, Cameron, Carter, Giguère, Grosart, Haig, Kinnear, Lang, Leonard, McGrand, Phillips (Prince), Robichaud, Sullivan and Yuzyk-(16).

The following witnesses were heard:
CANADA COUNCIL:
Me Jean Martineau, Q.C., Chairman;
Dr. David W. Slater, member and Dean, School of Graduate Studies, Queen's University;
Jean Boucher, Director; and
Frank A. Milligan, Assistant-Director and Head, Social Sciences and Humanities Division.
(A curriculum vitae of each witness follows these Minutes)
The following are printed as Appendices:
No. 49 -Brief submitted by Canada Council.
No. 50 -Brief submitted by the National Film Board.
No. 51-Brief submitted by the Canadian Wheat Board.
No. 52-Brief submitted by Farm Credit Corporation.
At 1:00 p.m. the Committee adjourned to the call of the Chairman.
ATTEST:
Patrick J. Savoie, Clerk of the Committee.

## CURRICULUM VITAE

Martineau, Jean, Q.C. (Montreal): Chairman of the Canada Council. Born in Montreal, 1895; son of the late Hon. P. G. Martineau. Education: St. Hyacinthe Seminary, St. Jean College and St. Laurent College; LL.L. University of Montreal; Hon. LL.D. Faculty of Law of the University of Montreal. Hon. LL.D. Faculty of Law of Laval University. Called to the Bar of the Province of Quebec in July 1919; Queen's Counsel in October, 1929. Bâtonnier of the Bar of Montreal and the Bar of the Province of Quebec, 1953-54. Senior partner in the law firm of Martineau, Walker, Allison, Beaulieu, Tetley and Phelan. Director of the Royal Trust Company, Monsanto Canada Limited, Chateau-Gai Wines Limited and a director of the Montreal Museum of Fine Arts. Appointed Chairman of the Canada Council in 1964.

Dr. John Francis Leddy (Windsor): Vice-Chairman of the Canada Council. President and Vice-Chancellor of the University of Windsor. Born in 1911 in Ottawa, but moved to Saskatoon at an early age. B.A. and M.A., University of Saskatchewan, post-graduate studies in classics at the University of Chicago, Rhodes Scholar at Exeter College, Oxford, (B. Litt. and D. Phil.). Joined the Department of Classies, University of Saskatchewan, in 1936, became head of the Department in 1946, dean of Arts and Science in 1949, and vicepresident (academic) in 1961. Appointed president of the University of Windsor in 1964. Has held positions of leadership in a wide variety of public and educational societies in Canada, including chairmanship of the Educational Council of Saskatchewan, the Humanities Research Council of Canada, the Canadian Catholic Historical Association, the Canadian National Commission for UNESCO, Canadian University Service Overseas, World University Service of Canada. Is currently international vice-president of World University Service. Has travelled widely around the world and has been delegated to many international conferences and meetings. Author of a large number of special articles in the fields of university education, the ancient classics, and the history of ideas. Has received many honors, including honorary degrees from several universities, the Human Relations Award of the Canadian Council of Christians and Jews; the Cardinal Newman Award of the Canadian Federation of Newman Clubs, and several papal awards.

Slater, David W. (Kingston): Professor of Economics and Dean of the School of Graduate Studies, Queen's University. Born in Winnipeg in 1921. Educated at the University of Manitoba (B. Comm.), Queen's University (B.A., Honours in Economics) and the University of Chicago (M.A. and Ph.D.). Served in the Canadian Army in World War II. After lecturing at Queen's University and Stanford University, joined the staff of Queen's University in 1952 and was promoted to professor of economics in 1962. Has been Dean of the School of Graduate Studies since June 1968. Served on the staff of the Royal Commission on Canada's Economic Prospects (Gordon Commission), in 1955-56. Has published many articles on economics and has served on committees studying education, economics, university affairs and the social sciences. Is currently a member of the Committee of University Affairs and editor of the Canadian Banker's Magazine.

Boucher, Jean (Ottawa): Director of the Canada Council. Born in Quebec City in 1919. Educated at Garnier College, Quebec, Laval University (LL.L. and L.Soc.). Post-graduate studies in public administration at Chicago University as a fellow of the Department of Political Science. Lectured in political science at Laval University from 1946 to 1950. Joined the Department of Citizenship and Immigration, Ottawa, in 1950 as assistant to the Deputy Minister and Director of Administrative Services, and was appointed Director of Citizenship in 1957. Commissioner of the Civil Service Commission of Canada in 1963. Appointed Director of the Canada Council in April 1965. Has been head or alternate head of Canadian delegations to several international conferences, and was a member of the Council of the North West Territories from 1953 to 1957. Is a charter member of the Institut Canadien des Affaires Publiques and has served on the boards of various scientific and educational organizations including the Canadian Social Science Research Council, the Institut Canadien d'Education des Adultes, the Canadian Institute of Public Affairs, and the Overseas Institute.

Milligan, Frank A. (Ottawa): Assistant-director of the Canada Council and head of its Social Sciences and Humanities division. Born in Halifax in 1921. Educated at the University of Manitoba (M.A. in history and political science). After serving in the Canadian Army during World War II, lectured in political science at the University of Manitoba (1947-49), then studied for two years at the London School of Economics under a Beaver Club scholarship. Associate professor of political science at the University of New Brunswick (1951-54). Joined the office of the deputy minister of Defence Production, Ottawa, in 1954, and two years later became his executive assistant. Appointed research director of the Royal Commission on Government Organization in 1960, and assistant secretary to the Cabinet in 1963. Joined the Canada Council as as-sistant-director in December 1966. In the course of his career, has served on a number of Canadian delegations to international conferences. Has published several historical papers on the Government of Manitoba and has written on the British nationalized industries and on the financing of the Canadian Crown corporations. Played an important role in the drafting of the Glassco Commission Report on Government Organization.

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## THE SENATE

## SPECIAL COMMITTEE ON SCIENCE POLICY EVIDENCE

Ottawa, Thursday, April 24, 1969

The Special Committee on Science Policy met this day at $10.00 \mathrm{a} . \mathrm{m}$.

Senator Maurice Lamontagne (Chairman) in the Chair.

The Chairman: Honourable senators, I am sure you are all very pleased to welcome again the representatives of the Canada Council. You will remember that when we began our public hearings the Canada Council was the first agency interested in research and, in their case, mainly in research in the Social Sciences, to appear before us.

As a result of the continuation of our hearings, they felt that it might be desirable for them to add to their first presentation, so we are very pleased to have them with us again this morning.

You will also remember that when the Canada Council appeared before us for the first time, the Chairman, Monsieur Jean Martineau, was not able to be with us. We are very glad to have him here this morning, and I would like to mention that this is perhaps one of the last appearances of Mr. Martineau in his capacity as Chairman of the Council, since he has chosen not to seek reappointment.

I want to say that Mr. Martineau is an old friend of mine. I have admired what he has done all his life. He has been, really in the fullest sense of that expression, a great Canadian, always devoted to the public interest. So, we are very pleased to have you, sir, with us this morning along with your colleagues.

On my left is Dean David Slater, who is a member of the Council and the Dean of the School of Graduate Studies, Queen's University. On my extreme right is Monsieur Jean Boucher, who is the Director of the Council; and on my extreme left, Mr. Frank Milligan, who is Assistant Director of the Council, his main responsibility, as I understand, being in
the field of the Social Sciences and the Humanities.

So, without any further introduction, I would ask the Chairman, Mr. Martineau, to make a few introductory remarks.

Mr. Jean Martineau, Q.C., Chairman, Canada Council: Mr. Chairman, thank you for your kind words, which were no doubt inspired more by your friendship than anything else, but they were very pleasant to hear anyway.

The way this room is arranged, this is the first opportunity, and probably the last, I have of talking down to such an august body as this committee of the Senate, and we will try to make the most of it. We are happy to be here for the second time. On the first occasion I could not attend because I was then before the Supreme Court, in the middle of a case, and it was impossible for me to obtain permission to leave it to appear before you; but this time I would not have missed it for anything.

We are glad to be here and to give you any information you might desire, because we realize the importance of the work you are doing, and we think that potentially this work can be of great assistance to all science in Canada, to give it, if not a direction, anyway to lead it and to help it develop as it should.

We of the Canada Council have done, I think, our best, but we are always willing to listen and to follow when the leadership is good. So, we are here ready to answer any questions that you might put to us on the additional brief we submitted to you a few days ago.

The Chairman: Merci beaucoup, M. Martineau. We shall now proceed to the question period, and I will ask Senator Cameron to initiate the discussion.
Senator Cameron: Mr. Chairman, I am glad to know that I was in distinguished company by being absent from the previous meeting with the Canada Council. It was a matter of
deep regret to me that I had to be in the west at that time.

I would like to preface my questioning by saying that I am sure all thinking Canadians appreciate the tremendous role the Canada Council has played since its inception in 1957. It has probably been the most significant single contribution to the arts in Canada.

Having regard to the numbers of people who have received scholarships and study grants, the results of whose work has been injected into the Canadian cultural stream, then it is true to say, I think, that there has been no comparable national investment of the same scale or the same impact. So, we start from that very favourable benchmark.

The Chairman: We are all anxious to hear the "but".

Senator Cameron: The Council's rapid growth, particularly in the last three years, when spending on social science programs has increased tenfold from $\$ 1.3$ million to $\$ 11.3$ million, is very significant because it is in this area of our society that there has been the greatest lag. In other words, there has been a tremendous need to catch up with the advances in the technical or natural sciences, and this is another significant step forward.

I think it is fair to say that the members of the Senate committee have been impressed by the fact that in the submissions that have come before it so far relatively little has been said about research programs in the humanities, although I am aware that we will probably get more of this when the universities come before us-at least, we hope so.

Because the Canada Council has become big business, and people are working under pressure, it is natural that from time to time mistakes will be made. Sometimes some of the mistakes may be blown out of perspective and cause a great deal of unfavourable publicity. I am going to refer to only some of these items. As a person who is in contact with a wide cross-section of the public I do know there has been a good deal of questioning of some of the minor decisions-and I want to empahsize the fact that they are minor, but in terms of public relations they do have an effect-and I am only going to mention these in passing.

One that caused a good deal of unfavourable comment, and which raised some eyebrows, was the small grant given to the piano smasher who came from New York to Van-
couver. The question is: How can that sort of thing happen?

The Chairman: It is just a publicity stunt.
Senator Cameron: It may be a publicity stunt on the part of the individual, or on the part of those who sponsored him, but it does reflect unfairly on the Council and the good work it has done.

Then there was the grant to the town fool in Vancouver. I do not know why Vancouver should be the centre of these peculiar aberrations, but it is a fact. This fellow has recently been convicted of some kind of offence, and, again, it has an unfavourable effect.

Then, there is the present controversy, and I think there is some room for discussion here. I believe that a scholarship grant has been made to a certain member of the faculty of McGill, one Gray by name. This man might qualify on the grounds of scholarship or potential scholarship, but it seems to me that in using public funds as a weapon, if you like, for social progress that we must look at more than just the question of a man's scholarship. I realize that a man must not be judged on the basis of his political views or the colour and length of his hair, but this again is a situation where a man takes a stand which, at least according to some judgments is anti-social.

It is sometimes pretty hard to justify this kind of grant. I do not question it on the basis of pure scholarship because you can make a case for it, but the fact that a chap like that can be given an award of this kind raises the question as to what checking is done on these people, and it also brings into question, by implication, the criteria for making such an award. I would like to hear something about that.

This is all by way of preface. Some people believe that the imbalance in the development of our society is caused by the lag between the application of science to the humanities as against the physical sciences. Has the Canada Council a specific policy for future action-oriented projects.

Again, taking some of your own statements in the brief where you say that research can be used as a tool of government, have you a program involving long-range planning and involving specific kinds of social action by governments, by private organizations, or other agencies?

Mr. Martineau: May I answer the first part of your question, Senator, by starting with

Gray. The Gray case, we realize, raised some very serious questions. We realized this so much that the full Council discussed it for about two hours. During that time every member spoke freely and expressed his own views. Everyone was in agreement-those who had judged him at first, and then the Academic Panel. The Academic Committee had been in favour of giving him the grant because of his high scholastic attainments. Then it came to us, and we discussed the very things you mentioned a moment ago. I wish you had been there because you would have seen how seriously we discussed that matter. After two hours I took the vote, one by one, and on division it was granted. But, it was given full consideration by everybody. We realized that this decision would not be popular, but the opinions on his scholastic attainments were such that these prevailed. This was the majority opinion, and it was followed.

So far as the piano smasher is concerned, well, we were just taken in. It was an official who handled the request, and he telephoned three persons whom he knew in Vancouver who all said this man was wonderful, and because of that we gave him $\$ 284$ to go there and smash a piano. They covered themselves with blood, and we were as surprised as every other Canadian was.

But, the Gray case involves certain very important questions. Perhaps the majority has made a mistake, but if so it was not for lack of thought. I think only the future will say whether it was right or wrong.

As to our program, perhaps Mr . Boucher can answer your question on that. I could, but I think he can do it better.

Mr. Jean Boucher, Director, Canada Council: As you have seen, perhaps, from our brief, we try to define our role as precisely that of an agency which is responsible for supporting that kind of research which is not the research immediately required in the pursuit of broad government objectives. The research required in the pursuit of the political objectives, or the broad social goals endorsed by the Government has to be staged, planned, financed, and programmed by government and by the government agencies that have distinct missions in these areas.

The Canada Council is a corporation that has been set up to subsidize and support the other kind of research, mostly the kind of research that is freely initiated by scholars
and scientists operating outside the government circle. This does not mean we do not respond more readily to certain types of applications. We are also sensitive to the social significance of the research done, but we must be sensitive first to the scientific significance of the research done. We welcome research that has as well immediate social significance, and a great deal of what we support has this kind of significance. On the other hand, we are not in a position to set practical objectives of social usefulness for the public that turns to us with all kinds of requests.

If you look at the table we have produced on page 46 of the brief, which has now been amended by a list of corrections that has been circulated, where totals are shown, you will see that the weight of support goes in certain directions and that this is very largely the result of the demand. It is certainly not the result of our own intervention. It turns out that the discipline with the largest support is history, followed by English literature, followed in quick succession by the three major social sciences-political science, sociology and economics-but right on their heels comes philosophy.

The only thing we can say about that is that this is what Canadian scholars are doing at the moment. We do not as yet have trends; we have not had these kinds of statistics analyzed over a period of years. It may well be that the year for which we did this computation is unusual; we are not yet in a position to say, so it will be a little while before we really know what is the pattern of initiative on the part of scholars.

The Chairman: I think we talked about this the first time we met, but basically your policy is to wait for applications and make awards on the basis of, as much as possible, scientific merit?

Mr. Boucher: Yes. I would like to add one thing. Senators should perhaps realize that the Canada Council program of support for research in the social sciences and humanities is not 12 years old; it is really only three or four years old. Before that there was not in this country any noticeable program of support, so it is very early in the game at the moment, and we thought that our prime responsibility was to offer a broad spectrum of support to draw out the competent scholars who had not been able up to then to give the measure of their talent, and that for a while the wisest thing for us to do was not to try to
prejudge the direction the research would take. We had to open up shop first.

The Chairman: I think Dean Slater has something to add to this.

Dr. David W. Slater, Member of the Council and Dean of the School of Graduate Studies, Queen's University: Mr. Chairman, I think it is extremely important to put the activities of the Canada Council in relation to the humanities and social sciences into the context of developments in these fields in Canada in the last ten years. I would especially emphasize the early stage of development. I do not think it unfair to say that in the social sciences and humanities in Canada, in the last decade for the first time in our history we have had a chance, for a number of reasons, to accomplish something very significant for our people. The central mission, if you like, is the mission of building up the capacity, the scholarly effort, the educational effort and the number of educated people in these fields.

If you go back ten years in this country, it was a very rare exception to find an advanced program of study and research in the humanities and social sciences in Canada. We were living off the rest of the world. A conjuncture of forces and events has given us a new opportunity. The most important element in that new opportunity is our own demography. We have at this stage the most rapidly growing young adult population, which is well educated up to a certain level and is seeking opportunities. We therefore have the greatest opportunity of any developed country in the world to now serve a young adult population. This has meant that the scale of activities in our universities and colleges is of a completely different order than it used to be. This very fact of a new scale has posed very great difficulties for us, not least of which is that we have as a society to invest enormous amounts in research, now and in the next decade, and invest them, as it were, in ourselves, in our young people and in the people who are working in educating them, with the pay-offs coming-when? Not tomorrow but five years from now, ten years from now, 20 years from now. That is the kind of investment process we are engaged in.

The fundamental point of it all is that the scale of our activity, while posing enormous burdens, allows us to aspire to a high quality and a broad range of work the like of which
we never had before. This, of course, has directly generated an enormous need for teachers, for researchers, for performers, for administrators who are knowledgeable and talented, and this in turn has meant an enormous demand on and opportunity for the Canadian universities and colleges.

I think, too, this country cannot live on the backs of the British and the Americans for the advanced training of their people as much in the future as it historically did. What we have done in the last decade is make a beginning, especially in the humanities and social sciences. The humanities and social sciences in this country have come along in a sense at least a decade, maybe two decades, maybe two and a half decades, after a comparable kind of development took place in our natural sciences in this country. What I think this means is that we have an enormous scale of responsibility, an enormous scale of improvement in our opportunities, a tremendous need for highly trained and educated people of all kinds. We cannot and should not live on the rest of the world in anything like the way we did before.

The central mission, if you like, associated with education and higher education, is in fact responding to that challenge. In the social sciences and humanities there have been two or three other things that have given new opportunity. The development of computing for example is an extraordinarily important thing in the social sciences and humanities because what that has meant is that we, for the first time in the history of the state of these subjects, are able to work with masses of data, and analyse masses of data, build really comprehensive and systematic models to inject indeed a very substantial element of science in the social sciences.
It is not only the social sciences it is the humanities too, because the thing that is especially interesting now is that a very strong drive exists in things like non-numeric computing in the humanities. In a subject like English you find the change, if you like the technology part of this new opportunity that we have. I believe therefore that what we have done in Canada by our universities development program and the Canada Council program are not identical, but closely interrelated.

In the humanities and social sciences for the first time we have begun to respond to this opportunity. I believe I could cite case
after case or example after example of indications where the program is producing success. It is producing payoffs and we are drawing into these subjects first class people who are working very hard. I think we are going to be developing a quality of teacher and researcher that is going to serve this country extremely well.

The Chairman: Would you give us a few examples? I have not visited universities for a long time.

Dr. Slater: Yes, I think in my field, which is economics, we are training an extraordinarily well educated and well trained young group of quantitative economists. These people are going to play a major role in the analysis of economic events, in sorting out economic policies and in the development of econometric models and the application of econometric models in government and in business. It is not an accident at all and it is not purely a matter of the Bank of Canada's initiative. It is not an accident that we have an active group of young econometrics and some of the best in the world. We could not say that 10 years ago. We did not have anything like this kind of resource. The business community is wanting these people and the Government is also wanting them. They are playing a role in modelling in quantitative approaches to all kinds of problems. The Canada Council has definitely made a contribution.

I will take another example which is especially exciting. One of the rather unique Canadian opportunities is in the field of nonnumeric computing, especially relating to information storage and retrieval. One of the areas which may be surprising to you, but which is of great interest is in law computing. The Canadian opportunity here has gotten some extraordinarily interesting features. Firstly, we have more than one legal system, therefore this is a problem and we have a sort of unique problem of fitting them together. We have the aspect of more than one language that is official. We have this problem because law is something which is precise in its use of language and therefore amenable to experimentation in information storage and retrieval and it presents an extraordinarily attractive opportunity for experimentation in this domain.

The developments in this field are things which have enormous impact in areas other than law computing. In other words, you are
dealing with a particular set of problems, but they have general implications for information storage and retrieval. Out of this we may get a unique development, a lead in information storage and retrieval. Not only is this a matter of importance from a scholastic point of view and a practitioner's point of view, it is very important in relation to Canadian development. We are never going to make a living out of trying to build fourth generation big scale digital computers, but we do have a great opportunity in developing peripheral software systems, et cetera, that are related to this type of non-numeric computing development.
The Canada Council is supporting nonnumeric computing. Within a framework of this broad mission there are many opportunities which are being developed through the Canadian Economic Council. As for the Canada Council itself, I think that its problems are problems of self-analysis, such as seeing what it is doing in regard to success and failures. My feeling is that the fundamental point regarding the Council, in the scaling up of this program, has been right for the time, in the most general, important and fundamental mission sense in this country. That is what I think we have got to keep our eye on, not the little mistakes as you yourself acknowledge, Senator Cameron. There is this non-numeric computing, for example, and this development of econometrics.
In this country one of the great disappointments has been the ineffectiveness of geographical analysis, space analysis, location of industry, and all that sort of thing, as well as urban analysis. I worked in this field for a time and I know a little bit about it. The problem, Senator Cameron, was that up until about 15 years ago you could have, on the one extreme, some nice, simple abstract geographical models, and on the other extreme you could have some extraordinary low empirical material. We were simply not able to bridge the gap between the abstract models and the data, because we did not have the data gathering manipulation analysis capacity.

We are getting it now. Geography in this country is just going through a revolutionary development, and the Canada Council is supporting projects which are part of that revolution.

This just perhaps illustrates the point, Mr. Chairman.

Mr. Martineau: May I try to answer directly? So far, the Canada Council has not initiat-
ed any research. It believes that the pool of scientists is not such now that it can do that. We are rather working on extending that pool and, when it is ready, the Canada Council should do that at some future date.

Senator Cameron: I appreciate all that has been said, but the point I am getting at is this. I am looking at the expenditures through the Canada Council as a tool of social policy in Canada. I think you have done a good job, I have said that in the beginning, and again, looking to the future, I know you have some arrangements for an interchange of membership between the Economic Council and the Canada Council and the Research Council, and I think this is all to the good.

I am wondering, however, because of the speed with which we are moving in social change, whether we can risk leaving it entirely to the academics. I am speaking as one who has been a member of a joint faculty council all my life and I know the kind of things that come up from time to time in requests for grants-such as in the role of the comma in literature, and things like that. I am wondering whether you are satisfied with the machinery we have today in the Canada Council, looking to the future, the integration of scholars, engineers, businessmen, and so on, in planning and anticipating the future.

Mr. Martineau: This is exactly what we have in the Canada Council. I myself, with all due respect to you, Dr. Salter, would not leave it all to the academics. The Council is not made up only of them. Far from it. It is composed of businessmen and practically every kind-

The Chairman: Even lawyers.
Mr. Martineau: Yes. Even though the academics are well represented on it, they are not a majority on it. I think we have a crosscut of everything. This is excellent from the point of view of the businessman, the engineer, the lawyer, together with the academics. This is safer than if it were limited to one group. For instance, if the law were given exclusively to the Bar, the Bar would see it from the inside and might miss seeing it from the outside, and that would not be good.

Senator Cameron: This is in no sense criticism. I simply ask, do we need to go a step further in the machinery we have created, in providing a means of involving non-governmental organizations and organizations to a greater extent than we have so far. Certainly
you have lawyers, engineers and businessmen on the Canada Council now, but they do not or may not-they bring the point of view of the industry or profession they represent, that is true, but how far do they go in involving the organizations in their communities in developing action projects for the future. This is what I am wondering. Is there any machinery?

Mr. Boucher: We would have to say that this does not go very far. It does not go much further than the initiatives taken by universities to pursue the same objective that you are raising. I do not know that it would really satisfy you as an answer, but it might be useful for senators to know the kind of questions which come up in actual fact in the management of the Council.

Over recent years, we have had our funds growing at a very substantial pace. The figure you quoted of $\$ 11$ million is a figure which is already two years old now. The figure now is $\$ 19.4$ million, so it has risen from $\$ 1.3$ million to $\$ 19.4$ million in something like five years. What has happened is that we have viewed the problem very largely as an operation of recovery, to bridge the gap between the kind of support provided for the social sciences and humanities and the kind of support that has been traditionally provided over decades for the natural sciences.

At the moment, we are spending-and this will surprise people, I do not think it is generally known-we are spending as much money on the social sciences and humanities as the NRC and MRC were spending six years ago. So we are where they were six years ago. But they had been at it for five decades and we have been at it for barely a decade. We are still able to support only a much smaller proportion of our researchers in training, that is, the doctoral students, and of our career researchers, through research grants. We have been working at reaching what we would regard as adequate levels of support.

At the same time, for the past couple of years, we have been asking the Govern-ment-and, we will have to admit, at the wrong time-for additional funds to provide development grants, to provide a new type of assistance which would be directed at strengthening certain specific areas of activity. This is not the moment to get this kind of deal from the Government. But the NRC had started this approach just before the austerity period. They have been building, they now
have three or four years of experience in this field. We still have not embarked upon it yet. We have not got the funds to do it. It is not that we are not asking ourselves these questions, but it is that, while our funds have grown tremendously, they have not quite allowed us to earmark special funds for the kind of special programs that you have in mind.

Mr. Marlineau: But we have asked for them.

Mr. Boucher: We have asked for them and we are reasonably confident that this is the kind of development the Government would be prepared to support as soon as the financial situation has eased up somewhat.

The Chairman: In other words, would you say that up to now and perhaps for some time in the future, the main function or the main mission of the Canada Council has been to build or try to build a capability for research within the university community?

## Mr. Boucher: That is right.

Senator Cameron: I would like to go back to Dean Slater's point. On the radio this morning there was a comment by Dr. Steele of Carleton University, in which he says that 80 per cent of the professors in the social sciences are non-Canadians-he did not say they were Americans.

I know this has been true up until a few years ago, but I was rather shocked if that percentage is accurate today.

Mr. Martineau: It is not. Mr. Milligan can show you.

Mr. Frank A. Milligan, Assistant Director of Canada Council: I think the truth is that at the moment no one has enough statistics to say what the percentage rates have been. There are some things we do know. We know that, with the extremely rapid growth of universities in the last ten years that Dean Slater has talked about, it would simply not have been possible to staff them with Canadians, simply because of the historic situation he described, where we have had a very anemic progress in advanced studies in this country and relatively few Canadians were going abroad to take advanced studies in Britain or the United States or France.

The only way that the universities could respond to the enormous demographic pressure was by hiring outside the country and,
as it happened, there was at the same time a loosening up of the supply in the United States.

I think there is a combination of reasons why American scholars suddenly began to find employment in Canada attractive. There is room here for investigation as to why American scholars were so willing to come here. It may be partly a matter of the political climate. It may be the Viet Nam situation in some cases. It may be partly that for the first time they began to find that salaries and working conditions and research support in this country were becoming competitive with the American universities. There may be a number of factors, but the fact is that they came, and came in large numbers.

As this happened, the incidence of its impact was uneven. In a large established institution like the University of Toronto there was a solid base of established scholars who were largely Canadians and the absorption of the newcomers was not too great a problem. But a new iniversity like Waterloo or Simon Fraser, or a rapidly-growing but relatively young one like Carleton, felt the effect of this uneven factor in the staffing of its faculties, even to the point where in some departments a majority of staff are non-Canadian-and, specifically, American.

This does create problems. It creates the problem of curriculum as these people bring their own academic interests with them. We have complaints that a department of English will offer six courses in the American novel and one course every second year in the Canadian novel. It is a reflection of the character of the particular departments. There is another problem, namely, that the hiring of staff in Canadian universities is very largely in the hands of the departments themselves. As a department becomes solidly or very largely American there is a tendency for it to hire through its own "old boy" network in the States. This is a problem that the universities have to face.

So in some of these institutions there are quite critical problems which they must cope with, but I am still convinced that it is a passing phase. I think part of the reason that it is a passing phase is reflected in the statistics which we are now able to put out about enrolment of Canadians in graduate schools both in Canada and abroad.
There has been an enormous growth of graduate schools, particularly in the humanities and the social sciences in this country.

For example, this year, in our own doctoral competition, for the first time over 50 per cent of those receiving first awards are intending to enter Canadian graduate schools. Three years ago it was less than 25 per cent. This is the kind of growth that is developing.
I would see that within three to five years we will be reaching the point-in fact in some disciplines like English literature and history it may well be before that-where the Canadian supply is fully equal to and perhaps even in excess of the needs of Canadian universities. It will not be in excess of the needs of this country, because I do not think there is any limit to the needs of the country for people with these kinds of qualifications in the humanities and social sciences.

As this happens there will be a readjustment in the balance of Canadian and nonCanadian scholars. Some of the people who have come from other countries will go back; some will Canadianize themselves. In fact, some are doing so now. It is reflected in the applications we get from them, where they indicate that they are shifting their research interests to Canadian matters. They have a learning process to go through and sometimes it is difficult for them, but some of them do it and do it very successfully

Some of our best scholars in this country now concerned with Canadian problems and Canadian development are people who have come to us from other countries.

As I say, there are very real current problems and I would not want to minimize them, but I think they are only current problems.

Senator Cameron: I would hate to think, Mr. Chairman, that our appointments would be made on a nationalistic basis. I think the criterion should be to get the best man regardless of where he comes from. I appreciate all the points you have made about the fact that we did not have a pool to draw on. We will have it within three to five years. This will make a change. But I think it is not good to have this kind of statement being made, unless the criteria on which it is made are also put forward.

The Chairman: It was without the use of computers.

Senator Cameron: Yes. Now, Dean Slater spoke about the fine work the economists are doing and I think this is correct. I think they have a big job to do yet to get our economy back on the rails. But in mentioning the econ-
omists, is there any significance in the fact that he did not mention the sociologists? Because these are the people who seem to be causing a lot of trouble, particularly in our new or instant universities.

This is an area in which there is a great lack in this country, a lack in the sense that we have done very little in using the sociological tool, but we seem to have been rather unfortunate again in some of our instant universities in the kinds of people who come in from outside, who do not know our conditions and who have been involved in actually promoting student unrest. I am sure this does not come from their scholarship. Have you any comments on that?

The Chairman: Do you mean that we are about to have to import university presidents?

Dr. Slater: Maybe we are going to have to have a new graduate school to produce new university presidents.

Seriously, I think we recognize that there are some problems. They are part of the fabric that Mr. Milligan has put to you, Senator Cameron. They are accentuated in the case of sociology by the newness and the difficulty of the subject itself and by our special backwardness in the development of sociology. So, in addition to every problem that Mr. Milligan pointed to, which are general problems, you have as well in sociology two additional problems. My belief, sir, is that sociologists are tackling very serious and difficult problems. Among the people they are attracting to the subject are some bright people, devoted people, people of very considerable skills, and my expectation is that some of the problems of sociology and some of the other problems we associate with sociology in some of our new universities are in themselves passing phases. But I am an optimist in this respect, sir.

Mr. Boucher: May I add, Mr. Chairman, that it is rather ironical that the one debate that is going on at this precise moment with regard to a divided approach in a department of sociology is happening at the University of Montreal, where the facts are exactly the reverse. There the contention of the young Canadian sociologists is that the imported sociologists are tamer than they are and are not as radical as they are. So it is by no means the general situation that it is the foreign-born sociologist who has been in Canada the source of worry or the source of
social disturbance. It is a fact, however, that this is a discipline which our society has not yet been able to use in a way which would dispel a good deal of the frustrations that its members feel.

Sociologists by definition are critics of society. That is their profession. And our society has not itself found ways of using them in a fashion which would put their talent to best use so that this frustration tends to take some exacerbated character at times. Our society has not found ways of using all our scientific talents. I am not sure that it uses chemists very well, or other people in the natural sciences. Certainly it has not yet found ways of using botanists or astronomers unless they are employed by government. We know that there are disciplines where the eventual use by society of the knowledge acquired is still very much a substantial problem, and we hope with the passing of time to find a solution but this will not be easy.

The Chairman: Could I ask a supplementary question on this. We are not just discussing the Canada Council here; we are discussing a very important problem. Have you made any studies about the way we are preparing sociologists in Canada, and not only in Canada but throughout the world because it seems to me that this is a world situation. I would think that it is quite difficult at the moment for a sociologist to interpret our society or to try to arrive at laws which describe the functioning of society without any kind of knowledge of economics and the infrastructure or the workings of the infrastructure of a society. The result is that not having good enough principles to interpret the behaviour of our society they tend to become more action-oriented because of the weakness of their scientific base.

Dr. Slater: I think there is something in that, although sociology is very much a mixed bag. I spoke earlier about having time to study urban problems. A decade ago much the best urban demographic work was being done by sociology. It was much the best by any test. If you take another example, it is not at all accidental that some of the strength of the Yale law school nowadays is because of its strength in criminology and the sociological relationships which exist and which people have studied very carefully using all sorts of methods. To take another example, and this of course is going to be one of the most fundamental things that will be the salvation of sociology, we find that it is being 20104-2
infused very much by quantitative methods and computer technology to the point that instead of running three spurious correlations in three hours you can now with a computer run 3,000 and you can run them on the most grandiose scale. Of course there may be people who want to correlate everything with everything else and thus arrive at sociological laws. In these cases without the use of scientific standards they will probably get clobbered.

The Chairman: Going back to the machine, that may be one way to opt out of our society.

Dr. Slater: I would not think so. The standards of evidence abstraction and confronting the ideas with evidence and trying to establish truths that are something more than spurious correlations-those forces will take hold and I think they will build very strongly, if you like, and they are going to purify sociology and I believe that is going to be a major force in the development of what we might call the scientific core of the discipline. I do not believe, Mr. Chairman, that action can be undertaken sensibly or effectively from a long-term point of view without a solid base of knowledge in which you have confidence, so that you can persuade the community that you know what you are talking about, that you have a base of evidence and thought and that it is not a superficial sort of approach. I do not believe therefore that sociology will be effective in action unless it has this solid core based on scientific and scholarly work to meet the very best standards. Again you can see I am an optimist in these things and I think there is some basis for optimism.

Senator Cameron: The pertinence of this discussion to this whole area may be that in awarding grants some more careful scrutiny, if I may put it that way although it is probably not the best way to put it, might be given, although I am sure this is already being done, to see what kind of people and what kind of projects are being supported. Perhaps the best way of putting it is to suggest that this might be given even closer scrutiny. However, I am going to ask one more question and then pass the questioning on to my colleagues.

Mr. Martineau: Before you do that, Senator Cameron, may I say that it is being given much more scrutiny than one might thinkeven from mere lawyers. We look at the project and say "should this not have it rather than that?" and "would this not be more

important for the country than that?". Probably we could do more of this.

Senator Cameron: I have one more question. On page 13 you discuss a problem which is of real concern to this committee and that is the question as to whether or not there should be a minister of science. I notice you say:

On the other hand, with the growing acceptance of interdisciplinary approaches and the growing need for common services, a good case could be made, although it has not been made yet, for a single Minister (not called a Minister of Science either) having responsibility for all programmes of aid in support of university research, including the national information services of the National Library and the Dominion Bureau of Statistics.
Have you anything further to say on that particular problem because it is something that this committee has to face.

Senator Grosart: May I add a supplementary, Mr. Chairman? Would you include the Canada Council under that Minister?

## The Chairman: Of course.

Mr. Boucher: I would not say that this is a suggestion because it is simply an idea thrown into the arena for discussion and it stems, of course, not from the general concern that has inspired people to suggest that there should perhaps be a minister of science. What we are saying at the moment is that the various governmental programs that are all directed in one way or another to support research development outside the government, in the universities mostly and in other private institutes or among consultant firms and similar bodies, have to come closer and closer together. Basically, they have to come closer and closer together for two reasons. The first is because more and more research cannot be nicely fitted into either the natural sciences or the social sciences or the humanities. More and more projects are interdisciplinary, and more and more should be interdisciplinary; and this trend must be encouraged by all means. No big issue or problem can be tackled unless persons with a great many different skills are brought together to tackle it. So, this is one reason why, at the moment, we find ourselves in constant consultation with NRC and other agencies-"What can you do with this?" We might be prepared to do
that much", "Will you pick this up, or shall we?" There are a number of disciplines which are frontier disciplines-psychology, geography, archeology, anthropology. All are partly accepted as the responsibility of NRC, and partly by us, so these problems are more and more common and their importance will grow.

The second problem is the development of common services. There is a report that has just recently come out, last week, the Tyas Report, on the establishment of a scientific information system. This report does not exclude the possibility that social research would be included under the system, but it is quite obvious that the report was not intended primarily to serve that purpose, and that a system like the one proposed might well not include the social sciences. It is obvious that if we were to make any such mistake we would very soon regret it, and bitterly.

This is why the very difficult problem that we have now-which we think may well be the major national problem in research, namely the development of national information services-is one which must almost from the outset include all the research, and it must be set up, perhaps not as suggested by the Tyas Report, primarily to serve the small manufacturer or the vast majority of manufacturers, but to serve the scientists, the engineers and the people who can read the information. These people are very largely the professional researchers. They could be in the employ of government; they could be in the employ of businesses; and a great many of them are in the employ of universities. So, if we are going to have any such system, it must be beamed at a very broad public.

This kind of thing could very well be under a minister who would see his responsibility as the support of research throughout the nation, of work done mostly by scientists, not necessarily limited to its industrial use and not limited either to its governmental use.

Senator Aird: A supplementary question, Mr. Chairman, was the Tyas Report a oneman report?

The Chairman: No.
Senator Aird: Was there a social science input into the report?

Mr. Boucher: It may be somewhat difficult for us to comment on the Tyas Report too much, but it is a fact it was written by a public servant, originally at the request of a minister. It is a report of a special nature; it
is not of the same kind as other studies. Included in the team of consultants were people coming from various fields, but mostly information experts.

Senator Grosart: I did not get an answer to my question, Mr. Chairman.

The Chairman: We have embarked on a broad but important subject.

Senator Yuzyk: Perhaps it could come up after my question.

Senator Grosart: But, Mr. Chairman-
The Chairman: Just a moment, please. I want to explain the procedure. Mr. Boucher has commented on a Minister of Science, and I understand that Mr. Milligan and Dean Slater would like to add comments; but I am in the hands of the committee.

Senator Grosart: I would very much like an answer. In fact, I would like to see more answers here and less lectures on the questions asked.

The question is a simple one: In the suggestion that a good case can be made out for a single minister whose responsibility in a certain area would include the National Library and the Dominion Bureau of Statistics, would the Council include the Canada Council under that minister?

The Chairman: I thought you received an answer to this.

Senator Cameron: Yes, he said, "Yes."
Senator Grosart: If he did, I am sorry, because I did not hear the answer.

Mr. Boucher: I am sorry senator, but it was quite clear in our minds. If you refer to the last sentence of that paragraph you will see that the minister we thought was as close as could be to that minister at the moment was the one already responsible for the Canada Council and the National Library.

Mr. Martineau: And the answer is, "Yes," senator.

Senator Grosari: That is all I wanted to know.

Senator Yuzyk: My question is along the same lines. On page 15 of the brief reference is made to a parallel Social Science Council of Canada, after mentioning the mandate of the Science Council of Canada.

Is the Canada Council prepared to recommend the establishment of a Social Science Council of Canada as a parallel step, shall we say, to a Minister of Science?

Mr. Boacher: I do not know whether I can speak for the whole Council on this, but I would say that the Council is probably not prepared to recommend this at the moment, because the Council does not yet know. how the Science Council will perform for the natural sciences.

Senator Yuzyk: We have some evidence now, because this has come up before our committee, on the work of the Science Council of Canada.

Mr. Martineau: We have no kingdom to defend, take my word. We are doing our best, and I think we have done pretty well so far with what we have had. If someone shows us that we could have done better than we have and that somebody else could do better with the same, then we have no objection; but before saying, "Yes," we have to be shown that we are not doing the job and that somebody else could do the job better with the same kind of money. Otherwise we say that everything is set up, we are doing it, and why duplicate?

Senator Yuzyk: In other words, you consider the Canada Council actually is doing the work of a proposed Social Science Council? I say that, because it has been proposed, on the part of some people, that a Social Science Council be formed.

The Chairman: I do not think the Canada Council would pretend that, because it has no responsibility to advise the Government on policy.
Senator Yuzyk: That is why I am asking the question here.

Mr. Martineau: Not on that. We do not do that, but so far as helping the social sciences to develop is concerned, I think everybody has been satisfied so far. If anyone else can do it better, then, all right, take it away from us, but until then...

Senator Yuzyk: At page 16 mention is made of a national social science institute. I would gather this is a more definite recommendation than the mention of a social science council.

Mr. Boucher: I would say that this is a reference to a proposal that has been bandied around, and one that has been mentioned by the chairman of this committee at times...

## The Chairman: Am I on trial now?

Mr. Boucher: This is a comment by the Council on what the Council thought was a proposal on which this comment might be welcome. The comment that we are making on this is that it would be a useful development especially if it pursued certain objectives rather than others, if it were primarily intended to provide a free opportunity for social scientists to spend some time away from teaching duties. If an institute like that were primarily established as is perhaps being suggested at the moment-and I do not think this was the original view of the chairman of this committee-as a sort of permanent substitute for royal commissions, or as a much more efficient research entity to do the research in the social sciences now being done within departments, the in-house research, then we are not quite sure that this would be the answer. First of all, we think that if the social sciences research done in government departments is deficient at the moment, then the problem would not be resolved by creating a single institute with a universal responsibility before the Government has tried to secure improvement in the performance of the existing research divisions of departments, quite possibly by changing the expectations placed upon them.

Senator Yuzyk: There is the National Research Council, and this would appear to be a sort of a parallel in the social sciences.

Mr. Boucher: Yes. I think that in that sense...

The Chairman: I think I should try to clarify this situation. I understand that there are more or less three possible functions to be envisaged. First, the providing of assistance to the social sciences by an agency supported directly or indirectly by the Government, and supporting research in universities and, possibly, in industry. Secondly, as Dr. Solandt has proposed, there should be perhaps a parallel council to the Science Council to advise the Government on science policy with respect to the social sciences, but this will be a very restricted function parallel to that of the Science Council.

Then there is the third thing which has been proposed by a few, the creation of a kind of research council within the Government which would conduct actual research itself. So, there are really three things which are quite different.

Senator Yuzyk: Yes, but we still have parallel developments in these two broad fields, the social sciences and the natural sciences. I am just wondering whether the Canada Council has been giving thought to this progression, shall we say, towards a ministry.

The Chairman: I understand from the brief that the Canada Council is satisfied with the status quo.

Senator Yuzyk: I have just one more question, Mr. Chairman. On page 22 of the brief you say:

Means are now being developed of involving academic advisers more closely in assessing the results of Council-supported activity.
And then further down the page you say:
The Council expects to undertake pilot projects of this kind during the current year.
Now, has such a pilot project been commenced at this stage?

The Chairman: I understand that Mr. Milligan is prepared to answer that question.

Mr. Milligan: Our problem in this area of evaluation is that the Council as an administrative organization is no better equipped to evaluate the results of its support than it is to evaluate the proposals that are made to it. We do not pretend to be specialists in economics, in history, or in English. Certainly, we cannot rival the expertise of the people who are applying to us and the people who are holding our grants. If there is to be evaluation it can only be done by enlisting the support and assistance of people who have that particular type of expertise.
In the past three or four years, as the program has developed, we have almost by act of faith been simply doing the best possible job we could in assessing proposals, and making the grants where the assessment supported the proposals and then, in effect, by an act of faith, assuming that the results would be worthwhile-not that there will always be success because failure is an inescapable part of any research activity. But now we do have to look at results, and I think we have to look at them at a number of different levels.

There is the analysis of the general direction and balance of the work that is being done with our support, and this is largely a statistical or global analysis type of thing. We have to draw on our records and again enlist
the aid of the scholars, to get the economists, for example, drawn into the process.

Senator Yuzyk: Would you get the D.B.S. involved also?

Mr. Milligan: The D.B.S. at the moment do not have any means of assembling this information, but if we can get the Canadian Economic Association. .

The Chairman: But they are looking at this.
Mr. Milligan: Yes. If we can enlist the Canadian Economic Association to look at the pattern of our grants to economists and analyze what has been done in the context of the total amount of activity by Canadian economists, they can see what impact we are making, and what sort of balance of activity there is among their own people, the economists of the country. They are in the best position to suggest where there are weaknesses and where special efforts need to be made to improve the balance of activity. This is one type of analysis that has to be done.

We did this on a very modest scale a year ago when we gave to the various learned societies lists of all the work we had supported, and asked for their comments and evaluations of it. In the future we will do this more systematically.

The other thing we must do is look at the individual projects we are supporting. Here again we will have to vary our methods according to circumstances, but in every case we shall have to enlist the help of the academics themselves.

For very large projects which we are supporting over periods of three or four years to the tune of $\$ 40,000$ to $\$ 60,000$ a year, it is clearly justifiable for us to assemble a small team which will go out to see what is being done and what is being accomplished. This is not to police the work, because the kind of people we would put on that team would be the kind of people who could make suggestions for the improvement of the work.

Senator Yuzyk: Do I understand that you have such teams at work this year?

Mr. Milligan: We will this year initiate the use of such teams on our projects. For smaller projects we will have to do it on a smaller scale, otherwise the cost of the evaluation will outrun the cost of the project itself.

This is the type of work that is being developed at the moment.

Senator Grosari: On that subject, what is the present procedure in respect of accounting by individual recipients for the expenditures of the money you grant?

Mr. Milligan: We require financial statements. Where the grants involve any use of university facilities, which a large grant includes, they are administered through the university and we get reports from the university. A considerable number of scholars have grants for travel to, for example, the British Museum or the Bibliothèque Nationale in Paris for a summer's work, and these smaller grants are made directly to the scholars, who must account on their own behalf. At the same time, we get reports or what has been achieved with the grants.

## Senator Grosart: From whom?

Mr. Milligan: From the scholars. There is no way, except at prohibitive cost, of policing it. There must be an assumption that these scholars are honest and conscientious people. We get indications from time to time from some academics that a colleague has been abusing his grant. That is very rare. I think it fair to say that there is no way of having a cast-iron guarantee that the money will be used precisely for the purpose for which it was given. Normally it will result in some evidence of the work having been done, in the form of a publication or something of that sort.

Senator Grosart: We are dealing here with public funds, and accountability has always been an essential principle in the spending of public funds. I ask this question because within the last three days two grantees of the Canada Council have been interviewed on the radio. The answer of the first when asked "Where are you going?" was, "I am not sure, but I think I'll go to Moscow", which was understandable, because it was a ballet dancer. Asked where she was going from there she said she did not know. When asked what course of study she was undertaking her reply was, "I am not sure I am going to undertake any. I want to see Europe." I have discussed this matter with other grantees and I get the impression that by and large there has not been in the past a pre- and post-audit of expenditure of these funds. If this were the Rockefeller Foundation the grantee might be told, "I think we would like to see you go to Europe." Here we are dealing with public funds. I would emphasize that we are dealing with people of normally not high income, and

I get the impression that the Canada Council seems to forget this at times.

Mr. Martineau: We have often had discussions on this and are very conscious of that problem. We have tried to find means of doing what you suggest. As a matter of fact, I have often proposed that spot checks be made, but that would be costly. Before granting this money we always get the best references, and only in the exceptional case is it abused. Even spot checks might not show it. We would have to make a check more than once during a year and it might be too costly. If you could find a way in which we could do it we would be very happy to hear of it.

Senator Grosart: Everybody spending public funds has eventually to find a way. This is an essential requirement; it is part of the trust and responsibility of anybody who has the granting of public funds.

The Chaizman: I think two of our other guests wish to add to this.

Senatior Grosart: I should like to define my question, because I am not particularly concerned with the system of policing or checking. I am relating my question to pre-audit and post-audit. In other words, how specific are the requirements so that the intention of the prospective grantee are laid down before the Council; and is there an audit, even from the reports of that person? I am not suggesting having police running around.

Mr. Martineau: You are speaking of individuals?

## Senator Grosart: Yes.

Mr. Martineau: With bigger grants we do check. We have considerable checks for the big ones.

Senator Grosart: I can understand that. I think it is well known that I have been in the public relations business all my life, and, if I may say so, some of your worst enemies are your grantees, who understandably exaggerate. I see a good many of them in my office and have heard them say, "I have got a Canada Council grant. I am going to Europe. I am going to have a hell of a good time." I have asked, "Is it that easy?" and they say it is.

Mr. Boucher: I think there are a certain number of things to say on this. First of all, a distinction must be made at least between support given to artists and support given to
scholars. I do not know whether the senator has in mind artists who have been sent abroad under the arts program of the Canada Council, or whether he has in mind scholars who have been sent abroad under Canada Council research grants. If they are artists, it is all a question of knowing whether they are going into a structured program or not. If you send a young writer abroad you do not send him to be registered in a definite program. He is going to live abroad and see the world, and this is very largely what the money is for; he is going to meet other writers. If he is a young musician he may well go into a structured program; he may well go to a conservatory, and so we will know whether he is registered in the conservatory. The same will apply with a young dancer.

I assume the object of the discussion here this morning is scholars. Here a distinction has to be made between the support of doctoral students and the support of researchers. Doctoral fellowships are not paid until we have evidence that there has been registration in an institution. When the award is made it may well be that the student has not yet completed his arrangements with an institution, but he will not get the money until this has been done. With research grants for Canadian scholars the system is very complex. Inasmuch as there would be expenditures in the nature of payments for services of others, such as the hiring of student assistants, the hiring of secretaries, the purchase of equipment or anything like that, the payments are all made through the administration of the university. We get periodical reports, and instalment payments are made only when the money is required. In that case we have evidence from the university that indeed student X and student Y were hired on such a date and have been working for so many months; that this or that equipment has been purchased or rented, or that the team is off to the Northwest Territories. This is all verified by the universities. We do not make a double check of university accounting. We will grant that we take this as being satisfactory evidence that the money is indeed well spent. This leaves out the possibility that when there are no such expenditures involved the only expenditures are the personal expenditures of the individual.

The scholar may want to spend two months at Harvard in the law library. He wants to have the travel money and some per diem while he is there. He will be given a cheque payable to him of a certain amount. If it is
small it probably will be in a single payment and will not be by instalment. If he goes for two months, we put the money in his hands when he is about to leave. We get a report from him when this is over. Every scholar is required to make a report and say what he has done. Of course there may be people who lie to us, but this can only be a small segment of our public. It is difficult for a scholar to keep coming back to us claiming to have done what we gave him money for if indeed he did not do it.

Mr. Milligan: I think there is one other part of Senator Grosart's question and that is the question of pre-audit. Every application for a research grant must carry with it an itemized budget and that budget is scrutinized. The people to whom it is sent for assessment are asked to comment on whether it is reasonable or not. These are people who have experience in field research and know what sort of costs are involved. It is also subject to certain limitations the Council, itself, imposes on its grants. The limitation is to the extent of the per diem allowed for subsistence as well as to the type of travel that may be used. They can only get an economy air fare for example. We would not pay them a first class steamship ticket or something of that sort. There is this type of budgetary control imposed from the moment the application comes to us.

Senator Grosart: Is there a post-audit of the pre-audit?

Mr. Milligan: There is a post-audit in the sense that the department of the treasurer of the council checks the expenditures which the applicant must submit on completion of his work against the budget which was approved in the first place.

Senator Grosart: Is there a further general audit of the validity of grants?

Mr. Milligan: I am not quite sure that I understand what you mean.

Senator Grosart: I will phrase it another way. The bank lends me money and they wish to know, first of all, what I am going to do with the money. Before I receive any more money they are going to want me to show them that I did what I anticipated I would do with that money. Now, the bank takes this over all its lending activities. This is all right. We are not going to lend this group any more money, however, we will lend this group, et cetera. Do you do this?

The Chairman: You are really now going a little bit further than the mere financial audit. You want also to ask whether there is a kind of qualitative post-audit.

Senator Grosart: My text, Mr. Chairman, is what I consider the best statement in the whole brief and, not strangely, it is the shortest, page 6 at the beginning of paragraph 11, "A science policy requires criteria."

Mr. Milligan: The criteria are the same as are required in the judgment of an application. It is scholarly merit and the competence of the man to do it. When we have a continuing project and successive requests for grants one of the things that is done is to get a report on what has been accomplished and this material, along with the application, is submitted or it may be, in many cases, resubmitted to assessors. The renewal is not automatic. There must be an assurance to the council from our assessment procedure that in the actual performance to date the original judgment still stands that the project was worthwhile and the man that was supported was competent.

Senator Grosart: Thank you very much. I must say that I am very satisfied with the answers given.

Dr. Slater: There are two or three points to be added which may satisfy my old friend, Senator Grosart, a little more. Research applications have to bear the signature of a responsible university officer. I am going to answer your questions from the point of view of a person who has the responsibility for signing the research application for the university such as NRC, Canada Council or any of them. They have to have a signature of a responsible officer of the university. This is very important. Secondly, the budget that is put into the Canada Council is a full disclosure budget, not just about the grant. It is the whole project and the various elements of financing that would be entered, including the Canada Council. The Canada Council, because of its full disclosure approach, gets the whole picture. Thirdly, in most universities the detailed accounting budget that is set up in the university administration indeed has to correspond to the budget. In most universities there is a research accounting operation that is carried out. If a person wishes to make any major change in his budget he must go to the Council and seek approval. A certain amount of changes may be made with consent, but the grantee on a large grant is not in a position to be a free wheeler and just simply
moving his money around. I think these things are very important and I think in signing research applications on behalf of a university and in assessing research applications, as a reviewer and looking at them and as a member of an academic panel, you are very conscious of the question as to how this fellow performs in this or that thing. That is one of the questions that comes up over and over again. It is a very general point of view in these things.

Give a man a little bit of money and take a chance. For the new man the small thing and so on, but let him show his wares and let him earn his way and only earn his way into larger grants. I think there is a hard-nosed approach to this thing inside universities and outside the universities that I believe you would find impressive, sir.

Senator Grosart: I was sold before, Dave, and not in danger of being oversold.

The Chairman: I am beginning to be afraid of bureaucracy-Too many questions...

Senator Grosart: If I could follow with one question coming out of that. The term free research is used quite frequently throughout the brief. Would somebody define free research as contrasted with unfree research?

Mr. Boucher: The term is short for "freely initiated research". That is what it means as against contract or commission.

Senator Aird: I would like to refer back to Dr. Slater's remark about freewheeling and to the appendices on page 40 and page 41. I noted with interest the different procedure that is involved inasmuch as the ultimate decision-making authority, is concerned as I understand it. On Appendix C, chart 1 lists the Canada Council, as contrasted to Appendix C chart 2, where the ultimate decisionmaking process lies with an academic panel of 18 members. It seems to me, on the remark made by Dr. Slater as to the content of approval, and perhaps not so much on the accounting side, that it is anomalous, that this division is contrary to the concept of it.

What I would like to ask, Mr. Chairman and Dr. Slater, is why there is this difference in handling applicants? It seems to me that the ultimate decision-making authority might very well lie the other way around. As a lawyer, Mr. Martineau, this is perhaps a mechanical question and it is one of policy, but it seems to me that when we are dealing with funds of this nature and when we are
dealing with important grants, the decisionmaking process might very well lie with the Canada Council on the more important ones.

## Mr. Martineau: But it does, senator.

Dr. Slater: I might reconcile this more quickly, because I have been a member of every one of those levels. The Council has the final authority on everything and takes final responsibility on everything. With respect to the adjudication process, the Council sets and agrees to the terms of reference of the doctoral fellowship program, the general criteria, etc, and takes responsibility for that. It does not as a council make a decision and a review of three thousand individual applications. It does not adjudicate three thousand individual applications as a council. The adjudication process itself, the terms of reference and composition, in the first place, are those things determined by the Council, and within that framework there is an adjudication, to select the particular candidates within those terms of reference. Thus, the terminal element is the Academic Panel.

Mr. Martineau: To make sure that there is no misunderstanding, may I say I have taken that long list, and there are thousands on it, and I have gone over it. I have put dozens and scores of questions as to why we had this project and why not that project, and so on. It is after this discussion that the list is approved generally. For the big grants, we go into it even more thoroughly.

Mr. Milligan: Every research grant over $\$ 10,000$ automatically goes to the Council for a decision. Every grant between $\$ 5,000$ and $\$ 10,000$ may be awarded by the Academic Panel. If there are any doubts in policy issues, the panel can refer this to the Council; or the efficers can propose to the Panel that it be referred to the Council.

Senator Aird: Then with respect I would suggest that you might amend the wording on Appendix C, Chart 2, because this says that these decisions are reported to the Council.

Mr. Boucher: This is correct, because this is the program of doctoral fellowships.

Dr. Slater: What is needed is, I think, a statement that the Council sets the regulations and the Council tests the credibility of the performance.

## Senator Aird: Yes.

Mr. Martineau: That is what we do.

Mr. Boucher: The answer really is that physically the Council, meeting as it does for the length of time it meets and at the frequency it meets, cannot clear all the thousands of awards that are made. So there is a system of delegated authority in the Council up to certain levels, of expenditure which are away below the levels of delegated authority in any Government department and in the Treasury Board. The review by the full Council is a great deal more demanding than prevails in any public agency in Ottawa.

Mr. Martineau: We would like to make the senator certain that I for one, and all the others, do look at this list, even if they have been granted, and we discuss them to see if the decision was good or not good. They come eventually before us. I am talking now only of the smaller ones.

Senator Aird: I thank you for the clarification and I would ask a question of which perhaps I should give notice, because I think it makes your case and your explanation or clarification much more precise. What percentage of applications do you turn down-in page 40, Appendix C, Chart 1, under the heading "Canada Council makes final decision". You might need notice of that, but you have told me that you look at thousands. I would be interested in knowing what is the percentage turned down.

Mr. Milligan: Mr. Chairman, what goes to the Council in the first place is the actual submission for a grant involving over $\$ 10,000$ or over $\$ 10,000$ in any one year. In this case, there is no decision until the Council has considered the submission.

In the second place, they get a report on actual grants under $\$ 10,000$ which have been approved, which have been awarded by the Academic Panel-or by the officers, if they are under $\$ 5,000$. They may question these but in fact the award has been made. They do ask questions about individual instances, about individual grants that have been made.

As has been said, there are always in the lists a certain number of awards that do raise questions in the minds of individual members of the Council and there is an opportunity to discuss them.

In addition, what goes to the Council is all proposals for rejection of applications. There is no rejection but by the Council-except in a competition like the fellowship competition where the making of an award involves
automatically the rejection of other applications. If we have 3,600 doctoral fellowship applications and if the academic panel approves 2,200 the other 1,400 are rejected by implication. In the case of a research grant, where there is no competition, that rejection is made only by Council.

To complete the answer, the failure rate varies among programs. In the competitions, there is provided, at the outset, a total amount of money or a total number of awards to be made. The failure rate will depend on the ratio of these to what turns out to be the actual number of applications received. In the case of the doctoral fellowship competition, the success rate this year was about 43 per cent so the failure rate was 57 per cent. In the leave fellowship competition, the success rate this year was 60 per cent, so the failure rate was about 40 per cent. These are in a competition. This does not necessarily mean that everybody who fails is lacking in merit; it is simply that there are only so many awards and this is the way they are distributed.

Each research grant application is looked at on its own merits. If it is found to have merit, an award is made. It is an open-ended program. The failure rate on this program is running at about 20 per cent. It is higher than that for the large grants. There is relatively a low failure rate for the small grants. I have not the precise figures, but I would expect the success rate to be between 85 and 90 per cent. For large grants it is between 70 and 75 per cent.

Senaior Yuzyk: What do you mean by large grants?

Mr. Milligan: Over $\$ 10,000$.
Senator Aird: Mr. Chairman, I think the ultimate decision-making process is important, and, in my mind, it lies with the Canada Council itself, regardless of all these input factors and how it gets there. Could you give me a percentage of the acceptance and failures at that level, the top level?
Mr. Boucher: You are really asking how many applications reach the Council with a recommendation with which the Council disagrees.

Senator Aird: Yes, sir.
Mr. Boucher: The answer to that is really very few, but the system is extremely demanding. When an application reaches the

Council it has gone through a much more elaborate system of checks and double checks than any other program run by a public agency in Ottawa. We do not want to make invidious comparisons, but our system is a great deal more demandng than that of any other agency. There are much fewer applications in any program which reach Council with a recommendation than in any other agency. Therefore, the Council generally agrees with the recommendations, but all the negative recommendations are presented to the Council and the decision is made by the Council. All the decisions on recommendations not to make awards are made by the Council, and the Council is kept aware of all the work done under delegated authority.

I am not sure that that is an entirely reassuring statement.

Mr. Martineau: Let me explain. This is where we start. The demand is made in one discipline; it is sent to from two to eight judges, experts in that particular discipline, and then they make the report. Their report and the requests then are sent to the Academic Panel composed of 15 men of the highest calibre. After that it goes through our own Academic Committee. Therefore, before it comes to the Council, it has gone through these three stages at the hands of experts, but, in spite of that, we do object and even those which have been recommended for rejection are submitted to us in case we should say that they should be granted. There are some very serious discussions on some applications which could have been refused which we think should be granted.

I admit that it is seldom that the Council as a whole will agree. Some are more critical than others, and, being a lawyer, I am usually quite critical, but the discussion takes place and no doubt the officers and the others all remember all these things and take them into consideration for the next batch of demands.

I am satisfied, as Chairman, that everything has been done to get the best. All we regret is that we are unable to give more to deserving ones because we have not got the money. But I have doubted some small ones; yes, I have, but they were the small ones. The others-no.

Dr. Slater: May I supplement Chairman Martineau's remarks by two small points: First, there are two members of the Council who are members of the Academic Panel. They play a role as a bridge and as trustees
of the Council. Those two members are members of the Academic Committee which is a subsection of the Council itself. The Academic Committee, in other words, the subsection of the Council, does screen so that the Council has an involvement. It is not just at a plenary meeting, but Council has an involvement directly in the Academic Panel, and it is the Academic Committee. There are screenings and there are demands that are recommended for rejection at both of those levels, and the Council people, from my experience, and I happen to be one of the two at the moment, are mindful of this and participate in this process of screening and there is real action at that point.

Senator Yuzyk: Who selects these experts, these adjudicators? Does the Council select thern before it goes to the academic committee?

Mr. Martineau: We do.
Mr. Milligan: I should clarify that. This is in the research grants program. We work under two different systems. In the research grants program each application is dealt with on its own merits and on the basis of its own substance so that it is analysed by the officers when it comes in and we then find the best qualified people to look at that particular application. The applicant himself is asked to suggest two people who are familiar with his work or whom he regards as being experts in this particular subject matter. It is not just a matter of being a sociologist. It must be someone who has worked and established a reputation for himself in that particular branch of sociology, in that particular area of inquiry.

The fact of the matter is that we are using somewhere between two and three times as many assessors as the number of applications we receive. These are drawn from all over the world, they are not committees of Canadian scholars. Half of our assessors are abroad. They are top American, British, French, German, Italian scholars. We are applying, in effect, international standards of scholarship to every research grant application we get.
The number of assessors we use will depend on the size and complexity of the request. There is no point in using a sledge hammer to crack a very small nut, but for major applications we get we may go as high as eight or nine assessors, or even more, if necessary. There is no limit imposed.

Senator Yuzyk: Is there a time limit for submitting these adjudications?

Mr. Milligan: No, it is an open-ended program and we will accept them at any time during the year.

Senator Yuzyk: But is there any time limit for submitting the assessment?

Mr. Milligan: We cannot enforce a time limit. We ask them for a report within normally a matter of two weeks. I might say, too, that we are one of the few grant-giving agencies in the world that pay for assessments. We do so because we ask these people to provide us with a service. Perhaps this has some effect in getting a quicker and perhaps more judicious response, one that is more carefully considered.

In the competitions the system is different, because here applications are accepted in batches with deadlines and they are weighed against one another. Some here we have to work in committees. In this instance the adjudication is on a somewhat broader basis. In the doctoral fellowship competition, for example, we will have a committee that is dealing with sociology and it will be composed of five Canadian sociologists who will look at all applications in sociology and rank them against one another and then give us a recommendation as to which ones should succeed.

Senator Robichaud: Mr. Chairman, first I would like to know if there is a public list available of the individual recipients of awards or grants.

Mr. Boucher: They are all listed in the annual reports from year to year.

## Senator Robichaud: Individually?

Mr. Boucher: They are not listed in any interim publication but, each year, all of them appear in the annual report with the amounts granted and the disciplines involved.

Senator Robichaud: Mr. Chairman, much has been said about the criteria used by the Council to come to a decision in making rewards or grants to individuals, and reference has been made to what might be considered an extreme case, the case of Stanley Gray. Unfortunately, I think we have many reasons to believe that this is not a one-of-akind case. I may say in passing that it is definitely having an adverse effect on the reputation of the Council, particularly among students.

Personally I have had occasion to listen to students discussing the different awards, and there is certainly a lot of misconceptions about the activities of the Council. Reference has been made to the criteria involved. It is true that a student or an applicant could be one of the leaders of his class and an extremely bright student. However, at the same time the same individual could be one of the main instigators of trouble, sit-down strikes or demonstrations such as we are having at some universities; he could also be publicly known to be distributing pamphlets at the university advocating disrespect for lawful authority. But at the same time apparently he could qualify for a Canada Council grant.

I listened a few weeks ago to a group of students discussing an individual case which happened in Ottawa and those students were talking amongst themselves about what they should do next year-whether they should do something sensational to attract attention so that they could then apply for a grant. Now I would like to find out more about the criteria and what steps are taken and what efforts are being made by the Council to get more information about individual applicants for awards or grants.

Mr. Boucher: Well, senator, I don't know what I could add to what Mr. Martineau said earlier. Perhaps there may be a few points I could make.

The Canada Council of course has not created the situation. That is the first thing that must be considered. These people before ever getting a Canada Council grant or award are being allowed to register at Canadian universities and before that in many cases they get provincial scholarships, so you see that the Canada Council is not the only institution in Canada which enters into the picture.

Secondly, the Canada Council up to now has not been faced with a situation where it has had to look into other criteria than scholarly criteria. On scholarly grounds there was never any doubt in anyone's mind that Mr. Gray was fully qualified. Then came the recent events which were widely broadcast and which became public knowledge. Knowledge of them had not been gathered through any special investigation on the part of the Canada Council; these events were in the pwblic domain and of course the Canada Council could not ignore them. We realized they could raise questions as to the scholarly merit of Mr. Gray. The Council looked into
that situation and we asked ourselves if these activities were of such intensity and frequency that they interfered with the performance of his scholarly duties. A somewhat similar situation would be if Red Kelly were to ask us for a doctoral fellowship and we in turn asked him "Do you intend to do doctoral work or do you intend to play hockey?" Also, there was the question of the nature of Mr . Gray's activities, whether his activities were of such a nature that the Council felt that they reflected on his scholarly objectivity or competence. The Council voted on that and the Council also voted on the question of certain criteria which might not be related to scholarship but which would be related to character and civic behaviour. The Council considered whether these criteria, or more precisely the evidence which the Council had borrowed from the public domain, were such as to lead the Council to conclude that the award should be withheld. As I say, the Council voted on all these things. It is impossible for anyone on the Council or anyone who observed the procedures to say why Mr. X voted yes or why Mrs. Z voted no. This was a collective decision and the only thing that can be said is that a majority voted, after prolonged discussion where every single member of the Council-for the first time, in my limited experience-participated in the discussion and came to the conclusion that the award should not be withheld.

There were other considerations involved, of course. Were the members dealing only with this instance? Were some of them concerned about how we could cope with future similar cases? It is not possible to say. But it is a fact that a vote was taken by a widely representative body of well established Canadian citizens who considered all aspects of the case and this is a very important element. It is not correct to think that the Canada Council simply ignored these problems. The Council in plenary did not discuss anything but precisely these issues and after lengthy discussion came to the conclusion that the award should not be withheld.

I do not think it is possible to go beyond that in this case.

Senator Robichaud: Thank you. I have other cases in mind also, but rather than discussing them publicly I would like to discuss them privately with members of the Council.

Senator Carter: Mr. Chairman, I would like to carry on with the points raised by Senator Robichaud in his questions. I would like to
take them one step further. One of the witnesses spoke about the assessment of candidates or applicants. When you make this assessment, do you do so on the basis of the usefulness of this man to society or to his country or is it simply related to his scholarly ability? It may well be that his scholarly ability is an asset in one direction, but it may be negated in other ways. In fact he may just be a clever rogue if his attitudes towards society are wrong.

The Chairman: But, Senator Carter, what is right and what is wrong?

Senator Carter: Well, take the person who has an adverse attitude towards law and order. I would say that he is wrong. For example a person trying to undermine the basis of our society is wrong. Is his scholarly ability weighted so much that it overcomes all these other factors?

Mr. Martineau: That is exactly what some of us said, senator. That is why it was on division.

Senator Carter: Yes, it was on division, but every person apparently has his own scale of values in this. Apparently there is no scale of values set down by the Canada Council.

The Chairman: That is why we have a democracy.

Senator Yuzyk: But we can always lose our democracy.

Senator Grosart: And a democracy must have certain criteria. That brings me to the question I was going to ask. What are the criteria that are laid down? We have heard a great deal about scholarship, and I am the last one in the world to regard the criteria of scholarship as being unimportant, but there are other criteria. Is there any consideration given to the will of the public who provide the money for these grants and awards? I am not saying that that is an overriding consideration, but as has been mentioned, we are living in a democracy. Has any consideration been given to the questions of rightness or wrongness? It is all very well to say that it is difficult to decide what is right and what is wrong, but all our lives we are trying to decide that question. I feel we are entitled to ask the Council to undertake this same exercise. It is simply not a justification of this decision to say "we discussed it and we took a vote on it". It would be a wonderful thing, and I am sure the Cabinet would love it, if
all they had to say was, "We have discussed this very seriously. We are all good Canadians. We have reached this decision, and we do not want to hear any more about it." What are the criteria? Is there a list of them? This comes into this whole question of research and science policy.

I am asking: Has the Canada Council done any research on its own judgments? I do not mean, have you sat around and kicked around opinions. Have you hired a group to say, "Let us look at our decision-making process"? This is the research. Have you done it-yes or no?

Mr. Martineau: I am not going to answer yes or no. You are just asking me if I have stopped beating my wife.

Senator Grosart: The reason I said thatand I am sure the Chairman would like me to say so-is that we are all impressed with the all-star team the Council has brought, but some of us pitchers down here are finding it very difficult to pitch to three batters at the same time.

Mr. Martineau: I have been there five years now, and it is the first time that a case like this has come up, but we had only to judge by the academic excellence of the candidates, and also the value of their project when it was in research. So, we look at the subject and the man, if he is capable of doing it, and if he were tops we would say, "Yes." We have never had the R.C.M.P. after them, to see whether they were faithful to their wives, or were married, or to investigate their morals. We did not look into that. But this time the Gray matter came up and it raised new questions which were discussed, but we have not up to now decided on any criteria. Maybe the Council will have to, but up to now this is the first time we have thrashed it out. If it happens again some criteria will emerge.

Senator Lang: Did the Canada Council deliberations on Gray's application precede or ante-date the recent tensions at McGill and the march on the campus?

Mr. Boucher: They followed. The march was on the Friday, and the Council met on the Monday.

## The Chairman: And Tuesday.

Mr. Boucher: His timing was beautiful.
Senator Carter: One of the witnesses said this morning that you perhaps have 3,000 or

4,000 applications for doctoral fellowships, and only 2,500 available, or something like that. How do you allocate them in such a situation? What is the basis of your allocation of the various scholarships in the various subjects? How come you have only a certain number one year? How do you decide you are going to have " X " doctoral fellowships and "Y" something else?

Mr. Martineau: We make up our budget, and we have so much money which we have to divide, and we divide it between arts and sciences, let us say, 19 and 11, and when we come to social sciences we divide it again, according to the advice we get, between grants to students and research. Then, after this division, if we have, let us say, $\$ 3$ million to give to doctoral students, it means if it is $\$ 5,500$ per man, that there will be only so many fellowships. So if we have 1,000 demands for them, we have only, maybe, 500 to give out of this money, because we have to keep within our budget.

Senator Carter: You make an arbitrary decision, first, between the humanities and science?

Mr. Martineau: No, I would not say it is arbitrary. As with all budgets, we try to divide according to needs the money we have. It is the same in the arts: you have music, theatre, dance, and this and that. So we are trying to make a fair division according to needs, but no one and no discipline is entirely satisfied.

Mr. Boucher: In the case of doctoral fellowships, the amount earmarked for them has been arrived at based on the estimated requirements. We have been going to the Government for the past few years asking for a certain amount of money, predicated on the flow of demands we anticipated and the rate of awards we regarded as adequate. So, when the Government decides that we can proceed with this kind of estimate there is already an allotment for doctoral fellowships set at a certain figure based on our anticipation of what the next competition is going to yield. If the number of applicants is greater than we had budgeted for, there will be fewer awards to applicants in that competition because by that time we do not change the budget, as the rest of the money is earmarked for other purposes.

Mr. Martineau: If we do not-as we did not this year-get the money we were expecting, it throws our budget off.

Mr. Boucher: We cut everything.
Mr. Milligan: Senator Carter also asked about the allocation by discipline. In fact, in the doctoral competition we do not distinguish between the humanities and the social Sciences, and we take it discipline by discipline.

What happens is that in each discipline there is a selection committee, or in the case of the very small ones two or three may be lumped together under a single committee. The applications related to that discipline are allocated to that committee. At the same time they are given a quota. That quota will be a uniform percentage quota for each committee. If the committee finds that the general calibre of applications is very high they may say they would like to have more and, in some cases, we may increase it slightly. In some instances the committee may say that the quota is excessive in terms of the standards they are applying and that they do not need all the places. But the quota allocated, in each case, is a uniform percentage quota for each committee.

Dr. Slater: I think it is important to keep in mind where this fits into the total picture. The Canada Council doctoral fellowship program is the tip of the iceberg in support of graduate students, the good graduate students. This is the major national prestige award program. Therefore, for Canadian citizens and landed immigrants, in every field of study, it is going to be the better group that comes up. We are starting from the better group. We do not even put in from our university a certain range of the middle cut of students. They are good students and should be there, and I defend them, but they are not candidates for Canada Council support.

There is considerable consciousness among the Academic Panel and Committee, etcetera, as to what is the quality of people getting awards in this field versus that field. There is a feed-back process, therefore, and if it turns out that people who are absolutely first-class are not getting awards in one field, and people who are good but are not absolutely firstclass are getting them in another field, then you ask questions. So, there is a feed-back process, and this is the sort of thing one hopes will work out with a good feed-back process to produce a good result over a run, let us say, of two, three or four years, recognizing that you can never get the thing quite perfect in any year.

Senator Lang: Mr. Chairman, I want to go back for a moment, if I may, to the evidence given by Mr. Boucher. First, he emphasized the extent of the support given by the Canada Council to the social sciences, and the rapid increase in that support over the last four or five years. Secondly, he acknowledged the fact that it was amongst the social science postgraduates and, I guess, the undergraduates that we detect what we might call the largest degree of behavioural aberrations in activities at the university. If I interpreted his remarks correctly, he also suggested that the reason this is so is because the social scientist does not find a constructive outlet for his expertise in our society-in fact, he may not be able to utilize his talents to the extent that are desirable in our society today.

I may be wrong in my premise there, and I stand to be corrected, but if that is the case do I not detect in that evidence the suggestion that we may be putting too much support behind the social sciences today in view of the present development of our society and the ability or willingness of our society at this stage of our development to absorb these talents adequately.

If you concur in my conclusion, how then can the Canada Council justify the rapid increase in expenditure for support in this particular area?

Mr. Martineau: We discussed that very question last night, so answer him, Mr. Boucher.

Mr. Boucher: I think I would have to start by saying that what the Canada Council does at the moment in supporting students who are already engaged in doctoral work in the social sciences and the humanities does not quite support 40 per cent of them. It by no means gives full backing. It is not in a position to give full backing to those who are training themselves for future careers in these fields.

In the field of support of teachers who are engaged in research, we barely support ten per cent of those who are already engaged in a career.

So, the Canada Council is still a long way from the point where it would start asking itself very seriously whether it has got too much money. What we can do with the limited funds that we have, in view of the segment of our parish that we can service, is that we can insist on quality, and we do insist.
on quality. We try to help the best within this universe.
How will society eventually make full use of these people is very difficult to say, but perhaps I could say one or two things. If you look at the natural sciences the thing you notice almost immediately is that while people are being trained in abstract disciplines such as chemistry and physics, there are also people at the same time who are being trained in engineering, so that for a long time now the people who have gone into the physical sciences have been able to make a choice between getting a degree, and even a higher degree, in pure science or in applied science leading to certain recognized professions in society. But society, as I said earlier, has not quite sorted out what use it can make professionally of the people who are trained in the pure disciplines.

The N.R.C. is talking now of producing a report whereby it may be shown that it is worried about the use that will be made in four or five years time of certain persons trained in the physical sciences. This to me sounds a bit like what was being said in the early thirties. Any of us who would have been asked then: "How many social workers can we afford?" would have come to the conclusion that we could afford none. We would never have justified setting up our schools of social work, because you cannot project employment from an almost non-existent demand.

For a good while the social sciences, very largely because they were terribly sensitive about their scientific capacity to compete with the natural sciences, shied away from the development of applied courses. Industrial relations started developing, and social work, but the social science people were trying to make a point of not developing anything which would resemble social engineering, so we are still very largely living with this problem.

If you try to understand why young people join a faculty of social science you will see that very few of them are scholarly minded. They are all reform minded. They all go there to change society. They are the people who are socially motivated, and they are action-oriented people. What the universities do with them very often is inhibit them so much that they are no longer good action people and, if they did not have it in them, neither are they very good scholars. So, this field of development is going through a very
difficult phase, but personally I would certainly hesitate to express concern at the moment about our over-production of good people trained in these disciplines.

I think very severe difficulties for these people will have to be met in finding their proper role and their proper acceptance by society so as to allow them to perform effectively. There will be an amount of waste for a while, but this is a bit like running an immigration program. You bring in immigrants to this country, and for a while some of them will have difficulty in performing to their full capacity. There will be some adjustments. There will be some hardship, but you have to have faith that our society will eventually be able to develop ways of using all of these people to the best of their capabilities.

The Chairman: Before we go on I would like to point out that it is now 12.30, and I have the impression that you still have a number of questions to ask. Would you like to adjourn now, and return this afternoon-and I understand our guests are willing to do that-or would you prefer to go on until one o'clock and complete the business for today?

Senator Haig: Let us adjourn and come back this afternoon.

Senator Lang: I have just one more question, Mr. Chairman.

The Chairman: I will allow you your question, but what are the views of the other members of the committee?

Senator Grosart: Depending on the time relationship between the pitcher and the bat, I hope we can get through and finish up at one o'clock. Two short answers would help.

Senator Lang: I am rather a sanguine person in asking this question. I for one am very sorry to learn that Mr. Martineau will not be seeking reappointment as Chairman of the Canada Council, because I think he is the kind of person in whom we all take pride in having as chairman of this body.

Mr. Martineau: Thank you, senator.
Senaior Lang: That being the case, I think he probably has attained a degree of objectivity already, even before his time has expired, and I would like to ask him, if I may be so bold, whether he would try to give us his objective assessment, as a layman and a lawyer and not as a chairman of the Canada Council, of that body's relative strengths and weaknesses today.

Mr. Martineau: Yes, I will, senator. The trouble is, I just love these dangerous questions! The Council is as strong as its members are and as strong as its officers are. I will start with the officers. We have officers like no other institution in Canada, and I say that not because they are here but because it is true. We have extraordinarily good officers in every field; they are outstanding.

The Council is only as good as its members. Its members must be chosen with extreme care. The chairman of this Committee had to choose them at times, and, if I may say so, once a member was chosen whom later we would rather not have had, who added nothing to the Council.

The Chairman: I will remember that.
Mr. Martineau: You have asked me the question, senators.

The Chairman: You give me the name and I will give you the background.

Mr. Martineau: I know the background. Generally speaking, by far the majority of the members have been excellent. The level of discussion and the disinterestedness of every member, except for the one to whom I have just referred, who did not last long, is absolutely admirable. The fact that we all come from law, or this or that, makes it, I think, a perfect blend. Mind you, at times the discussions are very tough, as they should be, but we usually come to some conclusion, because we are all open minded. It has worked wonderfully. When I think of what Canada was before the creation of the Council and before your chairman gave us the first \$10 million, I see now another Canada, thanks to the Council. I think that what you must do is try to give it more money, and for the ministers always to appoint good members, then this magnificent work will continue. This is what I believe, and I would be very sad if I saw the Council doing less than it is doing today, because what it does it does magnificently, even though, of course, it is human, like every other institution.

Senator Grosart: I have two questions which would seem to relate very closely to the work of this committee. They arise on pages 7 and 23 of the brief. On page 7 there seems to be a feeling on the part of the Council that there is something wrong with research contracts. The words used are "tempted" and "blandishments of research contracts". There is a contrasting statement
that departments should buy the research they want and not set themselves up as sponsors of research. We are often told the modern trend is that governments, of which departments are components, are the new Médici. First of all I would like to know the Council's objection to the funding of research by contracts, particularly in view of the fact that we are continually told that the American pre-eminence in the research field is due largely to funding by research contracts.

Mr. Boucher: The answer to that is simply that we are very sorry the text is obscure in that respect. We have nothing against research contracts.

Senator Grosart: They are called blandishments.

Mr. Boucher: We have nothing against research contracts except in the sense that they are more attractive, and at times possibly unnecessarily more attractive, than research grants. They provide the kind of support that research grants cannot provide, namely stipends. If you want to do something and turn to the Canada Council or to the NRC for support, these agencies will be able to pick up the expenses but will not increase your income. If instead you go to a department, and if instead of getting a grant for the department you can convince them to give you a contract, you will not only get your expenses paid but you will get paid for doing it.

Senator Grosart: Is there something wrong with this?

Mr. Boucher: There is nothing wrong with Government using contracts. We have no objection to that. The meaning of this is that we feel the Government should contract; that is what we mean when we say it should buy it. It should buy it through contracts.

Senator Grosari: I do not want to labour the point, but there seems to be a contradiction in the two statements.

Mr. Milligan: There are two additional points I might add. One is that in some cases what purport to be contracts and carry with them a stipend are in fact only grants.

## Mr. Boucher: That is right.

Mr. Milligan: It is, if you like, a form of unfair competition.

Senator Grosarì: Unfair competition with whom?

Mr. Milligan: With granting agencies like the Canada Council. It puts us at a disadvantage.

Senator Grosart: Not unfair competition with people seeking help?

Mr. Milligan: Not with people seeking help. The other point is that when the government departments enter into the grant-giving business they do so on a much smaller scale than we do, and certainly on a very much smaller scale than the National Research Council. They are not bodies that are particularly devoted to this particular function of supporting research. They do not have the same kind of procedures, the same kind of expertise if you like, that we have. Quite frankly, we feel they do not do the job of giving grants as well as we can do it.

Senator Grosart: This is not what they have told us. They have told us that they have the expertise; that they examine these things and they know what they are doing.

Mr. Milligan: They tend to rely very heavily on their own internal expertise, which is vastly inferior to the kind of expertise we are getting from all round the world in making assessments.

Senator Grosart: It is a very surprising statement that shocks me in view of the millions and millions of dollars now granted for the funding of research on the basis that you now criticize.

The Chairman: Not money in the field of social sciences.

Senator Grosart: I am not merely speaking of social sciences. It is a very serious criticism that has just been made of the funding of research by departments of government. We are told it is not as well done as by the Canada Council. We are told they have not the expertise. It is a fantastic criticism.

Dr. Slater: Time is getting on and it would take me far longer than we have left to reply. I could not provide Senator Grosart with a short answer. However, from experience of having been a grant holder and a contract holder in Canada and the United States, and now signing for research contracts, signing all grant contracts and trying to make the things fit together, I think I could provide some sort of useful background. I will undertake to furnish a supplementary statement on this, as a personal matter, not as a Canada Council matter.

Let me say, in short, you cannot run a really good research and teaching establishment unless you have got a reasonably secure central operation which has an ongoing basis and is funded in terms of general objectives and does not have too many strings attached. You can attach to this a lot of contract things on quite an effective basis. There are problems of fitting them together. You have got to simply realize that there are the problems of fitting them together and coping with them. We know something about how to put them together. I do not think it is right to say that we have done all that well in this country yet in fitting these things together. I think there are probably far more weaknesses in the contractual side of research support in this country at this stage than there are in the granting side. There are a lot of abuses. We think we know something about these, and I believe we know something about working them out. Perhaps to some extent this relates to another matter again, and I will try to make a personal statement as distinct from a council statement.

Senator Grosart asked a question about a ministry of science, and so on. I am going to argue very strongly in a separate statement, and I will file it with you, for approaches of co-ordination and relating things. That does not mean to say that it is a monolithic structure. That really itself would be very, very wrong. I am going to argue this from what may be a unique experience in Canada. I am a member of the principal granting body supporting, not only universities, but art galleries, museums, et cetera, in Ontario, and therefore have to see that side of the thing. I am also concerned now with certain aspects of the federal side and one of the few people that happens to be, in a sense, in a position to be actively involved in both of these things and not just in advice, in making decisions and spending money and taking responsibility for it. I am convinced that we are desperately short of effective communication and integration as well as co-ordination of many of our programs. The Canada Council has had difficulty in understanding what the provincial thrusts are and the provincial activities are differet from the national activities. There have been enormous efforts to relate these. Improvement is needed and fitting together. In this connection it is similar to the kind of issues that arise in relating contract activity and grant activity.

Senator Grosart: There have been some very thorough-going studies of this made in
the United States. It is not a new subject. This brings me to my second question which relates completely to this. On page 23 there is a reference to the Macdonald study. I gather that the Canada Council is a bit disappointed in that study. In section 41 I read that the council is now faced with a need for inventory of research in the social sciences. I think this committee has been much engaged in the problem of activity inventory which is the main reason, I suppose, for the back of cooperation and co-ordination that Professor Slater speaks about. What is the particular deficiency in this respect of the Macdonald report?

Mr. Boucher: A few months before the Macdonald report study was launched the Canada Council was deeply engaged in discussions with CAUT and AUCC to stage a survey of sources of financing of research for our area of jurisdiction, the social sciences and the humanities. What we wanted to know was what were we competing with? What was our role in the total picture? In order to define our role and especially for the future, we had to know how much money was pouring into the research community from foreign funds and Canadian funds, from contractual sources as well as from free sources of support and what all of these various forms of support covered and what restrictions were applicable. This is a field on which no one has full information. We were discussing this and were about to come to the conclusion that it would be difficult to do the survey unless we could also persuade the natural sciences to come in with us.

We then learned that the Science Council was staging the Macdonald survey and that Dr. Macdonald found it difficult not to go over into the social sciences. We came into the picture as partners with the Science Council to support the Macdonald survey in the hope, if not on the understanding that what we were after would be gathered by the Macdonald team. Well, it turns out that it has not been gathered. The Macdonald report will not tell us more than we knew three years ago about that and we are still asking ourselves what is the role of free grant or grants to freely initiated research in the total picture. How much income do researchers make through contracts and through consultant fees, and so forth?

Senator Grosart: Is this largely in the social sciences and humanities?

Mr. Boucher: I do not think the humanities have much of a problem, but what we think is a real problem-that is why we are concerned about certain forms of contracts and grants-is that of certain disciplines, let us say economics, to take one. The market situation for putting an economist on tap and getting him to work for you is such that an economist may well go on through his career responding only to contractual offers and quite possibly never undertaking what he himself would very much like to do, provided he had the same kind of financial support from some free source. We are somewhat concerned with the approach of government departments to financing research. We believe that when departments have identified a research gap that they need to have filled in order to meet their political requirements they should buy through contracts the services of researchers. This is perfectly acceptable and it should be encouraged. We feel on the other hand that when researchers want to do what they wish, when they have the possibility to turn to a department and say, "Well, now, do you like what I want to do and are you prepared to give me for that the same kind of support you would give to somebody you hired yourself of your own initiative?" This kind of possibility is somewhat disturbing, because in this way there is a tendency to distort the natural direction that would be taken by career scientists and especially for these special disciplines which at the moment are subjected to a great deal of solicitation. There is also the fact that in the United States grants given by foundations, even given by the National Science Foundation, are grants which carry a stipend with them. This means that while there is no doubt at the moment that a philosopher is not the object of multiple offers, certain very important people in our research community are subjected to this kind of solicitation.

Senator Grosart: Excuse me, is it your feeling that there should be a single agency responsible for the control or co-ordination of all grants for free research?

Mr. Boucher: I am not sure that we would put it in black and white, but I think the rule should be in departments that research would be either in house or under contract; that when a department requires it, it would contract; and research by grants would generally be supported by a research council, that grants would be the means which would characterize the research councils.

Senator Grosart: But is there not a very close relationship? We find over and over again that innovation or technological research projects feed back to the need for some basic research.

## Mr. Boucher: Yes.

Senator Grosart: Are you suggesting that if this happened, departments should be denied the opportunity to say they need some basic research?

Mr. Boucher: Not at all. Of course, we have to be juite clear that our major concern stems from something that is very largely peculiar to the social sciences, and very largely peculiar to only some of themprimarily things like economics. We have a feeling at the moment that one of our responsibilites may well be to make grants for freely initiated research reasonably competitive with research contracts-reasonably competitive. We would like the first class economist to be able to state what he wants to stage and get the kind of support for that which would be equivalent to what he might get if he simply looked around to get a contract-he does not have to look very far.

Senator Grosart: Do you see any hope on the horizon for a complete inventory of funded research in Canada? Does anybody see it?

Mr. Milligan: Not on the immediate horizon, but I think it is going to be essential within, say, five years.

Senator Grosart: Do you not think it essential now?

Mr. Milligan: It is essential now, but the means do not exist. There has to be a coding system if it is to be machine-readable. There is no coding system available which would serve a bilingual country. Not only that, it must be compatible with international systems, because this is part of the international activity. What is desperately needed is an international coding system which is immune to language, which is immune to the labels given to disciplines, which is concerned with the actual substance of research-so that any man working on research can find out where in the world-not just in this country-there is research being done on this project, where and by whom.

Senator Grosart: This is a different type of inventory to that which I had in mind. I had intended to speak only of a Canadian funding. If there are 20,000 of them ...

Mr. Milligan: I think the basic need is the other one. The kind of information you are seeking can be a very simple by-product, once the basic end is achieved.

Senator Grosart: Surely someone can make up one for these 20,000 ? Evidence we have had from departments is that when they sit down to decide they will give a grant to university X for project Y they have not the faintest idea what is in the estimates of any other department. I know we have had that evidence over and over again. That is the kind of inventory I speak of. It is a paper inventory.

The Chairman: Only within the Government?

Senator Grosart: Start with the Government, but a natural corollary would be the funding by industry and the Canada Council.

The Chairman: You will remember, Senator Grosart, that we had a long discussion about this with the Dominion Bureau of Statistics and they are supposed to work on this. I remember that we were expressing at that time the fear that they could not co-ordinate, even in that field, their activities with other government agencies. If we cannot co-ordinate in the gathering of figures, I do not think we will be able to co-ordinate very much when we come to the formulation of policy.

Senator Grosart: A very profound statement, Mr. Chairman, and I entirely agree.

The Chairman: In any case, I would hope that the Canada Council, when it embarks on this-and it is a very desirable objectivewould be prepared to co-operate at least with the DBS.

## Mr. Boucher: Certainly.

Senator Grosart: I have one final comment. The Canada Council seems to show some concern in people worrying about the role of the Treasury Board in science policy decisionmaking. May I assure them that there are very few subjects which have concerned us less than the Treasury Board, beccause if we find anybody in trouble in questioning by this committee, they almost always say that it is the Treasury Board which makes the decision.

Mr. Boucher: The point we were trying to make is not so much that. We are aware of course that the Senate committee has had two
sittings with the Treasury Board, but abroad in the country there has not been too much discussion of the kind of problems that come up with a following through of the PPB exercise. This is what we feel we will have to come to at some stage. The question that has to be asked is not how much money we can afford to spend on research, but how much money we can afford to spend on research compared to what we have for other purposes, and how much we can afford to spend on other objectives. It raises very much the whole question of broad priorities that that exercise could help us resolve. To some extent the Treasury Board has given a good deal of thought to using the method as a tool to analyze priorities within programs or within a single department, but not in any interrelated fashion across the whole spectrum of federal expenditures.

Senator Grosart: So that the problem now is not merely annual decisions but five-year projections which can throw the whole thing
out of kilter, far more than it is out of kilter now, if that is the position.

The Chairman: As there are no other questions, I wish on behalf of the committee to say I am very pleased indeed to thank the chairman and his associates for spending all that time with us this morning. I hope that we will have other opportunities, when he has retired from his present responsibility, to hear Mr. Martineau and to profit from his great wisdom.

Mr. Martineau: Thank you, Mr. Chairman. In the name of every member of the Council and the officers of the Council who are here this morning, thank you for your courtesy. Let me assure you that the questions which you put to us will not be forgotten. We will certainly be thinking of them and we will try to satisfy your just doubts, and that is all we can promise. Thank you again.

The committee adjourned.

APPENDIX 49

CANADA COUNCIL
bRIEF TO THE SENATE COMMITTEE ON SCIENCE POLICY
April 24th, 1969
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CANADA COUNCIL
BRIEF TO THE SENATE COMMITTEE ON SCIENCE POLICY
April 24th, 1969

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## PART I: GENERAL COMMENTS

## Scope of the Council's Brief

1. The Council had the privilege in March of last year of being the first witness before the Committee. Now that many views have been presented, the Council can put before the Committee more useful observations than those offered at the first sitting. This it wishes to do in Part I of the present brief. Part II will answer the questionnaire distributed by the Committee last September to the extent that jit bears on grantgiving programmes.
2. The attention of the Senate Committec has been and will continue to be drawn mostly to the natural sciences, to $R \& D$ in government and industry, and very much to development and innovation. Because of its mandate, the Canada Council must try and direct its remarks to research-. to research in the social sciences and humanities and to research in the universities. Reference will therefore be made to the broader issues only to bring out more clearly the point of view of university research and of the social sciences and humanities.
3. A national science policy must embrace policies adopted and administered by non-governmental institutions such as universities, hospitals and industry. However, for the sake of brevity, this brief will treat science policy only in so far as it is a responsibility of government.
4. Why do governments these days feel that they should have a science policy? Is it bccause they do not have one or because the one they have lacks coherence or is inadequate? Is the present policy inadequate because it is too timid and restrictive or because it is too unconscious and uncontrolled? Is it felt that science expenditures in Canada are too timid because they underuse Canadian talent, because they leave too many problem areas (mostly social) unresearched, because well before the year 2000 they will have pulled us out of international competition, or simply because they do not add up to $3 \%$ of the GNP? Is it felt that they are out of control because the pattern of governmental research does not reflect the balance of political priorities, because it shows wasteful overlaps and gaping holes, or simply because Cabinet has had to discontinue two or three of the more expensive projects? Is the government sharing the new suspicion that science could be easily as harmful as beneficial to society, that it should be kept in tighter check, or does the government believe that the non-use of science could be as harmful as its misuse, that the challenge lies not in slowing down the germination of new ideas but in taking more systematic and responsible advantage of them?
5. Asking ourselves, as a nation, not how we can best use new knowledge, but whether we can afford more research is not unlike asking ourselves whether we can afford to go on thinking, since research is only the systematic application of the mind to the solution of problems. Of course, we may well ask ourselves whether we can afford to let scientists have their own way at public expense, but then we must be prepared to ask ourselves
as well whether we can afford not to. In the end, the only valid questions in the research sector of science policy may well be how to achieve quality and weed out mediocrity, and how to husband, in and out of Government service, scarce and precious resources essential to national advancement.

## Government as a User, Maker and Supporter of Science

6. A satisfactory science policy cannot be achieved unless distinctions are made between the different roles performed by Government in its association with science. This is required to reveal the different motives which will guide Government in its attitudes and choices. It is often said, for example, that there is a difference between a science policy and a policy for science, or between a policy for the use of science and a policy for the advancement of science. But the practical implications of such a distinction for policy-making are seldom pursued. Actually, a government may be interested in science either as an instrument-as a tool for the achievement of broader social goals--, or as a national activity of intrinsic value. In the first instance, the government is a user of science or acts on behalf of the nation as a user of science. In the second instance, the government may be involved in science either as a public entrepreneur or as a supporter.
7. A good deal of the growing interest in a science policy can be traced to various attempts to have governments make more conscious use of the sciences in the pursuit of their political objectives or in their support of the broad objectives of the nation. This concern is widely shared by all those who feel the need for more effective action by governments or by publicly assisted institutions to resolve problems of growing
complexity and generally to achieve greater prosperity and welfare. Such a policy is directed at making national institutions ever more scientific in the discharge of whatever responsibilities they have assumed, and more particularly at making them ever more innovative. The emphasis here lies much more on development and innovation than on research. It is also very important to recognize that in so far as the government is a consumer, not a producer of science, its science priorities must be equated with its political priorities.
8. There are two other ways in which governments may be involved with science, this time not for its instrumental but for its intrinsic significance. Science is quickly becoming a major component of the total national activity. Along with other creative endeavours it will occupy a more and more important place in a post-industrjal society. Provided that society is geared to using its findings well, it will be capable of achievements of which we would not have dreamed before. More simply, it will occupy an ever-growing segment of the service side of the national economy. The leisure society will also be the scientific society. Leisure will largely be the privilege of the "working class" of to-day and a large share of the work will be done by the intellectually trained, who will make up a growing segment of the economically active population. Two consequences have begun to flow from this trend, one involving the State as an entrepreneur of science and the other, the State as a supporter of science.
9. As an entrepreneur, the State is led to undertake scientific activities not so much because they will assist in the discharge of its other responsibilities (although they may), but because certain scientific
undertakings are of such magnitude or character as to require governmental initiative, somewhat as is the case for public utilities. Science in this sense becomes another national service, a "mission" in itself on the government agenda. It can be concerned with research as well as development. Policy formulation is specially required here both to bring about more determined action in areas where continued neglect could soon spell disaster (such as greatly expanded scientific information services by DBS and the National Library), and to ensure the gradual decentralization of longstanding programmes (astronomy, nuclear physics, econometrics) when conditions which brought about government action in the first place have changed sufficiently.
10. The second consequence that £lows from the growing significance of science in our lives is that governments are now led to support university research no longer through sheer benevolence but through a sense of public responsibility for the health of a vital sector of the nation. Science is no longer a luxury consumer good but a fundamental prerequisite of contemporary society, and support of research as a national activity must be regarded as an investment in the building up of the social infra-structure. It also constitutes a mission in itself. Although it does not carry the same vote appeal as education, it is the most meaningful implication of a policy of universal education aimed at producing citizens who can not only assimilate knowledge and imitate foreign innovations, but advance knowledge and innovate themselves, especially in the social areas, where imports are not as easily assimilable. The work of scientists and scholars is then supported not so much for the imnediate or remote contribution that as a group they will
inevitably make to the growth of the GNP but because they already exercise in the nation a service occupation of the highest social significance. Whether or not governments can find in this enough of a political justification for public expenditures, they can always invoke more pragmatic grounds such as the need for strengthening universities, for training scientific workers required by them and by business, or for providing democratic safeguards against their own monopoly of knowledge.

Socia1 and Scientific Priorities
11. A science policy requires criteria. Can these be the same for a user's policy, an entrepreneur's policy and a supporter's policy? The Science Council has suggested that certain objectives identified by the Economic Council as social priorities might be taken as the objectives that would justify special government association with the work of scientists in these areas. But the Science Council does not say when scientific priorities can be equated with social priorities, and when they cannot. Of course, governments will not arrive at a satisfactory policy as users of science unless they can define their. own and the nation's broad social objectives. But these national goals will not help them define their roles as entrepreneurs of science or as supporters of science. The reason is that these roles must find their justification in their acceptance as social objectives in themselves. Unless governments are careful to make this distinction, their interest in science could become ambiguous. It might come to lie merely in the buying of time while a political consensus develops, rather than in the need for expert advice. What science, or at least the natural sciences, could contribute further to the understanding of pollution may well not be
what governments require to take action. While the research done on behalf of recent royal commissions and task forces has probably been of high scholarly significance, it can hardly be claimed that it was all required to provide assistance in the decision-making process. Governments themselves may begin to worry about the possibility that royal commissions will come to mistake scholarly inquiry for public enquiry. Scholars may begin to worry about the unpredictability of this source of government support.
12. Governments are already too often tempted to mobilize, through the blandishments of research contracts, as large a sector of the research community as they require for investigations which are politically imperative. In the process, insufficient use is made of the best scientific talent and free research itself may be stifled. Governments are not unaware of this danger but quite naturally find it difficult to ignore political requirements simply to protect an academic freedom which by itself offers little guarantee of great scholarly activity. The fact is that academic freedom is merely a pre-condition of scholarly achievement; it remains largely a fiction as long as the means to engage in effective free research are not provided. Free scholarly activity in the social sciences is at a critical juncture at the moment. The community of scholars is only now beginning to seek Canadian grants instead of American grants and Canadian contracts, but it is still hesitant to undertake large projects. Government departments would be ill-advised to discourage this emancipation process from which they can only benefit eventually. It is a good thing for scholars to have access to multiple sources of support but departments which need research should buy it and not set themselves up as patrons. It is doubtful that they need offer
special fellowships in the social sciences beyond those offered by the Canada Council, or that they need offer special research grants beyond their own research contracts and the Canada Council grants. It is even more doubtful that they should offer contracts in lieu of grants. This practice is particularly open to question since the provision made in research contracts for stipends, which the Canada Council cannot provide, only aggravates the 10 non-competitive situation of the Council in making grants for freely initiated research. Even the mission-oriented nature of a research project is not sufficient to make it exclusively a departmental responsibility as this would have the undesirable effect of 1 imiting Canada Council support to purely theoretical research. If the granting of funds to government departments for the assumption of a purely supportive role warrants review in missionoriented research, it does the more so in areas where departments have assumed a protective responsibility for whole scientific disciplines such as geography, labour economics or mental health.

Framework of a Supporter's Policy
13. It is the Council's conviction that a programme of aid to free research should not and, in practice, will not concern itself with distinctions between "right" and "wrong" areas of inquiry. There is just no evidence that the problem is that too much money is being spent on the wrong kind of research. We have even less assurance that the wrong kind of research in terms of immediate social utility would be the wrong kind of research in terms of scientific significance or even of eventual social utility. Such a programme of aid must concern itself, however, with distinctions as to the quality of research. We may quite rightly fear that too much money will end up
being spent on mediocre scholars. We must accept to support a fair number of researchers of ordinary competence if we are to attract the exceptional ones, but there is no justification for supporting applicants who appear mediocre at the outset. We must work, then, at tightening the screening procedures, developing an even more demanding system of pre-assessment and of progress audit and post-audit. From a purely managerial point of view, it is both necessary and not unduly expensive to have a sound pre-audit system of universal coverage, but the coverage of a review system must necessarily be limited to sample checks. It can only guide the granting agency in its future decisions and then only in general terms. Also an audit system should not be expected to exclude from future aid all applicants who have failed to reach their stated objectives, unless it reveals mediocrity that had escaped earlier scrutiny. The possibility of failure is inherent in all original research. As to cost-benefit analysis, whatever progress can be made in this respect will definitely be useful. However, university research must include the scientific as well as the social benefits, however more difficult the former are to quantify. In any instance, most progress made in this field will come ex post facto from specially trained observers rather than from individual scholars applying for support.
14. Over the past decade, the science expenditures of the industrialized nations have been growing at a considerably faster pace than the Gross National Product. The time was bound to come when governments would be asking themselves how long the trend could last. If governments to-day are having second thoughts about the pace at which scientific programmes can be allowed to grow, it is to a large extent due to the return of economic
uncertainty and to the abrupt accumulation of unmet social claims, old and new. The question, then, is how much will the merits of science expenditures weigh against those of social claims; the question also is how will governments choose between the cost-benefits of enabling measures and those of protective and remedial measures. To assess the social significance of science, we must ask ourselves why we have recently been letting science support grow by leaps and bounds. What were we trying to achieve? A simple and reasonably accurate answer would probably be that we were trying to bring the volume of scientific activity in the life of the nation to something like a critical mass, and that we regarded this expenditure as an eminently well-timed social investment. If this was so, how far are we still from the target and, in the case at least of the social sciences, how quickly must the target be reached if we are not to jeopardize the fulfilment of other social objectives?
15. For the last five years, the Canada Council has been trying to formulate, in its budgetary forecasts, targets related to what could be considered a basic level of support for the social sciences and the humanities. While the Government's response has been quite encouraging and has now brought the Council's budget up to the level where the NRC-MRC budget stood only six years ago, it has at the same time improved the position of natural scientists considerably; whereas the Canada Council can now support almost $10 \%$ of its universe of career scholars, nearly two out of three natural scientists are being supported. The Council's submissions to Treasury Board have been expressed in terms of requirements to assist, through research grants, a reasonable segment of the research community and,
through doctoral fellowships, a reasonable segment of the career researchers in training. To this, allowances have been added for the launching of a scientific information and communication system, for the rapid build-up of essential research collections, and for a programme of key institutional development grants. It must be realized that something like an annual $20 \%$ increase is required just to keep pace with the population growth on Canadian campuses and with cost increases. The Council remains of the view that while its position has been quite remarkably improved over the last five years, the recovery operation, by which the gap between the natural and the social sciences would be gradually reduced, has made very little progress. Unless its budget is doubled once more over the next two or three years, there is a grave risk that the expectations of its research community will be dashed again.
16. The Council believes that the search for an adequate science policy, if it is not to remain in the abstract, must be linked with the overall review of government expenditures which is now the object of the Planning-Programming-Budgeting scrutiny in the Treasury Board. It is disquieting that so little of the discussion that has taken place to date on the issue of a science policy has dealt with the Treasury Board and with its work on PPB. If Canadians want to know how much they should spend on science, they must be prepared to take an entirely fresh look at the way they have been spending money in the discharge of other governmental functions for the past several decades. It would be unfair and premature to comment in detail on the new experiment that Treasury Board is conducting. Still it must be said that PPB should offer choices not only within programmes
but also between programmes. Only a thorough questioning of all traditional patterns of expenditures will make it possible to see in proper perspective the significance (economic and otherwise) of the various roles that the Government of Canada will be called upon to perfom in the years ahead, and more particularly how, to meet the new challenges, it will be able to recover enough freedom of movement from the very restricted position where tradition has cornered it. There is already ample evidence that it would be suicidal to take the traditional patterns for granted and let the new programmes bear the brunt of financial pressure. If the $P P B$ analysis were allowed to run its full course, it would tell which government functions are preventive or protective, which are remedial and which are of an enabling nature. This would enable the Government to see that a programme of assistance to science is of the same nature as a programme of assistance to industrial development, that it is an enabling form of investment, intended to foster growth and to release creative talents of the best quality. Of course, it will never be politically easy for the government to make abrupt and radical changes in its pattern of expenditures. But it should be able to make the most enlightened choices as to how to spend whatever little additional revenue it can scrape in the immediate future, whether in remedying social defects, in protecting us further from undesirable occurrences or in bringing about conditions that will gradually enable Canada to use a larger measure of its underused creative skills.

## Science and Government Organization

17. The question of whether there should be a Minister of Science depends on whether one wants a Minister of Science to supervise a user's
policy, an entrepreneur's policy or a supporter's policy. If the sciences and especially the social sciences are to become, as they should, widely used instruments in the pursuit of broad national goals, it is difficult to see how a single Minister could discharge a promotional and co-ordinative role which must engage the attention of the whole Cabinet and Treasury Board. It is equally difficult to see how a Minister responsible only for the industrial use of science, but not for the wider field of social innovation, could properly be called a Minister of Science. On the other hand, with the growing acceptance of interdisciplinary approaches and the growing need for common services, a good case could be made, although it has not been made yet, for a single Minister (not called a Minister of Science either) having responsibility for all programmes of aid in support of university research, including the national information services of the National Library and the Dominion Bureau of Statistics. In Cabinet, he would speak on behalf of the university research and would assist his colleagues in ensuring a balanced distribution of departmental research contracts. It is generally understood that the President of the Treasury Board will, in time, relinquish his share of duties in this field, as in his new position he cannot indefinitely bear the responsibility for a particular area of expenditure. On the other hand, the Secretary of State is already responsible for the Cenada Council, the National Library, and the administration of the programme of assistance to universities through fiscal transfers.
18. 

Of course, a programe of incentives for industrial research must rest with the Department of Industry as similar programmes in the primary industries must rest with the functional departments. But that does not
settle the question of free university research. While there is a case for the Secretary of State assuming responsibility for all university support, there is no particular logic in bringing the NRC laboratories under him. Yet neither is there any particular incompatibility. It is true that the proposal would appear to place the aid-to-science programmes further away from industrial application. But here one should remark that the recent literature has provided us with a very incomplete picture of the applications of science. It is by no means industry alone that must develop a sense for using the fruits of science. More and more it is other national institutions, such as the large service institutions, universities, hospitals, mass media, etc. It is true that these institutions use the fruits of science mostly in the form of industrial products, but it is quite possible that there would be even greater industrial innovation if science were more responsive to the needs of all service institutions than if it were directly associated with industry alone. There most probably would be greater social innovation. The same must be said of technology. There is a tendency to think of technology as if it resulted exclusively from research done in the natural sciences when a good deal results from research done in the social sciences. It is very difficult to-day to distinguish between the technological progress made, say, in the communications media thanks to the work of physicists and engineers and the progress made thanks to the work of behavioural scientists. Besides, most technological lags, even in industry, have a primarily social explanation. Shortage of innovators in industry is a social problem. Actually, Canada's scientific contribution to the world of to-morrow might
well prove more original and significant in the field of social innovation than in the field of physical innovation.
19. Whether or not all aid to university research comes under a single Minister, the various agencies of the Government that share this responsibility will have to develop closer and closer liaison in order to ensure complementarity between services and consistency between programmes and in order to foster interdisciplinary undertakings. It might be premature and, by Canadian standards, ambitious to envisage the integration of all research aid programmes in a single foundation for the sciences and the arts. Still greater use must be made of the social sciences by all governmental bodies engaged in the study of problems of science policy. Not only is the question of the social usefulness of work done in the natural sciences a socio-economic problem, so is the question of planning, costing and staging programmes either of scientific initiative or of research aid. How the Science Council will gradually resolve this problem remains to be seen, although the presence of a few social scientists on the Council must have already proven helpful. In any instance, before the mandate of the Science Council is expanded to embrace concern for the direction taken by the social sciences, or before a parallel Social Science Council is established, it might be wise to wait and see what the present Science Council can do for the natural sciences. The courtship has barely started between two scholarly communities equally richly endowed with prejudices. It should be neither interrupted nor rushed. They still can make more progress in common undertakings than in policy discussions. When the recovery operation undertaken by the Canada Council is well advanced, and when the gap between the support
granted to the natural and to the social sciences has been substantially reduced, various forms of government organization may well be re-examined with a view to effecting greater integration of parallel policies and to bringing all the sciences together in fuller partnership. 20.

A decision on the advisability of establishing, along with the natural science laboratories of the federal government, a national social science institute would have to take into consideration the limited availability of top quality Canadian scholars in this field and, more particularly, the effect that this would have on the present programmes and plans. of Canadian universities. The government would have'to ask itself whether it is considering such an initiative as a user of science, as a science entrepreneur or as a supporter of science. The most promising solution would lie in the possibility that the government would be moved primarily by the third motive and that it would think of establishing an Institute not so much to have better research done on behalf of the government but in order to provide exceptional facilities where the best researchers might spend, on leave from teaching duties, various periods of time engaged in free research, a good deal of which could be of an interdisciplinary nature.

April 1969.

## PART II: DATA REQUESTED BY THE SENATE COMMITTEE

## Structure of the Canada Council

21. The Governor-in-Council appoints a Council of 21 members, including a Chairman and Vice-Chairman, and a permanent chief executive, the Director with an Associate Director. The Chairman and Vice-Chairman serve for terms not exceeding five years; other members for terms of three years; all may be re-appointed for a second term. The Council meets at least five times a year. (Appendix A gives the names and biographical sketches of members).
22. A key unit in the Council's programme of aid to research is the Academic Panel, made up of fifteen specialists broadly representative of all the social sciences and humanities. Outstanding scholars from universities in the different regions of Canada are chosen by the Council for membership on the Panel. Because membership of the Panel is rotating, the Council's programmes are reviewed critically by a somewhat different set of scholars each year. (Appendix B lists the names and university affiliation of members of the Academic Panel)
23. The Council's channeling of aid to research, is coordinated by the Social Sciences and Humanities Division. Headed by an Assistant Director, the Division is made up of 11 project officers and 16 supporting staff. Additional support is given by the Awards Service (6 officers, 9 supporting staff), which administers the annual competitions for Doctoral, Post-doctoral and Leave Fellowships, and the Finance Division, (6 officers, 12 supporting staff), which is responsible for the normal financial operations of the Council and provides data and analysis for programme planning and evaluation.
24. In the process of adjudication the Social Sciences and Humanities Division relies on the advice of many scholars, both as individual specialists and as members of a number of specially created panels. In the case of Research Grants, for example, there are almost three times as many scholarly assessors as applicants. Leading scholars abroad are sought for advice almost as much as experts at home, to help keep the Council's programme of assistance in line with international standards of scholarship. (The two charts of Appendix C show how these components work together in the adjudication of Research Grants and Fellowships.)
25. In addition the Social Sciences and Humanities Division, backed by the Awards Service, is responsible for the academic sector of a relatively modest programme of cultural exchanges with European countries, which the Council administers on behalf of the Department of External Affairs. Countries affected are Belgium, France, Germany, Italy, the Netherlands and Switzerland. Under this programme Canadian universities are offered grants to bring in outstanding visiting scholars from abroad and scholarships and fellowships are offered by competition to enable foreign scholars to undertake graduate studies or research in this country. Various committees here and abroad assist in the adjudication of candidates. (Appendix D shows how grants are adjudicated in this programme).

Ties with Parliament and Government Bodies
26. Created in 1957 by the Government of Canada as an independent body, the Canada Council reports annually to Parliament through the Secretary of State. The Council, which used to appear regularly only before the Public Accounts Committee of Parliament, is now also called before the Standing Committee on Broadcasting, Films and Assistance to the Arts. It
should be noted, however, that the Council spends nearly twice as much on aid to research as on the arts. The Council is a member of all consulting bodies brought together by the Department of External Affairs for periodic reviews of cultural and technical exchanges with other countries, including the Cultural Exchange Programme with European Countries mentioned above. 27. At a time when the boundaries between certain academic disciplines are blurring and when there is growing interest in interdisciplinary research, the Council's relationship with the N.R.C. becomes increasingly important. Informal consultation between the two Councils has enabled them generally to concert their activities in those disciplines that lie between their mandates -- such as psychology, archaeology, anthropology, geography. A formal tie is that the Director of the Canada Council is an Associate of the National Research Council.
28. The Council maintains ties with the National Museums of Canada. and the National. Arts Centre through membership of its Director on their respective boards. The Canada Council is also present at all discussions which bring together the cultural organizations which report through the Secretary of State.

## Programme Development

29. The Canada Council is the national agency for the development of freely initiated research in the social sciences and humanities. While a good deal of research is conducted by social scientists under contract to various government agencies, royal commissions and task forces, the Council is responsible for assisting general development of research in these disciplines. The Council now accounts for about $3 / 4$ of the funds expended by the Federal Government in the social sciences and humanities.

However the amount applied by the Canada Council directly to research grants is barely equal to that expended by the Federal Government for mission-oriented university research in the social sciences. Statutory basis for this programme is of course the Canada Council Act, sections 8 to 13 of which are attached as Appendix E.
30. Popular belief to the contrary, there are more Canadian scholars in the social sciences and humanities than in the physical and life sciences combined. In 1967-68 the totals were 9,180 as opposed to 7,012 .
31. The growth of Canada Council assistance to the social sciences and humanities in recent years can be viewed as a recovery operation. As recently as $1964-65$, the Canada Council spent only $\$ 1.4$ million on its academic programme, a token amount in view of the expansion that had already taken place in the social sciences and humanities. By 1968-69 Council assistance in this field had risen to $\$ 16.6$ million, and this year it is expected to amount to $\$ 19.4$ million, but still support to the human sciences in Canada lags far behind that given the physical and life sciences. The Canada Council has now almost reached the level at which N.R.C. and M.R.C. were six years ago. These two agencies reached a combined level of $\$ 86$ million in 1968-69. (Appendix $F$ shows the levels of Canada Council assistance over a six year period, with corresponding totals for the NRC and MRC).
32. Social scientists and humanists, long starved for research funds, are responding to the support offered by the Canada Council, as will be seen below. In the vital field of research training (Doctoral Fellowships), once the gap with the physical and life sciences has been closed, the Council's support should rise evenly in relation to the growth in graduate enrolment.
33.

Most Canada Council suppert to the social sciences and humanities goes to assist doctoral candidates through the final stages of their training as researchers and to provide direct support to free research by established scholars. The Council also assists research communication through grants for the publication of journals and scholarly works, for the holding of and attendance at scholarly conferences and for exchanges. To a limited extent the Council helps build up research facilities through grants for specialized library collections. All of these programmes are designed to increase Canada's research potential in the human sciences and, seen from another side, to create conditions whereby Canadian universities will be able to attract and hold scholars of the first order.
34. Attached as appendices are tables answering some often-asked questions about the distribution of Canada Council programmes of assistance. They are:

Appendix G -- Amounts awarded in 1968-69 classified by academic discipline; Appendix H --

Table 1.1 Doctoral Fellowships by province of permanent residence;
Table 1.2 Doctoral Fellowships by country of intended tenure and by university of intended tenure in Canada;

Table 1.3 Doctoral Fellowships by discipline;
Table 2 Post-doctoral Fellowships by discipline;
Table 3.1 Leave Fellowships by university of affiliation;
Table 3.2 Leave Fellowships by discipline;
Table 4.1 Research Grants by university of affiliation;
Table 4.2 Research Grants by discipline;
Table 5 Library Research Collection Grants by university.

## Programme Review and Revision

35. Means are now being developed of involving academic advisers more closely in assessing the results of Council-supported activity. This should lead to the involvement of scholars and their learned societies in field surveys of major research projects backed by the Council. They should also be involved in assessing the overall pattern of Councilsupported activity in specific areas, identifying any weakness that may be found and suggesting ways of redressing any imbalance. The Council expects to undertake pilot projects of this kind during the current year.
36. The Council has also developed its internal system of administration and record-keeping to keep pace with the rapid expansion of the academic programme. A complete overhaul of administrative methods was begun two years ago, with the assistance of the management-consultant firm UrwickCurrie. One result of this is that it is now possible to make a more analytical review of Council-supported activity, a necessary forerunner to the programme assessment and evaluation process outlined above.

## Developing Tools for More Effective Performance

37. Apart from the vexed question of financial resources, common
to all grant-giving bodies, the Council has had to face the problems attendant on entering a vast, previously unknown area of public subsidy.
38. The Dominion Bureau of Statistics provides virtually no information on research expenditures in the social sciences and humanities, which it does for natural sciences, and there are many other gaps in the statistical information provided by the Sureau on academic enrolment and facilities. 39. The Council cannot forecast its future needs until it has full information on the support coming from other sources, public and private, domestic and foreign, for both contractual and free research. At the moment
there is no stipend for the principal investigator attached to grants for free research, while there are stipends in contractual research and in grants from United States sources for free research. The Council must have full information on such stipends and other factors. It must know what its grants are competing with if it is to make free research attractive to Canadian scholars. The Council, in partnership with the A.U.C.C. and the C.A.U.T., was about to launch a survey on this question in 1966-67 when it joined forces with the Science Council of Canada in a broader review of the funding of university research conducted under the direction of Dr. Macdonald, former President of the University of British Columbia. Since the survey, now completed, did not in fact provide the necessary information the Council must now look for some other solution.
39. Along with the build-up of information needed to administer its programmes, the Council has had to be increasingly concerned with its retrieval. For example, the Council has always relied heavily on the opinions of scholarly assessors for research grants, as will be seen below. As more applications.come in and more assessors are added to an already extensive list, matching the two becomes a more complex and timeconsuming process. The Council has undertaken a study of a computer service to assist in this and other things. It will help in extending the list of assessors and in matching them more exactly with projects under consideration.
40. The Council is now faced with the need for an inventory of research in the social sciences and humanities. For obvious reasons, this must include all Canadian research activity in these disciplines,
as well as that supported by the Council, and will require a computer service. It is a necessary step in the process of programme review and revision described above.
41. The Council recognizes the large role to be played by the learned societies in the growth of research in the social sciences and humanities. They have received and are receiving Council assistance to help them perform more effectively, as described later in the brief under "Research Communication". It will nonetheless be some time before they can give the leadership expected from them, particularly in helping assess the Council's programme of assistance.

## Research Training

43. Well over half of Council support to the social sciences and humanities goes to assist doctoral candidates through the final stage of their training for a career of research and teaching. (Complete figures are in Appendix F). In $1968-69, \$ 9.3$ million was spent to award 2,155 Doctoral Fellowships, and an estimated $\$ 11.2$ million will be spent in the current year for 2,640 awards. Aimed at Canadians and landed immigrants to Canada enrolled in universities here and abroad, the programme of Doctoral Fellowships has developed in response to both an increased proportional demand from the doctoral candidates and an explosion in their numbers. For example, in 1970-71 there are expected to be 6,480 students eligible for Canada Council assistance. The corresponding enrolment figure in the physical and life sciences is expected to be 6,100 . (Appendix I shows past and projected growth of the "universe" of doctoral candidates in relation to Council assistance).
44. The dramatic increase in Doctoral Fellowship applications shown in Appendix $I$ can be attributed in part to new rates of support adopted in 1967-68; $\$ 3,500$ as the basic grant, rising to $\$ 4,500$ in the concluding stages of doctoral studies and with an added $\$ 1,000$ at each stage for those who had given up the security of regular employment to re-enter graduate studies. The higher rates and extended tenure make the Council's Fellowships competitive with the more attractive foreign programmes, which used to attract so many of the best Canadian students. The rates were adopted to help correct a situation in which, at last count, only $38 \%$ of social sciences and humanities teaching staff in Canadian universities held doctoral degrees, compared to $57 \%$ in the natural sciences. (A factor is that on the average it takes two years.longer for students in the former disciplines to complete their doctoral programmes). As mentioned above, provision is made in the rates to keep those who have completed residence requirements working at their theses, and to bring back to their doctoral work those who have set it aside for teaching or research posts. The Council was a year ahead of American foundations in adopting this policy. 45. The Canada Council has always extended its Doctoral Fellowships to Canadians who choose to complete their studies either abroad or in this country. The theory that this would maintain their ties to this country has been confirmed by a Council study (a summary is attached as Appendix J) which shows an average repatriation rate of $80 \%$ for those who did in fact choose to study at a foreign university. The fear that this policy of the Council might slow down the growth of graduate studies in Canada has proven groundless.
45. There has also been a sharp upward turn in the numbers electing to do their doctoral work in Canada. Among those awarded Fellowships this year, 1,006 intend to study in Canadian universities, $46.7 \%$ of the total. Three years ago there were 329 , or $29.8 \%$. Among those receiving a Fellowship for the first time this year (as opposed to a renewal), the percentage choosing to study in Canada is $50.2 \%$.
46. Behind these figures is the phenomenal growth of Canadian graduate schools in the social sciences and humanities, now training 16,000 full-time students, and expected to have an enrolment of 31,000 by 1973-74. Research Work
47. Aid to established scholars is expected to rise from last year's $\$ 4.2$ million to an estimated $\$ 5.4$ million during 1969-70. Three-quarters of this amount will be given in Research Grants to support the investigations of an estimated 1,030 social scientists and humanists; and 170 scholars will be awarded Leave Fellowships to assist them to free themselves for a year of research or study.

49 The number of career scholars who received Council assistance in 1968-69 represented $9.5 \%$ of the 10,470 social scientists and humanists on the faculties of Canadian universities, while requests for assistance during the year came from $12.1 \%$ of the universe. This year requests for assistance are expected from $13.5 \%$ of the universe, and awards should reach $10 \%$, pointing out the need for this programme to keep its momentum in pace with the growing research activity in the social sciences and humanities in Canada.
50. Under the programme of Izaak Walton Killam Awards, administered by the Council on behalf of the Killam Scholarship Committee, a total of $\$ 680,000$ is budgeted this year for awards to scholars of exceptional ability engaged in research of far-reaching significance, either in the social sciences or humanities. This programme is made possible by a $\$ 17$ million bequest of the late Dorothy J. Killam (Mrs. Izaak Walton Killam).
51. With the growth of the research grants programme the Council has shown more and more concern with the processes of adjudication, and especially with the sources and quality of the informed opinion available. Judgment rests upon not only a final review by an academic panel, broadly representative of the social sciences and humanities, but also upon prior detailed assessment by specialists. (The process is shown in Chart 1 of Appendix C). Leading scholars abroad are sought for advice almost as much as experts at home, to help keep the Council's programme of assistance in line with the international standards of scholarship. A welcome by-product of the system is that the comments of an assessor are often passed on to the applicant and prove useful to him in organizing his research plan.

## Research Communication

52. Canada Council support to research communication in the social sciences and humanities goes to individual scholars, to universities and to learned societies. Among present forms of aid are:
-- grants both for the large annual meetings of learned societies and for ad hoc meetings of specialists in key research areas where effective national or international coordination can be achieved;
-- grants to assist Canadian universities to bring in outstanding specialists as visiting scholars;
-- grants to enable Canadian scholars to take part in international learned conferences devoted to the discussion of current research;
-- block grants to the Social Science and Humanities Research Councils to assist publication of research works by Canadian scholars;
-- grants to enable learned societies to launch and maintain specialized journals of international caliber.
53. A recently completed study, backed by the Council, dealt with the feasibility of a common secretariat for the learned societies. In addition, discussions have been initiated with representatives of the Social Science and Humanities Research Councils of Canada and of the associations representing the various disciplines, to redefine their relation to the development of research in the light of the rapid growth of the Canadian academic community.

## Research Facilities

54. While the shortage of library resources is perhaps the most urgent problem of Canadian researchers it is becoming evident that they are also hampered by the inadequacy of other research tools and services as well. Increasingly the Council is drawn towards the support of such things as research inventories, data banking systems and survey research facilities. First steps in this direction have been taken during the past year through grants to the Social Science Research Council of Canada, several learned societies and individual scholars for studies of the research facilities available and the needs to be met.
55. The Council is very conscious of the need to build up library research collections. A Council-supported survey conducted by the AUCC recommends that present university collections be at least doubled. It is estimated that this would cost $\$ 100$ million for acquisitions alone, over the current level of purchases. To house and staff these expanded collections would require further expenditures of roughly $\$ 300$ million.
56. The Canada Council can play only a limited role in meeting this total requirement. The level of our aid in 1967-68 and 1968-69 has been limited to $\$ 1$ million a year for purchases of library research resources for the use of departments in the social sciences and humanities where there is an active programme of advanced research, including graduate studies. Although our budget for 1969-70 shows only $\$ 65,000$ for this programme, the Council will be able to maintain its level of aid at \$1 million a year. This is made possible by a budget accounting procedure.
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Mr. Jean Martineau, Q.C. (Montreal): Chairman of the Canada Council. Born in Montreal, 1895; son of the late Hon. P.G. Martineau. Education: St. Hyacinthe Seminary, St. Jean College and St. Laurent College; LL.L. University of Montreal; Hon. LL.D. Faculty of Law of the University of Montreal. Hon. LL.D. Faculty of Law of Laval University. Called to the Bar of the Province of Quebec in July 1919; Queen's Counsel in October, 1929. Batonnier of the Bar of Montreal and the Bar of the Province of Quebec, 1953-54. Senior partner in the law firm of Martineau, Walker, Allison, Beaulieu, Tetley and Phelan. Director of the Royal Trust Company, Monsanto Canada Limited, Chateau-Gai Wines Limited and a director of the Montreal Museum of Fine Arts. Appointed Chairman of the Canada Council in 1964.

Dr. John Francis Leddy (Windsor): Vice-Chairman of the Canada Council. President and Vice-Chancellor of the University of Windsor. Born in 1911 in Ottawa, but moved to Saskatoon at an early age. B.A. and M.A., University of Saskatchewan, post-graduate studies in classics at the University of Chicago, Rhodes Scholar at Exeter College, Oxford, (B.Litt. and D.Phil.). Joined the Department of Classics, University of Saskatchewan, in 1936, became head of the Department in 1946, dean of Arts and Science in 1949, and vice-president (academic) in 1961. Appointed president of the University of Windsor in 1964. Has held positions of leadership in a wide variety of public and educational societies in Canada, including chairmanship of the Educational Council of Saskatchewan, the Humanities Research Council of Canada, the Canadian Catholic Historical Association, the Canadian National Commission for UNESCO, Canadian University Service Overseas, World University Service of Canada. Is currently international vicepresident of World University Service. Has travelled widely around the world and has been delegated to many international conferences and meetings. Author of a large number of special articles in the fields of university education, the ancient classics, and the history of ideas. Has received many honors, including honorary degrees from several universities, the Human Relations Award of the Canadian Council of Christians and Jews; the Cardinal Newman Award of the Canadian Federation of Newman Clubs, and several papal awards.

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Professor Murray Adaskin (Saskatoon): Composer-in-Residence and Professor of Music at the University of Saskatchewan. Born in Toronto in 1906. Educated in Toronto. Studied violin in Toronto with Kathleen Parlow and in Paris with the late Marcel Chaillay. Studied composition with Canadian composer John Weinzweig, French composer Darius Milhaud and Charles Jones. After working with the Canadian Broadcasting Corporation, was appointed head of the Department of Music, Saskatoon Campus, in 1952. In November 1966, relinquished this post to be appointed composer-inresidence, one of the first appointments of its kind in a Canadian University. Has been guest speaker on several occasions and has adjudicated national composition contests. Organized and directed the first Composer-Exhibition Series in Saskatoon (1967). Is a charter member of the Canadian League of Composers, a member of the Canadian Association of Publishers, Authors, and Composers, and a member of the Saskatoon Art Centre Board. Has composed over 30 major works. His compositions have been performed and broadcast in many countries, and several of them have been recorded commercially.

Rev. Jean Adrien Arsenault (Charlottetown): Assistant Professor of French and fine arts at St. Dunstan's University, Charlottetown. Born June 23, 1925, at Mount Carme1, P.E.I. Attended public schools in P.E.I. and later Le Petit Séminaire de Québec where, in 1947, he obtained a B.A. (Laval). Studied theology at Holy Heart Seminary, Halifax, and philosophy at the Sorbonne on a French government scholarship. M.A. in Drama, Catholic University of America, Washington, D.C. Studied painting at the School of Fine Arts, Quebec City. Active in dramatics as a director and playwright.

Mr. Alex Colville (Sackville, N.B.): Artist. Born in Toronto in 1920. Educated in Nova Scotia. Studied fine arts at Mount Allison University. Taught at Mount Allison University from 1946 to 1960. An artist of international repute, his work is represented in the majority of Canadian

public collections, in the Museum of Modern Art, New York, and in many private collections in Canada and in the United States. As official war artist, he painted for the Army and Navy in the Mediterranean and in northern Europe. He is the designer of the Wild Life Series of special coins issued for the Centennial year.

Dr. J.A. Corry (Montreal): Political scientist, formerly principal of Queen's University. Born in Millbank, Ontario, in 1899. Graduated in law from the University of Saskatchewan and was a Rhodes Scholar from Saskatchewan at Oxford University. He was called to the Bar of Saskatchewan in 1930. Formerly a Professor of Law at Saskatchewan University and a former Hardy Professor of Political Science at Queen's University. Was vice-principal of Queen's University from 1951 to 1961, then principal until 1968. Is now on the staff of the Law faculty of McGill University. He is well known throughout the English-speaking world for his text-book DEMOCRATIC GOVERNMENT AND POLITICS (1946), and is the author of several other books: ELEMENTS OF DEMOCRATIC GOVERNMENT (1947) ; LAW AND POLICY (1959); and THE CHANGING CONDITIONS OF POLITICS (1963). From time to time he has been called upon to advise the federal government on Federal-Provincial relations and he was a contributor to the Rowell-Sirois commission. He has been member and chairman of the Social Science Research Council of Canada, and member of the C.B.C. Board of Governors. In 1957, he was mainly responsible for the launching of the Queen's Faculty of Law, and he was its acting dean for the first year. Has received honorary degrees from a number of universities and was named Companion to the Order of Canada in 1968.

Miss Andrée Desautels (Montreal): Musicologist, professor at the Montreal Conservatory. Studied piano, composition and music writing at the Quebec Conservatory of Music and art history at the University of Montreal. Was editor-in-chief of the Journal Musical Canadien for seven years and is well-known as a music critic with Montreal newspapers and on the CBC. Has been professor of music history and musicology at the Montreal Conservatory since 1949. As Assistant Commissioner of the Man and Music Pavilion at Expo '67, was responsible for much of the planning and organization of its program in co-operation with Les Jeunesses Musicales. Author of several publications on Canadian Music. Was founder and first chairman of the Association of Conservatory Professors of Quebec.

Mr. Louis A. Desrochers (Edmonton): Barrister. Born in Montreal in 1928, moved to Jasper, Alberta, at the age of 11. B.A. degree from the University of Ottawa. Received LL.B. from University of Alberta in 1953, and was called to Alberta Bar in the same year. Since then, has been director of CHRA radio station, Treasurer, Vice-President and President of the French Canadian Association of Alberta, Director and President of the Edmonton Family Service Bureau; member of the Board of Directors of Community Chest of Edmonton; member of the Northwest Territories Council; co-trustee of the Northwest Territories Flood Relief Fund; Member of the Advisory Board and Vice-Chairman of the Governing Board of the Misericordia Hospital; Provincial Treasurer of the Canadian Conference on Children. He is currently vice-chairman of the Board of Governors of the University of Alberta and Director of L'AssuranceVie Desjardins.
Mrs. Miriam Barber Dorrance (Vancouver): Born in West Templeton, P.Q., in 1894. Graduated from the Faculty of Dentistry, University of Toronto, with the degree of D.D.S. in 1921. Practiced dentistry in Lethbridge for $3 \frac{1}{2}$ years and has lived in British Columbia since 1929. A member of the Advisory Board of the Women's Committee to the Vancowser Symphony Society and Honorary Treasurer and member of the Board of Shaughnessy Hospital Auxiliary, she has been active for many years in the Community Chest, Canadian Girl Guides, Canadian Red Cross, and the University Women's Club of Vancouver. She is the wife of Dr. Wallace J. Dorrance.

Dr. Henry D. Hicks (Halifax): President of Dalhousie University. Born in Bridgetown, N.S., 1915. Educated at Mount Allison University and Dalhousie University. Rhodes Scholar to Oxford University, England. Called to the Bar of Nova Scotia in 1941. Served in the Royal Canadian Artillery during World War II, and in 1945, was elected to the Legislature of Nova Scotia. Appointed Minister of Education in 1949, and later assumed the additional post of Provincial Secretary. Became Premier of Nova Scotia in September, 1954. Leader of the Opposition from 1956 until he resigned as Leader of the Liberal Party in Nova Scotia in 1960. Dean of Arts and Science at Dalhousie University in 1960. Vice-President of the university in 1961 and President in 1963. Has received honorary degrees from several Canadian universities. Appointed to Canada Council in 1963. Served as President of the Canadian National Commission for Unasco (1963-1967), and lead the Canadian delegation to the General Conference of Unesco in 1964 and 1966.

Mr. Stuart Keate (Vancouver): Journalist, publisher of the Vancouver Sun. Born in Vancouver in 1913. Began newspaper work on the Ubyssey, campus newspaper at the University of British Columbia, and on graduation in 1935 joined the staff of the Vancouver Daily Province as a sports writer.

From 1935 to 1942, worked for the Province and the Toronto Daily Star as a reporter, columnist and movie critic. In the fall of 1942, joined the RCNVR in the information department, and saw service on ships in both the Atlantic and Pacific theatres, retiring with the rank of lieutenant-commander.

At the end of the war, joined Time Inc. in New York as a writer on Canadian affairs. From 1947 to 1950 , served as Montreal bureau chief for Time and Life, resigning in 1950 to return to the Pacific Coast as publisher of the Victoria Daily Times.

In 1959, when the Max Bell papers joined with the Siftons to form the FP Publications group, Mr. Keate was named a director of the parent company.

In May, 1964, he was appointed publisher of the Vancouver Sun, Canada's second largest daily, and named director of Sun Publishing Co. Ltd. and Pacific Press Limited.

In the course of his career, he has served as president of the Canadian Daily Newspaper Publishers Association, President of The Canadian Press (1965-66) and as a member of the Senate and Board of Governors of the University of British Columbia. He has contributed articles to Maclean's, Saturday Night, the Reader's Digest, N.Y. Times Book review, and many other national publications and has received the National Press Club award for outstanding contributions to journalism. He has also been active in the affairs of the International Press Institute and InterAmerican Press Association.

Mr. Napoléon LeBlanc (Quebec City): Vice-rector of Laval Iniversity since 1968. Was educated at Laval University, where he received the degrees of Bachelor in Agroromy and Master of Social Sciences. Travelled in Canada and in the U.S. on a Carnegie fellowship in 1953 to study the contribution of the universities to adult education. Professor in the Faculty of Social Sciences of Laval University, 1960, dean of the Faculty in 1961, and vice-rector of the University in 1968. Has been active in the field of adult education and was for six years co-director of the bilingual camp on adult education and intercultural relations held anhually at Láquemac.. Has written many papers on adult and labour education. A former president of the National University - Labour Education Commitee, the Cormission on Public Iibraries of Quebec, L'Institut Canadien d'Fducation des Adultes, the Catholic Comnitee of the Quebec Superior Council on Education, World University Service of Canada and L'Association Canadienne-Française pour I'Avancement des Sciences. Currently president of the Canadian Commission for Unesco.

Mr. Douglas V. LePan (Toronto): Principal of University College, University of Toronto, since 1964. Born in Toronto in 1914. Educated at the University of Toronto and Oxford. University. Served in the Second World War and was education adviser to General A.G. NeNaughton in 1942-43. Has held a mumber of appointments in the Department of External Affairs, including those of Minister Counsellor in Washington (1951-55) and Assistant Under-Secretary of State for External Affairs (1958-59). Was seconded in 1955-58 to serve as Secretary and Director of Research of the Royal Commission on Canada's Zconomic prospect (Gordon Comnission). From 1.959 to 1.964, was Professor of English Literature at Queen's University。A well-known writer, he has twice won a Governor General's iiterary Award, in 1953 for poetry in English and in 1964 for fiction in English.

Dr.Léon Lortie (Nontreal): Scientist and scholar, former secretary general of the University of Montreal. Born in Montreal in 1902. Educated at the University of Montreal, University of Paris (Docteur ès sciences physiques) and Cornell University. Professor of chemistry at the University of Montreal for many years, at the same time teaching chemistry, physics and scientific history in various Kontreil colleges.

Visiting lecturer for three years at McGill University. Appointed director of extension courses at the Universitr of Montreal in 1952, assistant to the Rector and secretary general of the Unjversity in 1962. Was a pioneer in the popular teaching of science and wrote many articles and papers on science subjects. Has also been active in public affairs and was the first Chairman of the Canadian Institute of Public Affairs. Former President of the Chemical Institute of Canada, the Association canadienne-française pour l'Avercement des Sciences and of a number of other organizations. Has been awarded honorary degrees by several universities. Actively interested in literature and the arts. President of the Greater Montreal Council of the Arts since 2957.

Dr. C.J. Mackenzie (Ottawa): Former President of the National Research Council and of Atomic Energy of Canada Ltd. Born in St. Stephen, N. B. , in 1888. A graduate of Dalhousie University and Harvard. Overseas service 1916-18 with C.E.F., awarded Military Cross. Returned to University of Saskatchewan in 1918 as Professor of Civil Engineering. In 1921, appointed Dean of the Engineering College at Saskatoon. Appointed to the Advisory Council of the National Research Council in 1935, made Acting President in 1939 and President in 1944. Resigned in 1952 to become President of the newly formed Atomic Fnergy of Canada Ltd. Retired in 1953. Has held many public offices and has received honorary degrees from many universities. Is currently Chancellor of Carleton University and a member of the Advisory Coucil, National Research Council. In May 1968, received the $\$ 50,000$ Royal Bank Award for outstanding contributions to "human welfare and common good". Often called "the dean of Canada's scientists".

Mr. Go Byron March (St. John's, Nfld.): Educator. Born in Old Perlican, Nfld. , in 1921. A graduate of Memorial University, Acadia, and Columbia University, New York (M.A. in Educational administration)。 VicePrincipal, then Principal of Curtis Academy in St. Johns, and later Principal of Prince of Wales Collegiate. Since 1963, has been Director of Education of St. John's United Church School Board. Has Been àsti tive in the educational life of Newfoundland, serving as an executive
of the Newfoundland Teacher's Association and as a member of the Royal Commission on Education and Youth.

Mrs. Pauline Kills McGibbon (Toronto): Born in Sarnia, Ontario. A graduate of the University of Toronto. Married to Donald N. McGibbon. Has been active in community affairs, education and the arts, serving on the executive boards of many organizations. Has been President of the University of Toronto Alumni Association, President of the Dominion Drama Festival, first President of the Children's Film Library of Canada and Vice-President of the Canadian Association for Adult Education. Is currently chairman of the Board of Governors of the National Theatre School of Canada, first vice-president of the Canadian Conference of the Arts, first vice-president of the board of governors of the Women's College Hospital, Toronto, and a member on the Board of Governor of the Elliott Lake Centre for Continuing Education. Has received several honours including the Canadian Drama Award for Outstanding Services to Theatre (1957), the Medal of Service of the Order of Canada (1967) and an Honorary LL.D. from the University of Alberta (1967) in recognition of the contribution of Canadian women to Canada in recert years.

Miss Kathleen M. Richardson (Winnipeg): Born in Winnipeg, Manitoba. Has been actively associated with a number of cultural organizations in Winnipeg, both musical and theatrical, and is widely known for her work with the Royal Winnipeg Ballet, having served as its President for four years. In recognition of her services with this Organization, she has been named its honorary president.

She has also been Secretary of the University Chamber Music Society; Board Member of the Junior League of Winnipeg; Chairman of the Royal Winnipeg Ballet School and has served on the Board of the Winnipeg Symphony Orchestra. She is a member of the National Executive Council of Pan-American Games and a director of James Zichardson and Sons Ltd。

Dr. Aileen D. Ross (Montreal): Sociologist, professor at McGill University. Born in Montreal in 1902. Educated at the University of London (B.Sc.) and at the University of Chicago (M.A. and Ph.D.) . Curriculum advisor at MacDonald College, P.Q., from 1940 to 1942. After serving for three years as instructor in the Department of Economics and Political Science at the University of Toronto, joined the staff of McGill University in 1945 and is now full professor in the Department of Sociology and Anthropology. Has held executive positions in such organizations as the Canadian Institute 'of International Affairs and the Canadian Citizenship Council, and served on the Canadian Delegation to the 1958 Unesco Conference. Has published many articles and papers in learned journals and is the author of two books: The Hindu Family in its Urban Setting, and Becoming a Nurse. She is currently president of the Shastri-Indo-Canadian Institute.

Dr. David W. Slater (Kingston): Professor of Economics and Dean of the School of Graduate Studies, Queen's University. Born in Winnipeg in 1921. Educated at the University of Manitoba (B. Comm.), Queen's University (B.A., Honours in Economics) and the University of Chicago (M.A. and Ph.D.). Served in the Canadian Army in World War II. After lecturing at Queen's University and Stanford University, joined the staff of Queen's University in 1952 and was promoted to professor of economics in 1962. Has been Dean of the School of Graduate Studies since June 1968. Served on the staff of the Royal Commission on Canada's Economic Prospects (Gordon Commission), in 1955-56. Has published many articles on economics and has served on committees studying education, economics, university affairs and the social sciences. Is currently a member of the Committee of University Affairs and editor of the Canadian Banker's Magazine.

Dr. Edmund Berry,
Department of Classics,
University of Manitoba,
Winnipeg, Manitoba.
Professor David Braybrooke, Department of Philosophy \& Politics, Dalhousie. University,
Halifax, Nova Scotia.
Dr. Jacques Brazeau, (Chairman)
Département de socjologie,
Université de Montréal,
Montréal, Québec.
Professeur Paul André Comeau,
Département des Sciences politiques,
Faculté des Sciences sociales,
Université d'Ottawa,
Ottawa 2, Ontario.
Professeur Vianney Décarie,
Département de philosophie,
Université de Montréal,
Montréal, Québec.
Professor E.J.H. Greene, (Vice Chairman)
Associate Dean of Arts,
University of Alberta,
Edmonton, Alberta.
Professor J.E. Hodgetts,
Principal,
Victoria College,
Toronto 5, Ontario.
Professeur W.F. Mackey,
Département de linguistique,
Faculté des lettres,
Universit:é Laval,
Québec 10e, Québec.

Révérend Père Bernard Mailhiot, O.P.,
Institut de psychologie, $\quad \begin{aligned} & \text { a } \\ & \text { In }\end{aligned}$
Université de Montréal,
Montréal, Québec.
Professor A.M. Moore,
Department of Economics,
University of British Columbia,
Vancouver 8, B.C.

12 Allan Place,
Ottawa 1, Ontario.
Dr. W.C. Desmond Pacey,
Dean of Graduate Studies,
University of New Brunswick,
Fredericton, N.B.
Professor A.E. Safarian,
Department of Political Economy,
University of Toronto,
Toronto 5, Ontario.
Monsieur Marcel Trudel, $\quad$, $\quad$ ?
Département d'histoire,
Université d'Ottawa,
Ottawa 2, Ontario.

Professor F.G. Vallee,
Chairman,
Department of Sociology,
Carleton University,
Ottawa, Ontario.

Appendix C, Chart 1. Procedure for the awarding of research grants in the social sciences and the humanities. *

| Applicant | Social Sciences <br> $\begin{array}{l}\text { and Humanities } \\ \text { Division }\end{array}$ | Assessors | Social Sciences <br> and Humanities <br> Division | $\begin{aligned} & \text { Academic } \\ & \hline \text { Panel } \\ & \hline \end{aligned}$ | $\frac{\text { Canada }}{\text { Council }}$ | Social Sciences and Humanities Division |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Sends in application Cescribing his project in detail. | Examines each application for eligibility and completeness, and selects specialists in the field to asséss it. (The number of assessors varies from 2 to 8 depending on the size and nature of the project). | Evalute each application as to its merits and to the qualifications of the applicant (commenting if appropriate on the budget submitted by the applicant), and submit recommendation. | Analyses assessors' comments and recommendations, and prepares submission to the Academic Panel. <br> Approves grants of $\$ 5,000$ or less. | Examines each submission and prepares recommendations to the Canada Council. <br> Approves grants of $\$ 10,000$ or less. | Makes final decision on the basis of Academic Panel's recommendations. | Announces decision to candidates and arranges for payment and administration of grants. Receives and analyses interim and final reports on research projects and takes note of matters that may have imp?i cations for future Canada Council policy. |

Appendix C, Chart 2 - Adjudication process for doctoral, leave and post-doctoral fellowships in the social sciences and humanities.
Applicant
Sends in
application
and supporting
documents.
Awards Service
Applications in
each category
are screened
for eligibility,
grouped on the
basis of disci-
pline and
directed to the
appropriate
selection
committee.

$$
\begin{aligned}
& \text { Selection Comnittees } \\
& \text { (5 members each) } \\
& \text { Each committee assesses } \\
& \text { applications within } \\
& \text { its field and } \\
& \text { produces a list of } \\
& \text { candidates recommended } \\
& \text { for an award. }
\end{aligned}
$$

$\frac{\text { Academic Panel }}{\text { (18 members) }}$
Reviews recommenda-
tions of selection
committees and
approves final list
of successful candi-
dates. These
decisions are re-
ported to the Canada
Council at its first
subsequent meeting.

## Awards Service

Announces results of competition to candidates and makes arrangements for payment and administration of awards. Receives and analyses interim and final reports from fellowship holders.

Appendix D, Chart 1 - Cultural Exchange - Procedure for the awarding of fellowships to citizens of foreign countries.

| Applicant |
| :--- | :--- | :--- |
| Sends in <br> application to <br> ine appropriate <br> government <br> department of <br> his country or <br> to the Canadian <br> consulate or <br> embassy. |
| Selection Committee |
| (In each of the parti- |
| cipating countries made up |
| of representatives from the |
| universities, the government |
| and the Canadian embassy). |
| Makes a preliminary selection |
| of candidates, forwards the |
| iist to the Canadian embassy, |
| which forwards it to Ottawa. |$\quad$| Awards Service |
| :--- |
| Groups the |
| applications by |
| area of interest |
| and sends them to one |
| or other of the two |
| selection committees |
| (one for the social |
| sciences and |
| humanities and the |
| other for the |
| physical and life |
| sciences.) |

Selection Committees (Each made up of six Canadian scholars).

Study applications, select award-winners, and notify the and notify the
Council's Academic Council's Academic
Comittee of their decisions.

Awards Service
Arranges
payment and administration of fellowships and receives progress reports from the fellowshipholders.

Appendix D, Chart 2 - Cultural Exchange - Procedure for the awarding of grants for visiting lecturers.

| The interested |
| :--- |
| Canadian university |
| Asks for a grant to |
| bring a foreign scholar |
| to teach at one of its |
| faculties for a |
| specified period. |


| Awards Service |
| :--- |
| Receives the |
| requests, sees |
| that all the |
| necessary |
| information is |
| included and |
| forwards them |
| to the members |
| of the awards |
| committee. |

> | Awards Committee |
| :--- |
| Made up of five |
| Canadian scholars). |

Studies the requests and decides on the distribution of grants, keeping in mind the funds available and the need to assure balance between the various universities.
Reports its
decisions to the

## Awards Service

Announces the decisions to the universities requesting grants and to the invited scholars, and administers the grants.




3



Objecte and Powers of the Councrl.

## Objects exd

policre.
8. (1) The objects of the Council are to foster and promote the study and enjoyment of, and the production of works in, the arts, humanities and social sciences, and, in particular, but without limiting the gencrality of the foregoing, the Council may, in furtherance of its objects,
(a) assist, co-operate with and enlist the aid of organizations, the objects of which are similar to any of the objects of the Council;
(b) provide, through appropriate organizations or otherwise, for grants, scholarships or loans to persons in Canada for study or research in the arts, humanities or social sciences in Canada or elsewhere or to persons in other countries for study or research in such fields in Canada;
(c) make awards to persons in Canada for outstanding accomplishment in the arts, humanities or social sciences;
(d) arrange for and sponsor exhibitions, performaneos and publications of works in the arts, humanities or social sciences;
(c) exchange with other countries or organizations of persons therein knowledge and information respecting the arts, bumanities and social sciences; and
(f) arrange for representation and interpretation of Canadian arts, humanitics and social sciences in other countries.
(2) The Governor in Council may assign to the Council Council to such functions and duties in relation to the United Nationis $\begin{aligned} & \text { aet in } \\ & \text { relntion }\end{aligned}$ Educational, Scientific and Cultural Organization as he U.N.E.S..C.O. considers desirable.
D. The Council may, in furtherance of its objects, make Univeroity grants to universities and similar institutions of higher erants.
learning by way of capital assistance in respect of building construction projects.
110. The Council may make by-laws regulating its pro- By-laws. ceedings and generally for the conduct and management of its activities, including the appointment of honorary officers and of adviscry committees.
II. The Council shall meet at least three times a year Mcoting of in the City of Ottawa on steh days as are fixed by the Counnil. Council and at such other times and places as the Council deems necessary.
12. The Director and Associate Director and the Pention employees of the Council shall be deemed to be employed fund. in the Public Service for the purposes of the Public Service Superannuation Act, and the Council shall be deemed to be a Public Service Corporation for the purposes of section 23 of that Act.
18. The Council is not an agent of Her Majesty, and, Not prent of exeept as provided in section 12 , the members and employecs Her Nesosty. and the Jirector and Associate Director of the Council are not part of the public service.

SOCIAL SCIENCES AND HUMANITIES PROGRAMME


[^0]
## A DISTRIBUTION BY DISCIPLINE OF AMOUNTS AWARDED UNDER THE

 RESEARCH TRAINING AND RESEARCH WORK PROGRAMMES1968/69

| Discipline | ResearchTraining |  |  |  |  | Totals |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Doctoral Fellowships* | Postdoctoral Fellowships* | Leave Fellowships* | Research Grants | Killam <br> Awards |  |
|  | $-$ |  | dol | - |  |  |
| ANTHROPOLOGY | 263,135 | 8,000 | 37,059 | 163,969 | 79,000 | 551,163 |
| ARCHAEOLOGY | 56,078 | - | 7,412 | 43,286 | - | 106,776 |
| DEMOGRAPHY | 17,255 | - | - | 11,645 | - | 28,900 |
| ECONOMICS | 737,641 | 32,000 | 88,941 | 263,282 | 58,926 | 1,180,790 |
| FINE ARTS |  |  |  |  |  |  |
| Architecture | 21,569 | - | 7,412 | 9,836 | 12,000 | 50,817 |
| Art History | 77,646 | - | 14,824 | 49,161 | 12,00 | 141,631 |
| Music | 150,979 | 8,000 | 14,824 | 55,450 | - | 229,253 |
| GEOGRAPHY | 267,449 | 8,000 | 66,706 | 161,657 | - | 503,812 |
| HISTORY | 1,298,420 | 48,000 | 207,529 | 368,837 | - | 1,922,786 |
| INDUSTRIAL RELATIONS | 51,764 | - | - | - | - | 51,764 |
| LANGUAGE \& LITERATURE |  |  |  |  |  |  |
| Asian | 17,255 | -- | 7,412 | 40,844 | - | 65,511 |
| Classics | 202,743 | 32,000 | 22,235 | 45,759 | - | 302,737 |
| English | 1,371,753 | 32,000 | 244,588 | 222,923 | - | 1,871,264 |
| French | 655,681 | 8,000 | 81,529 | 91,736 | - | 836,946 |
| German | 172,548 | - | 14,824 | 21,905 | - | 209,277 |
| Italian | 25,882 | - | 7,412 | 11,300 | - | 44,594 |
| Slavic (Russian) | 77,646 | - | 7.412 | 24,859 | - | 102,505 |
| Spanish | 120,783 | - | 7,412 | 37,374 | - | 165,569 |
| LAW | 215,684 | - | 29,647 | 171,882 | - | 417,213 |
| LINGUISTICS | 297,645 | 24,000 | 22,235 | 212,986 | - | 556,866 |
| MATHEMATICS | 276,077 | - | 37,059 | 4,355 | - | 317,491 |
| PHILOSOPHY | 923,129 | 24,000 | 148,235 | 46,319 | - | 1,141,683 |
| POLITICAL SCIENCE | 772,150 | 16,000 | 66,706 | 209,289 | 208,572 | 1,272,717 |
| SOCIAL PSYCHOLOGY | 474,506 | 32,000 | 51,882 | 243,300 | - | 801,688 |

See notes on next page.


Notes: * An average value has been used for each fellowship.
** OTHER represents primarily grants of an interdisciplinary nature.
**\% For purpos'es of comparison with the total cost of this programme which is shown in Appendix F, an amount of $\$ 39,357$ should be added to cover administrative expenses.

Table 1.1
DOCTORAL FELLOWSHIPS BY PROVINCE

> OF PERMANENT RESIDENCE
> $1965 / 66-1968 / 69$ (Fiscal Year)


Notes: Fellowships are listed under the fiscal year in which applications and awards were made although they were held during the following academic year.

Figures on awards relate to those originally offered by the Canada Council and do not take into account awards subsequently declined and re-offered.

For $1965 / 66$ regional totals only are available for applications received from the Prairies and the Atlantic provinces.

Table 1.2
DOCTORAL FELLOWSHIPS BY COUNTRY OF INTENDED TENURE AND BY UNIVERSITY OF INTENDED TENURE FOR CANADA

1965/66 - 1968/69 (Fiscal Year)

| Intended Destination | 1965 | 1966/67 | 1967/68 | 1968/69 |
| :---: | :---: | :---: | :---: | :---: |
|  | number |  |  |  |
| CANADA: |  |  |  |  |
| BRITISH COLUMBIA |  |  |  |  |
| British Columbia | 14 | 20 | 50 | 108 |
| Simon Fraser |  | 1 | 4 | 11 |
| PRAIRIES |  |  |  |  |
| Alberta | 5 | 24 | 39 | 60 |
| Calgary | - | 5 | 6 | 22 |
| Manitoba | 3 | 4 | 7 | 10 |
| Saskatchewan | 1 | - | 4 | 2 |
| ONTARIO |  |  |  |  |
| Carleton | 1 | 3 | 6 | 4 |
| Guelph | - | - | 1 | 1 |
| McMaster | - | 1 | 16 | 23 |
| Ottawa | 3 | 9 | 21 | 28 |
| Queen's | 6 | 24 | 57 | 78 |
| Toronto | 56 | 130 | 231 | 348 |
| Water100 |  | 5 | 14 | 21 |
| Western Ontario | 6 | 17 | 38 | 46 |
| York | - | - | 6 | 13 |
| QUEEEC |  |  |  |  |
| Laval | 13 | 27 | - 27 | 35 |
| McGill | 10 | 25 | - 51 | 96 |
| Montreal | 9 | 29 | 42 | 84 |
| ATLANTIC |  |  |  |  |
| Dalhousie | - | - | $5$ |  |
| New Brunswick | - | 5 | (2) 6 | 3 |
| UNSPECIFIED | 1 | - | 4 | 8 |
| AT TIME OF APPLICAT |  |  |  |  |
| TOTAL, CANADA | $\underline{128}$ | $\underline{329}$ | $\underline{635}$ | 1006 |

See notes on next page.

Table 1.2 (Cont'd)

| Intended Destination | 1965/66 | 1966/67 | 1967/68 | 1968/69 |
| :---: | :---: | :---: | :---: | :---: |
|  |  | - | - |  |
|  |  |  |  |  |
| OUTSIDE CANADA: |  |  |  |  |
| UNITED STATES | 163 | 321 | 448 | 550 |
| UNITED KINGDOM | 70 | 163 | 251 | 317 |
| FRANCE | 51 | 97 | 163 | 201 |
| OTHER COUNTRIES | 17 | 39 | 57 | 64 |
| UNSPECIFIED | - | - | - | 17 |
| AT TIME OF APPLICATIO TOTAL, OUTSIDE CANADA | 301 | 620 | 919 | 1149 |
| Hf ac |  |  |  |  |
| GRAND TOTAL | 429 | 949 | 1554 | $\underline{2155}$ |

Notes: Fellowships are listed under the fiscal year in which awards were made although they were held during the following academic year.

Figures relate to the original awards offered bythe Canada Council and do not take into account awards subsequently declined and re-offered.

The intended destination shown here is the first choice given by a candidate at the time of his application. It may differ from the university or country actually attended.

Table 1.3
DOCTORAL FELIOWSHIPS BY DISCTPLINE
1965/66-1968/69 (Fiscal Year)


See notes on next page.

Ta. 土e 1.3 (Cont'd)


Notes: Fellowships are listed under the fiscal year in which applications and awards were made although they were held during the following academic year.

Figures on awards relate to those originally offered by the Canada Council and do not take into account awards subsequently declined and re-offered.

Table 2 POSTDOCTORAL FELLOWSHIPS BY DISCIPLINE

$$
1967 / 68-1968 / 69
$$

Discipline

| $\frac{2}{c} 1967 / 68$ |  | $1968 / 69$ |  |
| :---: | :---: | :---: | :---: |
| Applications | Awards | Applications | Awards |
| - | - | 2 | 1 |

ANTHROPOLOGY
ARCHAEOLOGY
DEMOGRAPHY
ECONOMTCS
4
4
10
4
FTNE ARTS

| Architecture | - | - | 1 | - |
| :--- | :--- | :--- | :--- | :--- |
| Art History | - | - | - | - |
| Music | - | 1 |  |  |

Music

- 1

GEOGRAPHY
HISTORY
4
2
7
INDUSTRIAL RELATIONS
LANGUAGE AND LITERATURE
Asian
Classics
English
French
German
Italian
Slavic (Russian)

Spanish

## LAW

LINGUISTICS
1
1
3
6
1
1
4
SOCIAL PSYCHOLOGY
1
SOCTOLOGY
TOTAL
$\underline{\underline{29}}$
$\underline{\underline{21}}$
66
35

[^1]Notes: The programme of postdoctoral fellowships was first introduced in 1967/68. The fellowships are listed under the fiscal year in which applications and awards were made.

The figures on awards relate to those originally offered by the Canada Council and do not take into account the rare cases where awards were declined by successful applicants and re-offered to others.

Table 3.1
LEAVE FELLOWSHIPS BY UNIVERSITY OF AFFILIATION
1965/66-1968/69 (Fiscal Year)

University of Affiliation

| 1965/66 | 1966/67 | 1967/68 | 1968/69 |
| :---: | :---: | :---: | :---: |
| Applica- Awards tions | Applications | Applica- Awards tions | Applica- Awards <br> tions |

BRITISH COLUMBIA

| British Columbia | 13 | 9 | 24 | 19 | 34 | 25 | 35 | 25 |
| :--- | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: |
| Simon Fraser | - | - | 3 | 3 | 5 | 3 | 6 | 3 |
| Victoria | 4 | 2 | 1 | 1 | 6 | 4 | 12 | 5 |

PRAIRIES
Alberta

| 5 | 1 | 4 | 3 | 9 | 5 | 17 | 10 |
| ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: |
| - | - | 4 | 4 | 9 | 4 | 11 | 4 |
| - | - | - | - | - | - | 1 | 1 |
| 4 | - | 3 | 1 | 7 | 4 | 7 | 4 |
| - | - | 1 | 1 | - | - | - | - |
| 3 | 2 | 3 | 2 | 5 | 3 | 7 | 3 |
| - | - | - | - | - | - | 2 | 1 |

ONTARIO
Brock
Carleton
Guelph
Lakehead
Laurentian
McMaster
Ottawa
Saint Paul
Queen's
Royal Military College
Toronto
St. Michael's
Trinity
Victoria
Trent
Waterloo
Waterloo Lutheran
Western Ontario
Huron
Windsor
York

| - | - | - | - | - | 1 | 1 |  |
| ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: |
| 7 | 3 | 9 | 9 | 3 | 1 | 14 | 9 |
| - | - | - | - | - | - | 1 | - |
| - | - | - | - | - | - | 1 | - |
| - | - | - | - | 1 | 1 | - |  |
| 6 | 1 | 5 | 2 | 6 | 5 | 6 | 2 |
| 2 | - | 6 | 4 | 6 | 3 | 5 | 4 |
| - | - | 1 | - | - | - | - | - |
| 1 | 1 | 5 | 3 | 4 | 3 | 8 | 6 |
| 1 | 1 | 2 | 2 | 4 | 3 | - | - |
| 13 | 8 | 17 | 12 | 18 | 14 | 35 | 24 |
| 1 | 1 | 1 | 1 | - | - | 1 | 1 |
| - | - | 1 | 1 | 1 | 1 | - | - |
| - | - | 2 | 1 | - | - | 2 | 1 |
| - | - | - | - | 1 | 1 | - | - |
| 4 | 1 | 3 | 2 | 4 | 2 | 9 | 3 |
| 1 | - | - | - | - | - | 1 | 1 |
| 5 | 2 | 5 | 2 | 14 | 9 | 13 | 10 |
| - | - | 1 | - | - | - | - | - |
| - | - | 4 | 3 | 5 | 5 | 5 | 3 |
| 2 | 1 | 3 | 3 | 7 | 7 | 11 | 5 |


| - | - | - | - | - | - | 1 | 1 |
| ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: |
| 7 | 3 | 9 | 9 | 3 | 1 | 14 | 9 |
| - | - | - | - | - | - | 1 | - |
| - | - | - | - | - | - | 1 | - |
| - | - | - | - | 1 | 1 | 1 | - |
| 6 | 1 | 5 | 2 | 6 | 5 | 6 | 2 |
| 2 | - | 6 | 4 | 6 | 3 | 5 | 4 |
| - | - | 1 | - | - | - | - | - |
| 1 | 1 | 5 | 3 | 4 | 3 | 8 | 6 |
| 1 | 1 | 2 | 2 | 4 | 3 | - | - |
| 13 | 8 | 17 | 12 | 18 | 14 | 35 | 24 |
| 1 | 1 | 1 | 1 | - | - | 1 | 1 |
| - | - | 1 | 1 | 1 | 1 | - | - |
| - | - | 2 | 1 | - | - | 2 | 1 |
| - | - | - | - | 1 | 1 | - | - |
| 4 | 1 | 3 | 2 | 4 | 2 | 9 | 3 |
| 1 | - | - | - | - | - | 1 | 1 |
| 5 | 2 | 5 | 2 | 14 | 9 | 13 | 10 |
| - | - | 1 | - | - | - | - | - |
| - | - | 4 | 3 | 5 | 5 | 5 | 3 |
| 2 | 1 | 3 | 3 | 7 | 7 | 11 | 5 |


| - | - | - | - | - | - | 1 | 1 |
| ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: |
| 7 | 3 | 9 | 9 | 3 | 1 | 14 | 9 |
| - | - | - | - | - | - | 1 | - |
| - | - | - | - | - | - | 1 | - |
| - | - | - | - | 1 | 1 | 1 | - |
| 6 | 1 | 5 | 2 | 6 | 5 | 6 | 2 |
| 2 | - | 6 | 4 | 6 | 3 | 5 | 4 |
| - | - | 1 | - | - | - | - | - |
| 1 | 1 | 5 | 3 | 4 | 3 | 8 | 6 |
| 1 | 1 | 2 | 2 | 4 | 3 | - | - |
| 13 | 8 | 17 | 12 | 18 | 14 | 35 | 24 |
| 1 | 1 | 1 | 1 | - | - | 1 | 1 |
| - | - | 1 | 1 | 1 | 1 | - | - |
| - | - | 2 | 1 | - | - | 2 | 1 |
| - | - | - | - | 1 | 1 | - | - |
| 4 | 1 | 3 | 2 | 4 | 2 | 9 | 3 |
| 1 | - | - | - | - | - | 1 | 1 |
| 5 | 2 | 5 | 2 | 14 | 9 | 13 | 10 |
| - | - | 1 | - | - | - | - | - |
| - | - | 4 | 3 | 5 | 5 | 5 | 3 |
| 2 | 1 | 3 | 3 | 7 | 7 | 11 | 5 |


| - | - | - | - | - | - | 1 | 1 |
| ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: |
| 7 | 3 | 9 | 9 | 3 | 1 | 14 | 9 |
| - | - | - | - | - | - | 1 | - |
| - | - | - | - | - | - | 1 | - |
| - | - | - | - | 1 | 1 | 1 | - |
| 6 | 1 | 5 | 2 | 6 | 5 | 6 | 2 |
| 2 | - | 6 | 4 | 6 | 3 | 5 | 4 |
| - | - | 1 | - | - | - | - | - |
| 1 | 1 | 5 | 3 | 4 | 3 | 8 | 6 |
| 1 | 1 | 2 | 2 | 4 | 3 | - | - |
| 13 | 8 | 17 | 12 | 18 | 14 | 35 | 24 |
| 1 | 1 | 1 | 1 | - | - | 1 | 1 |
| - | - | 1 | 1 | 1 | 1 | - | - |
| - | - | 2 | 1 | - | - | 2 | 1 |
| - | - | - | - | 1 | 1 | - | - |
| 4 | 1 | 3 | 2 | 4 | 2 | 9 | 3 |
| 1 | - | - | - | - | - | 1 | 1 |
| 5 | 2 | 5 | 2 | 14 | 9 | 13 | 10 |
| - | - | 1 | - | - | - | - | - |
| - | - | 4 | 3 | 5 | 5 | 5 | 3 |
| 2 | 1 | 3 | 3 | 7 | 7 | 11 | 5 |


| - | - | - | - | - | - | 1 | 1 |
| ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: |
| 7 | 3 | 9 | 9 | 3 | 1 | 14 | 9 |
| - | - | - | - | - | - | 1 | - |
| - | - | - | - | - | - | 1 | - |
| - | - | - | - | 1 | 1 | 1 | - |
| 6 | 1 | 5 | 2 | 6 | 5 | 6 | 2 |
| 2 | - | 6 | 4 | 6 | 3 | 5 | 4 |
| - | - | 1 | - | - | - | - | - |
| 1 | 1 | 5 | 3 | 4 | 3 | 8 | 6 |
| 1 | 1 | 2 | 2 | 4 | 3 | - | - |
| 13 | 8 | 17 | 12 | 18 | 14 | 35 | 24 |
| 1 | 1 | 1 | 1 | - | - | 1 | 1 |
| - | - | 1 | 1 | 1 | 1 | - | - |
| - | - | 2 | 1 | - | - | 2 | 1 |
| - | - | - | - | 1 | 1 | - | - |
| 4 | 1 | 3 | 2 | 4 | 2 | 9 | 3 |
| 1 | - | - | - | - | - | 1 | 1 |
| 5 | 2 | 5 | 2 | 14 | 9 | 13 | 10 |
| - | - | 1 | - | - | - | - | - |
| - | - | 4 | 3 | 5 | 5 | 5 | 3 |
| 2 | 1 | 3 | 3 | 7 | 7 | 11 | 5 |


| - | - | - | - | - | - | 1 | 1 |
| ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: |
| 7 | 3 | 9 | 9 | 3 | 1 | 14 | 9 |
| - | - | - | - | - | - | 1 | - |
| - | - | - | - | - | - | 1 | - |
| - | - | - | - | 1 | 1 | 1 | - |
| 6 | 1 | 5 | 2 | 6 | 5 | 6 | 2 |
| 2 | - | 6 | 4 | 6 | 3 | 5 | 4 |
| - | - | 1 | - | - | - | - | - |
| 1 | 1 | 5 | 3 | 4 | 3 | 8 | 6 |
| 1 | 1 | 2 | 2 | 4 | 3 | - | - |
| 13 | 8 | 17 | 12 | 18 | 14 | 35 | 24 |
| 1 | 1 | 1 | 1 | - | - | 1 | 1 |
| - | - | 1 | 1 | 1 | 1 | - | - |
| - | - | 2 | 1 | - | - | 2 | 1 |
| - | - | - | - | 1 | 1 | - | - |
| 4 | 1 | 3 | 2 | 4 | 2 | 9 | 3 |
| 1 | - | - | - | - | - | 1 | 1 |
| 5 | 2 | 5 | 2 | 14 | 9 | 13 | 10 |
| - | - | 1 | - | - | - | - | - |
| - | - | 4 | 3 | 5 | 5 | 5 | 3 |
| 2 | 1 | 3 | 3 | 7 | 7 | 11 | 5 |

Manitoba
St. John's

Saskatchewan
Winnipeg


See notes on next page.
(12x

Table 3.1 (Cont'd)


Notes: Leave fellowships are listed under the fiscal year in which applications and awards were made.

The figures on awards relate to those originally offered by the Canada Council and do not take into account the rare cases where awards were declined by successful applicants and re-offered to others.

The category "Other" represents fellows who, at the time of their application, were either affiliated with an educational institution not listed in the above table or not affiliated with any Canadian educational institution.
Table: 3.2 LEAVE FELLOWSHIPS BY DISCIPLINE


[^2]

Notes: Leave fellowships are listed under the year in which applications and awards were made.

The figures on awards relate to those originally offered by the Canada Council and do not take into account the rare cases where awards were declined by successful applicants and offered to others.

Table 4.1
RESEARCH GRANTS BY UNIVERSITY OF AFFILIATION

1965/66 - 1968/69 (Fiscal Year)

| University of Affiliation | 1965/66 |  | 1966/67 |  | 1967/68 |  | 1968/69 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Applica- tions | Awards | Applications | Awards | Applications | Awards | Applications | Awards |
|  |  |  |  | dollar |  |  |  |  |
| BRITISH COLUMBIA |  |  |  |  |  |  |  |  |
| British Columbia | 10,353 | 10,353 | 140,185 | 88,898 | 118,074 | 99,426 | 231,979 | 145,333 |
| Notre Dame |  |  |  |  |  |  | 2,000 | 1,920 |
| Simon Fraser |  |  | 6,469 | 6,469 | 58,396 | 40, 742 | 84,937 | 57,983 |
| Victoria | 2,690 | 1, 500 | 20,969 | 20,969 | 28,245 | 25,680 | 96,732 | 64,128 |
| PRAIRIES |  |  |  |  |  |  |  |  |
| Alberta | 12,855 | 9,250 | 51,492 | 20,802 | 198,451 | 151,031 | 405,651 | 190,805 |
| Brandon | 12, | , | 400 | , | 1,400 | 400 |  |  |
| Calgary | ------ | ------ | 34,433 | 24,533 | 124,601 | 87,850 | 140, 133 | 109,440 |
| Lethbridge |  |  | 5,143 |  | 6,725 | 5,350 | 13,179 | 7,300 |
| Manitoba | 19,840 | 14,235 | 75,092 | 33,216 | 95,190 | 50,940 | 135,906 | 68,255 |
| St. Paul's |  |  |  |  |  |  | 4,130 |  |
| Saskatchewan | 24,699 | 14,900 | 27,141 | 11,307 | 46,385 | 38,385 | 70,923 | 28,026 |
| Winnipeg |  |  | 1,970 |  |  |  | 4,000 |  |
| ONTARIO |  |  |  |  |  |  |  |  |
| Brock | ----- | ----- | 1,550 | 1,550 | 37,587 | 4,202 | 32,680 | 14,670 |
| Carleton | 24,550 | 23,550 | 17,210 | 15,310 | 33,805 | 32,324 | 166,870 | 97, 248 |
| Gue 1ph |  |  | 16,325 | 11,275 | 55,974 | 29,919 | 36,962 | 29,683 |
| Lakehead |  |  | 2,350 | 1,000 | 4,200 | 4,200 | 3,076 |  |
| Laurentian | 7,300 | 4,000 |  |  | 11,436 | 9,281 | 55,303 | $37,763$ |
| McMaster | 4,500 | 4,500 | 17,500 | 11, 700 | 111,417 | 91,254 63,580 | 84,553 98,389 | $63,483$ |
| Ottawa | 12,130 | 9,650 | 42,325 | 13,852 | 82,583 3,050 | 63,580 3,050 | 98,389 3,400 | 77,076 1,900 |
| St. Paul's Queen's | 66,674 | ----- | 35,106 | 35,106 | 3,050 142,406 | 3,050 142,406 | 3,400 130,114 | 1,900 97,766 |


| University of Affiliation | 1965/66 |  | 1966/67 |  | 1967/68 |  | 1968/69 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Applica- tions | Awards | Applica- tions | Awards | $\begin{aligned} & \text { Applica- } \\ & \text { tions } \end{aligned}$ | Awards | App1ica- tions | Awards |
|  |  |  |  |  |  |  |  |  |
| ONTARIO (Cont'd) |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| College | 2,288 | 2,288 | 4,825 | 1,825 | 4,061 | 4,061 | 9,528 | 9,528 |
| Toronto | 34,024 | 29,524 | 194,579 | 179,043 | 254,443 | 254,443 | 436,894 | 395,421 |
| St. Michael's | -.-.- |  | 1,894 | 1,894 | 2,750 | 2,750 | 4,022 | 4,022 |
| Trinity | ------ |  |  |  |  |  | 3,976 | 3,976 |
| Victoria | ----- | ----- | 300 | ----- | 7,356 | 7,356 | 20,936 | 18,396 |
| Trent | 1,500 | 1,500 | 15,795 | 14,295 | 8,045 | 8,045 | 42,093 | 23,593. |
| Waterloo | 5,400 | 5,400 | 51,190 | 45,790 | 81,805 | 74,960 | 154,320 | 99,985 |
| St. Jerome's |  | 5, | ----- | ----- | 1, | ----- | 2,500 | 2,500 |
| Water100 Lutheran |  |  | 1,400 | 1,400 | 10,388 | 2,220 | 3,334 | 2,904 |
| Western Ontario | 14,626 | 12,526 | 87,069 | 84,069 | $103,772$ | $99,472$ | $88,398$ | 84,327 |
| Huron |  |  |  |  | $1,102$ | $\text { 1, } 102$ | $1,008$ |  |
| Windsor | 3,000 | 1,500 | 13,250 | 9,022 | 23,676 | 23,676 | $39,736$ | $29,531$ |
| York | 26,535 | 24,535 | 29,547 | 25,007 | 211, 764 | 177, 260 | 217,409 | 143,328 |
| QUEBEC |  |  |  |  |  |  |  |  |
| Bishop's |  | ----- | 1,580 85,537 | $1,580$ | ----- | ----- | $6,398$ | 4,813 94,319 |
| Laval | 26,558 | 25,083 | 85,537 | $40,947$ | 101,980 | 93,110 | $99,344$ | 94,319 |
| McGill | 71,719 | 50,580 | 67,902 | 65,202 | 159,690 | 119, 134 | 287, 198 | 260,147 |
| Montreal | 113,400 | 82,700 | 131,884 | $110,199$ | 243,850 | 124,514 | $360,132$ | $292,828$ |
| Loyola |  |  | $3,800$ | $3,800$ | 2,775 | 2,775 | $16,051$ | $16,051$ |
| Marianapolis |  |  | 2,200 |  | 53,617 |  | 8,275 24,600 | $\begin{array}{r} 2,415 \\ 15,750 \end{array}$ |
| Sherbrooke |  |  | 29,700 30,214 | 27,700 17,335 | 53,617 25,222 | 53,617 10,032 | $\begin{aligned} & 24,600 \\ & 93.842 \end{aligned}$ | $\begin{aligned} & 15,750 \\ & 14,602 \end{aligned}$ |
| Sir George Williams | 1,400 | 1,400 | 30,214 | 17,335 | 25,222 | 10,032 | 93,842 | 14,602 |
| ATLANTIC |  |  |  |  |  |  |  |  |
| Acadia |  |  |  |  |  |  |  |  |
| Dalhousie | 5,398 | 4,098 | 4,250 | 2,900 | $29,415$ | $20,285$ | $24,441$ | $21,951$ |
| Memorial | 1,000 |  | 8,480 | 2,980 | 17,600 | 10, 100 | $46,310$ | $43,310$ |
| Moncton | ---- |  | 2,700 | 2,200 | 4,945 | $1,900$ | $41,891$ | $5,000$ |
| Mount Allison | 950 | 950 7 | 1,200 | 1,200 | 2,326 | $2,326$ | 4,220 | $4,220$ |
| New Brunswick | 8,132 | 7,382 | 8,800 | 5,800 | 36,877 | 16,527 | 20,656 | 18,849 |
| Nova Scotia <br> Technical College | ----- | ----- |  | ----- | 4, 194 | 4,194 | ----- | ----- |
| Prince of Wales |  |  |  |  | 2,400 | 2,400 | ---- |  |

See notes on next page.

| University of Affiliation | 1965/66 |  | 1966/67 |  | 1967/68 |  | 1968/69 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | $\begin{aligned} & \text { Applica- } \\ & \text { tions } \end{aligned}$ | Awards | $\begin{aligned} & \text { Applica- } \\ & \text { tions } \end{aligned}$ | Awards | $\begin{aligned} & \text { App1ica- } \\ & \text { tions } \\ & \hline \end{aligned}$ | Awards | $\begin{aligned} & \text { Applica- } \\ & \text { tions } \end{aligned}$ | Awards |
| ATLANTIC (Cont'd) |  |  |  |  |  |  |  |  |
| St. Francis Xavier | -- | ----- | ----- | ----- | 5,280 | 3,780 | 7,148 | 4,374 |
| Saint Mary's | 885 | ----" | 4,000 |  | 800 | 800 | 1,271 | 1,271 |
| OTHER | 28,585 | 16,885 | 98,458 | 42,825 | 225,141 | 100,994 | 299,650 | 190,873 |
| total | 531,491 | 412,794 | 1,376,214 | 983,000 | 2,785,199 | 2,101,853 | 4,168,993 | 2,903,558 |

Notes: Grants are listed under the fiscal year in which they were awarded.


See notes on next page.

Discipline

| 1965/66 | 1966/67 |  | 1967/68 |  | 1968/69 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Applica- Awards tions | Applications | Awards | Applications | Awards | App1ications | Awards |


| $\frac{\text { LANGUAGE AND }}{\text { LITERATURE }}\left(\text { cont }^{\prime} \mathrm{d}\right)$ |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  |  |  |
| Italian | 3,000 | 1,500 | 2,000 | 2,000 | 9,402 | 9,402 | 11, 300 | 11,300 |
| Slavic (Russian) | 3,850 | 2,350 | 6,850 | 4,300 | 18,516 | 15,458 | 30,647 | 24,859 |
| Spanish | 3,750 | 3,750 | 15,395 | 14,695 | 17,377 | 14,977 | 44,946 | 37,374 |
| LAN | 11,500 | 11,500 | 21,525 | 16,525 | 85,400 | 85,400 | 175,517 | 171,882 |
| LINGUISTICS | 27,335 | 22,335 | 71,553 | 69,289 | 94,823 | 81,061 | 261,934 | 212,986 |
| MATHEMATICS | 2,953 | 2,953 | 25,650 | 25,650 | 50,400 | 50,400 | 7,755 | 4,355 |
| PHILOSOPHY | 5,820 | 4,630 | 43,637 | 36,937 | 83,846 | 68,519 | 63,507 | 46,319 |
| POLITICAL SCIENCE | 48,612 | 46,558 | 63,726 | 57,125 | 352,324 | 284,420 | 293,000 | 209,289 |
| SOCIAL PSYCHOLOGY | 17,376 | 13,676 | 121,223 | 95,430 | 224,596 | 181,266 | 313,419 | 243,300 |
| SOCIOLOGY | 180,000 | 141,450 | 265,333 | 151,810 | 361,850 | 218,264 | 639,062 | 378,370 |
| OTHER | 27,240 | 19,680 | 52,208 | 21,898 | 150,488 | 77,178 | 58,424 | 13,234 |
| TOTAL | 531,491 | 412,794 | 1,376,214 | 983,000 | $\underline{2,785,199}$ | 2,101,853 | 4,168,993 | 903,558 |

Notes: Grants are listed under the fiscal year in which they were awarded.
The category "Other" contains projects of an interdisciplinary nature as well as some projects in disciplines not listed separately because of the small number of applications and awards involved.


LIBRARY RESEARCH COLLECTIONS GRANTS BY UNIVERSITY
1965/66-1968/69 (Fiscal Year)

| University | 1965/66 |  | 1966/67 |  | 1967/68 |  | 1968/69 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Applications | Awards | Applications | Awards | Applications | Awards | Applications | Awards |
| BRITISH COLUMBIA |  |  |  |  |  |  |  |  |
| British Columbia |  | ----- |  | ----- | 181,150 | 64,000 | 184,340 | 70,000 |
| Notre Dame | 3,700 | ----- | ----- | ----- |  |  |  |  |
| Simon Fraser | 55,000 | 13,000 | 69,000 | 8,000 | 76,039 | 22,000 | 83,148 | 24,000 |
| Victoria | 43,957 | 6,500 | 64,500 | 5,000 | 43,300 | 19,000 | 82,925 | 21,000 |
| PRAIRIES |  |  |  |  |  |  |  |  |
| Alberta | 52,624 | 45,000. | 98,000 | 44,000 | 510,025 | 61,000 | 316,520 | 67,000 |
| Brandon | 30,558 | --.-** | ----- | ---- | ----- | - | -..-- | ----- |
| Calgary | 20,000 | 4,500 | 31,000 | 8,000 | 43,545 | 17,000 | 85,870 | 25,000 |
| Lethbridge |  |  |  |  |  |  | 13,360 |  |
| Manitoba | 50,547 | 20,500 | 62,750 | 22,000 | 80,000 | 34,000 | 97,000 | 28,000 |
| St. Paul's | 7,158 | 34,-500 | 15,000 | 6,000 | 13,000 |  | ------ | ----- |
| Saskatchewan | 306,863 | 34,500 | 277,513 | 21,000 | 593,463 | 57,000 | 598,580 | 51,000 |
| ONTARIO |  |  |  |  |  |  |  |  |
| Carleton | 30,900 | 15,500 | 123,100 | 18,000 | 76,060 | 31,000 | 120,270 | 34,000 |
| Guelph | , |  | 35,000 | 5,000 | 241,629 | 13,000 | 48,025 | 5,000 |
| Lakehead | ------ | ----- | ----- | 5, | 14,000 | , | 6,600 | - |
| Laurentian | ----- | ----- | ----- |  | ----- | ----- | 44,375 | ----- |
| McMaster | 181,880 | 23,000 | 233,880 | 19,000 | 110,355 | 68,000 | 185,351 | 68,000 |
| Ottawa | 86, 851 | 27,000 | 187,969 | 20,000 | 160,082 | 39,000 | 136,790 | 33,000 |
| Saint Paul | 28,000 | 11,000 | 85,600 | ----- | --7--- | ----- | 44,500 | 5,000 |
| Queen's | 42,700 | 36,100 | 85,600 | 33,000 | 97,863 | 52,000 | 109,030 | 49,000 |
| Toronto | 155,000 | 55,000 | 155,000 | 60,000 | 303,000 | 95,000 | 190,000 | 89,000 |
| St. Michae $1^{\prime}$ s | 25,000 | 11,000 | 14,000 | 10,000 | 10,500 | 9,000 | 12,200 | 8,000 |
| Victoria |  |  | 30,000 | 10,000 | 55,000 | 18,000 | 43,000 | 16,000 |
| Trent ${ }^{\text {Waterloo }}$ | 55,000 | ------- | 49,698 | 9,000 | 136,750 | 8,000 | 164,407 | 44,000 |
| Western Ontario | 124,650 | 19,500 | 59,630 | 27,000 | 208,388 | 48,000 | 65,000 | 25,000 |
| Windsor | 124,650 | 19,500 | 12,500 | 7,000 | 6,320 | 4,000 | 38,282 | 4,000 |
| York | 146,961 | ----- | 73,338 | 8,000 | 240,952 | 39,000 | 160,265 | 33,000 |


| University | 1965/66 |  | 1966/67 |  | 1967/68 |  | 1968/69 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Applications | Awards | Applications | Awards | Applications | Awards | Applications | Awards |
| QUEBEC |  |  |  |  |  |  |  |  |
| Laval | 70,500 | 40,500 | 107,500 | 34,000 | 174,000 | 61,000 | 186,700 | 55,000 |
| McGill | 101,046 | 23,000 | 160,000 | 39,000 | 99,500 | 60,000 | 241, 700 | 55,000 |
| Montreal | 100,000 | 26,000 | 168,063 | 37,000 | 214,361 | 64,000 | 323,857 | 63,000 |
| Loyola | 5,000 | 2,000 | 5,000 | 3,000 | 5,000 | 3,000 | 8,900 | --..-- |
| Marianopolis | , | , | 9,000 | , | , | , | ----- | --...- |
| Sainte-Marie | ----- | ----- | -.-.- | ----- | 4,260 | --.--- | ----- |  |
| Sherbrooke | 33,457 | 8,000 | ------ | -- | 68,077 | 17,000 | 150,056 | 12,000 |
| Sir George Williams | 12,500 | ----- | 4,000 | 2,000 | 4,000 | 2,000 | 17,730 | 5,000 |
| ATLANTIC |  |  |  |  |  |  |  |  |
| Acadia | 4,000 | 1,000 | -- | ------ | 20,000 | ----- | - | ------ |
| Dalhousie | 105,000 | 39,000 | 261,308 | 20,000 | 155,684 | 35,000 | 101,455 | 35,000 |
| King's | 10,000 | 2,000 |  |  |  | ---- | ----- | - |
| Memorial | 28,000 | 9,000 |  | ----- | 130,600 | 24,000 | 74,300 | 27,000 |
| Moncton | --- |  | ----- | ----- | ------ | ----- | 34,500 | 5,000 |
| Mount Allison | 26,660 | - | ---- | ----- | 5,000 | ----- | 4, | , |
| Mount Saint Vincent |  |  | 6,000 |  |  |  |  |  |
| New Brunswick. | 36,520 | 20,000 | 60,000 | 20,000 | 134,322 | 31,000 | 155,017 | 33,000 |
| Nova Scotia Technical | 1 7,000 | 5,000 | ----- | - | - | ----- | ----- | ----- |
| St. Francis Xavier | 5,000 | 5, | ------ | ------ | ----- | ----- | 16,000 | 2,000 |
| Saint Mary's | ----- | ----- |  | ----- | 25,000 | ----- |  |  |
| OTHER | 70,000 | 67,500 | 5,000 | 5,000 | 28,000 | 8,000 | 54,000 | 9,000 |
| TOTAL 2 | 2,062,032 | 565,100 | 2,463,349 | 500,000 | 4,269,225 | 1,003,000 | 4,194,053 | 000,000 |

Note: The category "Other" represents applications and awards for institutions other than those listed in the above table which may or may not have university affiliation.

THE GROWTH OF THE "UNIVERSE" OF DOCTORAL CANDIDATES AND ITS RELATIONSHIP WITH THE COUNCIL'S DOCTORAL FELLONSHIP PROGRAMME

Table A - Full-time graduate enrolment in Canadian universities and colleges

|  |  | 1963/64 | 1968/69 | 1969/70 | 1973/74 |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 1. All disciplines | No. | 11,300 | 28,600 | 34,000 | 55,500 |
| 2. Social Sciences and Humanities | No. | 5,800 | 16,000 | 19,000 | 31,100 |
| \% of all disciplines |  | 51.3\% | 56\% | 56\% | 56\% |
| 3. Studying towards a Ph.D degree: Total | No. | 1,450 | 4,000 | 4,750 | 7,775 |
| -- Canadian and landed immigrants | No. | 1,160 | 3,200 | 3,800 | 6,220 |

Notes: Total enrolment figures are from the D.B.S. "Survey of Higher Education" for $1963 / 64$ and based on W.M. Illing's and Z.E. Zsigmond's estimates for subsequent years.

The percentage of graduate students enrolled in the Social Sciences and Humanities has been established at 56 p.c. following the trend of recent years.

It is estimated that some 25 p.c. of the graduate students in the Social Sciences and Humanities are working towards a Ph.D. degree and that nonCanadians account for about 20 per cent of this group. Corresponding percentages in the physical sciences are believed to be substantially above these;i.e. around $40 \mathrm{p} . \mathrm{c}$. and $35 \mathrm{p} . \mathrm{c}$. , respectively.

Table B - Full-time Ph.D. enrolment of Canadian students in foreign institutions

$$
\underline{1963 / 64} \quad \underline{1968 / 69} \quad 1969 / 70 \quad 1973 / 74
$$

1. In the United States

$$
\text { No. } \quad 590
$$

1,230
1,340
1,950
2. In other countries

No.
265


450 650 $\begin{array}{lllll}\text { All foreign countries No. } & \overline{855} & \overline{1,640} & \overline{1,790} & \overline{2,600}\end{array}$

Note: Data on the enrolment of Canadians in the United States for the past years originate from the publication "Open Doors", an annual review of the Institute of International Education while the enrolment in other foreign countries has been estimated on the basis of fragmentary reports available mainly from the United Kingdom.

Table C - Doctoral Fellowships requested and awarded in numbers and as a percentage of the "Universe" of Canadian doctoral candidates

|  | $\underline{1963 / 64} \quad \underline{1968 / 69} \quad \underline{1969 / 70} \quad \underline{1973 / 74}$ |
| :--- | :--- | :--- | :--- | :--- |

1. "Universe" of Canadian doctoral candidates:

- in Canada
- abroad


## Total

2. Doctoral fellowships requested:

- \% of universe

3. Doctoral fellowships awarded:

- \% of universe

| No. | 1,160 |
| :--- | ---: |
| No. | 805 |

No. 1,965

No. $\quad 674$
$34.3 \%$

No. $\quad 184$
9.4\%

1,554
32.1\%

3,800
1,790
5,590
6,220
2,600
8,820

6,800
$77.0 \%$

4,760
54\%

SUMMARY OF A SURVEY OF CANADA COUNCIL DOCTORAL
FELLOWSHIP HOLDERS, 1958-59 to 1964-65

According to this Canada Council study, completed late in 1966, $97 \%$ of the Council's doctoral fellowship winners in the humanities and social sciences who studied in Canada were working in this country. As for those winners of fellowships who completed their studies in the United States or abroad, $80 \%$ had returned to work in Canada, and most of the minority then working in other countries hoped eventually to return. Some of the respondents to the survey had already worked in other countries and come back.

Almost all of the award-winners had received or were still working towards their Ph.D. The failure rate, at less than $4 \%$, was marginal. The survey also indicated that $92 \%$ of the award-winners who had already received their doctorate had taken up teaching careers in the universities.

The survey was made among the 809 fellowship winners of the first seven years of the programme, from 1958-59 to 1964-65. A detailed questionnaire was mailed to all 809, and replies were received from 588 , or $73 \%$ of the total.

The questionnaire revealed that all but $13 \%$ of the respondents then employed were working in Canada. $97 \%$ of the group who studied in Canadian universities were working here; $77 \%$ of those who took their doctorate in the U.S.A. had returned to Canada for employment; and the percentage of those returning from other foreign countries was even higher -slightly over $90 \%$. The combined repatriation rate was $80 \%$, and of the 58 award holders who were working abroad, 34 hoped to come back. A significant number of the respondents had come back to Canada from working abroad.

The repatriation rate was higher for women ( $84 \%$ ) and much higher for French speaking award holders (92.5\%).
(NOTE: Full text of the survey is published on pages 150-155 of the Council's 1966-67 Annual Report).

APPENDIX 50
A SUBMISSION TO
THE SENATE SPECIAL COMMITTEE ON SCIENCE POLICY
PRESEITTED BY

## THE NATIONAL FILM BOARD OF CANADA

$\qquad$

[^3]January 1969.

An organization which provides conmunication services invariably encounters difficulty in relating its operations to a precisely defined activity. In providing visual information programs for the Federal Government departments of Canada over many years, the National Film Board has been involved to varying degrees in many phases of the disciplines related to the physical, natural and social sciences, and education. In some cases the Board's role has been to record data, but with the complexity of technological evolution and its groving impact on social welfare, the demand for advanced interpretative films has become much more important.

The purpose of this paper, therefore, is not to identify this organization as a scientific research institution but rather to comment on scientific policy from a position in the void between technological and social development.

The tremendous publicity given to the use of motion pictures for entertainment purposes has obscured the fact that Canada originated other uses of the camera as a means of documenting its developments and resources. The first known technical demonstration films were produced by Thomas Edison for the Massey Harris Co., and were presented at the Canadian National Exhibition in Toronto in 1398. The Canadian Pacific Railway originated the use of motion pictures to record life in Canada as a means of encouraging immigration in the year 1900. The decision to produce films as part of the program of the Exhibits and Publicity Bureau of the Department of Trade and Commerce in 1914 was further evidence of Canadian initiative. This country owes much to the foresight of these pioneers in the medium and the tradition of innovation and experimentation which they passed on to those who followed.

The purposes of the National Film Board as stated in its Act are:

[^4](a) to produce and distribute and to promote the production and distribution of films designed to interpret Canada to Canadians and to other nations;
(b) to represent the Government of Canada in its relations with persons engaged in commercial motion picture film activity in connection with motion picture films for the Government or any department thereof;
(c) to engage in research in film activity and to make available the results thereof to persons engaged in the production of films;
(d) to advise the Governor in Council in connection with film activities; and
(e) to discharge such other duties relating to film activity as the Governor in Council may direct it to undertake."

The National Film Board's activities relating to science may be categorized under two general program headings:

## CONCEPTUAL PROGRAM

Objective:
The production, distribution, and utilization of informational and interpretative films and related materials dealing with the physical, natural and social sciences through the Board's Parliamentary vote, or as a result of funds invested by other government departments supported by the advisory services of appropriate scientists. These films are intended for audiences in Canada and abroad, and are available in as many as forty language versions as required.

The wide range of subject matter covered in this program is revealed in the following brief list of titles selected, at random, from a current catalogue:

## MENTAL SYMPTOMS Series:

1. Schizophrenia: Simple-type Deteriorated
2. " : Catatonic Type
3. $\quad$ : Hebephrenic Type
4. Paranoid Conditions
5. Organic Reaction-type - Senile
6. Depressive States: 1
7. Depressive States: II
8. Manic State
9. Folie à deux

## BIOLOGICAL SCIENCE:

1. The Development of a Fish Embryo
2. Embryonic Development - The Chick
3. Microscopic Fungi
4. The Changing Forest
5. Birds of Canada
6. Poisons, Pests and People

## NATURAL SCIENCE AND WILD LIFE:

1. Glaciation
2. High Arctic: Life on the Land
3. Life in the Woodlot
4. World in a Marsi
5. Trout Stream
6. Water Fowl - A Resource in Danger

## PHYSICAL AND APPLIED SCIENCE:

1. Antenna Fundamentals

Part 1: Propagation
Part 2: Directivity
Part 3: Bandwidth
2. In One Day - Weather Forecasting
3. Auroral Rocket
4. An Introduction to Jet Engines
5. Isotopes in Action

PHYSICS OF UNDERWATER SOUND Series:

1. Basic Principles
2. Velocity Profiles
3. Absorption and Scattering

## SOCIAL SCIENCE:

1. Knowing to Learn
2. The Living Machine
3. A Search for Learning
4. Indian Dialogue
5. Community Responsibilities

## TECHNICAL PROGRAM

## Objective:

The study, design, development and evaluation of equipment and processes required to meet unique Canadian conditions or to support new concepts in the art and technology of film making, and related imageforming systems.

## CONCEPTUAL PROGRAM

Historically, scientific endeavour has aimed at achieving a better understanding of the world and at developing valid theories concerning observable phenomena. The result has been the growth of separate disciplines and methodologies to permit detailed study of highly complex subjects. Increasing levels of specialization, however, have isolated scholars within rather rigid compartments which separated them, not only from other scientific disciplines but more importantly from the rest of the world.

Father John Culkin of Fordham University has pointed out recently that the development of our present communication systems has, in fact, eliminated rather than created gaps in our social order. At one time the parents could decide when and to what degree children would be permitted to participate in the adult world. Today, the average youngster can
extract as much visual information from television and related media as his parents. His entry into the more complex world cannot be regulated by the simpler methods of controlling access to information which were available before World War II. This continuous exposure to the adult world is creating a quite different kind of person. It is estimated that the average student leaving high school today has been exposed to more hours of television and motion pictures than to formal instruction. The optophonic man who may lack maturity and judgment is not deficient in factual information. Unfortunately, this knowledge cannot be fully separated from the emotional bias of the transmitting medium and this inevitably leads to certain distortions in interpretation of content.

Because the entire world can now share information, almost instantaneously it will become increasingly difficult to maintain the carefully constructed compartments of human activity and the mystiques associated with them. The apparent incongruities of our time, the technological advances which have polluted our air and water, the investment in the development of destructive systems of warfare when thousands of people are dying of starvation will be questioned more frequently and more vigourously in a world of increasing personal involvement. As a consequence of this situation much of the Board's experimental film program since EXPO has been directed toward study of the camera as an instrument to assess the impact of technological change on social welfare. Since this method permits two way communication it might be said that the National Film Board acts as one interface between man and the machine.

In developing these programs, the following objectives are con-

## sidered:

1. Film as the subject under investigation:
(a) how does it communicate and motivate?
(b) what are the best methods of using it?
(c) how can one cause the audience to identify with and react to the medium?
(d) how does one assess the effect of this means of stimulating and recording man's reaction to his environment?
2. Film as a research tool:
(a) as a passive recording instrument operating in real time, in expanded time, in compressed time, in dimensions that are smaller or larger than life-size;
(b) as a selective instrument reacting to pre-programmed instructions;
(c) as an integral research step which is not necessarily the end product.

CONCEPTUAL PROGRAM (cont 'd)

## 3. Film as an information device: <br> -- to report on research and scientific development and to interpret its effect on people.

## EXAMPLES:

To illustrate this part of the Board's program, one experimental project, the "Challenge for Change" series is reviewed below in some detail. This will give some indication of the scope of the work and will provide insights regarding the nature and variety of interrelationships In the participating groups. Brief descriptions are given also of other related activities involving experimental methods.

In its first year of operation, the Challenge for Change progran achieved significant results in its aim "to improve communications, create greater understanding, promote new ideas and provoke social change".

The concrete result was the production of 32 films which are proving effective in raising questions, provoking examination, and producing action in the field of poverty and social change.

## Cooperation

Challenge for Change is by no means only a Film Board project. Seventeen federal government departments and agencies contribute to its cost, though at least fifty percent of any year's expenditure is provided by the Board. The contributing departments and the Board together set the objectives and general directions of the program but operating decisions, including the style and content of films, are the Board's responsibility.

In addition to government participation valuable cooperation has come from as many organizations -- universities, school boards, municipalities, social agencies, provincial governments and voluntary associations of many kinds.

Distribution<br>From the start, film distribution was conceived as a major part of the program, of equal importance with film production. Integrated teams of film-makers and distribution officers have worked on many of the projects from the earliest stages. From this teamwork has evolved promising new methods of film use.

## Newfound land Project

One of the first projects in Challenge for Change was the examination, in depth, of Newfoundland, to determine how effectively the film medium - both its production and utilization - can be used to improve comunication between citizens and govarnment.

It was decided, as part of the Newfoundland Regional project, to examine closely a small island fishing community off the eastern coast, Fogo Island. The aim of this project was to generate confidence in the inhabitants so that they could formulate and express their problems as they saw them, as the first step towards solving them. This was recorded on film and later, in unfinished form, screened for the Islanders. It was hoped that the playback of differences of opinion and contradictions in attitude would help the Islanders clarify, in their own minds, their position.

The film record reflected the concerns of the people on a variety of issues. Fishing methods and processing, education, welfare, local government and co-operatives were all dealt with. There was also an attempt to capture the human aspact of the Island. The footage and the issues raised by it were debated in the screenings and later on the streets, in the schools and in the stores.

It is believed that there are common denominators in commities affected by poverty and that the footage shot on Fogo Island will be useful in other areas. The material was examined by social scientists, Community Development personnel at Memorial University as well as local and Federal Government authorities. Then the footage was edited into twenty-six films. Prints will be distributed to Comrunity Development and by National Film Board representatives who will take the films into Newfoundland communities with siailar problems.

The nature of the Newfoundland Regional Project is purely experimental. The measurable returns will not be in for a long time. What it is doing, without question, is to stimulate an area, and eventually, several areas, to become more conscious of their needs and problems; and a more conscious community is far better able to anticipate and shape its future.

The Protestant School Board of Greater Montreal has approved National Film Board participation in a program designed to provide an enriched environment in a school located in the midst of a large area of poverty. This enrichment program is composed of four phases: a Headstart program for preschoolers, creative utilization of films within the regular school curriculum, a film-making project for the children in the school and, finally, parental involvement in film programs in the evening.

Initiated by the National Council of Jewish Women and the United Church of Canada, the Headstart program is designed to provide children in poverty with a number of experiences which are common to middleclass children before they enter the school system.

Within the school itself, the National Film Board made available every kind of audio-visual aid - films, filnstrips, slides, 8 mm singleconcept loops, overhead projectuals and NFB still photographs. The object of this experiment was to teach the children visually what they cannot understand verbally in the curriculum. The teachers themselves were trained in the use of the equipment as wall as in the creative implementation of films within the curriculum.

The idea of children actually making their own films within the school system is a unique departure in the project from the usual verbal learning process. In the Lorne School project, both high and low achievers worked together on the production of the films. The role of the adult film-maker in the group is very important because in many cases it was the first meaningful relationship these children have had with an adult.

Films were used in the evening Adult Education sessions initially to interest the parents in coming to the school. Through these sessions, the parents were informed about the daytime projects and encouraged to form interest groups of their own at night on whatever subjects attract them, with or without the help of the project organizers.

Results of this program will be published when it is completed in June of 1969. In the meantime it has attracted wide spread interest from specialists in education and social welfare in Canada and the

United States.

## LEARNING PROBLEMS IN CHILDREN

The objectives in this series of films, produced in close cooperation with a group of Canadian child psychologists, was to fulfill a remedial role for younger children (about $7 \%$ of the school population) suffering from a series of functional disabilities, problems of body image and coordination, language problems, visual discrimination etc. These conditions in children are attributed to a variety of causes: minimal brain damage, hearing impairment, emotional difficulties or the effects of poverty. Extensive field testing was used to evaluate different production techniques in order to capture the attetnion of these young children and to involve them in a tactile sense with the teaching medium. In this experiment precise before and after measurements cannot be made. Evaluation is obtained through the careful observation of specialists. This program has received strong endorsement from scientists in the field and will be placed in international distribution in the near future.

## THE HARVARD PHYSICS Serias

The objective of this experiment was to determine how visual aid materials, in this case 8 mm film loops, could be integrated with textbooks in a program dealing with basic physics concepts intended for teenage audiences. The project involved joint participation between a group of Harvard scientists and the Board in the production phase with later support from an international distributing organization. The subjects include such titles as Motion Acceleration, A Matter of Relative Program Orbit, Vector Addition, Standing Waves, Kepler's Law, etc. The production method involved very close association with the consulting scientists to create interesting and stimulating filins which encourage interaction between the viewer and the projected image. Extensive field testing was used before the films were completed to insure that the loops were indeed achieving their aim.

This program has been successful in terms of meeting original conceptual objectives and recovery of costs through commercial sale contracts.

## THE NETSILIK ESKIMOS

The National Film Board provided film production services to
Educational Services Inc., a non-profit American organization financed by the U.S. National Science Foundation and Ford Foundation.

This ethnographic film project was an attempt to reconstruct and record the traditional culture of the Pelly Bay Eskimos as first reported by Rasmussen in 1919. Working with footage recorded by E.S.I., a series of nine films will be completed covering these subjects:

1. At the Caribou Crossing Place
2. At the Autumn River Camp

At the Mid-Winter Camp
At the Late Winter Camp
Jigging for Lake Trout
Stalking Seal on the Spring Ice
Group Hunting on the Spring Ice
Building a Kayak
Fishing at the Stone Weir

## LABYRINTH

This theme pavilion and show produced by the Film Board for EXPO ' 67 is perhaps the best example of a major project which illustrates what can be accomplished through total integration of creative and technical talents. The stages in this project included:
(a) Development of the conceptual plan to illustrate the theme, Man and His World.
(b) Development and testing of prototype designs for technical equipment to record, duplicate and display the multi-screen concepts needed for this presentation.
(c) The design of the architectural space in which several original automated presentation systems could be operated to maximum effect for the public.

It has been said that EXPO ' 67 established a milestone in visual
communication, "a place in which entertainment becane education".
Those involved in various EXPO projects, in retrospect, suggest
additional conclusions:
(a) It marked the beginning, not the end, of new concepts in communication which need continuing study.
(b) It revealed a considerable depth of multi-disciplinary talent in Canada for the creation of information environments which bring complex concepts to the average person in a manner that encourages voluntary participation.

## LABYRINTH (cont'd)

(c) EXPO provided an opportunity, unique in Canadian history, to experiment in the dynamics of human participation and involvement in information systems. It would be a tragic mistake to let the communication knowledge gained in this unique laboratory dissipate through failure to grasp its practical relevance to future development programs.

The foregoing summaries illustrate a continuing policy of experimentation with film in production techniques and in methods of utilization. The subject areas and the widely scattered audiences present conditions which are familiar to those in the social sciences in that they defy precise measurement of impact. Yet it is obvious that people need not only to be informed; they must also be assisted in interpreting the complex and rapidly changing environnent with which they are surrounded. Film makers would be the first to admit that this area of communication needs more detailed investigation to establish theories and methods which will help to make their work more effective. At the same time there appears to be no substitute for the intuitive creative sense which determines when action is neaded and in what form it is likely to have its desired effect.

## TECHNICAL RESEARCH PROGRAM

The Board's Technical Research Division is staffed by nine men, three of whom are graduate engineers, the balance skilled technicians. It operates on an annual budget of $\$ 130,000$. In addition, technicians in other divisions are encouraged to participate where possible in development programs.

The objectives of this program are:

1. The design of new equipment or modification of existing equipment to meet the requirements of the experimental film program, to improve the quality of the product, to accommodate new processes and to meet the requirements of improved efficiency and economy.
2. The provision of consulting and testing services related to motion picture and photographic matters to other government departments and to the Canadian commercial film industry.

Canada does not have a large manufacturing capability to supply the more complicated requirements of the motion picture industry. A few attempts to construct equipment in Toronto have proven to be unprofitable because of the modest market demands.

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With most of its specialized equipment imported from the United
States, Great Britain or Burope, the evolution of the Board's technical research progran followed a logical sequence of events:
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1. Services to production teams could not be maintained while cameras, sound recorders, etc., were sent back to the United States or Europe for maintenance. The answer to this problem was the creation of internal maintenance facilities.
2. The repair of equipment which must hold very precise tolerances required instrumentation for measuring and assessment of performance.
3. Growing skill and knowledge in repair and testing combined to suggest modifications which would improve performance or permit the modernization of old equipment.
4. The Board's production program had to be related to all of Canada. It could not operate within the controlled environment or conventional procedures of the typical feature film studio. Consequently, a Canadian style of production adapted to local conditions of weather and geography, has been developed. In turn this has indicated the need for equipment of unique design in which manufacturers saw little prospect of imnediate sales. Typical problems in this category would be:

Weather Conditions:
(a) How to set up and lubricate a camera for exterior use in the Arctic.
(b) How to adapt operating features to insure safety for the cameraman. For example, at 40 degrees below zero, it is virtually impossible, without freezing the hands, to manipulate small switches designed for studio use.
(c) How to adapt to local conditions. For example, the Buard has constructed a film studio in the Arctic from blocks of ice using Eskimo construction methods to record ethnological conditions.

## Geographic Requirements:

(a) How to provide dependable mobile field equipment which can be transported by canoe, dog sled or fishing boat as required.
5. Special demands imposed by the innovative nature of the Board's film production program. In attempting to present Canada and Canadians as they are rather than stilted stereotypes, it is necessary to create production facilities which permit normal operation without obscuring the dramatic content of what is being recorded or disturbing non-professional actors.

Typical projects of the technical program might be categorized
under these headings:

## OBJECTIVE I - EXAIPLES

(a) Development of precise and stable current controls for motion picture and recording machines.
(b) Automation of animation camera operation through the use of a computer control system and the design of appropriate interface circuitry. This has resulted in saving up to $65 \%$ of the time needed for certain very complex manual operations.
(c) Development in 1950 of the Sprocketape recorder which reduced the weight of a studio quality unit to 50 lbs . as compared with the Hollywood equivalent of 300 lbs . This basic design is also incorporated into the Board's studio facilities which have been in operation since 1956.
(d) Design of the first lightweight cordless sound camera used in the Board's pioneer work in the "cinema verite" production techniques. A major European manufacturer has incorporated many of these ideas in a camera now widely used throughout the industry.
(e) Development of all camera, sound and projection systems as well as program control elements for Labyrinth.

## OBJECTIVE II - EXAMPLES

(a) Provision of information and advice or audio visual systems, theatre design, motion picture techniques to other Government departments and the private film industry.
(b) Publication of a bulletin describing current technical development work at NFB which is circulated to seven hundred persons and organizations in Canada and throughout the world.
(c) Presentation of scientific and technical papers to professional bodies such as the Society of Motion Picture and Television Engineers, participation in various national and international bodies ranging from the Canadian Standards Association to the Union Internationale des Associations Techniques Cinematographique (Paris).

## FUTURE PLANS

The purposes and organization of the National Film Board obviously do not come within the conventional definitions of scientific programs and consequently it is difficult to discuss future development activities and related finances within the Committee's guideInes. The role of recording and interpreting information for and about Canadians must be, to a considerable extent, reactive. One cannot assume a purely pragmatic approach based solely on the success of a particular production method or specific advance in technology on the assumption that this course of action will meet future needs. To take such a position would imply that the methodology is more important than the content of an information service. Past experience has shown that this organization must be aware of a wide variety of developments in techniques and hardware

FUTURE PLANS (cont'd)
and must choose from these the best combinations to meet specific program requirements.

At this time the Board's imnediate concerns about future developments are:

1. Examination of the process of making films.

Recognition of film making as one of the new creative arts of this generation is apparent in the rapid development of university courses devoted to the subject. Students have indicated intense interest in cinematography and early experiments have shown that the basic techniques can be taught even to primary school children. It, therefore, becomes essential to explore in more detail the potential of this medlum. The Board's work on Fogo Island has revealed a new dimension in the use of film as an instrument of social development. This element of participation and involvement suggests many possibilities for further examination. Relatively little is known about the assessment of the impact of film on audiences, about its information storage capacity as compared to other systems, about its relationship to other processes in the creation of information environments etc.

## 2. The computer and film.

The Board is presently using a small computer to control a number of operations on an animation stand. In addition a larger computer is used on a shared-time basis to perform complex calculations of animation equipment movement and some preliminary work has been done in the use of a computer to generate drawings which are copied on film to create an animation sequence. Electronic slates and light pens provide unusual possibilities for the creative artist to react directly with the computer in the development of programing techniques which are not limited to the constraints of mathematical logistics. The possible applications of the computer in film editing, sound recording or as an indexing method for high definition film memory banks etc., are worthy of more study.

## 3. Film utilization.

The rate of increase of human knowledge presently exceeds our capacity to record, distribute and use it intelligently. Many textbooks are obsolete by the time they are published. In a similar manner the capacity of presently available film processes to meet anticipated future needs is very linited. The movement of film in cans to meet immediate reference requirements is, of course, an anachronism even now. It is fortunate that film images can be converted to electrical impulses for immediate dispatch to points of need. Among the many alternatives being considered, discussions are now under way, for exauple, regarding the possible establishment of an "electronic highway" to connect Boston and Montreal (with later extension to Washington). There are also the possibilities of producing low cost film copies on 3 milm or through the electron video recording method for home viewing through a converted television set. This is a particularly explosive area of development in which the impact will become much more apparent in the period of 1971-1975. At the same time this technological advance will render our present antiquated copyright laws totally obsolescent which suggests another area for urgent study.

## SUMMARY:

The process of film making is by its very nature innovative, exploratory and rarely routine. This kind of environment attracts and intrigues a stimulating cross section of Canadian professional and non-professional talents. At the present time the Board's staff Includes poets anc journalists, architects and biologists, medical doctors and lawyers, artists and draftsmen, engineers and technicians, teachers and drop-outs. In presenting its views on science policy, the Board does not presume to qualify as a scientific research organization within classical definitions of such activities, it does feel, however, that the nature of its operations, the sensitivity of its staff to current conditions in Canada as revealed in production research and audience reaction provides some insights waich may serve this Comittee of the Senate.

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It should be made clear that the purpose of these observations
is not to endorse or recomend some program of the "popular science" category to enhance or propagandize Canada's scientific efforts.

This has been done in the past and presumably will continue to make
a contribution in the future. It seems more important that a
statement of Canadian policy in the field of science should recognize and reflect some of the changing values of our time:

1. The increasing gap between the rate of technological levelopment and the real progress of human welfare.
2. The alienation of youth from nineteenth-century value systems -- systems which have allowed science (as well as many other disciplines) to become too isolated from the human dimension. This is reflected in the rejection of science by youth in the United Kingdom as reported by the Royal Society, the Association of University Teachers, and Sir James Taylor's observations.
3. The emergence of the informed adolescent who is exposed to and retains most of the current factual knowledge possessed by adults at a much younger age.
4. The disenchantment with a technological society which has not solved the problem of providing reasonable benefits to all levels of the population, and has pursued programs which reflect narrow views of self-interest without adequate thought of consequences.
5. The problems to be faced with the deluge of published material in most disciplines which exceeds human capacity for intelligent use.
6. The change in human commications from text orientation to electronic systems and the need for science to adapt to this process of evolution.
7. The need for scientific development programs to emerge from the constraints of the compartmental system and to recognize the advantages of multi-disciplinary approaches to problems which have been displayed in an impressive manner during World War II, EXPO ${ }^{\top} 67$ and the American space program.
8. In view of Canada's reasonably moderate resources, the need to focus attention on the areas in which significant advances may be made instead of piecemeal programs designed to give too little to as many as possible.
9. The importance of creating an atmosphere in which productive research can flourish. This creative process cannot develop its full potential in either a totally permissive or a completely rigid policy structure.
10. The impact of developments within one discipline on those of another discipline. The explosive progress in communication technology now makes it virtually impossible to enforce existing copyright laws. Despite this obvious fact and its serious implications with respect to contractual obligations involving intellectual properties little or no original research work on copyright is being carried on at Canadian Universities. It is, therefore, possible to assume that major improvements in handling data through the use of electronic systems could be delayed through legal suits until legislation catches up with what is now technical fact.

Concluding observations with reference to the specific terms of reference of the Senate Special Comittee on Science Policy.
(a) Canadian research programs in the field of motion picture film communication methodology and technical processes lags considerably behind that of the Socialist countries of Europe. As a typical example, Czechoslovakia having a population comparable to this country employs two hundred scientists and engineers in the VUZORT Institute (Canadian equivalent three engineers and six technicians) which is concerned solely with motion picture processes. In addition, the state controlled studios such as Barandov and the museums are used for experimental programs of various types. The benefits of this program are notable in that country's international critical and financial success in feature film production as well as the highly imaginative presentations such as Lanterna Magika and the national pavilion at EXPO. In the United States and most of the other western countries, experimental work in equipment and materials is carried out by the manufacturers. Recently the American film industry has moved to re-establish its former Research Council through the creation of the Motion Picture and Television Research Center. However, the democratic countries generally appreciate the growing need for more study of the film medium as the era of hardware orientation gives way to increasing emphasis on content.

In this area, the Film Board enjoys a unique international reputation for innovation. It is hoped that there will be continuing opportunity to develop this asset which has served as the model for most government film agencies since World War II.

In terms of research program, it is likely that more benefit can be gained from study of experimental production techniques than the development of equipment. The latter activity would
(a) (cont'd)
be a questionable venture in Canada in the light of a small domestic market and the industrial advantages which other countries possess through well-established supporting services (optics, instrumentation etc.) needed to maintain competitive costs.
(b) It is difficult, if not impossible, to determine what research programs are under way within the Federal Government structure. Quite likely this situation has led to the rather loose application of the tern (perhaps as a status symbol) to cover inconclusive activities and to pernit duplication of effort.

It would seem, therefore, that some coordinating body is needed to provide such services as:

1. Maintaining a central source of information on all

Federal research programs, manpower resources and facilities.
2. Through the use of appropriate comittees to review scientific research needs in terms of the multidisciplinary talents available anc designated national goals. There appears to be much merit in assessing research proposals in terms of the problem involved as well as on the narrower basis of departmental interests and mandates. A very determined effort must be made to break out of the traditional compartments in this respect.
3. Through a knowledge of the programs under way, the coordinating agency might identify gaps in planning where a major advance in one field simply creates new burdens in another area in which a parallel supporting activity should have occurred.

The objective of the coordinating agency, perhaps an expanded responsibility of the National Research Council, would be to create a research mosaic in which the
(b) 3. (cont'd)
individual areas of expertise would continue to function with provision for greater opportunity for crossfertilization and interdepartmental projects.
(c) Federal assistance to research and development activities might take the form of selective tax concessions to encourage projects which are in the national interest. Some allowance in the form of a special departmental research fund, might be made available when Parliamentary estimates are considered. This fund, limited to some specific percentage of a total vote, would be available only for approved projects. If approved, the investigation might be assigned by the Department concerned to other qualified organizations or individuals. This would create more incentive to develop research programs and they would not become lost as expendable items within a department's other priorities.
(d) In the long view, Canada's science nolicy should aim for:
(a) A financial structure tied to the Gross National Product.
(b) The creation of a regulatory body which would recognize and assess both the scientific and humanistic implications and goals of development programs. Particular attention here would be directed to discrepancies in the rate-ofincrease of technological achievement as compared with that of social welfare.
(c) The development of an information support program for science activities to encourage greater understanding and participation both in man and his world.

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## APPENDIX 51

## RESEARCH BY THE CANADIAN WHEAT BOARD

A Brief from The Canadian Wheat Board to the Senate Committee on Science Folicy


1. The Canadian Wheat Board is the exclusive marketing agency for Western Canadian wheat, oats and barley. The Board is given no statutory research functions. It has, however, initiated a number of research projects in order to secure the benefits of expanding knowledge and technological advance. It has also collected, since its inception, exact and detailed statistical data on all activities affecting its country, terminal and foreign operations.
2. In an era of almost fervent scientific activity in which rapid progress is being made in nearly all fields, the grain industry, and The Canadian Wheat Board in particular, cannot afford to underrate the benefits to be derived from scientific research. A broad, intensive and coordinated research effort by the entire industry is required. The proposed National Grains Council may prove to be the body which can provide the direction for and co-ordination of the research effort required.

## Canadian Wheat Board Research

3. The Canadian Wheat Board was established as a Crown Corporation under The Canadian Wheat Board Act of 1935. Section 25 of this Act stipulates that "The Board shall undertake the marketing of wheat produced in the designated area in interprovincial and export trade." Section 5 (1) states that, "Subject to regulations, the Board shall sell and dispose of grain acquired by it pursuant to the operations under this Act for such prices as it considers reasonable, with the object of promoting the sale of grain produced in Canada in world markets."

The Canadian Wheat Board then, is invested with the responsibility to market Western Canadian wheat, oats and barley. In essence, its control extends from the farm to the seagoing vessel. The Board issues to producers' delivery permit books, sets delivery quota levels, generally controls the flow of all grains from country elevators to terminal positions, makes sales for designated shipping periods and positions, and daily establishes asking prices for all grades of wheat in all export positions. The services of the Winnipeg Grain Exchange are utilized by the Board in selling oats and barley in store, the Lakehead or Vancouver. The Wheat Board renders to the producers all funds earned from the sale of grain less marketing costs and Board administration costs.
4. An organizational block diagram showing the main divisions and sections of The Canadian Wheat Board is attached.
5. No explicit statutory functions or powers regarding scientific research are written into The Canadian Wheat Board Act. The Board's prime responsibility is to market the Western Canadian farmers ${ }^{1}$ grain. It has never pursued a systematic policy of continuous research, but has, rather, undertaken research projects as they became necessary to enhance the Board's marketing activities. No organizational policies have therefore evolved which would define the Wheat Board's "policy toward science." Grain market research has traditionally been conducted by The Canadian Wheat Board, other federal agencies and the universities, largely independently of each other. However, with the establishment of the proposed National Grains Council, all federal agencies concerned with grain marketing as well as the organizations within the grain industry may undertake a more ambitious and
co-ordinated role in this area of research.
6. No defined steps are currently taken to hire members of university graduating classes for purposes of doing research. Personnel with university training and research experience are hired, but mainly to fulfill other functions. On occasion, they become involved in research projects.
7. In spite of the fact that the Wheat Board has no statutory powers in the area of market research, it would be impossible for any organization with the Board's authority and responsibility to function effectively without becoming involved in scientific pursuits as defined in Appendix B of the Senate Committee's "Guidelines." Of the five categories of research activity distinguished, The Canadian Viheat Board is involved in two: data collection, and research and development. But it is only in the area of data collection that the Board has been active on a continuous basis.
8. All Wheat Board research is conducted by or under the direction of personnel in the Winnipeg head office.

## Data Collection

9. All data collected are for operational purposes. Information supplied by a producer to the Board is regarded as "strictly confidential."
10. Statistical data of legal land descriptions, acreage by individual crops, and owners and tenants of land are obtained from the Producer's Delivery Permit Books which are issued annually for each farm unit.
11. A record of each delivery of grain by farmers to country elevators is kept through the medium of Cash Ticket-Producers Certificate forms
which are issued by elevator agents at the time of delivery. The certificate portions and related reports provide the Board with information on the volume, the kind and the grade of grain marketed.
12. Data on stocks of grain by grade on hand in all country elevators, receipts from producers, and shipments from country elevators are secured weekly from the "Form 101." The Form 101 is submitted weekly to The Canadian Wheat Board by all country elevator managers in the Board's designated area.
13. Complete statistical data are maintained on the amount of monies
advanced and the repayments made under the Prairie Grain Advance

Payments Act, of which the Board is Administrator.
14. The Board maintains complete data for all wheat sales in regard to the quantities sold, the selling prices, the grade of wheat involved, the destination of shipment, the port of exit for export grain and the period of shipment.
15. Special questionnaires completed by country elevator managers as required (usually four or five times a year), to secure statistical data by individual grains and grades, relative to production, farm stocks, farm requirements for feed and seed, and farm stocks of grain available for delivery to commercial facilities.
16. Data on acreage, yield, production, prices, imports and exports for all grains in virtually all countries in the world are collected continuously from secondary sources by Wheat Board personnel.

## Research and Development

17. No basic research (i.e., research without specific practical application)
is undertaken by Wheat Board personnel. Research which has been conducted can, almost without exception, be classified as applied (i.e., research which is directed toward specific practical applications). As requested in the "Guidelines, "only those projects which have been conducted since 1962 will be described in this brief.
18. Members of the Board are almost daily confronted with a host of problems requiring immediate decisions. To assist them in making sound decisions about short term marketing problems, they are able to call on technical experts trained in such diverse fields as economics, the agricultural sciences, computer technology and statistics. These technical personnel are able to draw on detailed knowledge of their fields and outline the alternative courses of action available.
19. Close surveillance of changing circumstances in all wheat importing and exporting countries is made by the three professionally trained members of the Board's Technical Services and Market Research Department. Their duties encompass such diverse functions as the collection of all information relevant to the sale of Canadian wheat in international markets, the dissemination of information about the Canadian grain situation, and customer service. Special attention is devoted to the milling and baking industries in wheat importing countries. The staff of this department, however, undertakes only short term studies. No long term research regarding the underlying technical, economic or political forces which affect supply and demand in individual foreign markets is pursued.
20. For an 18 month period in 1966 and 1967 , The Canadian Wheat Board financed two graduate students at the University of Wisconsin while they worked on research projects for their doctoral dissertations.

The objective of the first study, by H. F. Bjarnason and entitled "An Economic Analysis of 1980 International Trade in Feed Grains," was to predict 1980 world feed grain prices, production, consumption and trade flows for the major feed grain trading nations. The objective of the second study, by A. Schmitz, entitled, "An Economic Analysis of the World Wheat Economy in 1980," was identical, except that the commodity involved was wheat rather than feed grains. To accomplish the objective, demand and supply equations were estimated by the use of multiple regression techniques for each of the major trading nations, and these equations were then adjusted to represent 1980. For the remaining regions, point projections of production and consumption were made. The equations were adjusted to account for transfer costs and political policies, and equilibrium solutions were then achieved by the use of a quadratic programming algorithm developed for spatial equilibrium models by Takayama and Judge, and modified for international trade by Bawden. The two grain models now permit analyses of the probable consequences to Canadian grain producers of changes in domestic or foreign grain or trade policies.
21. The Data Processing Division of The Canadian Wheat Board is devoting increasing time and effort to research into systems and procedures, data processing and computer applications. The knowledge gained by the exploratory work of this department is being made available to other sectors of the grain trade.
22. A University of Manitoba graduate student in Computer Science, Mr. D. B. Fast, is currently being sponsored by the Board to investigate the nature and usage of primary data covering all aspects of grain handling. He intends to define these elements of data with


#### Abstract

quantities and interrelationships clarified, and to show conceptually how an information gathering system can reduce redundancy, improve efficiency of information dissemination, and provide a data base of information of value to the entire grain trade.


23. Long range plans are currently being directed toward the ultimate implementation of an Integrated Real-Time Management Information System for the grain trade. Two segments of the proposed system became operational with the commencement in the current crop year of: (a) the Producer Account Identification System, which provides a means of permanently identifying a producer and through the use of optical scanning techniques eliminates former manual methods required to introduce data into the computer system, and (b) the Churchill Terminal Project, which relieves the Wheat Board and grain companies of previous error-prone manual systems, and provides them with information from Churchill in as close-to-real-time as possible. The Churchill Terminal Project has forcefully demonstrated the practicability of exploiting new technologies such as telecommunications, multiprocessing, and real-time systems.
24. Other developments in the Data Processing Department which may be completed and applied in the near future include (a) a railway conveyance allocation and grain intransit project. This will involve the development of a comprehensive data base to be on line in large disk files capable of being interrogated by management through the use of display terminals, (b) Fort William and Vancouver terminal projects similar to the presently functioning Churchill pilot project, and (c) the development of a telecommunication network to serve the grain trade across Canada. Each agency, including the railways, lake shippers,
brokers, buyers, terminals, country elevators, the Board of Grain Commissioners and The Canadian wheat Board would transmit to and receive from a central exchange and repository of data, information pertinent to the requirements of the enterprise.
25. In the area of grain handling and transportation, a Wheat Board Commissioner and two economists have participated, in co-operation with representatives of the two major railways, the country elevator companies and the Board of Grain Commissioners, in the research program of a technical group appointed by the Grain Transportation Committee. The Grain Transportation Technical Group was established in the spring of 1967 to investigate the entire Western Canadian grain handling process, and to devise the most efficient system possible for moving grain from farms to the holds of ships docked at terminal elevators.
26. The Technical Group has made recommendations for ways to increase the throughput of grain at the West Coast, and for ways of loading grain with greater protein uniformity into vessels at Vancouver. Current projects include the development of a management information system for the grain trade, the development of a simulation model of the Western Canadian grain transportation system, and the development of a new system of ordering and moving grain from the country to terminal positions which is both very highly controllable and dependable.
27. The following reports have been published and distributed by the Grain Transportation Technical Group:
(a) "Proceedings of the Grain Transportation Workshop," September 6, 7 and 8, 1967.
(b) "Shipping Orders," Technical Report No. 1, October, 1967.
(c) "A Proposal for a Co-ordinated Shipping Order System, "Technical Report No. 2, March, 1968.
(d) "Movement of Grain Through West Coast Ports," Technical Report No. 3, March, 1968.
(e) "Management Information, "Technical Report No. 4, March, 1968.
28. A request is made in 2.10 of the "Guidelines" for commentary on the probable effects in the next 5 to 10 years of scientific activities in general on the Board's operations. It is, of course, virtually impossible at this point in time to predict what technological advances will be made; nevertheless, three of the areas in which scientific developments may be sufficiently revolutionary to affect Wheat Board. operations are: (a) the development of new, high yielding grain varieties, (b) innovations in grain handling and transportation, and (c) the development of new milling and baking techniques.
29. New, high yielding grain varieties would affect acreage seeded to individual grains, the outlets for these grains, and the prices at which the grains would be marketed. Innovations in grain handling such as the introduction of telecommunications for instant data transmission, the use of unit trains and super ocean bulk carriers for the transportation of grain, and the development of large, centralized country delivery points would make the Wheat Board's operations more effective. The development of new milling and/or baking techniques could affect the demand for the hard spring wheat varieties grown on the Canadian prairies relative to the demand for other kinds of wheat. The results of these scientific activities would in no way affect the Board's current function and responsibility -- the orderly marketing of grain.

30. Since the Farm Credit Corporation does not engage in scientific activities, this brief is confined to Sections II.2.2 and II.2.10 of the Guide for Submissions of Briefs.

## 2. Organization and Function

The Farm Credit Corporation was established by the Farm Credit Act (1959) and reports to the Minister of Agriculture. The functions of the Corporation are to make, administer and supervise farm loans as provided for in the Farm Credit Act and the Farm Machinery Syndicates Credit Act. Under the Farm Credit Act long-term loans are made to acquire and to improve farm land, to improve or erect farm buildings, and generally for purposes to increase farm efficiency and to increase the value of farm businesses. Under the Farm Machinery Syndicates Credit Act, the Corporation makes intermediate-term loans (up to seven years) to farm syndicates (groups of three or more farmers organized under this Act) for the joint purchase and operation of farm machinery.
3. The Corporation has five members appointed by Governor in Council. The Head Office is in Ottawa. There are seven Branch Offices and 127 field offices. Total staff is 630 .
4. In the last fiscal year the Corporation made 12,000 loans amounting to $\$ 264$ million. The Corporation has some 63,500 outstanding loans, one for every four commercial farms. About one billion dollars in loans is outstanding. Funds for loaning are provided by the Minister of Finance.
II.2.10 For organizations not currently engaged
in scientific activities
5. Although the Farm Credit Corporation is not engaged in scientific activities, its policies, responsibilities and operations are profoundly affected by new scientific and technical developments. The primary impact of scientific developments on the Corporation's activities is through their effects on the technology, operations, organization and financing of farming. A secondary effect of scientific developments is on the operations of the Corporation itself through improved management, staff training techniques, data processing, communications and generally in timeliness and efficiency of operations.
6. The exploitation of scientific developments has resulted in profound changes in agriculture in recent years. Mechanization, electrification, the use of chemicals and drugs and other technological developments have made possible much larger and more productive farm businesses, have resulted in greatly increased purchases of goods and services used in farming and in an increasing application of farm and business management skills.
7. The changes in farming which are most significant from the point of view of financing the farm sector are the expanded acreages, the larger and more sophisticated farm buildings and material-handling equipment, bigger and better field machinery and the more extensive use of fertilizers, pesticides, feed additives, etc.. To exploit the technological advances in crop and livestock production requires a larger long-term investment in land and buildings, larger intermediateterm investment for equipment and livestock and much larger annual cash outlays for operating expenses.
8. The technological developments referred to above have affected the organization and structure of farms. Very high capital requirements have encouraged two or more farmers, often related, to co-operate in the operation of farms. The nature of co-operation varies from simple exchanges of labour or machinery to partnerships and family farm corporations. Farming operations have become more specialized and require considerable technical and business knowledge by the farmer.
9. These developments in technology and farm organization have resulted in a continuing review and up-dating of the legislation and of the Corporation's policies and operations to meet the needs of modern farm finance. For example, on several occasions the maximum size of loans to farmers has increased, and provisions have been made to make loans to groups of farmers and to family corporations. The Farm Machinery Syndicates Credit Act was implemented to assist in reducing farmers, investment and operation costs for farm machinery. Proposed amendments are now before the House of Commons which would broaden this Act to provide loans for purposes other than to buy machinery. Provisions have been made for greatly increased funds for farm credit, recognizing that adoption of technological advances and scientific developments means higher capital requirements. Higher capital requirements have imposed difficulties on young people who wish to take up farming.

Proposed amendments to the Farm Credit Act are now before Parliament which provide for larger loans in relation to total farm assets to this group if the borrower has adequate management ability and will accept the advisory services supplied by the Corporation staff. This has imposed a requirement for highly trained staff who are able to provide this service.
10. The revolution in electronic data processing has had its impact on farms. A relatively recent development in this area has been the implementation of simplified methods of maintaining and analyzing farm business accounting records. Farmers send to a computer centre monthly records of farm business operations for tabulation and analysis. Although there are many systems and agencies in North America developing and operating such systems, it is believed that the Corporation's program includes more farmers than does any other agency in North America if not in the world. Through this program a valuable and unique bank of data is being accumulated. This experience has also been a contributing factor in developing a Canadian Farm Management Data System.
11. Another kind of scientific development which has an impact on the Corporation's activities is research in the social sciences and particularly in agricultural economics. The Corporation makes long-term loans for periods up to thirty years. Research in long-term projections of demand for and supply of farm products is therefore of considerable importance to the Corporation. Research into the probable supply response to changes in demand in different regions of the country is also of significance in the Corporation's operations. Research into the changing organization, structure and productivity of farms and projection of such changes into the future is also very relevant. Additional research fields of importance to the policies and operations of the Corporation are: research into changing capital and credit requirements, the demand for and supply of capital, the institutions affecting the demand and supply of funds, farm credit needs, alternative methods of providing farm capital, land tenure research and farm management research into the most profitable types, sizes and kinds of farm operations as well as into management requirements. The Corporation considers it essential to be advised on research results and of the implications of these results for its policies and operations.
12. The Corporation relies on various agencies for research in these areas. Among these agencies are the Canada Department of Agriculture, Departments of Agricultural Economics at Universities, the Agricultural Economics Research Council of Canada and various commissions, inquiries, task forcest, etc.. In some cases, the Corporation undertakes co-operative studies with the Canada Department of Agriculture and in others, it contracts studies.
13. Some of the impacts of these scientific and research developments over the next few years on the Corporation's policies and operations are indicated in legislation now before Parliament which would:
(1) increase the loaning capacity of the Corporation by 35 per cent to nearly $\$ 1.4$ billion;
(2) expand the authority to lend to farmers who have organized their businesses as farming corporations or co-operative farm associations;
(3) make it easier for a farmer to start his son in farming;
(4) enable the Governor in Council to establish interest rates rather than having them prescribed in the Act as at present;
(5) enable loans to be made to Indians on reservations;
(6) enable the Corporation to assist in administering funds under the Fund for Rural Economic Development Act;
(7) increase the maximum loan where two or more farmers are farming together and
(8) enable loans to be made up to 90 per cent of the value of the security to those with more than average managerial skill.
14. With respect to the Corporation's own operations, the Corporation has commissioned a number of studies over the last five years to improve the effectiveness of its work in the light of scientific and technological developments. These studies have been undertaken by management consultants and include a study of the Corporation's data processing and steps which might be taken to incorporate latest techniques in this field. In the management area other studies have been made on organization, salaries, administration and management structure and co-ordination. The Corporation also uses internal task forces to study and make recommendations on certain types of problems.
15. In summary, the scientific and technological developments which are occuring in agriculture profoundly affect the policies, responsibilities and programs of the Corporation. They impose requirements for highly trained staff, greatly increased capital requirements, refined techniques and policies in the provision of loans, advice and supervision to farmers and for sophisticated management and data processing methods in the Corporation's operations. Although some research work has been done by the various agencies in the economic and social aspects of farming, it is considered that this type of research has seriously lagged behind research in the biological and natural sciences in agriculture. With the rapid commercialization of agriculture and of farm finance which has been occuring in the past and its undoubted continuation, it is considered that economic and farm management research will be of even greater importance in farming and in its impact on the Corporation's policies and operations in the future.

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[^6]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. 42

WEDNESDAY, APRIL 30th, 1969

## WITNESSES:

Department of Industry, Trade and Commerce: Jack Hamilton Warren, Deputy Minister; David B. Mundy, Assistant Deputy Minister; V. J. Macklin, General Director, Office of Economics Branch; Hugh Charles Douglas, Deputy, Industrial Research Adviser; R. K. Brown, Deputy (Scientific), Office of Science and Technology; and D. G. Boxall, Scientific Consultant-Materials, Office of Science and Technology.

## APPENDIX:

No. 53-Brief submitted by the Department of Industry, Trade \& Commerce.
No. 54-Brief submitted by the Department of Public Works.
No. 55-Brief submitted by the Emergency Measures Organization.
No. 56 -Brief submitted by the Dominion Coal Board.
No. 57-Brief submitted by the Library of Parliament.
No. 58-Brief submitted by the Public Archives of Canada.
No. 59-Brief submitted by the St. Lawrence Seaway Authority.

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# MEMBERS OF THE SPECIAL COMMITTEE ON <br> 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 affimative."

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 wasResolved in the affirmative.

ROBERT FORTIER, Clerk of the Senate.

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## MINUTES OF PROCEEDINGS

Wednesday, April 30, 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), Aird, Belisle, Bourget, Carter, Grosart, Haig, Kinnear, McGrand, Robichaud, Sullivan and Yuzyk-12

In attendance: Philip J. Pocock, Director of Research (Physical Science)
The following witnesses were heard:
DEPARTMENT OF INDUSTRY, TRADE AND COMMERCE:
Jack Hamilton Warren, Deputy Minister;
David B. Mundy, Assistant Deputy Minister;
V. J. Macklin, General Director, Office of Economics Branch.

Hugh Charles Douglas, Deputy Industrial Research Adviser;
R. K. Brown, Deputy (Scientific) Office of Science and Technology;
D. G. Boxall, Scientific Consultant-Materials, Office of Science and Technology;
(A curriculum vitae of each witness follows these Minutes.)
The following are printed as Appendices:
No. 53. Brief submitted by the Department of Industry, Trade \& Commerce.
No. 54. Brief submitted by the Department of Public Works.
No. 55. Brief submitted by the Emergency Measures Organization.
No. 56. Brief submitted by the Dominion Coal Board.
No. 57. Brief submitted by the Library of Parliament.
No. 58. Brief submitted by the Public Archives of Canada.
No. 59. Bhief submitted by the St. Lawrence Seaway Authority.
At 12.45 p.m. the Committee adjourned to the call of the Chairman.

## ATTEST:

Patrick J. Savoie, Clerk of the Committee.

## CURRICULUM VITAE

Boxall, D. G. Born October 22, 1921 at Sheffield, England. Graduated from the Honours School of Metallurgy, University of Sheffield in 1942. From 1942-46 was with Power Jets (R\&D) Ltd. as a development metallurgist. Came to Canada in 1947 and after brief stays with A. V. Roe (Canada) Ltd. and the British Columbia Research Council, joined the Department of Mines and Technical Surveys in 1949, and seconded to the Chalk River Nuclear Laboratories of NRC. In 1955 joined the Civilian Atomic Power Dept. of Canadian General Electric becoming Manager of Materials Engineering. In 1967 left C. G. E. to become scientific consultant-materials, with the Office of Science and Technology, Department of Industry, Trade and Commerce. Member of American Institute of Mining, Metallurgical and Petroleum Engineers, American Society for Metals, and Ontario Association of Professional Engineers.

Brown, R. Keith. M.A. Mathematics and Physics, University of British Columbia. 1942-48 Lecturer in the Physics Department, UBC, responsible for the organization of laboratory work and instruction of a pre radar radio course given to RCAF radio technicians by the university. 1948-49 Assistant Research Physicist, B.C. Research Council, responsible for contract industrial research projects with firms mainly in the Vancouver area. 1950-51 Radiation Physicist at B.C. Cancer Institute. 1951-58 Defence Research Board, participation in and later supervision of the work of a small group (scientists, engineers and technicians) responsible (in co-operation with an industrial contractor) for the design, development and testing of an airborne, doppler navigation radar. This device is now in use in the RCAF, United States military aircraft and several of the world wide commercial airlines. 1959-64 Section Head, Satellite Instrumentation Section, Defence Research Board, responsible for the organizing, direction and supervision of a group of scientists, engineers and technicians carrying out the design, development, construction, testing, launching and operation of the artificial earth satellite Alouette 1. 1964-65, Chief, Government Telecommunications Planning, Department of Transport. 1965 to present, Deputy, Scientific, Office of Science and Technology, responsible for supervision and direction of a group of senior scientific and engineering consultants. Member of Institute of Electrical and Electronics Engineers, the Ontario Association of Professional Engineers and the Canadian Association of Physicists.

[^7]fighter, and the preliminary design of the CF-105 fighter, and the preliminary design of the CF-105 Arrow supersonic fighter. In 1954, Mr. Douglas joined the Department of Defence Production, Aircraft Branch, and was subsequently appointed Chief of the Division responsible for the development and production of Aircraft, Aircraft Engines and Guided Missiles. From 1960 to 1963, he was attached to the Canadian Embassy at Bonn, Germany, and represented the Department of Defence Production and the Canadian Commercial Corporation in Germany and several other European countries. In 1964, Mr. Douglas transferred to the Department of Industry as Deputy Industrial Research Advisor, which position he continues to hold in the Department of Industry, Trade and Commerce. Mr . Douglas is a member of the Engineering Institute of Canada, the Association of Professional Engineers of the Province of Ontario, and the Canadian Aeronautics and Space Institute.

Macklin, V. J.: Born in Grande Prairie, Alberta in November 1917, attended public and high school in Grande Prairie and graduated with a B.A. (Honours in Economics) degree from the University of Alberta in 1939. Joined the federal service in 1939 first with the Department of Agriculture and subsequently was employed in the Department of Munitions and Supply, the Department of National Defence, the National War Labour Board, the Western Labour Board and the Department of Reconstruction and Supply. Transferred in 1949 to the Department of Trade and Commerce where he became Director, Economics Branch in 1951, and General Director, Office of Economics in 1967. Presently holds this same position in the new Department of Industry, Trade and Commerce.

Mundy, David B., who was appointed Assistant Deputy Minister, Department of Industry in October, 1963, was born in Edmonton, Alberta in 1919. He was educated at the University of Alberta from which he graduated in 1940 with a Bachelor of Commerce degree. Upon graduation, he joined the Canadian Army and served from 1940 to 1945 in England, France, Belgium, Holland and Germany, retiring from the service in 1945 with the rank of Captain. From 1945 to 1951, Mr. Mundy served in the Trade Commissioner Service of the Department of Trade and Commerce and occupied posts at Liverpool and Stockholm. For the year 1950 he was loaned to the Department of Fisheries to conduct an economic study and initiate a new project. In 1951 Mr. Mundy joined the Department of Defence Production and from 1952 to 1954 he served in Paris with the Canadian Delegation to the North Atlantic Treaty Organization. Mr. Mundy returned to Ottawa in 1954 to be Director of the Armament Branch of the Department of Defence Production. In 1956 he became Director of the Electronics Branch, and in November, 1962 he was appointed Assistant Deputy Minister of the Department of Defence Production. He was also appointed Assistant Deputy Minister of the Department of Industry and served in both capacities until October 1968. An extensive government reorganization of industry-oriented department took place during the summer and fall of 1968 , and Mr. Mundy was appointed Assistant Deputy Minister (External Services) in a new department of Industry, Trade and Commerce. His present duties include responsibility for the Canadian Trade Commissioner Service, and International Defence Industry programs.

Warren, Jack Hamilton, appointed Deputy Minister effective April 1, 1969 of the newly-formed Department of Industry, Trade and Commerce, was born
in 1921 near Chatham, Ontario, and graduated from Queen's University, Kingston, in 1941, with a B.A. degree. Mr. Warren served as Deputy Minister of the former Department of Trade and Commerce from September 1964 until his present appointment. He joined the Department of External Affairs in 1945, and in 1948 was posted to the Office of the High Commissioner for Canada in London. Mr. Warren returned to Ottawa in November 1951, and was transferred to the Department of Finance in 1954. He was posted to the Canadian Embassy in Washington as Financial Counsellor, and was also appointed Alternate Executive Director for Canada to the International Monetary Fund and International Bank for Reconstruction and Development. On returning to the Department of External Affairs in 1957, he was posted to the Permanent Delegation of Canada to NATO and the Organization for European Economic Co-operation, with special responsibility for European regional economic developments. In September 1958, Mr. Warren was appointed Assistant Deputy Minister of Trade and Commerce. Mr. Warren has represented Canada at many international conferences concerned with trade and economic affairs. In September 1960, he was elected Chairman of the Council of Representatives of the General Agreement on Tariffs and Trade, and was Deputy Chairman of the Canadian Delegation to the GATT Tariff Conference, held in Geneva, Switzerland, in 1960 and 1961. He was Chairman of the Contracting Parties of GATT from 1962 to 1965. Mr. Warren is Chairman of the Board of Directors, Export Credits Insurance Corporation, a Director of the Industrial Development Bank and a Director of Canadian Patents and Development Limited. He is a member of the Canadian Government Specifications Board, the National Design Council, the General Adjustment Assistance Board, the Automotive Adjustment Assistance Board, and the Machinery and Equipment Advisory Board. During the Second World War, he served with the Royal Canadian Navy as an executive officer. He is married and has four children.

## THE SENATE

# SPECIAL COMMITTEE ON SCIENCE POLICY 

## EVIDENCE

## Ottawa, Wednesday, April 30, 1969

The Special Senate Committee on Science met this day at 10:00 a.m.

Senator Maurice Lamontagne (Chairman) in the chair.

The Chairman: Honourable senators, this is our last meeting for phase 2 of our inquiry. We have now finished hearing the agencies of government interested directly or indirectly in research and development. When we meet in the middle of May we will start the last phase of our inquiry and we will begin receiving representations from the private sector.

To end this second phase, this morning we have with us very important people, the representatives of the Department of Industry, Trade and Commerce, a department which is mainly responsible for stimulating and encouraging industrial research in Canada. I am sure that we will have a most interesting discussion about the various programs which have been initiated in recent years to encourage that kind of research and development.

Representing the department are $\mathbf{M r}$. Warren, the Deputy Minister; Mr. Mundy, Assistant Deputy Minister; Mr. Brown, Deputy, Scientific, Office of Science and Technology; Mr. Douglas, Deputy, Industrial Research Adviser, and Mr. Macklin, Director, Economies Branch of the department.

And so, without any further introduction, I will ask Mr. Warren to give us his opening remarks and then we will have the usual question period.

Mr. Jack Hamilton Warren, Deputy Minister, Department of Industry, Trade and Commerce: Merci M. President, it is a pleasure for myself and my colleagues to have the opportunity to appear before this committee of the Senate and we appreciate the occasion.

Honourable Senators, I should, perhaps, explain that Dr. Orr, who was Scientific

Adviser to the department has taken up a foreign appointment and pending appointment of his successor, Mr. Brown and Mr. Douglas are sharing the responsibility of leadership for our Office of Science and Technology.

Honourable Senators, it is a pleasure, as I have said, for the Department of Industry, Trade and Commerce, to present our submission to this Special Committee on Science Policy. I do not intend to take up your time discussing the department's submission in detail, however, I should like to summarize, briefly for you, our role, as we see it, in this field and to give you some idea of our thinking about the future.

The objectives of the Department of Industry, Trade an Commerce are set forth in The Government Organization Act 1969 which states, in part, that the minister shall promote the establishment, growth and efficiency of manufacturing and processing industries in Canada, contribute to the sound development and productivity of Canadian industry generally and foster the expansion of Canadian trade.

Duties of the minister which are of particular relevance to the work of this committee provide that he shall develop and carry out such programs and projects as may be appropriate to: (a) assist manufacturing and processing industries to adapt to changes in technology and to changing conditions in domestic and export markets, (b) assist manufacturing and processing industries to develop their unrealized potential, to rationalize and restructure their productive facilities and corporate organizations and to cope with exceptional problems of adjustment, and (c) promote and assist product and process development and increased productivity, the greater use of research, the application of advanced technology and modern management techniques, the modernization of equipment, the utilization of improved industrial design and the development and application of sound industrial standards in Canada and in world trade.

It is our conviction that the achievement of these objectives for our secondary industry, can best be accomplished by an integrated approach to the complex of factors bearing on growth rather than by treating in relative isolation the different elements, including research and development, which make up the innovative and adjustment process so important to Canada's industrial development, trade expansion and future prosperity. The merger of the Departments of Industry and of Trade and Commerce will, it is hoped, enable us to accord balanced treatment to the many related problems and opportunities of the mandate given to us by Parliament. The blend of skills now available in the new department provides competence and knowledge in the many disciplines involved in the total process so that the programs I am about to describe will be operated in an organization which takes account of the interactions among all the factors involved, including of course science and technology. The organization chart of the department which is before you, in our submission, illustrates the way in which we are structured to perform our tasks.

A growing mass of evidence indicates that a major element in meeting the objectives I have outlined for our manufacturing and processing industries and our trades is the effective exploitation of science and technology. Recent studies indicate that increases in productivity resulting to a great extent from new technology, have been a major factor in the spectacular economic growth which has occurred in the United States over the past 50 years. Comparative studies indicate that Canada has devoted less resources to research and development, which is such a key factor in innovation and growth, than many of the industrialized countries. In 1965, the latest year for which statistics are available, total Canadian expenditures on scientific research and development amounted to $\$ 682$ million or $1.3 \%$ of the Gross National Product. This is low by comparison with such nations as the United States- $3.4 \%$, the United Kingdom$2.3 \%$, the Netherlands- $1.9 \%$, or Japan- $1.5 \%$.

Many authorities in Canada, over the past few years, have urged that more Government sponsored development activity should take place in Canadian industry. More recently, we have made an analysis of Government $R$ \& D expenditures in industry, in relation to the Gross National Product, and these figures are available in table form for distribution. The figures do not permit a break-out between research and development, but it can
be assumed in this case that the vast majority of these expenditures are of a development nature. Unfortunately, as can be seen from this table, we have not been gaining ground with respect to the level of Government expenditures in Canadian industry for this purpose in relation to our Gross National Product. You will note that the existing programs of the Department of Industry, Trade and Commerce are large contributors.
A feature of scientific activity in Canada warrants comment from the viewpoint of the work of this Department. While we have in Canada a record of in-house university and government research of which we can be proud, this effort does not seem to have been matched by a comparable effort through industrial research and development and related innovative activities to improve our product mix and otherwise secure the potential economic benefits for our country. This becomes evident, when considering that, of the total national research, development and innovation effort Canadian industry performs only $42 \%$ by comparison with $66 \%$ for the United States, $67 \%$ for Great Britain, or $65 \%$ for Japanese industry.
Part of the explanation no doubt lies in the subsidiary-parent relationship of many of our manufacturing companies which has enabled Canadian industry to import rather than create much of our modern technology. However, this is by no means the whole answer. Environmental factors, both those established by government and those present in industry, have also been very important. I believe that in Canada, both at the Government and industrial level, we have been slow to recognize how rapidly changing technology was influencing production and consumption patterns and how important it was and is for Canada fully to participate in the innovative process if our country was not to fall behind as a major industrial and trading nation. Happily, there has in recent years been a growing recognition of this phenomenon and priorities are being adjusted accordingly. But much remains to be done both by industry and government.
In the Department of Industry a number of important programmes were developed and set in operation to encourage industry to increase its development and innovative activity by means of financial incentives. Many specific activities of the Department of Industry and of the new Department are also oriented in this important direction.

We have set up and are administering five programmes which provide financial incentives for industrial research, development and innovation activity. I shall describe each of these briefly.
First the Program for the Advancement of Industrial Technology known as PAIT.
This programme was set up to promote the growth of efficient, competitive manufacturing and processing industries in Canada. It provides risk capital for development and innovative projects which appear likely to lead to a marketable product or a new or improved process. The Crown shares the risk and the company making the proposal is expected under current PAIT regulations to repay the Crown share if the project is successful.
The Second is the Defence Industry Productivity Program known as DIP.

The immediate objective of this programme is to develop and sustain the technological capability of Canadian industry for the purpose of defence export sales or civil export sales arising from that capability.

The programme is aimed at those companies or elements thereof which have or may develop a defence-oriented capability employing advanced management engineering and technology directed to defence export sales or related civil export sales.

The Third is the Industrial Research and Development Incentives Act known as IRDIA.

This programme, set up by Act of Parliament, unlike the first two, is not project oriented. It is a general incentive conceived to provide an overall stimulus to industrial research, development and innovation. Canadian firms are not required to receive authorization before undertaking the work but may at the completion of each financial year submit an application for a grant based on their research, development and innovative activity during the year. This grant amounts to $25 \%$ of eligible capital investment in scientific, research and development facilities and $25 \%$ of the increase in current research and development expenditures over the average of the previous five years.

The Fourth programme is the Building Equipment Accessories and Material Program known as BEAM.

The objective of the BEAM programme is to increase productivity and efficiency in the manufacture and use of building equipment, accessories, and materials. Much of the mass
of available information and technology is not readily available to the different elements in the industry. To help rectify this situation the Department has taken the initiative in consultation with industry in designing an information system for the dissemination of information pertinent to building equipment, accessories and material.
And Fifth, the Industrial Research Institutes Program.

It is the view of this department that Canada has much to gain from a closer liaison than now exists between industry and educational institutions-particularly universities and technical institutes. This programme provides grants to universities to help cover administrative expenses of institutes they establish to work with industry and in particular to undertake, on a contract basis, scientific research activity for industrial firms unable to maintain their own research facilities and personnel. It is hoped that this programme will, on the one hand, assist the universities to improve their understanding of the problems of industry and, on the other hand, help industry to become acquainted with the latest pertinent scientific and technological developments.

Details of these five programmes and their administration are covered in Appendices M to $Q$ in the brief you have before you.

In addition to these specific programmes the Department undertakes a variety of other activities many of which are oriented towards the application of science and technology in industry. The following are examples: (1) We carry on continuing studies and analyses of the scientific and technical policies of other Government Departments and agencies and of Governments of other countries so that we may be well aware of the possible impact of these policies on Canadian industry, and ensure that we do not overlook programmes and techniques used by other countries which might be appropriate to the Canadian scene.
(2) We have initiated on a continuing basis a series of techno-economic surveys of sectors of industry. These studies will provide the department with important guidance as to the potential of each industry sector, and the state of technology within an industry. We hope that the surveys will reveal the priority which the industry should attach to research and development, possible areas and appropriate methods of support, and the degree of support which may be warranted.
(3) Technological Forecasting: While technological forecasting cannot be exact because
of the unpredictable nature of innovation and invention, a systematic attempt to forecast technological trends is now recognized as being a necessary part of industrial development planning. The department plans to develop this technique and to make it available in advising and assisting industry.
(4) Scientific and Technical Information Services: The Department has taken a strong interest in and has provided considerable assistance to the study undertaken by the Science Council of Canada on this subject. We expect to continue strong activity in this area both to provide the necessary information services within the department and to ensure that Canadian industry is properly served by any national system which may evolve.

As can be seen from the foregoing the department has laid the groundwork for a wide range of scientific and technological activities. Much useful work is under way and a series of government assists to industry have been developed and applied. But it is clear from what is happening in the competitive world around us, from the accelerating rate of technological change and from the comparative figures I mentioned earlier that both in industry and government we must do more to sustain and advance our position. And the effort must be of a scope and duration and effectiveness to achieve the objectives established and approved.

I believe there is a strong case to be made for improved and more adequate incentives to encourage Canadian industry to change established patterns of operation, to introduce new marketable products and to specialize and rationalize. I consider that in looking at the various government programmes to assist industry in its research and in the application of new technology we should have in mind the whole of the product cycle leading through research and development to preproduction, production and marketing. From the trade and industrial point of view it is the end result of new marketable products which is most important. As in golf, the follow through is what completes a good swing and gets the ball straight up the fairway. We are looking at all our programmes and, in cooperation with them, the related programmes of other agencies such as the National Research Council and the Defence Research Board from this point of view.

In developing innovative projects and programmes with industry, the opportunities are great and so sometimes are the risks, but we believe this risk-taking to be worthwhile. We
have learned from past experience that failures in projects are less likely to be technical failures than management failures. For this reason we place great stress on analyzing proposals from industry against the long-term plans of the company, and we look for a demonstrated ability to carry the process through to the final stage, which is the sale of the product on a profitable basis.
As members of this committee will realize, there are two types of departmental programmes to help industry increase the level of research and development activity. One is the statutory type of programme in which we attempt to create an environment more conducive to a generally higher level of research and development activity, and the other is the specific project-oriented form of assistance where the firm is required to meet very precisely defined objectives. We believe that a mix of both types is necessary, but what is required at this stage is probably more emphasis on the project-oriented type of assistance.

As our work in the new department proceeds we will expect to bring forward necessary changes to existing programmes and possibly new programmes for government approval calculated to assist and speed up the innovative process in Canada and so move towards fuller and more rapid achievements of our departmental objectives. Our experience in handling existing programmes, including the administrative controls designed to ensure programme integrity, financial soundness and continuous monitoring of achievement in relation to objectives will, I trust, ensure that the resources which the government may be willing to place at our disposal will be well applied. We hope to develop a balanced range of incentives and other assistance which will both sustain and encourage product development generally and selectively encourage developments of particular priority for the economy where partnership between industry and government may be the essential key to breaking through to new and higher ground in technology and production.

Thank you, M. President and Honourable senators, for the opportunity to make this presentation.

The Chairman: Thank you very much.
Senator Cameron expressed an interest in initiating discussion this morning, but because of...

## Senator Grosart: Technological problems.

The Chairman: Yes. He has been unable to be with us this morning so that, at the last minute, our staff asked Senator Grosart to pitch in.

Senaior Grosari: Thank you, Mr. Chairman.
First of all I think I am sure we all wish the new department, if I may call it that, very great success in the big job it has ahead of it. This is one of several reorganizations in this particular area of industry, trade and commerce, all obviously tending towards a more sophisticated and efficient machine to perform the very necessary government function of upgrading the level of research and technological development, and innovation in Canada, and I am sure we wish you very great success in that.
I wonder if, just to set the picture in some kind of a context, you would update the broad figures indicating the input of R. \& D. into industry in Canada. The last figures we have are the O.E.C.D. figures in the now famous Orr Report. I think you said he is leaving you and going elsewhere in the foreign service.

Mr. Warren: Yes, he will be the Scientific Advisor and Senior Officer in charge of scientific and technological activities in the Canadian High Commission in London, England.

Senator Grosart: Will he be seconded by your department?

Mr. Warren: He is under the jurisdiction of the Department of External Affairs, as I recall the administrative arrangements that have been made, but his posting has been worked out in consultation with the Science Secretary, External Affairs, ourselves and other departments such as N.R.C.

Senator Grosart: I am sure he will be very valuable in that new posting. On our behalf please wish him success.

Mr. Warren: Thank you, sir.
Senator Grosart: We all recall, I think, that in this report to the Science Council, of 1967, the general effect was to indicate that of the nine selected countries for comparison, Canada was at the bottom of the list in terms of percentage of G. N. P. input into industrial R. \& D. both by performance sector and source of funds. You have given us a table this morning which refers, as I read it, only to
federal government funding so there is not an immediate comparison here.

May I ask you if there has been any noticeable improvement since four or five years ago which is really the effective date of the Orr figures in the R. \& D. component either of industries' own funding or in performance?

Are we any better off than we were when the rather discouraging O.E.C.D. report came out?

Mr. Warren: I wonder if I could ask Mr. Douglas, who worked on the original report and the updating of it, which I believe to be done on a two year basis, if he would respond to Senator Grosart's question?

Hugh Charles Douglas, Deputy Industrial Research Adviser: Mr. Chairman, I think, as you are aware, looking at the document before you, the Dominion Bureau of Statistics released preliminary information on their 1967 survey of industrial research and development just last Friday.

## Senator Grosart: Yes.

Mr. Douglas: This gives us some indication of the expenditures which have been made by industry as a performer in that year in comparison with the 1965 data which was included in the report of Dr. Orr. Unfortunately we do not have a figure for the total research and development expenditures in Canada but I think that from what we know of federal government expenditures and what is revealed about the industrial research and expenditures in this daily bulletin of last Friday we can say that the picture in terms of expenditures as a percentage of gross national product, or of industrial expenditures in terms of a net output or, value added, has not changed substantially since 1965 .

The Chairman: In terms of research activity, but in terms of the financial contribution to such activity?

## Mr. Douglas: Well-

The Chairman: Would it be true to say that industry tends to finance a greater proportion of its own research activities and government less than in 1965 according to these reports?

Senator Grosart: Well, do we have any figures showing industry funding of its own R. \& D.?

Mr. Douglas: Yes, we have.
Senator Grosart: Current?

## The Chairman: For 1967?

Mr. Douglas: For 1967. These are the figures that were published just last Friday, sir, and it shows that the total expenditures by industry in 1967 had increased by $9.7 \%$ over 1966 and that the 1966 increase was $12.5 \%$ over 1965.

Now, these rates of growth are somewhat less than the rates which were experienced in the years 1963 to 1965 when the average rate of increase in expenditures for research and development in industry was of the order of about $24 \%$.

Senator Grosart: The average rate of increase?

Mr. Douglas: The annual rate of increase was about $24 \%$.

Now, you mentioned the question of expenditures financed by industries. In 1965, I think I have the figures here .

Senator Grosart: It is $31 \%$.
The Chairman: They say here, in this publication, that in 1965 industry financed $71 \%$ of its intra-mural R. \& D. compared with $77 \%$ in 1967.

Senator Grosart: Mr. Chairman, we seem to be far apart on figures. The table I have here, which is gross national expenditures on $R$ \& D (this is Dr. Orr's Report) shows industry as a source of total funds for R. \& D. as $31 \%$ in 1965.

The Chairman: This is the total.
Senator Grosart: That is what I am concerned with. I am concerned with the total. This is the only way we can get a picture as to whether there is any improvement. It is important what the sources of funds were and the changes in the relative percentages of the sources of funds, but my question is related to the total picture.

The Chairman: In order not to be confused, Senator Grosart, the figures I just gave were only for the industrial sector and they say here that in 1965, $71 \%$ of research done in industry was financed by industry.

Senator Bourget: Mr. Chairman, does it include the grants or subsidies given by different departments?

The Chairman: No, that is contributions by industry, $71 \%$ in 1965, $77 \%$ in 1967, that is only for industry.

Senator Grosart: This checks out with another table I have here which is the one dated November 11th, 1968, prepared, I imagine, by Dr. Orr as Industrial Research Adviser as I think he was at that time. This is a public document and it shows the 19671968 figure for federal government expenditures as $26 \%$ in the industrial sector so this would about check out with your figure.

I will have to admit I am a little confused here. What I would like is a current comparative figure to the figure of $31 \%$ which was industry expenditure on R. \& D. as a percentage of GERD Gross National Expenditure on R. \& D.).

Mr. Douglas: No, we do not have revised figures for the total gross expenditure on research and development.

Senator Grosart: Would you say this figure of $31 \%$-again I stress it is industry's total contribution to R. \& D.-is up or down?

## Mr. Douglas: As a source of funds?

## Senator Grosart: As a source of funds?

Mr. Douglas: I would think it has not changed substantially, that would be my estimate.

Senator Grosart: That is, in a way discouraging and perhaps this can lead on to my second question which concerns the fact that I think we can all recognize that straight, raw comparisons between countries may not always be valid. Canada may be a particular case, particularly in view of the availability of our R. \& D. through subsidiaries and so on. Would you care to comment on that? Should we compare our figures numerically or should we make qualifications? If we should make qualifications then what qualifications should we make?

Mr. Warren: I think, Senator Grosart, we should try to get hold of whatever information is available. You know the work that Dr. Orr has done, and which has been used by the O.E.C.D., I think needs to be updated. I think that in making judgments there are some qualitative elements that you want to put in. Certainly there are benefits that flow to Canada from the import of technology, but in terms of the innovative process and the end of the product cycle of marketing, goods from Canada and new goods that are competitive internationally, I think it is very important we do focus also on the amount that is being done in Canada because it is the
work that is being done in Canada that is most likely to give us a product which will be marketed internationally and which will not simply be an image of a product produced elsewhere by a parent company.

Senator Grosart: I am very glad to hear you make that observation, sir, because I think it is a very, very important one. Again, I keep referring to Dr. Orr, but he is the source of most of the reading material I have been able to find. This is the thesis that he developed quite strongly in the "Tripartite Chemical Engineering Conference" an article, which appeared in Industrial Canada. He makes this very point, we must innovate in Canada to get that extra time-jump in the selling of the product that comes out of the innovation. I am a little disturbed that your department does not have these figures more precisely for this reason. There is an assumption here, in your incentive programmes, the three big ones, civil and defence, that there needs to be a further input of R. \& D. into Canadian industry.

The question I would ask is; have you any scientific support for this assumption, which is really the basis of the whole departmental program. Why do you say we should have more?

Mr. Warren: Because, sir, of the very rapid change in the product mix that is going into consumption and use throughout the world in the decades we have been living through and projected into the decades ahead. The pattern of goods moving is changing very rapidly. Many of the goods that are now used by companies and purchased by consumers were just not on the market $10-15$ years ago. In world trade terms you find that the greatest growth in world trade now is coming between developed countries, between manufacturing countries, because of the great specialization of use of equipment and source materials and inputs. This is where the growth is to a greater degree than in the trade and materials and we have to, if we wish to maintain our position as a leading industrialized nation, have some of that new product as well as old product to offer to our own consumers and in world markets.

Just to revert to the earlier part of your comment, sir, I don't look at the business of home grown innovation and development nor imported technology as complete alternatives. I think we have to use both, take the benefit of the imported technology where it is the appropriate input and build on it and build
our own so we get the double advantage in our world competitive position. When I say, "world competitive position" I am referring to the competition in our market from imports as well as our possibility of penetrating world markets, particularly for our manufactured goods, now, in addition to our materials with new products that can win markets.
The Chairman: Just supplementary here, if in the process we are too severe or too strict in insisting that these innovations or this development work should lead to improvement in Canada primarily. In certain cases this might discourage research in Canada though.
Mr. Warren: I am afraid, Mr. President, I do not follow you.

The Chairman: Because of that rigidity that you may have in certain of your programmes. If these firms, doing the research in Canada, are not allowed to exploit the technology then the research work may not be done because of the parent and subsidiary relationship.

Mr. Warren: We endeavour, in our programmes, to make sure that the actual research and development is done in Canada and we wish to encourage the companies to get the benefit of that work for Canada through production in Canada which increases our employment and our package of goods for sale domestically and for export.

There is provision, as I understand it, in the PAIT programme for certain exceptions to be made where something cannot be economically justified for production in Canada, but I think it would be questionable whether, $a b$ initio, in a programme we should be using the public funds to finance research and development and innovation in Canada without a control that would tend to make sure that the benefit comes to Canada and which could simply mean that the result of that R. \& D. and innovation was exploited from another country.

Senator Bourget: Then what are your recommendations to improve the growth here in production? Is it through the creation of production research connected with universities as recommended by Dr. Orr?

Mr. Warren: Our feeling, sir, is that more should be done in the industries themselves so that the result of the research and development ends up in a marketable product. We would like to see a bias in government thinking towards more work done by the compa-
nies related to the whole product cycle, not simply for research and development's sake.

Senator Belisle: Could I ask a supplementary question?

You mentioned, Mr. Warren, that your department gives grants to universities to further studies in order to assist industry. How is the selection made regarding universities?

The Chairman: That is not supplementary.
Senator Belisle: What criteria are used to determine which university shall be assisted first in the technical field or a line of industry?

Mr. Warren: Perhaps, Mr. Brown, you would speak to our work with universities, particularly the programme that has been oriented to the development of the research institutes by universities that were willing to work with industry and provide service to industry.

The Chairman: Will you allow me, at this stage, to interrupt? Could you postpone this question please?

Senator Belisle: Yes.
Senator Grosart: Your chart on page 25 (the organization chart of the department) seems to indicate, on first glance, a down-grading of the Office of Science and Technology. Is this just a graphic misconception? When I read the responsibilities of the O.S.T. it seems to be much more important than to be put away down on your chart. Does this office participate at the management level?

Mr. Warren: In the Management Committee this office is not directly represented, but it is represented by the Senior Assistant Deputy Minister responsible for the whole of industrial and trade development activities in the department, Mr . Kniewasser. I think the chart, which you have on page 25 , tends to give a visual distortion of the importance attached to the industrial and trade function of the department. This function includes industrial development inputs, export oriented inputs, and scientific and technological inputs and our external services abroad. It is a very central part of the activities of the integrated department and in our normal displays this whole block of functions is up at the top in line with the Assistant Deputy MinisterIndustrial and Trade Policy, and the other senior echelons of the department. It was our
view, since the objective of the department has to do with efficiency and growth of Canadian industry and trade, that the input from research and development and scientific and technological activities was most appropriately cited within the industrial and trade development function. I again refer you to the notion of the product cycle with work aimed at an integrated effort leading to the end result of new products, greater productivity and growth for Canada. So, in our view, these scientific and technological activities are properly positioned close to these elements of the departments which are working on industrial and trade development.

Senator Grosart: And yet it would seem to have the policy responsibilities. For example, in Appendix C, Page 32, it has the job of advising with respect to national science policy. My first question actually would be; Who would you find to advise in the present circumstances on national science policy?

Mr. Warren: Perhaps I should take that question very carefully, Senator Grosart.

Senator Grosart: Well, there are some good answers.

Mr. Warren: I could reply in this way.
The Chairman: You are always careful.
Mr. Warren: We need to have, and it has been recognized from the beginning of the Department of Industry, in our work and input into the total scientific activities of the government, we have to be able to play into that process the needs, as we are able to identify them, in industry. We have to have links with that total scientific work of the government. But, importantly from our point of view, in relation to the objective of the expansion of our growth and prosperity and our trade, we use this office for that linkage, and we have the expertise in that office. I do not think that we pretend to have any unique responsibility for science policy in Canada.

Senator Grosart: No, you merely say, "to advise with respect to-", and I take it that you are using science policy in a rather more restricted way than we might be inclined to use it in this committee, I accept that.

Mr. Warren: That is what worried me about your question.

Senator Grosart: There seems to have been developed over the years a rather surprising imbalance between federal funding of $R$. \& D.
in the civil sector the defence sector. You have given us some figures here, totals, for example of the PAIT programme. I accept the fact, of course, that PAIT and IRDIA are new whereas DIP has been operating for some years. However, if we look at Page 47 we see the total Crown commitments to date on PAIT are $\$ 23$ million, on IRDIA, perhaps $\$ 5$ million, then if we jump over to Page 72...

The Chairman: You have them all on this table, Senator.

Senator Grosari: Well, I did my homework on this table and I prefer to stay with the one which I used for my homework. I come up with a figure of $\$ 148$ million in the defence sector. Would you care to comment on this. I think it is obviously an historic fact, are you going to continue to put this much stress on the funding of R. \& D . in defence as against the civil sector?

Mr. Warren: I would ask Mr. David Mundy, the Assistant Deputy Minister of External Services who is responsible for the DIP programme to explain. I simply observe, by way of introduction, I think the figure of \$148 million you mentioned probably includes something in excess of $\$ 50$ million for years when the DIP programme was operative before the other programmes were involving expenditures.

Senator Grosart: Perhaps even more than that.

David B. Mundy, Assistant Deputy Minister: Well, Senator Grosart, I think your point is well taken. I think we recognize, in the Department of Industry, Trade and Commerce, that from the long term point of view we want to increase the emphasis of the activity of the department with respect to support of industry for civil oriented projects. I think I should point out though, that in the long run there is really not that much more Canadian government expenditure which is devoted to defence activity now as compared with, for instance, 1958-1959. If you will refer to the table, which was issued this morning, you will note that in 1958-1959 the Department of National Defence had a $\$ 47,500,000$. programme which was really...

Senator Grosart: Excuse me, would you mind identifying that because I am not familiar with it.

Mr. Mundy: Yes, sir, it is this table.
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## Senator Grosart: Yes.

Mr. Mundy: And if you refer to the lefthand side, "1958-' 59 ", you will see that under the first group there, Department of National Defence is $\$ 47,500,000$. which is virtually the sole contributor, as you will see from the bottom figures, to expenditures in industry.

Now, this was the year of the Avro Arrow cancellation.

Senator Grosari: I thought we would come to that,

## The Chairman: It did not come from me.

Mr. Mundy: You will notice what happened to defence expenditures in the immediate following years and you will also notice, in the last year in which we have figures, that it is still only at the $\$ 13,100,000$. level. So I think that if one takes a look at the long term one will see that the emphasis on total government expenditure on defence in industry has really not risen. However, recognizing this, we have taken a number of new initiatives in the Department of Industry, Trade and Commerce and its predecessor, the Department of Industry, and you will see that whereas there was a defence assistance programme started up in 1959-1960 and following into the three subsequent years, it was really the only programme of assistance to industry in that time period. We have now expanded from 1961-1962 on into a number of other programmes with a great deal of emphasis, on the civil sector.

A further point I would make is that one year ago we altered the defence industry productivity programme so that it can include projects which employ defence technology but which are utilized for civil export sales opportunities. We have established, as a target, despite the fact that the Treasury Board doesn't give us any more money, that we will have a portfolio of projects within that programme which are about $50 \%$ civil oriented and about $50 \%$ defence. So we take your point, sir and we are trying to meet it.

In addition to that, as the Deputy has indicated, we are undertaking studies at the present moment with the view to coming forward with new initiatives and the emphasis, of course, will be in the civil sector.

Senator Grosart: Yes, and of course the history of technological developments since the war has indicated that there is a very high degree of spinoff into the civil sector
from defence spending. Has that happened in Canada?

Mr. Mundy: Yes, sir. I think this point is also a very good point. We have to recognize that in the aero space and electronics industry that the new knowledge, the new technology, by and large, comes through the defence route. The same technology today will be, five years or ten years from now, common in the civil products of that industry. So, it is most important that we keep up to date in the new technology, but it is also important that we exploit it for civil opportunities.

Senator Grosart: You show about one billion dollars in sales which can be directly tied to this $\$ 148$ million expenditure. This is not the highest ratio in the world, but under the circumstances probably a pretty good one. Could you indicate some of the projects where there has been spinoff of your figure of 78 successful projects?

Mr. Mundy: Yes, sir.
Senator Grosart: Give us a few illustrations.

Mr. Mundy: Well, I think if I just take them at random I would include as outstanding projects, which got their technology through the defence, route, the family of VSTOL aircraft which De Havilland is engaged in. As you probably know, the latest and perhaps most successful member of that family is the Twin Otter, which happens also to use another programme, the PT6 which is a United Aircraft engine, a completely new gas turbine engine, which was developed through assistance from the government and a large company input which was basically defence technology but now also has turned out to be an engine in which about $50 \%$ of the sales are going into the civil market and in which we predict even more emphasis will be on the civil side.

Another example is the Doppler Navigation Equipment in which Marconi has probably the main industrial input and in this area there have been a number, although it is primarily defence sales to start with, there have been a number of sales to civil airlines.

Perhaps even more dramatic is flight simulators. The technology on flight simulation and particularly the advanced technology in digital flight simulators has come again through the defence route where the first requirement was and where we had some of our own national defence requirements. Now,
the company, Canadian Aviation Electronics, has been extremely successful in recent years in obtaining a world reputation for digital flight simulators for a whole family of commercial aircraft sold to Europe and the U.S. market and we regard these as outstanding examples of the spinoff of civil sales from defence technology.

The Chairman: Outside the aviation field, do you have other examples?

Mr. Mundy: Yes, I think we have a number of examples of what you might call the more pedestrian type of thing where we have developed metal components for instance and a capability which now is providing quite a back-up to these companies in their general portfolio of civil sales. Now, this capability is not in the normal research and development sense. It is a technological capability of advanced production methods and it is proving extremely useful for these companies in their civil sales, but has been sparked by the fact that in order to get a defence contract you usually had to have tape controlled machine tools and the advent of this new production technology has enabled them to increase their civil sales.

Senator Grosart: I don't want to get into the counter mortar radar business particularly but in that connection the question was raised as to whether it was the best way to go about marketing the innovations in Canadian industry by giving your department virtually the whole responsibility for marketing. D.R.B. (the Defence Research Board), indicated that maybe they might have done a better job of selling some of these things than you.

Mr. Mundy: I had not heard that.
Senator Grosart: I am not saying this is so, I merely am raising the whole question, the policy question, of the marketing responsibility which is, after all, the end target of your departmental activities. It is so that you have almost a total responsibility there.

Mr. Mundy: Well, sir, I think that it is true that we can get a high degree of support from purely military agencies such as D.R.B., Department of National Defence, the Armed Forces, and they have been extremely cooperative and it has been a matter of government policy to insure that we do marshal all our resources of the government because this is what our competition is doing, in order to make these particular sales. I think it is true, however, to say that the lead probably has to
be taken by the people who have some really good marketing expertise and we have an organization known as the International Defence Programs Branch which has a market research group, a market planning group and also has a number of representatives who are stationed in the United States and with our other NATO allies who are responsible for knowing as much as possible about the upcoming requirements of foreign countries and for negotiating international agreements of completely informal or perhaps of a formal nature to insure that the environment for Canadian industry is a good one when they have something to sell.

Now, the fact that a number of people have referred to the counter mortar radar as being a failure, I think merely indicates that in this business you are operating in high risk areas. There is a marketing risk quite often which is unknown, but you have to take your losses with your successes. In fact sometimes I think that we have not had enough losses which may indicate that we have not been taking enough risks in the process. The degree of failures we have had in the programme has been remarkably small. Some people might argue we should have been taking greater risks.

Mr. Warren: Senator Grosart, on your general point of marketing, I think the merger of the two predecessor departments into the single Department of Industry, Trade and Commerce, brings together in one department most of the skills that exist in the Canadian government with respect to foreign marketing and negotiation of access to foreign markets. We regard the marketing activity as very much part of the total product cycle.

Senator Grosart: I can see this fitting in with your facilities and your trade commissioners and so on.

The Chairman: One last question for the time being, if you don't mind.

Senator Grosart: I was just going to say that I have a good many other questions, but would just like to ask one.

The Chairman: If we want, I assume that we can spend the whole day with you.

Mr. Warren: We are entirely at your disposition, Mr. Chairman.

Senator Grosart: My question refers to the input of technological information into Canadian industry. It is referred to several
times in your brief as one of the responsibilities you undertake. I would be interested in knowing what facilities and capabilities you have for doing a good job here. I don't need. to stress the importance of it. I know you are fully aware of it. The question would be: Who goes to get technological innovation: information? How do you find it? How do you process it? How do you bring it in? How do you store it? How do you retrieve it?

Mr. R. K. Brown, Deputy, Scientific, Office of Science and Technology: I can comment on. this, Senator Grosart. If you are thinking in terms of day to day input to an industry, particularly to the technical engineering people, who may want to get their hands on the very latest information on technology, such a system as I think you are envisaging, a central or a nationwide system which would enabie any industry in Canada to get rapidly at this sort of information does not exist.
I am sure you are aware that there has been a very large study, just completed, started under the Science Secretariat, and completed under the auspices of the Science Council on Scientific and Technical Information and I am sure you are also aware this was fostered initially by our department. We were enthusiastic to see this sort of thing done and we have provided one man, full time, and one man, part time, throughout this whole study. In fact, the man leading this study is from the Department of Industry originally.

Senator Grosart: Excuse me, perhaps I can narrow your answer. These studies seem to relate more to the earlier stages, the research and early applied stages. What I am concerned with mostly in this question is the innovation stage, the sort of thing the Japanese did with the transistor. What I am really concerned with is that obviously the average Canadian firm just has not the facilities to do what the Japanese did, extend themselves all over the world and so on, but my question really relates to the thesis of Dr . Orr, in that article, where he says it is not price in the world market any more, it is that early jump. on innovation.

Mr. Brown: If I may just finish the little bit on information?

Senator Grosart: Yes.
Mr. Brown: I would hope the emphasis on a national system, this of course is up to much further discussion, would be heavily on just what you are looking for because while the system is not perfect, the scientists, doing their initial research, have at least a worka-
ble system now, and what is completely lacking is a rapid information system not completely lacking because some industries do have their own, for the working engineer who is ready to innovate, who is building his background just at this stage. I think this would be a contribution there. It is not the only one, of course. There is no simple, single answer to this. Our industrial research institutes, which I am going to mention later, are a very small, I think maybe an effective assistance here in that some of these innovations are at the finger tips of people in universities and for a small Canadian industry particularly we hope to see a steady flow, and there have already been some evidences of such, but to insure that Canadian industry takes advantage of every possibility and technical innovations is going to require an attack on all fronts.

Our programmes, Mr. Mundy has been talking about, are one of our major efforts because we do just that. We support the innovation. If we have contacts with innovations within the department which we think apply to Canadian industry we have a complete, whole group, sub-group organizations, the operations branches to see that they get this information. They are continually visiting industries.

Mr. Warren: Mr. Mundy may want to add a comment on the defence side, but very briefly at the present state of the art we have our Office of Science and Technology trying to monitor what is happening in the world outside Canada as well as inside Canada. We have them doing a little technological forecasting. So far as the dissemination of information is concerned, where there are breakthroughs which may change the real economic base of industry, our line branches which comprise commodity officers who know that particular industry, are in constant touch with the industry directly through seminars and through publications etc. The Branches do what they can; but that, I would say, is a poor substitute for a proper information system for scientific and technological information such as could be envisaged for Canada.
Senator Grosart: Your missions abroad, this would be one of the functions of this approach?

Mr. Warren: I would say that the missions abroad are not really so equipped, with the possible exception of the International Defence Programs Branch which is working
in this area of new technology in the defence production areas of different countries with which we have relationships. These people are able to get skilled scientific and analytical information back on innovation. That would also be true of the scientific liaison office of our High Commission in London. At this stage your average Trade Commissioner would not be programmed for this work and might not, at this stage, have the skills.
Senator Grosart: I am sorry, I was referring to the missions you send abroad.
Mr. Warren: The industrial development missions we send abroad, of which there are a number listed here, are to have a good look at what happens elsewhere to see if there are any lessons to be learned by Canadians.
The Chairman: While our efforts in this field seem to be relatively small, it seems to me we are in danger of confusion in this kind of activity in your department as compared with the responsibilities that the Science Secretariat is supposed to have in the international field.
Senator Grosart: And everybody else.
The Chairman: And everybody else. But, I was just beginning with the Science Secretariat.

Mr. Warren: We start with the particular mission of the department which is industry and trade oriented so there is a selectivity to our work in this area which I hope complements and is complementary to the intelligence abroad which the Science Secretariat may do.

The Chairman: Are you in contact with them? Do you know what they are doing? They have, I understand, an overall responsibility in this field.
Mr. Warren: I would be very disappointed if my office were not. Mr. Douglas, your office is in touch with the Science Secretariat?
Mr. Douglas: We are indeed.
Senator Bourget: Have you got a committee of the departments?
Mr. Warren: There are a number of interdepartmental committees.

The Chairman: On international relations?
Mr. Warren: Well, I think that perhaps there are two different things that we are
discussing here. With regard to our position on international organizations on scientific activities, the Science Secretariat takes the lead and any participation that we have in such activities is under their leadership on straight scientific activities and science policies; but I think that these missions we are talking about, these industrial missions, are just not for scientific purposes. They are broadly industrial missions to acquaint different sectors of industry with what is going on abroad in their area of interest, not only in the technological sense, but in marketing, production, financing, in every sense.

Senator Grosart: But, you have to know the product first.

Mr. Warren: Perhaps Mr. Mundy could say a word on this.

The Chairman: But apart from the missions, I understand that the missions have a very specific purpose, then I don't think the danger of confusion is very great there unless there are three or four different agencies and three or four missions for the same purpose. I do not think there is a great danger in this.

Apart from this, for the general functions and general relations with the rest of the world, we are told that the N.R.C., for instance, is conducting a lot of activities in this field, that the Science Secretariat has been given the overall responsibility so far as our relations with other countries are concerned, and then you have responsibilities too, and where is this being co-ordinated so that each agency would compliment each other?

Mr. Brown: I could make a comment here.
Mr. Warren: I will try a general comment first, Mr. Chairman.

Perhaps, at the expense of repeating myself, as I understand it, where it is generally scientific, intelligence for scientific purposes, the N.R.C. has a great historical position and the Science Secretariat is coordinating it. Again, I would like to repeat that our interest would be in innovations and developments that affect industrial growth and have an application to our mission. So I think that would narrow down what you feel is a large area of overlap.

The Chairman: Well, the Science Secretariat has a large responsibility too. They have, if I remember well, they told us that they were responsible also to try to fore-
east the implications of technological development on our society and in order to do that I presume they would have their own service of technological forecasting. Are you not trying to do, more or less, the same thing for your own purposes? At what stage are these activities co-ordinated?

Mr. Warren: I think at the stage when they sort out their work tasks in the inter-departmental consultations.
Mr. Mundy, I wonder whether you could enlighten us in this area.
Mr. Mundy: Well, Mr. Chairman, the question raised by Senator Grosart about access to world technology is vital to our whole economic picture and is something of great importance, naturally, as a result of this. I think the point is, that the peculiar environmental features which hold in Canada of geography and economies and politics give us some special access to the fount of most advanced world technology which, of course, is the United States. Most of this technology resides in industry, but it also resides in government establishments as well and it is, of course, absolutely essential that we play our cards right to ensure that we take advantage of this particular environmental feature which is extremely beneficial to our economic development. I think that we have escaped, as a result of being able to take advantage of these circumstances the outcry which there is in Europe about the technological gap with the U.S.A. at least we have escaped it so far and we have got to make sure we continue to escape it.

## Senator Grosart: "Defy les Americanes".

Mr. Mundy: The effort which we undertake has many facets in it. We have a special relationship with the Americans in the defence field, but we have also a special relationship in the general industrial field because of the parent-subsidiary type of set up which generally prevails between Canadian industry and United States industry and we negotiated agreements at the government level which will give us access to this technology.

For instance, we have an arrangement called a memorandum of understanding on research and development with the United States Armed Forces. This means that those giant and extensive laboratories in the United States, with their tremendous resources that pour out advanced technology; where we have a joint programme, are available to us
for the basic technology. We are able, when we enter into joint programmes with the United States, to build on that technology, this basic technology, and develop specialized capabilities in some particular sphere.
Another example in the purely civil area is that, as you are well aware, a major effort in Canada in recent years, has been to obtain sub-contracting from the big United States airframe producers and the technology which we acquire there is from the parent company, not necessarily to a subsidiary in Canada, but also to a sub-contractor who may be in a completely different corporate set up. What we find there is that the production techniques, for instance, new welding techniques which they have in the United States; that we gain access to these basic techniques by reason of exercizing a sub-contract relationship with a United States parent for advanced products of the aero space industry.
So, I think it is true, Senator Grosart, that we are aware of the problem, the importance of it and of working at many levels within government and industry to ensure that we do keep ourselves up to scratch in technology in those areas where our industry has specialized.
Senator Robichaud: Mr. Chairman, I notice from Pages 82 to 89 we have a list of major projects funded or performed by the department under the PAIT programme and also under the DIP development incentive programme. Now, we have a list up to December 31, 1968, and going through this list I find that under PAIT we have listed 150 projects and of those only 4 have been undertaken in the Atlantic Provinces. Under the DIP development incentive programme, where we have 58 projects, 5 have been undertaken in the Atlantic Provinces. Now, could we have any comment as to why there should be such a trend?

Mr. Warren: I think, Senator Robichaud, that this reflects the fact that at the present the concentration in many of our companies' activities in Canada is in central Canada.

Senator Robichaud: Well, are there no requests coming in from the Atlantic Provinces, no industries are asking for this type of assistance?

Mr. Warren: Well, to the extent that they ask and their proposals are eligible, they are served; but I think it is inevitable, in looking across the spectrum in Canada, that those requests will be less from areas where there is less industry.

Senator Robichaud: I can well understand they would be less but when they only represent approximately $2 \frac{1}{2} \%$ of the total it seems to me that there must be a reason for it besides the point that industries are centralized in central Canada, Quebec and Ontario, but is this type of assistance publicized, is it made known to different areas?

Mr. Warren: Yes, sir.
Senator Grosart: Mr. Chairman, could I perhaps ask a supplementary question? In the old Industry Act, there was a responsibility, I think it was in Part 2 of the Act, for area development, is that a responsibility of the new department or has that gone over too?

Mr. Warren: The responsibility is that of the Ministry of Regional Economic Expansion.

Senator Grosart: So along the line of questioning that Senator Robichaud is taking, you have really turned this responsibility over to another department which brings up the whole question again of co-ordination. Surely regional development must still be one of the criteria in your decisions. How important a criterion is it at your level?

Mr. Warren: Well, one of the answers is that the government has established a department which concentrates the different facilities we have to deal with the problems of regional disparity in Canada. Part 2 of the answer is, of course, it does not mean in the department we ignore this problem. Indeed, I could assure you that as a matter of policy in administering these programmes we are out looking for candidate industries in the less developed regions of Canada to help and see if we can encourage them either to take part in the programme or to equip themselves to take part in the programme; but the basic facts would remain, I think, that even with such efforts, the mass of your expenditure is going to relate to central Canada until much greater progress than at present has been accomplished in overcoming regional disparities.
Senator Robichaud: I think Senator Grosart has touched part of my second question which was related to your statement on Page 12 where you describe the organizational functions of the department and you mention, "The effectiveness of the government's activities in the areas of science and technology as they relate to industrial development would be improved through greater co-ordination of the various programs involved."

Now, are you referring to programmes undertaken by the department or by different departments of the government or projects undertaken by the industry proper?

Mr. Warren: We are referring there, sir, to programmes administered by other agencies where we think...

The Chairman: But all related to research and development?

Mr. Warren: All related to the broad cycle that I have mentioned, for example, the programmes of the National Research Council and Defence Research Board, where we think maximum co-ordination, within the different areas of specialization, is extremely desirable. We believe, of course, in very, very exact co-ordination within the department amongst its own programmes and it is part of our normal vetting of a project to know whether that company in that connection has taken advantage of any other government programme.

Senator Robichaud: As a follow-up then of your chart, on Page 25, you mention different branches of the department. You have given a food branch, which is naturally related to a federal department such as Fisheries and Agriculture. Could you give us a brief description of the co-ordination that exists between the Department of Industry, Trade and Commerce and those two departments?

Mr. Warren: Well, our mandate, Senator Robichaud, is particularly for the manufacturing and processing industries, the trade of Canada generally, and tourism in Canada. Conceptually you could think of the work of departments like Agriculture and Forestry carrying on the production up to the stage where it entered into the manufacturing or processing point in the spectrum of upgrading of our production and it is there that our people take over. In the Agriculture, Fisheries and Food Products Branch particularly, we are concerned so far as industrial development is involved with processing and manufacture, but we are concerned with the whole of the process from the raw material up so far as trade is involved since we may sell both fish and processed fish products.

Now, there is a very close liaison at the working level between the Branch and the relevant elements, in this case, of the Department of Agriculture or of the Department of Fisheries, both on product development and marketing and trade policy.

Senator Robichaud: Do you have continuous, existing inter-departmental committees?

Mr. Warren: Sometimes inter-departmental committees, more frequently it is done on a day to day routine to be in touch with other departments. If there is a particular project, you might set up a committee for it. The day to day relationship is a good liaison with the departments.

The Chairman: I am sorry, before going to the Senator I had forgotten Senator Belisle.

Senator Belisle: It is obvious that my honourable colleaques did their homework last night. They are asking very intelligent questions. I have done my own work on the poverty committee for to-morrow morning.

The Chairman: You raised a question?
Senator Belisle: There is no rush for it. Sometime this afternoon. Just go ahead.

Senator Bourget: I am in the same position, Mr. Chairman. My questions have either been asked by either Senator Robichaud or Senator Grosart. I would like to ask Mr. Warren; what do you think of the effectiveness of Gaugman's Incentives To Industry having to do with research? Do you think that up to now they are adequate or could they be changed? Could they be improved?

Mr. Warren: I would hope that they could be improved and this flows from our basic recognition of the priority that has to be given to innovation if we are to maintain our position as a manufacturing nation and a trading nation. It flows from the figures I mentioned in my statement. It suggests we are not doing as much as other countries. It flows from what I would regard as the normal, proper administrative practice of continuing to review programmes to see where they may have had strengths or weaknesses and to build on those strengths. It is part of my thesis that the government should be doing more by way of incentives to help industry to help itself.

Senator Bourget: According to Dr. Orr's Paper, in the conference that he gives to the Engineering Institute of Canada, he seems to imply there is too much research done today. Could you comment on this?
The Chairman: In industry do you mean or in government or in general?

Senator Bourget: Research in general.

Mr. Warren: Well, simply to turn the question over, sir, I believe that more should be done to make sure that the benefits of research, pure and applied, are carried thiough to the end of the betterment of our economy so that I would urge that more be done in the area of industrial research.

Senator Bourget: Are you the one to recommend to the government the establishment of those research institutes to which Dr. Orr made reference in this paper?

Mr. Warren: Yes-
Senator Bourget: I feel, myself, it is a very good recommendation. I would like to have your views on that.
Mr. Warren: This is one of our programmes.
Senator Bourget: So far you have spent only $\$ 40,000$ to three or four universities.

The Chairman: I think that Mr. Douglas has new figures. I think the figure you have just quoted is wrong.

Senator Bourget: Well, it was printed there and I am taking what I have read.
Mr. Douglas: Thank you, Mr. Chairman. There have been grants awarded to four universities so far to assist them in establishing industrial research institutes and the total amount of these grants is $\$ 500,000$. These grants are paid in annual or semi-annual instalments over an initial period of normally 3 years. To date expenditures are $\$ 230,000$, so just about half of the total grants have been paid.
Senator Bourget: Were there other universities, other than those four mentioned in Dr. Orr's papers?
Mr. Douglas: Well, I don't recall.
Senator Bourget: There were three, I think, in Ontario, and one in Nova Scotia.

Mr. Douglas: There is the University of Windsor.

## Senator Bourget: Yes.

Mr. Douglas: The Nova Scotia Technical College.

## Senator Bourget: Yes.

Mr. Douglas: McMaster University and the University of Waterloo. Those are the four.

Senaior Bourget: There are no others?
Mr. Douglas: We are in discussions with a number of universities, but no others have come forward yet for assistance under the programme.

Mr. Warren: This discussion covers universities in many parts of the country.

Mr. Douglas: Yes indeed.
Mr. Brown: The point was made, and it has not been answered; How do we select these universities? If I may go back for just a minute into the history of this?

The Chairman: I am interested in Windsor.

## Mr. Warren: Paul Martin?

The Chairman: That is what I thought.
Mr. Brown: The programme was initiated within the department in early response to proposals by several universities of which one was Windsor, and another was McMaster, and still another was the Nova Scotia Technical College. That is, either the Department of Engineering, or, the President of each of these universities has the kernel of this idea in his mind, or, a somewhat similar approach and he would approach us and we undertook a number of lengthy discussions and the result was this programme, which is only a small programme. One has to take this problem carefully because the prime responsibility of universities is teaching, not contract work for industry, but we did feel there was a lot of expertise in university that should be made available to industry, near the university particularly, and so the prime objective of these institutes is that the universities shall first serve industry locally. As Mr. Douglas has pointed out four are in operation, and it was an experiment. We were unsure whether it would turn out well or run into trouble so we wanted to play it at a low key until we had a look at them. But, we were unable to keep it at a low key because the word got around to a number of universities who inquired. So we have now informed, not rigorously, every university in Canada, but we have certainly made certain that any university with an effective engineering and science department knows the details and possibilities and we have left it at that. We have not attempted to do a hard sell on this. We have left them to come to us. As Mr. Douglas has pointed out, we have had inquiries from universities in Quebec, the Western Provinces, in addition to the four that were
mentioned. None of those inquiries have jelled yet, but I think at least two or three of them will do so in the next year or two.

Senator Bourget: How is the cost shared between the university in that case and industry and the help they get from your department?

Mr. Brown: Our department provides only administrative and overhead costs. That is, the salaries of the director, assistant director, and other officers associated with overhead, clerical help and travel. The terms of reference of the institutes require that when they do work for industry it be done on a contract basis where the industry pays the whole cost of the research except, of course, they are operating in an organization whose overhead is, in part, covered by our operation.

Senator Belisle: Mr. Chairman, seeing you were concerned as to the location of Windsor, and Senator Martin, I should say that someone should have done more. I, as Chairman of the Board, have not got too much to report but I am satisfied with the answer.

The Chairman: Senator Bourget?
Senator Bourget: Some of my questions have been answered.

The Chairman: If you want to come back we have plenty of time today.

## Senator Carter?

Senator Carier: Thank you, Mr. Chairman. Before I start my own question I would really like to ask a supplementary question based on the line of questioning opened up by Senator Grosart and Senator Robichaud.

Senator Grosart referred to your organization chart on Page 25 and the apparent down-grading of the Office of Science and Technology. Now, I remember when the new Department of Industry was set up in 1963, and when the government telephone directory came out it seemed that the Department of Industry was set up along parallel lines with the Department of Trade and Commerce and practically duplicating the same branches, certainly with the same titles if not the same duties. Now, I have been wondering what has happened since these two have been brought together into one department. Has there been any reduction of personnel?

Mr. Warren: Yes, senator. I am afraid I have not brough the exact figures of savings but I think it was of the order of 80 or 90
positions that were saved. Of particular interest, I think to you, following your line of questioning, is the functions of those so-called line branches, the ones that deal with the chemical industry, machine industry, and so on, have been combines do that in the one place the two functions that were separately performed can be brought into proper relationship, the function of industrial development and the function of helping in the export markets.

The Chairman: Can you tell us who won in the process of negotiation?

Mr. Warren: I don't think there was any question of winning, Mr. President. I think that the economics of the situation probably dictated the desirability of putting these two functions of government together. If you think of a company that is endeavouring to develop a new line of production or to market products that it has not marketed before, conceptually in a world where tariff barriers are coming down and where the important thing is to be internationally competitive, that is competitive against imports, competitive in third markets where you have to get the volume of production that allows you to get the economy of scale to be competitive internationally, then you have to think about markets going beyond Canada when you are thinking about your broad development plan. So your industrial development and marketing functions have to be considered together in developing a sound proposal for moving forward. I think the integration of the two ministries permits this. It also means a businessman coming to Ottawa with his problems, which he sees from the company point of view, has fewer doors to knock on to talk about both industrial development and trade development and he has a place where he can be directed to the other areas of government where he may have problems to discuss. Then the third element, of course, is the saving in your administrative overheads in having a single department. So I think these are three of the things that may well have been in the government's mind in deciding to put the departments together.

The Chairman: How many Assistant Deputy Ministers are there in the Department?

Mr. Warren: There is one Senior Assistant Deputy Minister and two other Assistant Deputy Ministers, Mr. Kniewasser, Mr. Schwarzmann, Mr. Mundy.

The Chairman: How many of those were from the former Department of Inudstry and
from the former Department of Trade and Commerce?

Mr. Warren: Mr. Mundy came from the Department of Industry. Mr. Schwarzmann came from the Department of Trade and Commerce as did Mr. Kniewasser.

Mr. Bourget: Mr. Warren, you have established the Standards Council of Canada and the BEAM programme; don't you think those two projects are duplicating the work done by the National Research Council? They also look into that kind of standards and also the construction of houses.

Mr. Warren: With respect, I don't think so, Senator. The proposal for a national Standards Council of Canada, which is not yet before the House, would bring together in one place in Canada, in the Standards Council, all those interested in standardization activities of which the National Research Council is only one, the Government Specifications Board another, the Gas Association of Canada another, and importantly, the Canadian Standards Association. The interest of the provinces and municipal authorities and the academic community in standards are also involved and the Council should allow an integrated approach to this very important area of work, which relates so importantly to industrial efficiency. If you have disparate standards you are going to have smaller runs of product and less capacity to sell across the country. The same thing is true of international trade where it is very, very important that international standards that may be set take into account Canadian standards and vice versa. So, the Standards Council, I feel, is a major new operation to bring these interests together and to provide an integrated approach here and into the international sphere of Canadian interest in standards. But the BEAM programme has been developed really to try and move that industry forward to a higher level of technology. It is not only the information system that is being developed for the construction industry. We are also trying to sell concepts of modular components, to have interchangeability in building procedures and components throughout the country and work on the National Housing Code. All this is designed to gain a greater productiveness and efficiency from the construction industry as a whole which, as you know, is made up of many, many companies spread throught the country. The N.R.C. had inputs into the technical work on wood products, but we are trying to deal here with
the construction industry as a whole, the whole efficiency of the building process in Canada.

Senator Grosart: Has the Canadian Standards Council been set up yet?

Mr. Warren: No. sir.
Senator Grosart: Is it on the immediate horizon?
Mr. Warren: Yes, sir.
Senator Grosart: That may be a policical question.

The Chairman: Do you have a supplementary question, Senator Bourget?
Senator Bourget: I cannot see very much difference between your programme and the work that is now being done by the National Research Council regarding housing.

Mr. Warren: May I ask if Mr. Boxall, one of our officers, could clarify the distinction?

Mr. D. G. Boxall (Scienitific ConsultantMaterials, Office of Science and Technology Department of Industry, Trade and Commerce): I might say a few words on that, Senator. Looking at it on a technical plane, we have the big difference between the BEAM programme and the work done by the National Research Council. It is the difference between the component and the system. The National Research Council, in its laboratories, does a great deal of extremely valuable work in the former. For instance, to pull out something at random, N.R.C. has been extremely active in the development of good insulating windows and in methods of heat insulation. That though, however, is only part. Before you can get this window or this system of insulation into a house or an office building cheaply, you have to look at the whole system of house building, and this is where the BEAM programme takes over. There is nothing really new in systems building, if you look at the components, what is new, is taking together the parts, as it were, the windows, the beams, the furnaces, which have been developed, not just by N.R.C., but by other organizations and welding them into a system which the contractor can use.

Perhaps you might say, I don't know if the parallel is an awfully good one, you might say that the N.R.C., if you like, is the builder of the cars or aircraft and that the BEAM programme is a system of transportation. In other words, cars have no use without roads,
traffic lights, and how you weld them into a whole. Dœs that help to answer your question, Senator?

Senator Bourget: Yes, it dœs, but do you work closely with the N.R.C.?

Mr. Boxall: Yes the Department does. I am not myself, too closely connected with the BEAM programme, but I will attempt to speak for them. The N.R.C., particularly the building research division, is represented on the committees and there was a most successful conference under the BEAM programme in Ottawa about a year ago which was actually a reverse trade mission, and I might digress for a few seconds here. This was a very valuable instance of how the department brings information to industry. I think there were 400 or 500 people present. It was a conference and the department brought to Canada, from the United Kingdom, from the Netherlands, from France, from Sweden; architects, engineers and successful contractors from the businessman's viewpoint and presented it to the Canadian industry. I may say, that at that conference the building and research people of N.R.C. took part both as speakers on the programme and had a very active part in the formulation of planning that went into it.

Senator Bourget: Thank you.
Mr. Warren: Senator, I am advised that the N.R.C. element concerned was very, very closely associated with the development of the BEAM programme and there is a very close working relationship. We are here acting as the catalyst to give industrial application to the most modern technology.

The Chairman: Thank you, very much. Senator Carter?

Senator Carter: I am still on the organization chart, Page 25. Now, I think Senator Robichaud had raised a question about agriculture and fisheries and in your reply you said that your responsibilities were more with the manufacturing industries.

Mr. Warren: So far as industrial development, but no so far as trade is concerned where we cover the whole spectrum.

Senator Carter: Well, every industry, it seems to me, has a number of problems which affect all sorts of various things. For example we have had technical problems, we have had economic problems, there are transportation problems, particularly the wheat
industry; transportation problems, sales problems, productivity problems, and the same would apply to the fisheries and the ship building industry. I am wondering, it seems to me that somewhere in the government structure there should be somebody or some group who would be charged with looking at the problem, the whole problem, from all its angles instead of-I know you have interdepartmental committees which bring together different angles, but that does not appear to me to be good enough. It would also seem to me that the logical place where that group should be charged with this overall responsibility, is somewhere in your department, but I don't see any provision for it. I am wondering, first, does it exist elsewhere in some other government structure, or, if not, don't you think it would be a good thing if we had that?

Mr. Warren: Senator Carter, to the extent that a place exists where the problems of an industry are looked at as a whole, I think it would be not unfair to the other departments to say that it is precisely in these industrial line branches that are listed across the bottom of the chart on Page 25 and where a great proportion of the manpower of the Department of Industry, Trade and Commerce is concentrated. I outlined to you the legal position of the responsibility of the department which concentrates on manufacturing and processing, but we conceive of our mandate as embracing the welfare of the particular industry generally so that our people in thinking about a processing development or manufacturing development do not close their minds to the economics of the raw material input and they work closely with other departments in that. But, they comprehend, in their thinking about the well being of an industry, all the elements that go into it, but some of those elements may not be under our control. To take an example, supposing, hypothetically, you wanted to grow some new grades of grain in the western economy. Well, the control of the seeds that can be used in our prairie economy is vested in the Department of Agriculture and its agencies but that wouldn't prevent our people talking to the agriculture people about it.

Senator Grosart: That is what happened in the rapeseed case, almost an exact case, isn't it?

Mr. Warren: To carry your thinking further, if I may, and without disrespect, I think it might be hazardous to envisage a govern-
ment structure composed of a hundred departments each one of which was in charge of a particular industry.

Senator Grosart: I am not saying that they are supposed to be in charge. I suppose, within the overall set up there would be somebody who would be keeping an eye on the individual industry. I am thinking about the one group or branch that would be always looking at it as a whole. Let me illustrate by asking you a question. Let us take the ship building industry. Canada is a maritime country. We are a fishing country. All over the world, especially in the under developed areas, there is a tremendous expansion. They are short of protein. Who is looking at the fishing industry to see where Canada can expand the ship building industry to supply these people with ships, fishing equipment, things like that? Who, in your department, or anywhere is keeping an eye open for opportunities?

Mr. Warren: The Aerospace and Marine Branch is looking at precisely those things as well as administering the subsidy programme.

Senaior Carter: The Aerospace and Marine Branch of your department?

Mr. Warren: Yes.
Senator Carter: Now, at the bottom of page 2 of your brief, you state that the Department of Industry has engaged in a wide range of study and analysis of engineering technology and economics. Have you carried out any studies to find the impact of federal taxation on productivity generally and particularly as it applies to the electronics industry and the computer industry?

Mr. Warren: I don't think so, sir. We do not have with us this morning people from the Electrical and Electronics branch, but if I can give you a general reply it is that, as I have indicated in my previous reply, in these industry branches the officers concerned are looking at the whole spectrum of elements that affect the well being of an industry. Now, that would include, from their point of view, although they would not be the element in the government as a whole that would have the control, the elements of taxation involved. For example, supposing you are looking at a given industry and you find that at the present level of tariffs, for example, the cost of the inputs of that industry seem to be a disadvantage to that industry, and if, after you have checked that out against your
general economic analysis and your trade policy people, you will discover there is some advantage, perhaps, in reducing those costs. Then it is quite conceivable that we, in the Department of Industry, Trade and Commerce, would go to the Department of Finance and ask them to consider a rebate, for example, on the tariff on those component parts or similarly that something would be identified about the administration of the customs where we would approach National Revenue, but not simply because an industry had made a representation to us because we are the business department but because careful analysis had suggested to us in the totality of our look at the industry and the total responsibility that the case may warrant intervention with another department.

Senator Carter: Well, I am not sure whether you have made a survey on the electronics industry or computer industry. Have you made a study of the impact of taxation on these industries?

Mr. Warren: We have certainly studied both these industries very carefully. What I am nervous about doing is assuring you, sir, that we have made a particular study of the impact of taxation on those industries.

Senaior Carter: That is what I am getting at. Have you made a study of the impact of taxation on any industry?

Mr. Warren: My answer is that the taxation impact is one of the factors we take into account in examining the position, relative, of all the industries.

Senator Grosari: Supplementary to Senator Carter's question: Has there been any study, that you know of, of the relative effectiveness of cash incentives or grant incentives as against tax rebate incentives?

Mr. Warren: It is a question that is very often discussed in industry as you know.

Mr. Mundy: Well, if I may just speak briefly on that, Mr. Chairman. Under the predecessor programme it was originally envisaged that it be a tax incentive. However, I believe that as a result of various studies which were undertaken it was felt it would be more equitable to convert this into a straight, outright grant so that those companies which were not in the happy position of having enough gross profit against which to charge expenses for R. \& D. would also be able to take advantage of this particular gov-
ernment incentive as well as the ones that did have this profit position. So that was the reason in that instance of converting a taxation incentive into an outright subsidy.

Senator Grosart: This seems to have been a major policy decision and I am wondering whether any of these studies are available.

Mr. Warren: I wasn't in the department at the time.

Were the studies uniquely made in our department or were they views that were developed also in the Treasury?
Mr. Douglas: And the Department of Finance.

Senator Grosart: It would be very interesting to see those because industry seems to like the tax incentive approach and yet I can see the inequities that can very easily develop.

The Chairman: It seems to me, in this field, there are all kinds of potential inequities. If you give a grant to a particular company and then it makes a profit out of this, then it is another particular manifestation of inequity.

Senator Grosary: But industry often asks, for example, that all legitimate R. \& D. expenditures be corporate tax exempt.

Mr. Warren: It is already a proper cost chargeable against their taxation. It enters into cost in the normal way. What the programme does is add a grant.

Senator Grosart: I would say it enters in a rather abnormal way from my experience with the Income Tax Department.

The Chairman: I wonder if some of you have looked at the evidence that has been before us which was presented by Mr. Mackenzie, former Deputy Minister of Trade and Commerce, and was a member of the subcommittee of the Economic Council on these incentives, and he came out very, very strongly, although he is now, I presume, very objective, being retired from his former company.

Senator Grosart: He will never be objective.
The Chairman: He was certainly very much in favour of the tax incentive formula.

Senator Grosart: Sometimes it is said that our government and others are getting grant-happy.

Mr. Dougals: I think, if I may make a comment here, Mr. Chairman, the grant formula was favoured by the Carter Commission and in the course of our-

The Chairman: And the tax formula by the Economic Council.

Mr. Douglas: The Economic Council's committee, yes. We examined, very carefully, the briefs, submissions and information that had been provided to the Carter Commission in considering this question. The report of the commission had not been published at the time, but we had access to their briefs and to the evidence that they took on this point.

Senator Grosart: I wonder, Mr. Chairman, if it would be too much to ask Mr. Warren to prepare a memorandum on the views of the department on these two conflicting theories. I make this suggestion to you, not to him, as to whether this would not be a very valuable piece of paper for us to have.

The Chairman: Well, if they don't want to do it for us perhaps we will have to do it ourselves.

Senator Grosart: No, but we have the evidence here now that studies have been made and one of the complaints some of us have from time to time about the announcement of government policy is that we are not always told the components that went into that policy so we are inclined to be critical when we are not perhaps always correct.
The Chairman: I was just giving the alternative so they might prefer, at the end, to do it themselves rather than having us do it.

Senator Grosart: I leave it in your hands.
Mr. Warren: My hesitation in replying, Mr. Chairman, is there is a question in my mind, as a Deputy Minister, as to whether the question and the submission made by Senator Grosart does not bear on government policy as a whole including that of the Minister of Finance.

The Chairman: I think that we might postpone this.

Mr. Warren: What I might offer is a couple of comments, at this stage, if it would be of interest to the committee.

Senator Grosart: Certainly, yes.
Mr. Warren: As I understand, one of the inputs into the thinking of the government in this connection was if assistance is given to
particular groups, companies, et cetera, through the taxation system, it is rather less identifiable to the House of Commons when the estimates of departments are presented than if that assistance is clearly identified and related to the object of the programme, which systems of grants, which can be mathematically equivalent to what might be available to companies through taxation, were used. From the point of view of our department, as I mentioned in my opening comments, we think in terms of our industrial development, of the need for rather more specialization in Canada, rather more selectivity of objectives, and this tends to lead you to the project approach, an approach which allows you to sit down with the company and agree on objectives that relate to their interests, and the interests of the country as a whole, and allow you, in the provision of your assistance, to work with them to ensure, as I think Mr. Mundy mentioned earlier this morning, that the company concerned has the capability, managementwise, financial-wise, marketing-wise, to carry through in the case of many of our programmes to the point where there will be payoff for the economy and, I think that those are the thoughts that were in my mind in response to your question.

Senator Grosart: In other words, the incentive is more closely tied to action and it is more identified.

The Chairman: And controlled.
Senator Grosart: Yes. And you see the carrot and the donkey a little more clearly.

Mr. Warren: You can see, as legislators what itis that is being done.

Senator Carter: Could I follow up by a question on taxation?

## The Chairman: Yes.

Senator Carter: Last year the Globe and Mail carried an article by Roger Newman in which he quoted Mr. Roy A. Phillips, President of the Electronics Industry Association of Canada, and Mr. Phillips is quoted as saying this:

Our industry certainly has to do a better job of communicating with the government and the public, Mr. Phillips said recently. Canadians obviously do not realize the industry's value or the government would have removed our discriminatory tax burden. As a result I will spend most of my presidential year try-
ing to improve our techniques of communication, clarifying our story so it is easily understood.
The Chairman: Did he mention the tax problem that they have?

Senator Carter: No, he did not. Well I did not read on but the basis of my question was: In the face of a thing like that, a statement like that from a very important company, a very important industry for Canada, where we can get into outside markets, if we can, surely if a president of a company makes a statement like that somebody would make a rebuttal or would at least make a study of that, of what he was talking about.

Mr. Warren: The Association has been very active, sir, in increasing its communication with the government. It has been up several times to Ottawa to meet both with us and with officials of the Department of Finance to discuss certain aspects which are within the purview of the Minister of Finance, particularly the excise tax on television sets, but it is an area of industry where we have worked very, very closely with the group and I think I am correct in saying that we have been in touch with the Department of Finance in connection with a certain number of their publications.

Senator Carter: I have a number of questions, Mr. Chairman, but if you will permit me one more then I will give somebody else a chance.

This morning Senator Grosart raised the question of technical management innovation and on pages 2 and 3 of your brief you state that that is one of your rules and objectives and that to attain those objectives you have carried out a number of programmes and you go on to say, and I am quoting now:

Most of these programs have aimed at encouraging industry to increase its R. \& D. activity and to undertake technical and management innovation;
That is the question that Senator Grossart raised this morning.
Now, Donald A. Schon, writing in the International Science and Technology, published an article which was entitled, "The Fear Of Innovation". He said, in effect, that the modern industrial corporation wants new technology and wants new ideas and then he goes on to say, and I am quoting his words:

If it, that is the corporation, believes that technological innovation is essential to
corporate growth, but on the other hand it fears innovation and it tries in various ways to prevent it.
Now, I wonder, in the light of your experience with your programmes and your efforts to promote technical and management innovation, if you would care to comment on this statement and if you find that there is such a problem as described by Mr. Schon, what are you doing about it?

Mr. Warren: I would ask Mr. Mundy and Mr . Douglas to comment, in detail, on your question. If I might make a general comment by way of introduction. It needs to be remembered, I think, for many, many years, Canadian industry was focussed particularly on the protected domestic market together with some special access to commonwealth markets that arose from the Imperial Preference System. With the lowering of tariff barriers to trade that has taken place since the war, there has been much freer access between countries to trade in goods and, as I mentioned earlier, the impact of this has led most people and many thinkers in the companies to realize that for their long term health they have to achieve what I have termed "international competitiveness". Given that the product mix in international trade is changing so rapidly, that means that they must come up to date and develop product lines that can be sold. I would think that in Canadian industry there has been a much greater recognition of this in recent years than in the past years, after the war, and more and more management is recognizing this. But, I don't think that all of management, by any means, has yet recognized that if they are to be healthy and profitable, 5,10 years ahead, that they have to be working to keep in the forefront of their particular area of production. So I think we would have, in Canada, a not untypical mix for industrialized countries of a number of companies who are thinking ahead, trying to plan their product development for a new market or even creating markets for new products. This is what is happening, but there are companies that are more relaxed and not making the investment in the future.

In response to the second part of your question; we have indicated to you the programs, PAIT, IRDIA, DIP which have been developed and which are available to industry designed precisely to do this, and we hope to resolve this problem and to adopt these programmes and develop new programmes as we go ahead.

Senator Carter: I am not clear from what you said if there is actually a problem, if this fear of innovation is actually a problem. Have you found it to be a problem?

Mr. Warren: I would like now to ask Mr. Mundy and Mr. Douglas to respond on experience in administering the programmes.

Mr. Mundy: Well, Senator Carter, I think it is true to say that there is a certain resistence in industry to technical innovation and new management techniques. I think this is only natural if you are running a company and suddenly you are presented with a problem that to be internationally competitive you have to convert your complete equipment to tape control of machine tools or if you discover that a management consultant's report tells you you have got to reconstruct your whole management, you have to go off on different product lines, that you have to tackle export markets rather than the domestic market, obviously this presents the senior management of the company with a very severe problem. So, I think it is quite natural there would be a certain resistance. However, I believe that in our experience we have had some outstanding examples of a very good response from Canadian industry with a certain amount of leadership and environmental activity being provided by the government. The example which I would give of this is the aero space and electronics industry. We were looking, earlier this morning, in response to Senator Grossart's question about how in 1958-1959 there was $\$ 47$ million spent through the Department of National Defence in basically those aero space and electronics industries. Now, this sort of expenditure was related to an environment where they were not internationally competitive. They had allocated contracts to a large extent from the Canadian government. They were on cost plus type of contracts, a great number of them. Now, with the advent of the cancellation of the Avro Arrow the new environment of international competitiveness through production sharing, these companies were suddenly faced with this thing you are talking about. They had to change their way of life. They had to adopt new equipment. They had to become competitive with United States' firms. They had to acquire new technology. They had to acquire new management techniques.

Our view in government is that the response from these industries was really magnificent because you can see that in a space of a relatively short period of time they have
converted themselves to a group of companies whose major effort is in the export market, who are selling competitively, both military and civil products and who are completely at home in an international trading environment. We feel that this has pointed the way to an area of considerable benefit for the long term economic future of Canada in that we have firms now in the high technology industries who have succeeded in doing this. So, I think the answer to your question would be that there have been a number of examples where they have responded well and that cooperation between government and industry has been very beneficial. I could give some examples of how we do co-operate with them in these objectives. For instance, when we lay down the criteria for our programmes of assistance we include some criteria with respect to long term planning. In other words, we say to companies who come forward with R. \& D. proposals that we want them to state what their long term plan is, how they are going to reconstruct their company to meet these new environmental factors, and the companies work with us on this in order to adapt themselves to the new modern management techniques.

The Chairman: Have you made any study of the causes, the real causes, of the weakness in industrial research in Canada? We always say, "well, this sector of research is weak because we have so many subsidiaries here in Canada and it is because of the limitation of our domestic market." Do we have a study which has been made, which explains, at least which points out to the main causes of that weakness?

Mr. Warren: Mr. Douglas?
Senator Grosari: Could I ask a question?
The Chairman: Or is it because our industry cannot specialize and cannot develop into bigger enterprises?

Senator Grosart: Just a supplementary question that might also be answered at the same time. Are we sure there is a weakness? Have you a target for the redistribution of funding of R. \& D. in Canada as between the main funding and performing sectors? We can come back to this 32 per cent back in 1965. Now, Senator Lamontagne suggested there is a weakness. It has been said there is a weakness. Have you a target?

Mr. Warren: We have not a target, sir, we are sufficiently low and upward movement is
what we are after. We do review our programmes, you know, our list of successes and failures. As I mentioned earlier, we have frequently found the failure was perhaps not on the technical side but the management capacity of companies. But I rather think we do not have as good a crystal ball as you would like us to have, sir.

The Chairman: But, unless you have as clear a picture as possible of the sources of weaknesses, it seems to me that it is very difficult for you to develop the right kind of incentive programmes. Because you may not get at the real source of the weakness if you do not know it. So, I come back to my original question.
Senator Grosari: Yes, both qualitatively and quantitatively.

The Chairman: Not so much quantitatively. We know quite a bit about the quantities but I don't think we can explain yet, at least I have not seen any serious study which explains the weakness of our sector here in Canada as compared to that of the United States, compared to that of Great Britain, because in these two countries, as you know, over 60 per cent of the research is done in industry.
Senator Grosart: But if we look back we see a real problem. Take the Arrow problem, I am sure, Mr. Chairman, that you listened very carefully to the pluses of the Arrow because you might want to revise that chapter in your autobiography.
The Chairman: It won't be more than a footnote.

Senator Grosart: The point here was that suddenly we found ourselves with a very, very large part of the total funding of $R . \&$ D. in industry in one particular project and if we look at the chart, we see how government funding in industry drops year after year, so that today we are not back to the level (as a percentage of G.E.R.D.) of government funding in industry when the Arrow was cancelled. Now, we have these various incentive programmes. I am surprised you have not a target. Why not make a post-audit and say, "All right, DIP was supposed to do this, IRDIA was supposed to do this". Has it increased this very important sector of our economy 1, 2, or 3 per cent.

The Chairman: I wanted to go back to this, senator, I wonder if you would allow them to answer my question?

Senator Grosart: I am sorry, I think it is germaine to your question, particularly the Arrow part.

The Chairman: Have you made any study of this?

Mr. Douglas: Mr. Chairman, we have not made any comprehensive study of the weaknesses of industry which I think was your question in this area.

The Chairman: Is this due to a managerial gap? Is it due to the fact our firms are too small, is it due to the fact that we have too many subsidiaries? Do you accept the conclusions of the Watkins Report, for instance, that subsidiaries of foreign owned firms in Canada do at least as much research as comparable Canadian firms?

Mr. Douglas: Well, on this latter point, certainly the evidence we have would indicate that their conclusion is right in this regard. A very substantial amount of industrial research and development that is undertaken in this country is undertaken by foreign controlled companies and, of course, this, I think, reflects the fact that a very large proportion of the so-called science based in industry is foreign controlled. So that, as you would expect, they are the ones that are doing the research and development.

The Chairman: If the Watkins Report is right then the fact we have so many subsidiaries here does not explain the weakness of our industrial sector insofar as research and development is concerned because they say that on the whole they are doing more than comparable Canadian firms.

Mr. Douglas: Yes, but I think there are, perhaps, some other factors you have to take into account. First of all there are many firms in the Canadian industry which it is hard to conceive would be able to undertake any independent research development or maintain any independent research and development at all. I think only $10 \%$ of the industrial establishment in Canada employ any more than 100 people and about $14 \%$ of the firms have less than $\$ 1$ million annual sales.

The Chairman: Well, this is exactly what I am getting at; Has there been a study of all these basic weaknesses of the private sector in Canada, because if the real source of weakness is that our firms are too small, I don't think that the kind of programmes you have here now are going to meet that problem.

Mr. Warren: Mr. President, I wonder if I could make a distinction, for the committee, between a definitive study, which I think was the first thought of your questioning, and our ongoing work. Have we yet, or now a book that we can give you that says, "Here are the R. \& D. weaknesses of Canadian industry and the reasons therefor.", which we could give to you to study? I think the answer to that is, "No", not as a comprehensive, completed piece of work. But het whole crux of the work of our department in all its aspects has to do with the efficiency and productivity and growth of Canadian industry and we look at that from the point of view of the aggregates as Mr. Macklin does in his economic analysis. We look at it by industry sector and trade policy, and the process of study and evaluation of the strength and weaknesses of our industry is going on all the time.

The Chairman: For instance, would you say there is a managerial gap? We were told this morning there is no technological gap developing in Canada. Would you say that there is a managerial gap developing?

Mr. Warren: My opinion would be that we need considerable improvement in the management, in certain of our companies. In the day and age in which we live I think that management is going to have to be a very, very important part of keeping up with the times.

Senator Grosart: Mr. Chairman, I think that I would say the plans were perhaps to gain access to such studies. We are looking for input in the long run as the committee hearing into national science policy. Over and over again we run up against this problem because people say, "We know all about that. We are talking about it. We have interdepartmental committees." But, we are having great difficulty in this committee finding definitive material. I will give you an example out of our own record. The Science Council made this statement in their brief to us:

The fatigue failure of engineering materials is now the most wide spread and intractable problems of engineering design.
This was their statement. I asked Dr. Schneider:

How much of this research work on many industries should be doing a conCanada? This seems to be one area where many industries should be doing a continuing job on the subject.

Dr. Schneider referred the question to Mr. Thurston. His answer is this:

The answer is very simple, sir, it is effectively zero.
Now, here is a particular case. We have not heard any more about it but they say this is one of the major problems and an expert from the council says-Canadian industry"zero".

The Chairman: Well, in any case I don't want to pursue this very much longer. There is no comprehensive study of the Canadian situation and the major sources of weakness.

Now, I see that in 1967-1968 the total amount of grants to encourage industrial research, outside of the defence field and apart from contracts, of course, is about \$13,500,000 . The first three programmes are here, on the right column of your table.

Now, while I am sure you agree this is not very big, what is the cause of the relatively small size of that amount? Is that because of lack of funds from the government or is it because you do not receive enough requests or that the requests you receive are not eligible under the specified conditions of your programme?

Mr. Warren: I think that there is quite a lot in the pipeline, sir, that is not reflected in the figures. Perhaps Mr. Douglas would speak to the civil programmes.

Mr. Douglas: Well, I think in general we cannot say it is due to lack of funds. As an overall statement, I think that would be correct. Grants under the Industrial Research and Development Incentives Act are statutory payments, so that we are not concerned with an appropriation for that purpose. On the other programmes we have not, at least in the last few years, run short of funds on any programmes that I am aware of. Would you agree with that, Mr. Mundy?

Mr. Mundy: Well, Mr. Chairman, if I may add a word on this; It is true that for the particular programme that we have authority from the government to provide assistance to industry that the degree of funding is not a particularly limiting factor. However, I think that what may well be a limiting factor is the degree of incentive which is provided to Canadian industry bearing in mind their competitive postion, vis- $\grave{a}-v i$ is other industries of other governments who have a wide range of programmes which, in many instances, give a much higher degree of support than we do.

The Chairman: What would be the general proportion of the application you are rejecting now?

Mr. Mundy: Well, in the programmes that I am dealing with, I think it is quite rare when we in fact reject an application.

The Chairman: So that you do not receive many applications?

Mr. Mundy: No, I think it is true to say, Mr . Chairman, that the applications are not coming forward in the volume that we would like to see them come forward. You cannot necessarily reach the conclusion from this that it is sloth on the part of industry. I think the conclusion that could be reached is that, in terms of business judgment, they are not attractive enough for them to enter into the very high degree of risk into which they have to enter.

The Chairman: This is an assumption or is it a conclusion that you had arrived at from your experience and your discussions with industry?

Mr. Mundy: I would say it is a conclusion, not an assumption, Mr. Chairman.

Senator Bourget: Has he got enough contacts with the industry?

Mr. Mundy: Yes, sir. The whole of our department is structured so we have contacts with all Canadian Industry.

The Chairman: But, if it is generally agreed that industry does not do enough and that your programmes are not attractive enough, what remains to be done?

Mr. Mundy: I think what remains to be done is to try to devise programmes acceptable to the government which are also acceptable to the industry.

Mr. Warren: And to fund them as required.
Senator Bourget: Has industry asked anything from you? Have they made recommendations to improve or change the existing propetitive position, vis- $\grave{\alpha}-v i s$ other industries of is not represented in all the programmes you have there, there must be something lacking there.

Mr. Warren: The industry is very interested. We are reviewing programmes in the department to see where they can be improved on a basis acceptable to the government and more attractive to business.

The Chairman: You refer in your brief to a review of these programmes which has been made for the Treasury Board. At what stage is that study at present?

Mr. Warren: That study is under review in the Treasury Board at present.

The Chairman: It has been presented to the Treasury Board?

## Mr. Warren: Yes.

The Chairman: Then you also referred to the desirability of integrating all the programmes designed to stimulated industrial research. Would you care to further comment on this? You would include, of course, the grants which are offered by the National Research Council and by the Defence Research Board.

Mr. Warren: In our review of programmes, these, as well as our own programmes, have been displayed and analysed. I don't think, unless I am mistaken, sir, that I referred to a total integration. I may have referred to an integrated approach.

The Chairman: But, what do you mean then by "an integrated approach"?

Mr. Warren: Well, as I mentioned in my comments to you this morning, we feel that the most sensible approach to the business of developing our industry in the areas where there will be marketable products, which in most cases will involve important inputs of new technology, is to look at the spectrum of the product cycle from the point of conception of the idea, the research, the development, through to the prototype, pre-production, production and marketing. It is the feeling of the department, and I think it is the feeling of those who worked with us in this review, that the display of government programmes should be such that the spectrum is adequately covered in a balanced way so that when something is begun and which, in its initial phases proves fruitful, there are other programmes of assistance that help industry to pick it up and bring it through to the production stage. That is the approach we are taking and we hope that the different programmes, many of which are administered in our own department and some of which are administered by the National Research Council and the D. R. B., will do that in the sense of covering the spectrum and permitting a logical sequence to move through the business system.

The Chairman: They are not doing that now?

Mr. Warren: There is a very close working relationship, sir, between the different programmes because of the interlocking nature of the committees, but we feel the programmes can be adjusted to do the job better.

The Chairman: You speak here of the necessity for greater co-ordination of these various programmes.

Mr. Warren: That is correct.
The Chairman: You would not encourage the complete integration of these programmes and making one government agency, like your department, responsible for all these programmes?

Mr. Warren: Well, if that were the government's decision, we would be very happy to do it, but I think that at the moment we are aiming for a better co-ordination of the services of programmes rather than saying the D.R.B. and the N.R.C. must yield up entirely their interests in this field.

The Chairman: Yes. Now, in terms of economic research, we have not touched on this very much this morning, but I understood from your brief that the kind of economic research which is done in the department is purely what I would describe as development work. It leans to advise exclusively and that sort of thing.

Mr. Warren: It does not exclude, by any means, new techniques of analysis.

The Chairman: Which are necessary.
Mr. Warren: Tailored to our needs in the department as set by the objectives of the department. So that there is a good deal of work done that way to good purpose. I don't think we have what you would call pure economic researchers trying to push back the frontiers of knowledge about economics. Perhaps Mr. Macklin, who is here with me, could comment.
V. J. Macklin, General Director, Office of Economics Branch: Mr. Chairman, the main crux of the economics work in the department is directed to the continuing review of the development of the Canadian economy and of the world economy as it affects the Canadian economy and particularly to the various aspects of that development relevant to the decisions which have to be made in the department. This work is done, for example,
to permit us to look at performance of the total economy or performance in commodity markets and in country markets; also to provide perspective and background and briefing in connection with particular decisions that have to be made and issues that arise, which, as you can appreciate, are very numerous; and also to look at the economic implications of alternate courses of action in various fields. This work then is primarily what I think you might call applied analysis. Now, of course, in doing this we, as resources permit, try to improve the techniques and methods of that analysis. But, I would say that this aspect of our work is supplementary to the applied analysis to which I referred.

The Chairman: One of the reasons I asked that was that the cover of your brief this morning reminded me of the cover of the "Hidden Report", so I was wondering if the "Hidden Report", was prepared in your department, but I know it was not.
Well, if we are to go on, I suppose that Senator Carter would leave very soon. I would be alone here and we might adjourn to have a nice chat. I would certainly have quite a number of other questions to ask. But, I
suppose that we will be able to pursue this discussion on another occasion.

Senator Carter: Are we meeting this afternoon?

The Chairman: I do not think so.
Senator Carter: I thought we were.
The Chairman: Well, this is not my understanding. We may have to revise this.

Would you remain available in case and we will communicate with you by telephone?

Mr. Warren: Of course.
The Chairman: In any event, we will check and if we do not come back I wish to thank you very much, at least provisionally.
Mr. Warren: I would like to thank you, sir, and through you, the committee, for a very stimulating and thought provoking session for us. There are some ideas here as to areas of work we will want to take under advisement.

The Chairman: Thank you very much.
The committee adjourned.

# DEPARTMENT OF INDUSTRY, TRADE AND COMMERCE 

SUBMISSION<br>TO<br>the Senate of canada<br>SPECLAL COMMITTEE ON SCIENCE POLICY

APRIL, 1969

# DEPARTMENT OF INDUSTRY, TRADE AND COMMERCE 

SUBMISSION
TO
THE SENATE OF CANADA
SPECIAL COMMITTEE ON SCIENCE POLICY

FOREWORD
1.

This submission is presented on behalf of the newly created Department of Industry, Trade and Commerce. The information supplied in this brief is organised insofar as possible on the basis of the responsibilities and functions of the unified Department. It will be apparent, however, that much of the historical data relates to the period before the
 2. A few difficulties were encountered in providing some of the detailed information requested, partly because of the organizational changes that have taken place in the past few years, and partly because the scientific activities are not always isolated and recognizable within a department concerned with the whole field of industrial development and trade promotion.

3. At the request of the Deputy Minister of the Department of Industry, Trade and Commerce, the Office of Science and Technology undertook the compilation of this brief.


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## 1. HISTORICAL BACKGROUND

1.1 The Department of Industry (DOI) came into being with the passage of an Act respecting the Department of Industry in July 1963, the general intent of which was that the new Department should promote the welfare of Canadian manufacturing industry.
1.2 The Department was initially organized in close coordination with the then existing Department of Defence Production (DDP). In fact, at both intermediate and senior levels a number of positions were common to both departments. During 1967 a decision was reached to separate the two departments and by November 1967 when the Department of Industry moved to its present quarters, separation was essentially complete.
1.3 During the latter half of 1968 and continuing into 1969 , the functions of the Department of Industry were progressively integrated with the Department of Trade and Commerce. The new department of Industry, Trade and Commerce came formally into being on March 28th, 1969, when assent was given to the Government Organization Bill 1969. 1.4 The merger has consolidated the involvement of the operating branches in the fields of science and engineering since those branches of the Department of Trade and Commerce whose work encompassed these fields have now been amalgamated with the corresponding industry branches from the Department of Industry to form the operating branches of the new department. The office of the Industrial Research Advisex (now the Office of Science and Technology) continues to have the prime responsibility for science policy and for ensuring the scientific integrity of all departmental activities.

## 2. ROLE AND OBJECTIVES

2.1 The objective of the Department of Industry, Trade and Commerce is to "promote the establishment, growth and efficiency of manufacturing, processing and tourist industries in Canada, contribute to the sound development and productivity of Canadian industry generally and foster the expansion of Canadian trade".
2.2 A major factor in meeting this objective is the part played by science and technology in industrial growth and productivity. There are a multitude of areas and a variety of ways in which science and technology impinge upon this task. These vary from the establishment of completely new industries and industrial sectors such as the various synthetic materials industries (e.g., fibreglass reinforced polyester) and the solid state devices sector of the electronics industry, to major improvements in existing industries, as for example, the oxygen process in steel making, the developments in the field of powdered metals or the use of automatic process control in a wide range of process industries.
2.3 In addition to the direct effect of creating new industries, displacing old established industries and providing a steady stream of innovations for existing industry, science and technology has created a major challenge in the areas of staff training and skills over the whole spectrum of workers from the semi-skilled laborer to the most senior executive. Retraining, redirection and reorientation of whole groups of skilled workers is becoming a continuous process.
2.4 The importance of the impact of new technology - which has developed out of scientific research and engineering development - on almost every phase of every industry has been recognized by most countries as warranting particular attention at the Government level.

Accordingly, in its organization the Department of Industry was structured especially to take into account this most significant factor in the development and expansion of a sound Canadian manufacturing industry. Over the past four years, the Department of Industry has engaged in a wide range of study and analysis principally in the areas of engineering, technology, and economics. The prime purpose of these activities has been to achieve an understanding of the characteristics, problems, needs and potentials of the various industry sectors and as a result a number of

## 2.4 (Continued)

programs have been formulated and set in operation. Most of these programs have aimed at encouraging industry to increase its R \& D activity and to undertake technical and management innovation; they have been responsive to industry's needs as understood by the Department. A11 projects supported have resulted from specific applications for assistance under the various programs.

## 3. ORGANIZATION

### 3.1 Department Organization

3.1.1 The Organization chart presented as Appendix A shows the current organization of the Department of Industry, Trade and Commerce.

### 3.2 Channels of Communications

3.2.1 The Department reports to Parliament through the Minister of Industry, Trade and Commerce. An annual report showing the operations of the Department is submitted to Parliament by the Minister on or before the 31st day of January each year.
3.2.2. Communication between the Department and other Federal Departments and agencies include a structure of interdepartmental committees. Representatives of the Department serve on certain advisory committees of other government departments and agencies. Where necessary and appropriate external members of these committees are drawn from industry and the universities as well as other Federal agencies. The work of the Department is assisted and liaison with industry is facilitated thrpugh numerous advisory committees.
3.2.3 Appendix B is a 1 ist of the Department's advisory committee and interdepartmental committees on which the Department is represented.

### 3.3 Units Responsible for Scientific Activites

3.3.1 The Department does not undertake intramural research and development. It funds extramural research and development through its incentive and assistance programs. Internally it carries out technical and economic studies, which provide an essential base for policy recommendations and for the industrial assistance programs.
3.3.2 The responsibility for scientific activities is spread throughout the Department, and almost all units have some responsibility in this area. The units most actively involved are the Office of Science and Technology, Office of Economics and the Operating Branches. The units involved in scientific activities are shown on the organizational chart of Appendix A.
3.3.3 The basis of the original DOI organization was ten operating branches (now nine), each representing a particular industrial sector as shown in Appendix A. Each branch is concerned with a number of fields of technology employed by the industry concerned, and includes personnel with a variety of backgrounds such as economics, marketing and engineering.
3.3.4 In addition to the appreciable strength in engineering in the branches, three advisory groups were established reporting directly to the Deputy Minister - the Office of the Industrial Research Adviser, the Office of the Economic Adviser and the Industrial Policy Adviser. The prime role involving science policy was assigned to the Office of the Industrial Research Adviser. This office was given the responsibility for ensuring the scientific and engineering integrity of all departmental activities.
3.3.5 In the new combined department two of these offices, Industria1 Policy and the Industrial Research Adviser (now the Office of Sciace and Technology) remained essentially unchanged. The Office of the Economic Adviser is now incorporated in the Office of Economics. 3.3.6 The structure and the responsibilities of the Office of Science and Technology (OST) are described in detail in Appendix C, however, it may be useful at this point to summarize the role of this office.
3.3.7 The office provides a cadre of qualified specialists in the various scientific or engineering disciplines to formulate policy recommendations to promote technological progress in industry, to advise on specific technical questions which arise in the various Departmental programs and activities, and generally to provide a capability for sound direction and decision-making on scientific and technical issues.
3.3.8 In addition to advising the Minister and Deputy Minister on specific questions of a scientific nature affecting Departmental or Government policy, this office also formulates plans, develops programs and generally has cognizance over the scientific/technological activities of the Department. Moreover, OST endeavours to communicate within Government industry needs in the area of science and technology and inject techno-economic and related industrial considerations into the formulation of national science policy and the research programs of the various Federal Government Departments which affect industry. 3.3.9 Since one of the major functions of this office is the development of programs in support of industrial R \& D, it was considered that the office should administer these programs, at least in their early stages. Accordingly the Office of Science and Technology has administered several technological programs such as the Program for Advancement of Industrial Technology (PAIT) and the Industrial Research and Development Incentives Act. These technological programs are described elsewhere.
3.3.10 The work of the Office of Economics consists largely of interpretative reporting, briefing and advisory activities necessary for the day-to-day work of the Department and Government, including the development and implementation of policies and programs of an operational nature. Such activities involve for the most part the assimilation and application of existing information or theory to particular issues or tasks. They do not customarily involve the development of new theory or knowledge and, accordingly, are not considered to come within the scope of research activities as defined. (See Appendix T).
3.3.11 To improve the usefulness of this informational and advisory function it is necessary from time to time to collect new information and evolve new techniques or methodology. Such activities are in support of the main operational functions of the Office of Economics.


3.3.12 It will, therefore, be apparent that the economics work of the Department consists primarily of informational and advisory programs involving some supporting research activities which are carried on as integral parts of the operational programs by operational personnel. 3.3.13 Fina11y, the International Defence Programs Branch, operating within the Branch structure of the Department, administers a major industrial R \& D support program - the Defence Industry Productivity Program (DIP).

### 3.4 Internationa1 Agreements

3.4.1 To assist in meeting the Department objectives, the Department of Industry, Trade and Commerce, in conjunction with other departments (mainly Department of National Defence, Department of Defence Production and Department of External Affairs) undertakes measures to encourage the development and production in Canada of defence equipment to meet the needs of allied countries. This is done in order to offset in part the effect on our balance of international payments resulting from substantial purchases of defence equipement abroad for our Armed Forces and to assist in maintaining an industrial defence base in Canada at an adequate and competitive level of technological sophistication. These measures include the negotiation of cooperative defence research, development and production (RDP) arrangements between Canada and other friendly nations, and the promotion of export sales of Canadian defence products.
3.4.2 The International Defence Programs Branch is the organizational unit which has the responsibility for overall defence market development and promotion, and the establishment of RDP arrangements with other countries.
3.4.3 A major part of the activity of the International Defence Programs Branch fosters "scientific activity" as defined in Appendix B of the Guideline, Senate Special Committee on Science Policy. In carrying out its activities the International Defence Programs Branch seeks out, identifies and gathers intelligence on opportunities with
which to promote RDP programs and assists in negotiating Government Agreements which provide a basis for establishing specific RDP projects. Implementation of programs and projects is carried out in conjunction with Canadian defence industry.
3.4.4 The Department has formal and informal agreements with a number of foreign countries covering various aspects of cooperative defence research, development, and production activity. A list of the more important agreements is given in Appendix D.
3.4.5 These agreements have provided a broad framework within which development and production has eventually taken place in Canada. The agreements have, therefore contributed to the advancement of Canadian technological capability and capacity.
3.5 Overseas Offices
3.5.1 The Department maintains, through its International Trade Commissioner Service, of fices in most countries of the world. These offices, however, are only incidentally concerned with scientific activity. 3.5.2 Members of the International Defence Programs Branch are stationed at offices in the following countries.

Belgium, Brussells<br>France, Paris<br>Germany, Bonn<br>Italy, Rome<br>United Kingdom, London<br>United States, Boston, Dayton, Detroit,<br>Los Angeles, Philadelphia

## 4. ORGANIZATIONAL FUNCTIONS

### 4.1 Statutory Responsibilities and Functions

4.1.1 The activity of the Department of Trade and Commerce in the area of enquiry was minimal.
4.1.2 The statutory functions and powers of the Department of Industry were those contained in the Department of Industry Act which is reproduced as Appendix E. Subsection (III) of Section 7 of the said Act reads as follows: -
"To promote the development and use of modern industrial technology in Canada and improve the effectiveness of the participation by the Government in industrial research."
4.1.3 The statutory functions and powers of the new Department of Industry, Trade and Commerce are set out in Part III of the Government Organization Act, 1969, which is reproduced as Appendix V.
4.1.4 The Department has the statutory responsibility for the administration of the Industrial Research and Development Incentives Act which is reproduced as Appendix $F$. This Act provides grants, payable in retrospect, which are based on the capital expenditures and operating expenses undertaken for research or development activity. The grand amounts to $25 \%$ of approved capital expenditures plus $25 \%$ of the amount by which eligible expenditures made in any year exceed the average of such expenditures for the preceding five years.
4.2 Functions and Responsibilities in Relation to Other Federal Agencies 4.2.1 It is the responsibility of the Department to ensure that the needs and problems of Canadian industry in the area of science and technology are well known to the National Research Counci1, Defence Research Board and the Departments of Transport, Communications, Energy, Mines and Resources, and Agriculture. Conversely, the Department is heavily dependent upon these agencies for technical advice and guidance in its day to day evaluation of industrial proposal and its development of policy, long term plans and programs.
> bay 4.2.2 This Department receives a continuous flow of advice and assistance from the large research laboratories of $N R C, D R B$, and $E M R$, and similar but less frequent help from many other government agencies.

> A number of interdepartmental committees provide excellent liaison.
4.3 Functions and Responsibilities in Relation to Industry
4.3.1 It is a responsibility of the Department to analyse and make knwon within Government the viewpoint and interests of the manufacturing and processing industry. This includes interpreting industry needs relative to $R$ \& $D$ and technological innovation, anticipating the effect of new technology and helping to ensure a Canadian environment which encourages industry to develop a sound scientific and technological base. The Department is frequently invited to take part in interdepartmental
discussions in order that it may make known the interests of Canadian industry. A particular case in point is the Canadian Communications Satellite program. The then Department of Industry was invited by the Satellite Communications Project Office to attend Project Office planning meetings and officers of the Department are currently maintaining close liaison with the Department of Communications personnel to ensure

4.4 Functions and Responsibilities in Relation to Educational Institutions
4.4.1 It is the view of this Department that Canada has much to gain from a closer liaison than that which now exists between industry and educational institutions - particularly universities and technical institutes. Accordingly, the Department sponsors specific programs and continuing activities to this end where appropriate. The Inđustrial

Research Institute Program, which is described in detail in Appendix P, is an effective functioning example.
4.5 Functions and Responsibilities in Relation to International Scientific Activities
4.5.1 The Department is represented at meetings of international organizations such as $O E C D$ and has supplied specialists to assist the deliberations of OECD committees.
4.5.2 Personnel of the Office of Science and Technology are charged with the responsibility of monitoring scientific activities related to industrial development outside Canada by visits to scientific agencies both public and private in other countries and by attendance at scientific meetings and conferences.
4.5.3 The operating branches have organized a number of industrial missions to the U.S. and overseas to study the technology, equipment, productivity, and management of a variety of industries. This has proved to be an effective means whereby industry can obtain a first-hand knowledge of important advances in industrial technology. A partial list of these missions is given in Appendix $G$.
4.6 Review of Operational Effectiveness, Duties and Goals
4.6.1 As previously discussed, following initial organization, the Department of Industry has been reorganized twice - at the time of separation from the Department of Defence Production, and at integration with Trade and Commerce. Operational effectiveness, responsibilities and goals have been reviewed upon each occasion. The mechanisms for regular review and revision of the new Department of Industry, Trade and Commerce are presently being developed.
4.7 Outside Studies of Operating Procedures
4.7.1 There have been none.
4.8 Relationship Between Responsibilities and Powers, and Activities
4.8.1 The relationship between the responsibilities of the Department and its activities and programs is discussed in the previous sections. The Department has authority to execute plans and programs such as those described and is free to seek authority (or propose legislation) for new programs as it deems necessary.
4.9 Major Hindrances
4.9.1 Analytical work on industry problems including those concerned with the application of science and technology would be improved if DBS statistics were available on a more detailed basis and in some cases more prompt1y.
4.9.2 The effectiveness of the government's activities in the areas
of science and technology as they relate to industrial development would
be improved through greater coordination of the various programs involved.
4.10 Changes in Organization Functions
4.10.1 The Government Organization Act 1969 which received assent on March 28th, 1969 established the new Department of Industry, Trade and Commerce.
4.10.2 The duties, powers and functions of the new Minister of Industry, Trade and Commerce are set forth in Sections 15, and 16, as follows:

Section 15
"The duties, powers and functions of the Minister
of Industry, Trade and Commerce extend to and include all matters over which the Parliament of Canada has jurisdiction, not by law assigned to any other department, branch or agency of the Government of Canada, relating to:
(a) manufacturing and processing industries in

Canada:
(b) tourism; and
(c) trade and commerce generally."

Section 16
(a) promote the establishment, growth and efficiency of manufacturing, processing and tourist industries in Canada, contribute to the sound development and productivity of Canadian industry generally and foster the expansion of Canadian trade;
(b) develop and carry out such programs and projects as may be appropriate to (i) assist manufacturing and processing industries to adapt to changes in technology and to changing conditions in domestic and export markets, (ii) assist manufacturing and processing industries to develop their unrealized potential to rationalize and restructure their productive facilities and corporate

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organizations and to cope with exceptional problems of adjustment, and
(iii) promote and assist product and process development and increased productivity, the greater use of research, the application of advanced technology and modern management techniques, the modernization of equipment, the utilization of improved industrial design and the development and application of sound industrial standards in Canada and in world trade.
(c) improve the access of Canadian produce, products and services into external markets through trade negotiations and the promotion of trade relations with other countries and contribute to the improvement of world trading condi-
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## tions:

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(d) promote the optimum development of Canadian export sales of all produce, products and services:
(e) provide support services for industrial and trade development, including information, import analysis and traffic services:
(f) analyze the implications for Canadian industry, trade and commerce and for tourism of government policies related thereto in order to contribute to the formulation and review of those policies: (g) compile and keep up to date detailed information in respect of manufacturing and processing industries in Canada and of trends and developments in Canada and abroad relating to Canadian industrial development and trade; and (h) promote the optimum development of income from tourism and compile and keep up to date detailed information in respect of the tourist industry and of trends and developments in Canada and abroad relating to tourism.
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## 5. PERSONNEL POLICIES

### 5.1 Hiring Policies

5.1.1 The Department does not itself, carry out research and development. Accordingly, it has no need for policies and criteria to identify those who will be effective researchers.
5.1.2 To fulfil its responsibilities effectively the Department does, however, require personnel with a knowledge of the Canadian Secondary Manufacturing Industry, and in some cases with a demonstrated capability in the research and development area. It has been the policy, therefore, in manning the industry line branches, to hire a majority of experienced professional personnel; only a relatively small number are hired from the university graduating classes. In the operational branches the requirement is for people with a general rather than a specialized technical background. In the Office of Science and Technology it is the policy to recruit those with extensive experience in research, development, or sophisticated engineering design.
5.1.3 All personnel are recruited through the Public Service Commission with which the Department works in close collaboration. 5.1.4 On occasion some difficulty has been experienced in obtaining qualified and experienced people as the Department is in direct competition with industry.

### 5.2 Further Education of Staff

5.2.1 Staff are encouraged to maintain and develop their professional competence by continuing education. Encouragement is given to the acquisition of additional academic training by defrayment of onehalf of the fees incurred for relevant evening courses. Individuals are also sent, as appropriate, on short courses which will have direct benefit, and full salary and expenses are paid.
5.2.2 Staff are selected to take courses offered by the Department or the Public Services Commission in such fields as administration, management and languages.


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## 6. DISTRIBUTION OF ACTIVITIES

### 6.1 Regional Pattern of Expenditures

6.1.1 The regional pattern of the Department's expenditures for scientific activities by provinces is shown in Appendix $H$.
6.1.2 The expenditures shown include all the major extramural disbursements of the Department according to the location of the organization receiving the grant. It is realized, however, that the receiving organization may spend the grand in whole, or, in part in a province other than that in which it was received.
6.1.3 Department expenditures have been made in all the provinces except Prince Edward Island. The distribution of expenditures is of course strongly influenced by the existing geographical distribution of industry.
6.2 Regiona1 Development
6.2.1 The general and specific assistance programs administered by the Department are available to all Canadian companies on an equal basis irrespective of geographical location. It might be expected, however, that the programs would contribute in some measure to regional development in that the smaller industries in the less industrially developed provinces may find it more difficult to obtain financing from private sources.
6.2.2 An example of the way in which the incentive programs can help in regional development is the assistance given towards creation of a crab fishing industry on the east coast through financial assistance under the PAIT program.
6.2.3 The Industrial Research Institutes, which are discussed in a later section of this brief are likely to prove of particular value in the western and maritime provinces. In these provinces access to expert advise is of more difficult to obtain than in the highly indusrialized central provinces.
6.2.4 The Area Development Agency which until the recent reorganization was part of the Department of Industry was specifically charged with the responsibility for regional development. Section 10 of the Department of Industry Act read as follows: -

The undertaking of research and the making of investigations respecting the means of increasing employment and income in designated areas; and the preparing and carrying out of such programs and projects to improve the economic development of designated areas as may be appropriate to the purpose of this Part and that cannot be suitably undertaken by other departments, branches or agencies of the Government of Canada.,

## 7. PERSONNEL ASSOCIATED WITH SCIENTIFIC ACTIVITIES

7.1 The present establishment and strength of the Department is given in Appendix I. 1 .
7.2 The statistical data requested for the professional staff of the units associated with scientific activities is provided in Appendix I.
7.3 The number of staff in each degree category on educational 1eave is:

Master - 1
7.4 The number of university students given summer employment is given in Appendix I. It is not possible to determine with any degree of precision the proportion of this number who were employed in the field of scientific activity.

## 8. EXPENDITURES ASSOCIATED WITH SCIENTIFIC ACTIVITIES

### 8.1 Total Funds Expended

8.1.1 The external expenditures by the Department for scientific activities are given in Appendix J. It was not entirely possible to show the expenditures according to the categories given in the "Guide for Submission of Briefs and Participation in Hearings." Wherever possib1e, however, this has been done. $\quad$ 高

### 8.2 Operating and Capital Funds

8.2.1 The intramural expenditures on scientific activity cannot be derived from the existing records. The reason is that until now the resources were allocated and expenditures accounted for by the tradi-
alit tional governmental method based on objects of expenditure and organizational units. Hence there are no records on the expenditures associated with functions, scientific disciplines, etc., as defined in the guidelines. This situation will be ameliorated by the change to the Planning, Programming and Budgeting system.

### 8.3 Expenditures for University Education of Staff

8.3.1 Funds expended to further professional university education of staff were:

| $1967-68$ | $\$ 2,060$ |
| :---: | :---: |
| Iacyana $1968-69$ | $\$ 5,214$ |












## 9. RESEARCH POLICIES

### 9.1 Intramura1 Activities

9.1.1 The Department does not undertake intramural research but does carry out studies and analyses related to research, engineering development and technological innovation. As indicated in Section 2, these activities are aimed at an understanding of the problems, needs and potentials of all industry sectors. The resulting projects and programs have been directed to overall industrial growth and have been responsive to the initiative of those industries which have taken advantage of them.
9.1.2 The guiding principle in setting priorities and selecting from among competing industrial requests for assistance has been to aim at "maximum benefit to Canada".
9.1.3 For the type of activity outlined above, Critical Path Network (CPN) and Program Evaluation and Review Technique (PERT) are not normally necessary. These techniques are used, however, wherever it is appropriate to do so.
9.1.4 Considerable use has been made of consultants in support of intramural studies and programs. Examples of the use of consultants are cited in Appendix K .
9.1.5 It is not the policy of the Department to provide general support for research programs in the university. However, use is made of the universities in support of Department intramural studies, or, to undertake specific research projects where this is considered necessary in the national interest. Examples of such university support are given in Appendix L.
9.1.6 A11 programs and projects are under continuous review and evaluation. Projects are terminated or given lower priority and allocation of resources wherever it becomes apparent that greater benefit would be obtained from starting a new program or project.
9.1.7 Intramural and contracted extramural research results are transferred to those having potential need of them by formal and informal reports supplemented by personal contact.

### 9.2 Extramural Activities

9.2.1 The Department has proposed and had accepted for funding five major programs: -

Program for Advancement of Industrial Technology (PAIT)
Industrial Research and Development Incentives Act (IRDIA)
Defence Industry Productivity Program (DIP)
Industrial Research Institutes Program (IRI)
Building Equipment, Accessories and Materials Program (BEAM)
9.2.2 Full details of the objectives, methods of funding, administration, etc., of the above programs are given in Appendices $M$ to $Q$.
9.2.3 The objectives, effectiveness, and administration of the various research and development incentive programs are currently being reviewed at the request of Treasury Board by an interdepartmental task force under the chairmanship of the Senior Assistant Deputy Minister of the Department.
9.2.4 Projects authorized, or supported, under any of the incentive programs, PAIT, IRDIA or DIP, are carried out by the industry or organization which initiated the proposal or claim. Since the federal government provides only part of the funds and more particularly because the objective of these programs is to strengthen the scientific and technological base of the applicant, the results including patents and proprietory information, remain the property of the organization receiving support. Transfer of these results to a third party is, however, subject to certain limitations specifically stated in the contract between the Government of Canada and the entrepreneur involved. As an example, under PAIT and DIP, technical information, design data or details or processes, may not be transferred for the purpose of production outside of Canada without permission of the Minister.
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## 10. RESEARCH OUTPUT

10.1

10.1.1 Any patents arising from the research and development activities supported by the Department's general and specific incentive programs - PAIT, IRDIA, DIP - are the property of the company or organization doing the work. The number of patents obtained is not known. 10.1.2 As the Department does not have the patent rights arising (1) from its support of industrial research and development the licensing of patents is not a normal activity of the Department.
10.2 Books and Journal Articles
10.2.1 Research findings originating in projects supported by the Department are proprietary to the firm and therefore publication would only be made by the company concerned at its discretion. 10.2.2 Department personnel have, however, published in the technical and professional journals, articles dealing with the scientific 901) activities of the Department. A complete list of these articles is not 0 available, but some typical examples are given in Appendix $R$.
10.3 Department Reports
10.3.1 The Department prepares reports on its internal scientific taolonactivities, and on information obtained from external sources. These reports are given appropriate government, industrial, and public circulation. A partial list of department reports is given in Appendix R.
10.4 Conferences
10.4.1 The Department sponsors and arranges conferences and seminars
where this is the best method of transferring essential information to industry. It is a valuable way of stimulating industry to incorporate in their everyday practices the latest technological advances. Appendix $S$ gives details of conferences sponsored by the Department.
10.4.2 Members of the Department frequently present papers at
international, national, and professional meetings and conferences.

### 10.5 Transfer of Foreign Scientific and Technological Data

10.5.1 Foreign scientific and technological data obtained by the Department is transferred to industry and other extramural groups by meetings, reports and by personal contact.
10.6 Former Staff
10.6.1 Staff turnover has been minimal since the establishment of the Office of Science and Technology in 1964. Turnover in the Economics Branch has also been sma11; a few economists have moved into other government departments and agencies, and a few to industry and banking.
10.7 Office of Science and Technology
10.7.1 Since no intramural research is undertaken in the physical sciences, no research teams, in the usual sense, have been developed. A group of scientists and engineers covering a wide range of science and technology has been established in the Office of Science and Technology. These men have been carefully selected to provide highly qualified specialists in each of the fields listed below.

Industrial Chemica1s and Pharmaceuticals
Polymer Chemistry and Foods
Textile Technology
Meta1 Techno1ogy
Mechanical Engineering and Production Processes
Transportation Technology
Aerospace Technology
Power Systems
Communication Systems
Computer and Control Systems
Electrical and Electronics Technology
10.7.2 They had, before joining the Department, reached a position of Director of Research in a large industry or were undertaking advanced sophisticated engineering design. This group represents an effective team which has initiated directly or provided the nucleus for study groups which have been responsible for major scientific and technical studies not only to meet departmental requirements, but also for inter-departmental purposes such as:

1. Scientific and Technical Information
2. Domestic Satellite Communications
3. Transportation
4. OECD Technology Gap Studies

### 10.8 Office of Economics

10.8.1 A second strong professional team has been developed in the Office of Economics. This team includes seven economists with doctorate degrees.
10.8.2 The Office of Economics consists of four main Branches, namely; General Analysis, Investment Analysis, Market Analysis and Productivity. Each of these Branches conducts scientific support activities to some extent, but in each case such activities are subordinate to the primary informational and advisory function. The work of this team is described in Appendix T.

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11. PROJECTS
11.1 Project Lists
11.1.1 Appendix $T$ is a partial list of the projects carried out by or funded by the Department since 1962. In the case of PAIT and DIP projects because of the requirement for industrial secrecy it is not possible to give the title of the project, but only the company name. No project details are available for work performed under IRDIA.
11.2 Case Histories
11.2.1 Appendix U presents case histories of some selected intramural and extramural projects.

DEPARTMENT OF INDUSTRY, TRADE AND COMMERCE


## Inter-departmental and Advisory Committees Having DITC Representation

Advisory Committee, Program for Advancement of Industrial Technology
Inter-departmental Committee for Defence Development
Weapons Advisory Group
Canadian "Mallard" Advisory Group
Electronics Advisory Group
Inter-departmental Committee, Defence Industry Modernization for Defence Export Program
Defence Research Board, Advisory Committee on Defence Industrial Research
Inter-departmental Committee on Wood Harvesting
Inter-departmental Committee on Low Cost Textile Imports
Inter-departmental Advisory Committee on Furniture
Inter-departmental Advisory Committee on Lumber
Inter-departmental Advisory Committee on Plywood and Panel Products
Inter-departmental Sub-committee on Hearing Aid Industry
National Research Council, Associate Committee on Propulsion
National Research Council, Associate Committee on Avionics
National Research Council, Associate Committee on Aerodynamics
National Research Council, Associate Committee on Aeronautical Structure and Materials
National Research Council, Associate Committee on Agricultural and Forestry Aviation
National Research Council, Associate Committee on Automatic Control
National Research Council, Associate Committee on Geodesy and Geophysics
National Aeronautical Establishment, Technical Advisory Panel
National Research Council, Advisory Committee, Industrial Research Assistance Program
Inter-departmental Advisory Committees, Canadian Government Specifications Board, on:

| paper sizes |  |
| :--- | :--- |
| furniture |  |
| paints |  |
| soaps and detergents |  |
| chemicals |  |
| sealants |  |
| waxes and polishes |  |
| corrosion prevention | wlastics |
| packaging materials |  |
| silicon water repellants |  |
| adhesives |  |
| drug manufacture |  |

painting standards
concrete curing compounds

Army Reconnaissance Scout Vehicles Committee

Functions and Responsibilities of the Office of Science and Technology
1.0 Science/Technology Policy and Planning

The Office of Science and Technology provides a cadre of qualified specialists in the various scientific or engineering disciplines to formulate policy, to promote technological progress in industry, to advise on specific technical questions which arise in the various Departmental programs, and activities, and generally to provide a capability for sound direction and decision-making on scientific and technical issues.

In addition to advising the Minister and Deputy Minister on specific questions of a scientific nature affecting Departmental or Government policy, this Office also formulates plans, develops programs and generally has cognizance over the scientific/technological activities of the Department.

Moreover, the Office of Science and Technology (OST) acts as the spokesman within Government for industry research needs and injects technoeconomic considerations into the formulation of national science policy and the research programs of the various Federal Government Departments which affect industry.

### 2.0 Scientific Services

The provision of a scientific "intelligence" to guide policy formulation and program activities is provided by a nucleus of specialists in each of the major scientific or engineering discipline of concern to Canadian manufacturing industry. The aim of OST is to provide leadership in all scientific matters with which the Department is concerned and endeavour to ensure the scientific integrity of its programs.

### 2.1 Scientific Advice and Technical Appraisal

Scientific advice and guidance is required in many aspects of the Department's activities, quite apart from the obvious needs of the various $R$ \& D programs. Technical appraisals are required for all PAIT projects and a substantial number of IRDIA claims. In addition, evaluations are carried out for all projects submitted under the Defence Export Development Program, the DRB Defence Industrial Research Program, and the NRC Industrial Research Assistance Program in each of which the Department participates as a member of the respective advisory committees.

### 2.2 Scientific Liaison

The scientific consultants act as the link between the Department and the scientific community both within and outside government especially with a view to enlisting the support and active participation of government laboratories, universities and technical societies in support of Departmental programs. In particular, OST maintains close working relationships with the Science Council, Science Secretariat, Privy Council Committee on Scientific and Industrial Research, National Research Council, as well as various international agencies such as the Organization for Economic Cooperation and Development.

### 2.3 Technological Forecasting

The forecasting of technological trends likely to result from current scientific research provides the essential basis for the formulation of industrial policy and long-term planning. This involves continuous review of latest developments in fundamental science, and the assessment of their impact on the various industrial sectors leading to recommendations for new policies or programs designed to exploit the new technological opportunities.
2.4 Techno-Economic Studies

In identifying worthwhile directions for the concentration of industrial research effort and in formulating plans therefor, there is a continuing requirement to undertake systems analyses, studies in depth of technical feasibility, and assessments of the commercial feasibility of different technical solutions to industrial problems or opportunities. Such studies involve the formation of inter-disciplinary study groups under competent leadership to provide factual data as a basis for program direction and as a guide to the selection of $R \& D$ projects for Departmental support.

Past studies have included the industrial impact of the AECL Intense Neutron Generator Project, Canadian industrial capability for the development of a Domestic Communication Satellite, Systems Definition and Planning Studies for a Domestic Communications System, Studies of the State of Technology and Innovation in six Canadian industries (contribution to OECD "Technology Gap" studies).
2.5 Scientific and Technical Information

In terms of industrial progress, the effective utilization of existing technical information is probably just as important as the
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## 2.5 (continued)

 generation of new scientıfic knowledge. An important task therefore
 is the establishment of an effective system for storing, classifying, retrieving and disseminating scientific and technical information in a form which can be readily assimilated and applied by industry. To this end, OST fostered the initiation of a national study on this subject under the sponsorship of the Science Secretariat and made a major contribution in terms of manpower and financing. When the study is complete, it is expected that OST will have a major role to play in the implementation of its recommendation as regards the provision of scientific and technical information to Canadian industry.

An Information Systems Analysis Centre (ISAC) has been planned and extensive data on information systems and techniques has been acquired.

### 3.0 Technological Programs

In furtherance of the Department's technological mission, three major programs of direct financial assistance for industrial R \& D have been established together with three programs for the provision of technical services to industry. OST bore full responsibility for policy formulation, program planning and implementation of each of these programs. For the IRDIA and PAIT programs which involve many individual projects and firms, casework is undertaken by the appropriate industry sector branches with control and coordination being exercised by program offices. In all other programs which deal with industry collectively and which do not lend themselves to a sectoral approach, program administration is centered in OST.

### 3.1 Industrial Research Institutes

The purpose of the Industrial Research Institute program is to provide financial assistance to Canadian universities to help them establish and maintain research institutes to undertake contract research on behalf of industry. Assistance under the program takes the form of a grant payable in annual installments to cover costs of establishing and administering the Institute. To March 31, 1968, grants amounting in total to $\$ 476,157.00 \mathrm{had}$ been authorized under the Program to assist the establishment and maintenance of Industrial Research Institutes at four Canadian universities.

The program is administered by OST which is responsible for negotiating terms and conditions and administering agreements under which the grants are made. Applications are assessed against established criteria, and if satisfactory, are recommended to Treasury Board for approval.

### 3.2 Standards Council of Canada

Because of the importance of standards to the quality of industrial production and more especially to participation in international trade, the Department of Industry, Trade and Commerce took the initiative in promoting the formation of a national standards body to deal with all aspects of this matter. As a result, Cabinet authorization was given to proceed with the establishment of the "Standards Council of Canada" which would be responsible for general policy and coordination of standards activities on the national level, Canadian participation in international standards activities, and would provide a channel for government financial assistance to standards setting bodies.

A Secretariat has been set up in OST to arrange for the establishment of the Standards Council and the preparation of the necessary legislation. Eventually, although the Council will operate semi-autonomously, it is expected that the Department will act as the focal point for contact with the Federal Government and the channel through which financial support will be provided.

### 3.3 Technical Seminars and Publications

This program was established in recognition of the growing need for industry to be kept informed of new discoveries and developments in science and technology which has been taking place at an ever increasing rate in recent years. Under the program, the Department underwrites the cost of technical seminars and publications serving the needs of industry by reimbursing financial losses up to an agreed amount. To date a number of seminars have been sponsored under the program on such subjects as automatic process control, ultrasonics, technological forecasting, and polymer science.

The program is administered by OST which is responsible for assessing and approving applications for assistance under the program, and for negotiating the terms and conditions for support.

### 3.4 Analysis of Industrial R \& D Performance

4. The analysis and interpretation of statistics on the $R \& D$ performance of Canadian industry represents an important input to the formulation of policies and the evaluation of the effectiveness of Departmental programs in this regard. A comprehensive survey of Canadian Industrial Research and Development for 1965 was presented to the Science Council, and will be


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## 3.4 (continued)

re-issued biennially as new DBS statistics become available. This activity also involves comparison of Canadian industry performance against that of other industrialized nations and elucidation of the economic impact of research and development on industrial success and export achievement.




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## Office of Science and Technology

Statement of Duties and Responsibilities

1. To stimulate technical innovation in Canadian industry by promoting the development and use of modern technology and generally upgrading its technological capabilities and competence.
2. To improve the effectiveness of Canadian Government participation in, and support for, industrial research and development.
3. To advise on all scientific and technical matters relevant to Departmental responsibilities and to formulate and recommend appropriate policies, plans and programs therefor.
4. To advise with respect to national science policy and other aspects of government policy affecting the technolagical performance of Canadian industry (e.g. industrial standards, patent policy, procurement practice, etc.).
5. To identify the needs of Canadian industry for research and development and for related scientific and technical services (e.g. scientific and technical information, industrial standards, testing, and consulting) and to develop policy, plans and programs to meet such needs.
6. To be responsible for the policy aspects and scientific integrity of all technological programs and activities within the Department.
7. To evaluate and make recommendations on requests from industry, universities, trade associations, scientific and technical societies for assistance to promote industrial research and development or to provide related scientific and technical services for Canadian industry.
8. To provide advice and assistance to Branches of the Department and to other government departments and agencies on matters affecting or pertaining to industrial research and development and on other scientific and technical activities in Canadian industry generally.
9. To keep informed of scientific advances and of current activities in the various fields of industrial technology, and to assess their significance and relevance for Canadian industry by conducting technological forecasting and techno-economic studies.
10. To maintain effective working relationships and coordination with the scientific activities of other government departments and agencies, universities, and industry relating to Departmental interests (particularly the Science Council, Science Secretariat, National Research Council, Advisory Panel on Science Policy, etc.).
11. To represent the Department with respect to scientific and technical matters at national and international meetings and conferences of government, trade, industry, university, scientific, and technical organizations.
12. To evaluate the research and development performance of Canadian industry and to assess the effectiveness of Departmental incentive and assistance programs in this regard.

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1. Canada - U.S.
1.1 Canada/U.S. Defence Production Sharing Agreements 1959 and 1963.
1.2 Memorandum of Understanding in the field of Cooperative Development - November 1963 (Complementing the Can/U.S. Production Sharing Program by establishing a cooperative program in defence research and development).
1.3 Canada - U.S. Afreement for Qualification of Products (1968) (Defines conditions and procedures to be used for reciprocal listing of products of Canadian and U.S. manufacturers on 2ualified Products Lists maintained by the U.S. Department of Defense and Canadian Department of National Defence.)
2. Canada - West Germany
2.1 Memorandum of Understanding regarding research, development and production (RDP) programs between the Department of Defence Production and the German Ministry of Defence (1965) (Provides for cooperation and collaboration in the field of defence development and production so that duplication of effort for common defence requirements can be avoided).
2.2 Apreement between Canada and the German Ministry of Scientific Research for the 1 aunching of rockets carrying German experiments and the establishment of a real time telemetry station at the Churchill Rocket Range. (The agreement is expected to be signed in the near future). Involves, in addition to the Department of External Affairs, National Research Council, Department of National Revenue (Customs \& Excise) and the Department of Finance.
3. Canada - France
3.1 Intergovernment agreement (Nov. 1967) concerning Research Development and Production of defence equipment (Similar to 1965 apreement with West Germany).
4. Canada - U.K.
4.1 Informal agreement on defence RDP cooperation (1963). Resulted in establishment of Anglo-Canadian Committee for Cooneration in Defence RDP.
5. Canada - Norway
5.1 Afreement regarding joint production in Norway of M-72 light anti-tank weapon, using Canadian launcher and Norwegian bomb.
6. Multi-Lateral Agreements
6.1 Memorandum of Understanding on development and evaluation of a reconnaissance drone between Canada, West Germany and United Kingdom (1965). (Provides for joint participation in development).
6.2 Memorandum of Understanding on production of a reconnaissance drone among Canada, West Germany and United Kingdom (1967). (Provides for Cooperative Production).
6.3 Agreement on Joint Development and Production of a multi-role combat aircraft (MRCA) - International Defence Programs Branch personnel were largely instrumental in getting the responsible authorities of Canada, West Germany, Italy, Belgium, the Netherlands, and United Kingdom together to work out the first phase of this joint program. Because of financial problems and its incompleted defence review, Canada has given notice of its inability to participate in the program, at least at this time.
6.4 NATO - Departmental interest centres around the activities of the conference of National Armaments Directors (CONAD) established in 1966 to direct cooperative armaments research, develoment and production programs in support of the Armaments requirements of NATO countries.
7. ABCA Aereements
7.1 These agreements between the armies of U.S., Britain, Canada and Australia provide for cooperation in the standardization of military equipment. The Department of Industry,

# Trade and Commerce/IDPB keeps close watch on the work of committees administering these agreements in order that potential Canadian development and production can be exploited. Currently, one of the most important ABCA Agreements is for the development of the "Mallard" secure communications system. 

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## 12 ELIZABETHII.

CHAP. 3

An Act respecting the Department of Industry.
[Assented to 22nd July, 1963.]

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 Department of Short title Industry Act.

## Interpretation.

2. In this Act,

Definitions
"Agency." "Commis. sioner."
" Depart ment."
" Deputy Commissioner."
(e) "designated area" means any district or "Designated locality in Canada designated by the Governor area. in Council pursuant to section 9; and
(f) "Minister" means the Minister of Industry. "Minister,

## PART I.

## Department Constituted.

3. (1) There shall be a department of the Government of Canada called the Department of Industry, over

Department constituted. tated. which the Minister of Industry appointed by Commission under the Great Seal of Canada shall preside.
(2) The Minister has the management and Management. direction of the Department and holds office during pleasure.

Deputy Minister

Temporary appointments.

Termination of temporary appoint. ments.

Duties, powers and functions of Minister.

Further duties.
4. bue The Governor in Council may appoint an officer called the Deputy Minister of Industry, to be the deputy head of the Department and to hold office during pleasure.
5. (1) The Governor in Council may appoint persons having special knowledge of any manufacturing industry to advise and assist the Minister in the work of the Department, at such salaries and upon such other terms and conditions as the Governor in Council sees fit, including payment of a share of pension contributions or premiums under any benefit plan of which such persons are members.
(2) No person appointed pursuant to subsection (1) shall continue to be so employed after the 31st day of December, 1964.
6. The duties, powers and functions of the Minister extend to and include all matters relating to manufacturing industries in Canada over which the Parliament of Canada has jurisdiction, not by law assigned to any other department, branch or agency of the Government of Canada.
7. The Minister shall
(a) cause the Department to acquire a detailed knowledge of manufacturing industries in Canada;
(b) promote the establishment, growth, efficiency and improvement of manufacturing industries in Canada; and
(c) develop and carry out such programs and projects as may be appropriate
(i) to assist the adaptation of manufacturing industries to changing conditions in domestic and export markets, and to changes in the techniques of production,
(ii) to identify and assist those manufacturing industries that require special measures to develop an unrealized potential or to cope with exceptional problems of adjustments, and
(iii) to promote the development and use of modern industrial technology in Canada and improve the effectiveness of the participation by the Government of Canada in industrial research.
8. In addition to the duties, powers and functions conferred by sections 6 and 7, the Minister shall exercise and perform all the duties, powers and functions vested in or required to be exercised and performed by the Minister of Defence Production notwithstanding anything contained in the Defence Production Act.

PART II.

## Area Development.

9. The Governor in Council may designate as a designated area for the purposes of this Act any district or locality in Canada that is determined to require special measures to permit economic development or industrial adjustment by reason of the exceptional nature or degree of unemployment in that area.
10. The powers and duties of the Minister in relation to the Agency referred to in section 12 shall include
(a) the undertaking of research and the making of investigations respecting the means of increasing employment and income in designated areas; and
(b) the preparing and carrying out of such programs and projects to improve the economic development of designated areas as may be appropriate to the purposes of this Part and that cannot suitably be undertaken by other departments, branches or agencies of the Government of Canada.
11. Subject to any existing statutory provision, the Governor in Council may authorize and direct departments, branches and agencies of the Government of Canada to undertake in the execution of their respective duties and functions such special measures as may be appropriate to facilitate the economic development of any designated area or the adjustment of industry in that area.
12. (1) There shall be established an Area Development Agency under the direction of a Commissioner for Area Development, who, together with a Deputy Commissioner for Area Development, shall be appointed by the Governor in Council to hold office during pleasure.
(2) The Commissioner and Deputy Commissioner shall be paid such salaries as are fixed by the Governor in Council.

Minister to exercise and perform duties. powers and functions of Minister of Defence Production.

Designated area.

Powers and duties of Minister in relation to Agency

Powers of Governor in Council.

Establish. ment of Area Development Agency

Salaries of Commissioner and Deputy Commissioner.

Commisesioner 13. (1) The Commissioner is the chief executive
chief executive officer and responsible to Miniater.
Absence, etc. of Commis sioner officer of the Agency and is responsible to the Minister for the work of the Agency.
(2) If the Commissioner is absent or unable to act or if the office is vacant, the Deputy Commissioner has and may exercise all the powers and functions of the Commissioner.

## PART III.

General.
Gemaral 14. The Minister, in exercising his powers and
authority
of Minisfer. carrying out his duties and functions under this Act,
(a) shall, where appropriate, make use of the services and facilities of other departments, branches or agencies of the Government of Canada;
(b) may, with the approval of the Governor in Council, enter into agreements with the government of any province or any agency thereof for the carrying out of programs for which he is responsible, and any such agreement shall be laid before Parliament within fifteen days after the execution thereof if Parliament is then sitting or, if Parliament is not then sitting, on any of the first fifteen days next thereafter that Parliament is sitting; and
(c) may consult with, and organize conferences of, representatives of industry and labour, provincial and municipal authorities and other interested persons.

Establishment of advisory committees
15. The Governor in Council may establish advisory and other committees to advise or aid the Minister or to perform such duties and exercise such powers as the Govemor in Council may specify, and may fix the remuneration and expenses to be paid to the persons so appointed.

Annual 16. The Minister shall, on or before the 31st report. day of January next following the end of each fiscal year or, if Parliament is not then sitting on any of the first five days next thereafter that Parliament is sitting, submit to Parliament a report showing the operations of the Department for that fiscal year.

1053-54, .. 21. 17. Section 4 of the Salaries Act is amended by adding thereto the following:
"The Minister of Industry . . . . . . . . . . . . . . 15,000."
18. Schedule A to the Financial Administration R.S..c. 1 is Act is amended by adding thereto the following:
"Department of Industry."
15. This Act shall come into force on a day to Coming into be fixed by proclamation of the Governor in Council. force.

ROGER DUHAMEL, F.R.S.C.
QUEEN'S PRINTER AND CONTROLLER OF STATIONERY
OTTAWA, 1963

Appendix $F$

## 14-15-16 ELIZABETH II.

CHAP. 82

An Act to provide general incentives to industry for the expansion of scientific research and development in Canada and to effect certain related amendments to the Income Tax Act.

> [Assented to 10th March, 1967.]

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 Industrial Research Short title. and Development Incentives Act.

## INTERPRETATION.

2. (1) In this Act,
(a) "applicant" means a corporation that has "Applicant." applied for a grant;
(b) "application" means an application for a grant; "Applica-
(c) "approved" means approved by the Minister; "Approved."
(d) "average of eligible current expenditures" by
a corporation in its base period means an amount calculated in accordance with section 7;
(e) "base period" of a corporation has the meaning assigned by section 6 ;
(f) "corporation" means a corporation incorporated in and carrying on business in Canada, other than a corporation that is exempt from tax under Part I of the Income Tax Act by section . 62 of that Act;
(g) "eligible current expenditures" by a corporation in a fiscal period means an amount calculated in accordance with section 5 ;
"Average of eligible current expenditures."
"Base period."
"Corporation.'
"Eligible current expenditures."

2 Chap. 82. Industrial Research and Development. 14-15-16 Eliz. II.

(h) "fiscal period" in respect of a corporation has the same meaning as in the Income Tax Act;
(i) "grant" means a scientific research and development grant under this Act;
(j) "grant period" means the fiscal period of an applicant in respect of which an application is made;
(k) "Minister" means the Minister of Industry; and
(l) "regulation" means a regulation made by the Governor in Council pursuant to section 14.
(2) For the purposes of this Act, two or more corporations shall be deemed to be or to have been associated with each other in a fiscal period if, for the purpose of section 39 of the Income Tax Act, the corporations are or were, as the case may be, associated with each other in that period.

Other expressions.

Scientific research and development grant authorized.

## Research

and
development likely to benefit Canada.

## Scientific Research and Development Grants.

mitted to him pursuant to this Act and such other information as he considers relevant, is satisfied that the scientific research and development in respect of which the expenditure was made is likely to result in benefit to Canada if it is successful, and, where the Minister is not so satisfied,
(a) no amount paid to the corporation in respect of such scientific research and development, and
(b) no property acquired by the corporation for the purposes of such scientific research and development,
shall be taken into account for the purposes of any provision of this Act.
(3) An application under subsection (1)

Application.
(a) shall be made within
(i) the six months next following the end of the applicant's grant period,
(ii) where the applicant was associated in its grant period with another corporation, the six months next following the end of the fiscal period of the other corporation ending in the grant period,
(iii) where the applicant was associated in its grant period with two or more other corporations, the six months next following the end of the last of the associated corporations' fiscal periods ending in the grant period, or
(iv) the six months next following the day on which this Act comes into force, whichever period ends last;
(b) shall contain such information as is specified by a regulation made under paragraph ( $c$ ) of section 14 and as may be prescribed by the Minister; and
(c) shall be in such form and be certified in such manner as may be prescribed by the Minister.
(4) If the Minister is satisfied that circum-

Extension of time. stances not reasonably within the control of a corporation
justify an extension of the period fixed by paragraph (a) of subsection (3) within which an application by the corporation shall be made, he may extend the period, either before or after the expiration thereof.

## Calculation of Grant.

4. (1) A grant authorized by the Minister to be Amount of paid to an applicant, other than an applicant referred to in grant.
subsection (2), shall be an amount equal to $25 \%$ of the aggregate of
(a) the capital expenditures by the applicant in its grant period on scientific research and development related to the business and directly undertaken by or on behalf of the applicant; and
(b) the amount by which the eligible current expenditures by the applicant in its grant period exceeds the average of eligible current expenditures by the applicant in its base period.

Associated corporations.
(2) Where an applicant was associated with one or more other corporations in the applicant's grant period, a grant authorized by the Minister to be paid to the applicant shall be an amount equal to $25 \%$ of the aggregate of
(a) the capital expenditures by the applicant in its grant period on scientific research and development related to the business and directly undertaken by or on behalf of the applicant; and
(b) where
(i) the eligible current expenditures by the applicant in its grant period exceed the average of eligible current expenditures by the applicant in its base period (the amount of which excess is hereinafter referred to as "the applicant's increase"), and
(ii) the aggregate of
(A) the eligible current expenditures by the applicant in its grant period, and
(B) the total of the eligible current expenditures by each of the corporations associated with the applicant in its grant period, in the fiscal periods of the associated corporations ending in the grant period,
exceeds the aggregate of
(C) the average of eligible current expenditures by the applicant in its base period, and
(D) the total of the averages of eligible current expenditures by each of the corporations whose eligible current expenditures are required to be included for the purposes of clause (B), in the base periods of those corporations
(the amount of which excess is hereinafter referred to as "the association's increase"), that proportion of the association's increase that the applicant's increase is of the aggregate of
(iii) the applicant's increase, and
(iv) where the eligible current expenditures by any corporation associated with the applicant in its grant period, in the fiscal period of the associated corporation ending in the grant period, exceed the average of eligible current expenditures by the associated corporation in its base period, the total of the amounts of such excesses for each of the corporations associated with the applicant in its grant period.
(3) Notwithstanding subsection (1) or (2), where an applicant was associated in any fiscal period included in its base period with a corporation
(a) with which the applicant was not associated in its grant period, and
(b) in respect of which all or substantially all the business that was carried on by that corporation in its last fiscal period before such association ended was acquired in any manner whatever by
(i) the applicant,
(ii) one or more corporations associated with the applicant in the applicant's grant period, or
(iii) by the applicant and one or more corporations described in subparagraph (ii),
an amount equal to one-fifth of the eligible current expenditures by that corporation in any of its fiscal periods ending in any such fiscal period of the applicant in which the applicant and that corporation were associated shall be added,
(c) for the purposes of paragraph (b) of subsection (1), to the average of eligible current expenditures by the applicant in its base period, or
(d) for the purposes of subparagraph (ii) of paragraph (b) of subsection (2), to the aggregate of the amounts determined pursuant to clauses (C) and (D) of that subparagraph,
whichever is applicable.
(4) No capital expenditure in respect of

Expenditures not included.
(a) land upon which movable or immovable property is or may be situated,

Where associated in base period only.
(b) any property that is acquired by the applicant in its grant period and that
(i) is sold or otherwise disposed of by the applicant,
(ii) ceases to be used by the applicant for the purposes of scientific research and development, or
(iii) is lost or destroyed
in the grant period, or
(c) the replacement or repair of lost, damaged or destroyed property, other than property to which paragraph (b) applies, where an amount has been paid or is payable under a policy of insurance in respect of the loss, damage or destruction and no amount has become payable by the applicant to Her Majesty by virtue of section 10 in respect thereof,
shall be included for the purposes of this section, and no expenditure
(d) that in the opinion of the Minister is not reasonable in the circumstances, or
(e) that is made wholly or mainly to acquire rights in or arising out of scientific research, shall be included for the purposes of this section or section 5 .

## Determination of Eligible Current Expenditures.

Eligible current expenditures.
5. (1) The eligible current expenditures by a corporation in a fiscal period of the corporation is an amount equal to
(a) the aggregate of the current expenditures in Canada by the corporation in the fiscal period
(i) on scientific research and development related to the business and directly undertaken by or on behalf of the corporation,
(ii) by way of payments
(A) to an approved association, university, college, research institute or other similar institution,
(B) to a company incorporated in and resident in Canada and exempt from tax under Part I of the Income Tax Act by paragraph ( $g c$ ) of subsection (1) of section 62 of that Act, or
(C) to another corporation,
for scientific research and development related to the class of business of the corporation, and
(iii) by way of repayments to Her Majesty of or on account of amounts paid to the corporation under an Appropriation Act and on terms and conditions approved by Treasury Board for the purpose of advancing or sustaining the technological capability of Canadian manufacturing or other industry,
minus the aggregate of
(b) any amount paid to the corporation in the fiscal period in respect of scientific research and development, other than an amount paid as a grant under this Act;
(c) subject to any regulation made under paragraph (e) of section 14 , where property acquired by the corporation for the purposes of scientific research and development, and in respect of the acquisition of which a current expenditure was made by the corporation,
(i) is sold or otherwise disposed of by the corporation,
(ii) ceases to be used by the corporation for the purposes of scientific research and development, or
(iii) is lost or destroyed, in the fiscal period, an amount prescribed by regulation; and
(d) subject to any regulation made under paragraph $(f)$ of section 14, where the corporation in the fiscal period sells or otherwise disposes of goods or services in the production or performance of which property acquired by the corporation for the purposes of scientific research and development is utilized, an amount prescribed by regulation.
(2) Notwithstanding subsection (1), where, in Idem.
determining the eligible current expenditures, by a corporation in a fiscal period in accordance with subsection (1), the aggregate of all amounts described in paragraphs (b) to (d) of that subsection exceeds the aggregate of the current expenditures described in paragraph (a) thereof,
(a) the eligible current expenditures by the corporation in that fiscal period shall be deemed to be zero; and
(b) where the eligible current expenditures by the corporation in that fiscal period are required to be included for the purposes of clause (B) of subparagraph (ii) of paragraph (b) of subsection (2) of section 4, the total referred to in the said

Scientific research and development related to a business.
clause (B) shall be reduced by the amount of such excess.
(3) References in this section to scientific research and development relating to a business or class of business include any scientific research and development that may lead to or facilitate an extension of that business or business of that class.

## Base Period.

6. (1) Subject to this section, the base period
(a) of an applicant is the five fiscal periods of the applicant immediately preceding its grant period; and
(b) of a corporation associated with the applicant in its grant period is the five fiscal periods of the associated corporation immediately preceding its fiscal period ending in the grant period.
(2) Where any of the five fiscal periods
(a) of an applicant, or
(b) of a corporation associated with the applicant in its grant period,
referred to in subsection (1) is less than 365 days, the base period of the applicant or the associated corporation, as the case may be, is the minimum number of consecutive fiscal periods thereof, immediately preceding the grant period or the fiscal period ending in the grant period, as the case may be, necessary to comprise at least 1,826 days.
(3) Where the applicant or a corporation as-

Deemed to have fiscal periods.

Average of eligible current expenditures.
7. (1) Subject to this section, the average of eligible current expenditures by a corporation in its base period is an amount equal to one-fifth of the aggregate of the eligible current expenditures by the corporation in the fiscal periods of the corporation included in its base period.
(2) Where the total number of days in the base period of a corporation is greater than 1,827, the amount determined under subsection (1) shall be reduced by an amount equal to one-fifth of that proportion of the eligible current expenditures by the corporation in the earliest fiscal period of the corporation included in its base period that the number of days in its base period in excess of 1,827 is of 365 .
(3) Where an applicant's grant period or, in the case of a corporation associated with the applicant in its grant period, the fiscal period of such corporation ending in the grant period is less than 365 days, the average of eligible current expenditures, calculated in accordance with subsections (1) and (2), by the applicant or the associated corporation, as the case may be, shall be reduced by that proportion thereof that the number of days by which the grant period or the fiscal period, as the case may be, is less than 365 days is of 365 days.

## Payment of Grants.

8. (1) Subject to subsection (2), an amount authorized by the Minister to be paid to an applicant as a grant shall be paid to the applicant by the Minister of Finance out of the Consolidated Revenue Fund.
(2) Where an applicant, in the manner prescribed by the Minister, requests the Minister to credit towards the payment of income tax all or any part of any amount authorized to be paid to the applicant as a grant, that amount or that part thereof shall, on the requisition of the Minister and in lieu of the payment thereof to the applicant as provided under subsection (1), be paid to the Receiver General by the Minister of Finance as a payment on account of income tax that is or may become payable by the applicant under the Income Tax Act.

## Tax Provisions.

9. (1) An amount authorized to be paid to an applicant as a grant is exempt from income tax.
(2) Paragraph ( $h$ ) of subsection (6) of section 20 of the Income Tax Act does not apply in respect of a grant authorized to be paid under this Act.

## Recovery of Grant.

10. (1) Subject to subsection (2), where a grant has been authorized to be paid to a corporation in respect of a

Amount subtracted.

Grant period or fiscal period less than 365 days.

Payment out of Consolidated Revenue Fund.

Payment on account of tax liability.

Grant exempt from income tax.

Grant does not reduce capital cost for tax purposes.
capital expenditure made in respect of the acquisition of property that
(a) is sold or otherwise disposed of by the corporation,
(b) is lost, damaged (by other than normal wear and tear) or destroyed, or
(c) ceases to be used by the corporation for the purposes of scientific research and development within a period described in one of the following paragraphs that is applicable to that property, the amount specified in that paragraph immediately becomes payable by the corporation to Her Majesty, namely:
(d) within one year from the end of the fiscal period in which the property was acquired, an amount equal to $100 \%$ of the grant or grants authorized to be paid to the corporation in respect of all capital expenditures made by the corporation in respect of the acquisition of the property;
(e) in the case of equipment, after the termination of the year referred to in paragraph (d) but within five years from the end of the fiscal period in which it was acquired, an amount equal to
(i) the amount described in paragraph (d), minus
(ii) one-fifth of that amount for each full year or portion of a year that has elapsed since the end of the year referred to in paragraph ( $d$ ); and
(f) in the case of property other than equipment, after the termination of the year referred to in paragraph (d) but within ten years from the end of the fiscal period in which it was acquired, an amount equal to
(i) the amount described in paragraph (d), minus
(ii) one-tenth of that amount for each full year or portion of a year that has elapsed since the end of the year referred to in paragraph (d).
(2) Where the property described in subsection (1) is property that was lost, damaged (by other than normal wear and tear) or destroyed, no amount becomes payable to Her Majesty by virtue of subsection (1) unless an amount payable under a policy of insurance in respect of the loss, damage or destruction has not, within one year from the end of the fiscal period in which the property was lost, damaged or destroyed or such further period as the Minister may in writing allow, been expended on replacing or re-
pairing the property and, in that case, an amount determined in accordance with subsection (1) becomes payable to Her Majesty immediately upon the termination of that year or any further period allowed in writing by the Minister.
(3) Every amount
(a) that becomes payable by a corporation by virtue of this section, or
(b) that has been paid or credited to a corporation as or on account of a grant, and to which the corporation is not entitled,
may be recovered at any time as a debt due to Her Majesty or may be retained, in whole or in part, by the Minister of Finance out of any grant subsequently authorized to be paid to the corporation.

## General.

11. (1) Notwithstanding any provision of the Income Tax Act, the Minister of National Revenue or any person designated by him for the purpose may, upon the request of the Minister, advise the Minister
(a) whether an applicant is or was associated in its grant period or in its base period with any other corporation;
(b) whether any particular expenditure of a corporation is a capital or current expenditure;
(c) as to the duration of any fiscal period of a corporation; and
(d) whether a corporation is exempt from tax under Part I of the Income Tax Act by section 62 or any provision of section 62 of that Act; and may give the Minister such information as is necessary for the purposes of any regulation made under paragraph $(h)$ of section 14.
(2) Any advice or information that may be given to the Minister pursuant to subsection (1) may be given to any officer or employee employed by Her Majesty in connection with the administration or enforcement of this Act who is designated by the Minister for the purpose.

## 12. The Minister may

(a) obtain the advice of any agency or department of the Government of Canada carrying on activities in the field of scientific research and development on whether any particular activity constitutes scientific research and development;
(b) obtain the advice of the Department of Trade and Commerce on whether any particular

Manner of recovery of amounts owing.

Minister of National Revenue may give advice.

Advice may be given to designated employee.


Information privileged.
13. All information with respect to a corporation obtained by an officer or employee of Her Majesty in the course of the administration of this Act is privileged, and no such officer or employee shall knowingly, except as may be necessary for the purposes of sections 11 and 12 or in respect of proceedings relating to the administration or enforcement of this Act, communicate or allow to be communicated to any person not legally entitled thereto any such information or allow any such person to inspect or have access to any application or other writing containing any such information.

## Regulations.

14. The Governor in Council may make regulations providing for any matters concerning which he deems regulations are necessary to carry out the purposes and provisions of this Act and, without limiting the generality of the foregoing, may make regulations
(a) prescribing or defining anything that by this Act is to be prescribed or defined by regulation;
(b) defining the expressions "capital expenditure", "current expenditure", "equipment" and "scientific research and development";
(c) specifying information that shall be provided by a corporation for the purposes of subsection (2) of section 3 ;
(d) prescribing factors that shall or shall not be taken into account by the Minister in deciding whether an expenditure was made in respect of scientific research and development that is likely to result in benefit to Canada if it is successful and the conclusions or inferences, if any, to be drawn from any particular factor;
(e) prescribing circumstances in which no amount need be subtracted pursuant to paragraph (c) of subsection (1) of section 5 where property described in that paragraph is sold or otherwise disposed of, ceases to be used for the purposes of scientific research and development or is lost or destroyed;
(f) prescribing circumstances in which no amount need be subtracted pursuant to paragraph (d) of subsection (1) of section 5 upon the sale or other disposition of goods or services described in that paragraph;
(g) prescribing the amounts that shall be subtracted pursuant to paragraph (c) or (d) of subsection (1) of section 5 ;
(h) prescribing, notwithstanding section 5 , the circumstances and manner in which information submitted to the Minister of National Revenue for the purposes of section 72 or 72 A of the Income Tax Act may or shall be used in determining the eligible current expenditures of a corporation;
(i) prescribing the books and records to be kept by any corporation that has applied for or received a grant and by any corporation associated with such corporation;
(j) providing for the examination, audit and copying of the books, records and property of any corporation that has applied for or received a grant and of any corporation associated with such corporation;
(k) providing for the disclosure to the Minister by a corporation by which an amount has become payable to Her Majesty by virtue of section 10 of such information as may be necessary for the enforcement of that section;
( $l$ ) specifying, either generally or in respect of a particular provision of this Act, the circumstances in which property shall be deemed to be or not to be acquired for the purposes of scientific research and development;
$(m)$ specifying, either generally or in respect of a particular provision of this Act, the circumstances in which a corporation shall be deemed to cease or not to cease using property for the purposes of scientific research and development; and
(n) either generally or in respect of a particular provision of this Act, respecting the day on which any property in respect of the acquisition of which a capital or current expenditure has been made by a corporation shall be deemed to have been acquired by the corporation.

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## Offences.

Offences.

Idem.

Institution of prosecution.

Application of Act.
15. (1) Every person who,
(a) in respect of an application for a grant, knowingly makes a false or misleading statement in or fails to disclose a material particular in any application or other document or wilfully furnishes any false or misleading information is guilty of
(i) an indictable offence and liable to imprisonment for a term not exceeding two years, or
(ii) an offence and liable on summary conviction to a fine not exceeding $\$ 5,000$;
(b) contravenes or fails to comply with any regulation made under paragraph ( $i$ ) or ( $j$ ) of section 14 is guilty of an offence and liable on summary conviction to a fine not exceeding $\$ 1,000$; and
(c) fails to comply with a regulation made under paragraph ( $k$ ) of section 14 is guilty of an offence and liable on summary conviction to a fine not exceeding $\$ 100$ for each day of default and not exceeding in all $\$ 5,000$.
(2) Every officer or employee of Her Majesty who contravenes section 13 is guilty of an offence punishable on summary conviction.
(3) A prosecution by way of summary conviction for an offence under subsection (1) may be instituted at any time within five years from the time when the subject matter of the complaint arose.

Application of Act.
16. This Act is applicable to expenditures on scientific research and development in any fiscal period of a corporation ending in the calendar year 1966 or any subsequent calendar year.

## Annual Report.

17. The Minister shall as soon as possible after the end of each fiscal year prepare a report on the administration of this Act during that fiscal year and shall cause such report to be laid before Parliament forthwith upon the completion thereof or, if Parliament is not then sitting, on any of the first fifteen days next thereafter that Parliament is sitting.

Amendments to Income Tax Act.
18. (1) Subsection (2) of section 72 of the Income Tax Act is repealed and the following substituted therefor:
> "(2) The Minister may obtain the advice of the Department of Industry, the National Research Council, the Defence Research Board or any other agency or department of the Government of Canada carrying on activities in the field of scientific research as to whether any particular activity constitutes scientific research."
(2) Paragraph (a) of subsection (4) of section 72 of the said Act is repealed and the following substituted therefor:
"(a) "approved" means approved by the Minister after he has, if he considers it necessary, obtained the advice of the Department of Industry or the National Research Council,"
(3) Subsections (1) and (2) are applicable to the 1966 and subsequent taxation years.
19. (1) Section 72A of the said Act is amended by adding thereto, immediately after subsection (4) thereof, the following subsection:
"(4a) Notwithstanding subsection (4), where prop- Idem. erty described in subsection (4) has been disposed of by a corporation in a taxation year, the amount that the corporation is required by that subsection to include in computing its income for that year shall be reduced by one-fifth of that amount for that year and each previous taxation year of the corporation ending after its 1967 taxation year."
(2) Section 72 A of the said Act is further amended by adding thereto the following subsection:
"(7) Where a grant has been authorized to be paid to a corporation under the Industrial Research and Development Incentives Act in respect of expenditures on scientific research and development (as defined for the purposes of that Act) in a taxation year, the corporation is not, and shall be deemed never to have been, entitled to make any deduction under this section in computing its income for that year."

16 Chap. 82. Industrial Research and Development. 14-15-16 Eliz. II.
(3) Subsection (1) is applicable to the 1968 and subsequent taxation years and subsection (2) is applicable to the 1966 and subsequent taxation years.

ROGER DUHAMEL, F.R.S.C.
QUEEN'S PRINTER AND CONTROLLER OF STATIONERY OTTAWA, 1967

## Appendix G

Partial List of Industrial Missions to Foreign Countries Sponsored by Department of Industry
(1) Clothing Mission to Europe - to study production methods and technology of clothing industry (1962).
(2) Leather Prade Mission to Europe - to study all aspects of leather industry (1962).
(3) Fabric Trade Mission to Europe - to study methods of fabric production (1964).
(4) Technical Wood Products Mission to the Western United States to study advances in technology of wood products (1965).
(5) Technical Mission to Europe - to study production methods and technology of Particleboard Industry (1965).
(6) Footwear Technical Mission to Europe - to study methods of footwear production (1966).
(7) Technical Mission to Europe - to study use of prefabricated structural ceramics in industrialized building (1966).
(8) Technical Mission to Europe - to study powder metallurgy industry (1967).
(9) Technical Mission to Italy - to analyse production techniques in the Electrical Major Appliance Industry (1967).
(10) Technical Mission to Europe - to study use of prefabricated concrete components in industralized building (1967).
(11) Technical Mission to Scandinavia - to study techniques used in Chemical Pulp Industry.

Regional Pattern of Expenditures

Table 1. PAIT Support by Province



Table 2. IRDIA App1ications (1967) by Province

|  | $\frac{\text { Grant Authorized }}{}$ |
| :--- | :---: |
| Nova Scotia | $\$ 000$ |
| New Brunswick | 108 |
| Quebec | 7 |
| Ontario | 2,494 |
| Manitoba | 2,036 |
| Alberta | 62 |
| British Columbia | 229 |
| TOTAL | $\$ 5,240$ |

Table 3. DIP (Development only) Support by Province

|  | Total Funds | Canadian Gov't. <br> Funds |
| :--- | ---: | :---: | :---: |
| Newfoundland | 335 |  |
| Nova Scotia | $\$ 000$ | 230 |
| Quebec | 4,360 | 1,829 |
| Ontario | 220,179 | 113,366 |
| Manitoba | 105,291 | 55,516 |
| Alberta | 6,886 | 5,773 |
| British Columbia | 1,083 | 496 |
| TOTAL | 270 | 135 |

Table 4. DIP (IMDE only) Support by Province

| Can. Gov't Funds |
| :--- |
| Nova Scotia |
| Quebec |
| Ontario |
| Manitoba |
| Alberta |
| TOTAL |
| 14,932 |

$\qquad$

TABLE I
Personnel Establishment, Denartment of Industry, Trade \& Commerce

PROGRAM
EST ABL ISUMENT
CONT. TERM
1968-69
EMPLS. EMPLS
(31/1/69)
Administration Group

| Executive  <br> Minister's office 17 <br> Deputy Minister $\frac{25}{42}$ <br> Administration  <br> ADM (Admin.) 3 <br> Financial Services 60 <br> Personnel 77 <br> Prof. \& Amin. Services 202 <br> Prorram Analysis 1.2 <br>   <br>   | $\begin{array}{r} 15 \\ 17 \\ \hline 32 \\ 2 \\ 44 \\ 75 \\ 168 \\ 4 \\ \hline 293 \end{array}$ | $\begin{array}{r}3 \\ 2 \\ \hline 5 \\ \\ 2 \\ 1 \\ 28 \\ 5 \\ \hline 36\end{array}$ |
| :---: | :---: | :---: |
| $\begin{array}{lr} \text { Travel Develomrient } & \\ \hline \text { Gen, Director's office } & 2 \\ \text { Office of Tourism } & \frac{292}{294} \end{array}$ | $\begin{array}{r} 2 \\ 250 \\ \hline 252 \end{array}$ |  |
| Industry \& Trade Develomment  <br> Sr. ADM (I. \& T.D.) 6 <br> Design Adviser 47 <br> Scientific \& Techn. Adviser 36 <br>   <br>  89 <br> Secondments | $\begin{array}{r} 5 \\ 35 \\ 26 \\ \hline 66 \\ 20 \\ \hline 86 \end{array}$ | $\begin{array}{r}11 \\ 2 \\ \hline 13\end{array}$ |
| Operations Groun  <br> ADM (Onerations)  <br> Aerosnace \& Marine 5 <br> A\&ric., Fish. Food Products 75 <br> Anparel \& Textiles 48 <br> Chemicals 57 <br> Electrical \& Electronics 92 <br> Machinery 103 <br> Materials 75 <br> Mechanical Transport 54 <br> Wood Products 63 <br> Prorram Office - Operations $\mathbf{2 2}$ <br>  661 | $\begin{array}{r} 5 \\ 64 \\ 69 \\ 36 \\ 50 \\ 69 \\ 83 \\ 64 \\ 42 \\ 54 \\ \hline 18 \\ \hline 554 \end{array}$ | $\begin{array}{r}7 \\ 4 \\ 2 \\ 3 \\ 8 \\ 3 \\ 1 \\ 5 \\ 1 \\ 1 \\ \hline 35\end{array}$ |
| Promotional Sunnort Services General Director's Office Industry \& Trade Publicity $\quad 83$ Industry \& Trade Services Trade Fairs \& Missions | $\begin{array}{r} 3 \\ 79 \\ 115 \\ 18 \\ \hline 215 \end{array}$ | $\begin{array}{r}4 \\ 1 \\ \hline 11\end{array}$ |
| External Services <br> ADil Office <br> International Defence Program 103 <br> Program Office 5 <br> Trade Commissioner Services 864 (350-514) | $\begin{gathered} 3 \\ 88 \\ 4 \\ 773 \\ (294-479) \end{gathered}$ | 6 1 |
| SUB-TOTAL I.\&T.D. $\begin{array}{r}\text { 976 } \\ \hline 958\end{array}$ | $\begin{array}{r} 868 \\ 1723 \end{array}$ | 7 66 |


| Trade \& Industrial Policy |  |  |  |
| :---: | ---: | ---: | ---: |
| ADM (Trade) | 18 | 18 | 1 |
| Area Nelations | 51 | 47 |  |
| General Relations | 39 | 33 | 1 |
| Industrial Policy Adviser | $\frac{13}{121}$ | $\frac{11}{109}$ | 1 |
| Economics \& Trade Analysis | 92 | 71 | 8 |
| World Exhibitions | 0 | 9 | 1 |
| TOTALS | 2861 | 2489 | 117 |

TABLE 2
Country of Birth, Secondary Education, Bachelor Degree of Professionals Having a Bachelor's Degree as a Final Degree



TABLE 3
Country of Birth, Secondary Education, Bachelor Degree, Master Derree of Professionals Having a Master's Degree as a Final Degree


## TABLE 4

Country of Birth, Secondary Education, Bachelor Degree, Doctorate Degree of Professionals Having a Doctorate Degree as a Final Derree

| Doctorate <br> Final <br> Derree | Country <br> of <br> Birth | Country of <br> Secondary <br> Education | Country of <br> Bachelors <br> Degree | Country of <br> Doctors <br> Degree |
| :--- | :---: | :---: | :---: | :---: |
| Americas | 5 |  |  |  |
| Canada | 5 | 6 |  |  |
| U.S.A. | 0 | 0 | 0 | 7 |
| Eurone |  | 2 | 2 | 3 |
| Czechoslovakia | 2 | 2 | 1 |  |
| Germany | 2 | 1 | 1 | 2 |
| Hungary | 1 | 1 | 1 | 0 |
| Italy | 1 | 2 | 2 | 1 |
| Netherlands | 2 | 2 | 2 | 0 |
| U.K. | 2 | 15 | 15 | 1 |
| Total | 15 |  | 15 |  |

TABLE 5


TABLE 6
Official Languages Proficiency (Bilingualism)

|  | Bachelors' | Masters' | Doctorate |
| :--- | :---: | :---: | :---: |
| Percentage able to <br> operate effectively <br> in Canada's two <br> official languages* | 26 | 21 | 40 |

*Based on individuals assessment of their own capability

TABLE 7
Previous Employment by Degree

|  | Bachelors' | Masters ' | Percentage <br> of Total <br> Professional <br> Personnel* |  |
| :--- | :---: | :---: | :---: | :---: |
| Doctorate |  |  |  |  |
| Industry |  |  |  |  |
| University (Staff) | 136 | 40 | 12 | 70 |
| Provincial Departments <br> or Agencies <br> Other Federal Agencies | 19 | 7 | 4 | 11 |

[^8]TABLE 8



Table 2. IRDIA Support by Industry Group For Companies With Fiscal Years Ending in 1967

*The large difference between the grant applied for and the grant authorized can be explained by the fact that processing of application is not complete.


Table 4. DIP (IMDE only) Support by Industry Group

|  | $\frac{\text { Can. Gov't Funds }}{\$ 000}$ |
| :--- | :--- |
| Primary Metals, Ferrous | 625 |
| Primary Metals, Non-Ferrous | 181 |
| Metal Fabricating | 2,156 |
| Machinery | 652 |
| Aircraft and Parts | 14,552 |
| Other Transportation Equipment | 545 |
| Electrical Products | 3,329 |
| Other Chemical Products | 40 |
| Scientific \& Professional Instruments | 1,236 |
| Other Manufacturing | 4 |
| ToTAL | $\$ 23,321$ |





## 5. Selection Criteria

### 5.1 Applicants

5.1.1 Applicant comnanies are assessed as to their technical and financial resources and facilities. The management, [solnfotechnical and marketing skills of the company, and the corporate an characteristics, are of special interest. The applicent is 20 expected to have the engineering, production and marketing capability necessary to plan and implement the development tonf project and exploit the results in domestic and export markets. ak bou The technical capability of the applicant is evaluated on the basis of previous work in the field, the availability of qualified staff, or of arrangements for technical competence on a subcontract basis. Marketing skills are assessed on the basis of previous sales, the market survey, and the adequacy of the existing or planned marketing organization and distribution network. Cornorate characteristics of interest are the record of past performance, the influence of foreign control, and any legal restrictions on access to international markets. 5.1.2 Regarding facilities, the applicant is expected to have the toals of the trade and equipment suitable for the conduct of the development project and follow-on manufacturing. If facilities are not adequate for these purposes, the applicant is required to outline firm nlans on how he proposes to acquire buas them.
5.1.3 The financial status of the applicant is evaluated by analysis of audited financial statements for the past three years, submitted by him. Financial resources should be adequate to enable the company to carry out the project on a sound financial basis, and there should be a satisfactory accounting system. If additional capital is required to undertake the project, or to exploit it commercially, the means of raising this capital bare determined and assessed.

### 5.2 Profect

5.2.1 Projects are required to be based on sound scientific principles, to be technically feasible within the time and cost


#### Abstract

limits of the project, and to be sufficiently advanced in performance to ensure that the developed product or process will be technically competitive by the time the marketing stage is reached. The main technical problems associated with the project should have been identified and the technical risks reduced to the practical minimum by the development plan pronosed. A Statement of Work is drawn up and becomes part of the PAIT Assistance Agreement. The qualifications and experience of the technical personnel directly involved in the project should be adequate to perform the technical tasks outlined in the develomment plan. 5.2.2 In addition to the technical requirement, each project is evaluated for its commercial feasibility. A market analysis is required from the company, defining the total market in terms of the requirement (price reduction, improved performance, simplicity, reliability, etc.), prospective customers, growth of market, distribution problems, and competition. Particular attention is given to export possibilities, and the proposed marketing plan. Where price is a critical factor, a production cost analysis is required.


## 6. Form of Assistance

6.1 PAIT assistance is provided in the form of a conditional loan, which may be nrovided to qualifying applicants for up to $50 \%$ of the estimated cost of the project without reference to Treasury Board for contract authorization.
7. Allowable Costs

### 7.1 Canital Costs

7.1.1 The PAIT Program does not underwrite the costs of acquisition of buildings or general purpose capital equipment for research, development or production purposes. General purpose equipment is defined as equipment which has a useful life beyond the duration of the development project and can be utilized for nurposes other than the development project without major modification or alteration, i.e., equipment which can be sold for more than scrap or salvage value or utilized for other
research and development purposes or for production purposes. However, during the period in which such equipment is used for research and development purposes related to the project, its onerating costs including an allowance for depreciation expense is allowable. This costing policy is also applied to nrototype plants where the complete facility is larger than is essential for research and development purposes.
7.2 Current Cösts
7.2.1 Allowable current costs include direct labour (research, desien, development, fabrication), direct materials (all material inputs essential to development and test), prototypes or pilot plants, reasonable overhead charges (apportionment of such indirect costs as supervision, rent or taxes, depreciation, power and light, heat and insurance - excluded are selling and financing costs), subcontracts and consultants, special test and laboratory equipment consumed during the project, and such other direct costs as patents and necessary travel related to the project.

## 8. Terms of Penayment

8.1 PAIT conditional loans must be repaid to the Crown with interest if the project is successful and the results are exploited commercially. Interest accrues from the dates of issue of payments to the company and is comnounded annually as of March 31 . The rate of interest is that nrevailing at the time of negotiation of the formal repayment agreement with the company, this rate being established quarterly by the Department of Finance as the government's lending rate. Repayment to the Crown is normally on a royalty basis out of sales, but the company has the option of repaying the Crown with interest in a lump sum at any time. The company has up to ten years to repay the PAIT contribution to the develonment project.
8.2 In the event that the project is not successful or the market prospects do not warrant putting the results of the project into commercial use, then the project is terminated and the loan is forgiver, (becoming in effect a rrant.)

[^9]Consultant is responsible for the technical appraisal, and the PAIT Office is held responsible for ensuring that all other aspects are compatible with the program criteria and program objectives before submission of the application to the PAIT Advisory Committee. Applications are sponsored before the Committee by the line Branch. 11.2 The PAIT Advisory Committee is an interdepartmental committee at the Assistant Deputy Minister level, and is chaired by the General Director of Science and Technology. The Committee is composed as follows:

| Chairman: | General Director, Science and Technology |
| :---: | :--- |
| Members: | Assistant Deputy Minister - Operations |
| ITEC |  |$\quad$ Assistant Deputy Minister - Trade Policy

monitors projects on a program basis, consolidating estimates, encumbering funds under Vote 10 , and negotiating with the line branch either a termination apreement or a repayment agreement as appropriate at the conclusion of a project.

## 12. Exnenditures

12.1 The Denartment expenditures on the program have been:

| $1965 / 66$ | 428,218 |
| :--- | :--- |
| $1966 / 67$ | $4,596,100$ |
| $1967 / 68$ | $6,364,904$ |
| Anr $1 / 68$ | $2,414,280$ |
| Dec $31 / 68$ | $13,803,503$ |

## 13. Results and Achievements

13.1 Since the inception of the PAIT Program, 167 projects have been anproved involving a total research and development expenditure of over $\$ 49$ million, of which the PAIT share is $\$ 25.5$ million. Thirty projects have been completed or terminated prior to completion. Twenty-one of these nrojects are expected to achieve sales. The remaining nine projects were failures either in a technical, marketing or financial sense.
13.2 The 21. successful nrojects to date involved a total PAIT expenditure of $\$ 1,350,000$. The 9 unsuccessful projects were terminated at a cost to the Crown of $\$ 257,000$. Since PAIT expenditures on successful mrojects will be repaid out of company sales, the net cost to the Crown is renresented by the expenditure on unsuccessful nrojects, i.e. $\$ 257,000$. When the sales resulting from the 21 successful nroiects $(\$ 92.3$ million) are related to the cost of the unsuccessful projects $(\$ 257,000)$, the sales/cost ratio is $360 / 1$. Already, within one year of completion of the 21 successful projects, actual sales to December 31,1968 , are over 40 times the Crown's unrecoverable expenditure on the unsuccessful projects. To December 21, 1968 , repayment agreements had been signed with 13 of the 21 successful comnanies, and the rest were under negotiation. Five comnanies are presently repaying out of production.

```
13.3 The 21 successful projects cover a broad spectrum of industrial
innovation including electromamnetic mineral prospecting equipment,
environmental control instrumentation, corununications, electronic
data disnlay devices, automated equipment, industrial process
control techniques, and woods harvesting equipment.
13.4 The criteria for evaluating the results of a project are
related to the economically remenerative aspects of industrial R&D:
    - sales of price and performance competitive products of
        unique Canadian design in large domestic and export markets;
        and
    - value added as a measure of economic output and growth
        resulting from the project; and
    - benefits such as increased employment, establishment of
        new capital facilities and equipment for manufacturing
        of the developed product, upgraded employment skills,
        and advanced manacement and marketing techniques related
        to product innovation as a factor in modern business enterprise
```

13.5 Tynical case histories of some completed projects are given in











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## Industrial Research and Development Incentives Act

1. Program Objectives
1.1 The primary objective of the Industrial Research and Development Incentives Act, which authorizes the Department's Industrial Research and Development Incentives program, is to induce Canadian corporations to expand scientific research and development likely to result in economic benefit to Canada. The specific objectives of the Act are:
(a) to encourage an increased growth rate in industrial research and development by:
(i) inducing Canadian corporations to undertake new and expand existing scientific research and development programs, the results of which, if successful, will be exploited by the Corporations;
(ii) inducing Canadian corporations to provide well equipped facilities for such work.
(b) to encourage the establishment of independent research anc
development laboratories, research associations and technical consulting services whose purpose is to provide specialized support services for industrial research and development;
(c) to encourage greater co-operation between industry and universities on research related to industrial problems.
2. Program Authority
2.1 The authority for this program is the Industrial Research and Development Incentives Act, 14-15-16 Elizabeth II, Chapter 82 of the Statutes of Canada. The Act was assented to March 10, 1967. Industrial Research and Development Incentives Regulations were promulgated in Order-in-Council P.C. 1967-1048 dated May 25, 1967.
3. Eligible Applicants
3.1 The incentive is available to all taxable Canadian corporations carrying on business in Canada.
4. Qualifying Activities
4.1 The activities qualified under the Act are scientific research and development as defined in Section $2(2)$ (d) of the Regulations, which state: "Scientific research and development" means systematic investigation or search carried out in a field of science or technology by means of experiment or analysis, that is to say,
4.1 Qualifying Activities - continued
(i) basic research, namely, work undertaken for the advancement of scientific knowledge without a specific practical application in view, Applied research, namely, work undertaken for the advancement of scientific knowledge with a specific practical application in view, and development, namely, use of the results of basic or applied research for the purpose of creating new, or improving existing, materials, devices, products or processes,
and where such activities are undertaken directly in support of scientific research and development, includes activities with respect to engineering or design, operations research, mathematical analysis or computer programming and psychological research, but does not include activities with respect to -
(iv) market research or sales promotion,
(v) quality control or routine testing of materials, devices or products,
(vi) research in the social sciences or the humanities,
(vii) prospecting, exploring or drilling for or producing minerals, petroleum or natural gas,
(viii) the commercial production of a new or improved material, device or product or the commercial use of a new or improved process,
(ix) style changes, or
(x) routine data collection.
5. Form of Assistance

Assistance is provided in the form of tax free cash grants. At the request of the applicant company, a cheque will be forwarded to the Department of National Revenue as a credit on account of any income tax which is or may become payable under the Income Tax Act.
6. Allowable Costs
6.1 Capital Costs
6.1.1 Grants will equal 25 per cent of capital expenditures made by an applicant for scientific research and development carried out in Canada during the grant year. These must be related to the business of the applicant and directly undertaken by or on behalf of the applicant.
6.2 Current Costs
6.2.1 Grants will be equal to 25 per cent of the increase of eligible current expenditures made by the applicant in Canada over the average of such expenditures in a base period consisting of the five immediately preceding years.

## 6.2 (continued)

### 6.2.2 The terms "capital expenditures" and "current expenditures"

 are defined in Section $2(2)$ (a) and (b) of the Regulations.
## 7. Terms of Repayment

7.1 The Act does not require repayments as such, but grants may be recovered in other instances if property for which a grant has been
authorized is transferred from research and development use to some other use.
8. Title to Results and Property
8.1 The title of any results or property arising out of the program,
e.g., designs, inventions, patents, prototypes, equipment, etc., remains with the Corporation.
9. Obligations of Applicant
9.1 A Corporation that applies for a grant shall certify, with respect
to scientific research and development carried out, that was financed in whole or in part by the Corporation, that:
(a) It is carrying out all such scientific research and development for the purpose of strengthening the business of the corporation or facilitating an extension of such business.
(b) It is free to exploit in Canada the results of all such scientific research and development, and the corporation is free to exploit the results of all such scientific research and development in all export markets (where this is not possible, will state the countries to which the corporation is not free to export) and shall undertake to exploit the results of such scientific research and development in Canada, unless according to sound business judgment, it would be uneconomic to do so.
10. Administrative Procedures
10.1 A brief description of the administrative procedures, upon receipt of an application by the Program Office, is as follows:
(a) The Line Branch or Branches are asked to prepare an assessment and recommendation concerning the scientific research and development and benefit to Canada aspects of the application.
(b) The Program Office will examine the financial aspects of the application to determine the eligibility of particular costs and check the accuracy of the amounts claimed. All applications will be subject to discretionary post-payment audit by the Audit Services Branch, Office of the Comptroller
10.1 (b) (continued)
of the Treasury; pre-payment audits may be requested by the Program office in consultation with Financial Services Branch.
(c) The Line Branch or Branches will forward their assessments and recommendations to the Program Office who will review these assessments and recommendations in conjunction with the pre-payment audit (if any) and if necessary discussions will be held with the Line Branch or Branches concerned. If it appears necessary that further examination is necessary, the Program Office will seek the written opinions of staff advisers and other government departments or agencies, and if required further discussions will be held with the Line Branch or Branches. Following the Program Office recommendation and authorization the application will be forwarded to the Financial Services Branch for concurrence. Following this, the application will be passed to the General Director, Office of Science and Technology, will be passed to the General Director, Office of Science and Technology, or his delegated alternate for approval and signature.
(d) In the case of major policy issues, applications may be referred to the IRDIA Policy Committee and then discussed with the Deputy Minister.
(e) The General Director, Office of Science and Technology, will also obtain the concurrence of the Deputy Minister before rejecting applications.
(f) The Financial Services Branch will arrange payment to the applicant or to the Department of National Revenue as a credit against Tax Liabilities.
(g) The Program Office will notify the applicant, the Branch and the Department of National Revenue of the disposition of the application.
10.2 Administratively, a system has been provided for corporations to request a prior opinion as to eligibility under the Act, with regard to eligibility as research and development and benefit to Canada aspects. A procedure similar to that for an application is followed in handling a request for a prior opinion with the Department.
11. Expenditures
11.1 The actual disbursements were $\$ 2,131,353$ in fiscal 1967, and $\$ 10,261,638$ for the first nine months of fiscal 1968.


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## 12. Results and Achievements

12.1 Generally speaking, industry has welcomed the program. Participation has been good. Applications for fiscal years ending in 1967 numbered 533. Applications for the 1968 company fiscal year are running $45 \%$ higher than 1967 applications did at this time last year. Of the 180 applications for 1968 received to date, 74 are from companies who did not make application in 1967.
12.2 The benefits payable with respect to given company fiscal years are closely in accord with the estimates made when the program was proposed. Actual expenditures have lagged as a result of delays on the passage of the legislation and the fact that most large companies did not submit their 1967 applications until the June 30, 1968 deadline. This, together with a decision to review each application carefully in the initial year of dealings with the company, has meant that the program is just beginning to reach the projected average monthly expenditure levels.
12.3 The administration has proceeded smoothly. About $5 \%$ of the applications assessed to date have been rejected in total. Reductions in the claims have averaged about $18 \%$. Less than $5 \%$ of the assessments to date have been disputed, and all but one settled to the applicants' satisfaction.
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$\qquad$
$\qquad$
$\qquad$

## The Defence Industry Productivity Program

## 1. Program Objectives

1.1 The immediate objective is to develop and sustain the technological capability of Canadian industry for the purpose of defence export sales or civil export sales arising from that capability.
1.2 Such industrial capability is a means toward four main goals, two of which relate directly to national defence and constitute the initial and still valid aims of the Program:
(a) To minimize cost of acquisition of equipment for DND (by making it possible to purchase abroad when necessary to achieve competitive prices); and, (b) To retain in Canada defence industrial capability for use by DND in servicing and maintaining its advanced equipment (by substituting the opportunity of defence export sales, in place of dependance on DND requirements).
(c) To ensure maximun industrial benefit from the advanced technology and management techniques inherent in defence research, development and production by makinc possible competitive participation in foreign markets.
(d) To support co-operative programs with our Alfies in Military Research, Development and Production (the Production Sharing Progran).

## 2. Prorram Authority

2.1 In its present form, the Proeram was given approval on lst 1'ay, 1968, by a Cabinet Committee considering a Miemorandun to the Cabinet" dated 24th April, 1968, and entitled "Defence

Industrial. Development". This approval was later confirmed by Cabinet.

## 3. Elimible Applicants

3.1 To be eligible, companies must be identifiable as belonging to Canadian defence industry. This industry sector is defined as those companies or elements thereof which have or may develop a defence-oriented capability or capacity employing advanced management
engineering and technolagy directed to defence export sales or civil export sales which arise from the capability or capacity.

## 4. Oualifying Activities

4.1 Assistance under this Program includes product research, development, test, and evaluation and product and process innovation; tooling, manufacture of prototypes, sample batches and all other non-capital cost activities associated with the establishment and qualification of a production source; advanced manufacturing equipment; test and quality control facilities; data handling equipment.
5. Selection Criteria
5.1 Develoment Projects

The following considerations are taken into account when
assessing a proposed project.
(a) the extent of production sharing potential
(b) the extent of real interest within the applicable associated government service(s)
(c) the extent to which the associated government is prepared to monitor the project to ensure that the end product meets its development specifications
(d) the extent to which the resources of $\operatorname{DND}$, such as technical assistance, test facilities, G.F.E., etc., may be available
(e) the extent of Canadian military interest
(f) the extent to which existing Canadian industry is capable of accepting the responsibility for development
(g) the extent of commercial implications
(h) the extent to which Canadian industry is prepared to share financially
(i) the extent of long range economic benefits to Canada in terms of technological advancement, financial advantaces, continuity and suitability within the Canadian industrial engineering base.

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[^10]
### 5.2 Canital Equipment \& Source Establishment Projects <br> The criteria outlined below are taken into account before recommending expenditures for either a capital assistance or source establishment project.

(a) the extent of present and future foreign defence markets which the company can expect to capture
atrmolghood as a result of the proposed assistance; as a secondary consideration, domestic defence markets
(b) potential commercial use of equipment, end items or facility
(c) the amount of Canadian content in the end items to be produced and, in the case of capital equipment, in the equipment itself
(d) the extent of the recipient company's efforts to identify and exploitdefence export markets, to establish suitable programs for retraining personnel, to review production planning, and, where applicable, to cuarantee efficient employment of the capital qolovab Ihs 80 equipment
(e) relationship of the company's proposed investment to all other forms of Crown assistance received, past, present or pronosed and success in exploiting such assistance
(f) compatibility of the pronosed new production facility with the company's existing competence, plans and finances; and the degree to which the new facility would fill a gap, and increase the efficiency of the plant
(r) the ability of the company to finance its share of the costs
(h) imnact on the company's efficiency, production cost and profitability,

In addition to the above, the following criteria must also
be taken into account for carital assistance projects:


(i) versatility of the equipment for production of a range of items
(k) the rate of obsolescence or economic life of the capital equipment; the degree to which the equipment is the most advanced for the intended purpose
(1) the ability of proposed equipment to perform work which cannot now be done in Canada, or in recipients facility, with a view to minimizing duplication of facilities in Canada.

## 6. Forms of Assistance

### 6.1 Develoment Projects

The Crown's assistance is provided in the form of a sharedcost contract. The particular sharing ratios of the total approved costs of the project can vary widely, depending upon various factors, Including the number of participants in the project (e.g. costs could be contributed by the Crown, Company, and one or more allied Governments). Generally speaking, the Crown matches the Company ${ }^{\circ}$ s particular contribution. To date, on an overall basis, the Crown has contributed approximately $50 \%$ of the total costs of all development projects under this Program.

### 6.2 Canital Assistance Projects

Assistance in the form of a shared cost contract is provided to pay for the acquisition cost of approved equipment. The companyis share ( $50 \%$ ) is recovered by the sale of the equipment to the company over a five year period.

### 6.3 Source Establishment Projects

Assistance is provided, in the form of a shared cost contract, for specified costs of the project. Normally costs are shared equally.
7. Terms of Re-Payment

### 7.1 Canital Equipment Projects

The company re-pays its agreed share (i.e. $50 \%$ ) of the total acquisition cost of approved equipment to the government over a five year period without interest.
7.2 Develonment Projects \& Source Establishment Projects
Recoumment of Her Maiesty's Contribution
(a) In normal circunstances the employment of funds is limited to those companies which are prepared to make

```
an adequate contribution. In such cases, there
is no recovery of the Government contribution except
where the profit realized on the initially supported
develomment and/or follow-on production orders is
beyond that considered fair and reasonable. For the
purpose of this assessment, an adequate contribution
in support of the development contract equals or exceeds
that of the Government.
(b) In cases where the contractor is not able to make an adequate contribution (as defined above), a Government contribution is considered provided that any contract entered into with the company contains a condition that repayment will be made to the Government as follows: (i) \(25 \%\) of all profits up to \(10 \%\) and all profit in excess of \(10 \%\) realized from the initially supported development contract and/or follow-on production until an equal contribution to the development project has been made by the company and the Government, and
```

(c) If the develoment project to which the Government has contributed results in the contractor becoming the sole source of supply, in addition to the profit arrangements set forth in (a) and (b) above, it is expected that the follow-on production orders will enable the contractor and the Government to recover simultaneously their contributions in whole or in part on a pro-rata basis, i.e. in the form of a Noyalty payment. Recovery of the Government contribution will be at a rate to be determined in consultation with the Financial Advisor.
(d) As an alternative to refunding any amount to the Government, it may be arranged for the company to invest an equivalent amount on special projects, to be approved by the Department in advance, in the field of product development or source antablishment.
(e) To detemine the repayment position, costs are computed in accordance with DDP-31 (Revised 11/57) in the case of military requirements and in accordance with generally accepted accounting principles in the case of commerial sales. To determine profit, the company contribution, but not the Government contribution, to development costs, will be considered an element of cost. Recovery of profits over $10 \%$ arising from contracts placed by DDP on behalf of any Canadian Government Department is not applied against recovery of the Government contribution to development projects. It may be acceptable for the contractor to arrance for a statement to be submitted to the Denartment, certified by a responsible officer of the connany, substantiating the profit position. In addition, each contract contains the Department's usual discretionary audit clause, which permits audit by A.S.n. (Denartment of Finance). The company rust arree to an examination of the cost and profit mosition of the comany resulting from the initially supported develomment contract and any follow-on




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$\qquad$

## 8. Title to Results \& Pronerty

### 8.1 Source Establishrient Projects

Not annlicable. This situation does not arise.

### 8.2 Canital Equinment Projects

Title remains with the Crown until the company had paid its arreed share of the costs.
8.3 Develoment Sharing Projects

The disposition of design rights is a negotiable point and depends on the circumstances (e.g. sharing ratio, participation of a foreign couintry, etc.) of the individual proposal.
2. Profram Administration
9.1 Develomment Projects

If after a freneral, overall review of a proposal the
Denartment's opinion is favorable, it is referred to the appropriate Technical Advisory Group. (These groups are staffed by DITC, DND, DDP. These are three separate groups, namely, Aerospace, Electronics and Weapons). The TAG is responsible for determining the technical suitability of the proposal and reports to the Inter-departmental Comittee for Defence Develomment (IDC Committee). The IDC Committee membershin is as follows: -

Assistant Deputy Minister (External Services), Department of Industry, Trade and Commerce, Chairman
Assistant Deputy Minister (Logistics), Department of National
Deputy Chairman (Scientific) Defence Research Board
Assistant Deputy Minister (Operations) Department of Defence
General Director, Office of Science and Technology, Department
of Industry, Trade and Commerce
Assistant Secretary, Treasury Board
General Director, Defence International Programs Branch,
Department of Industry, Trade and Commerce

This Committee makes a recommendation to Treasury Board.
9.2 Source Establishment \& Capital Assistance Projects
If following the meneral, overall review the Department elects to further consider the pronosal it is submitted to the Industry Modernisation for Defence Exports (IMDE) Committee for appraisal.



```
Assistant Deputy Minister (External Services), Department
    of Industry, Trade and Commerce, Chaimman
Financial Adviser, Department of Industry, Trade and Commerce
Industrial Policy Adviser, Department of Industry, Trade and
                                    Commerce
General Director, Defence International Programs Branch,
                        Denartment of Industry, Trade and Commerce
General Director, Machinery Branch, Department of Industry,
                            Trade and Commerce (Adviser)
This committee makes a recommendation to Treasury Board for
``` approval in principle. The Department of Defence Production nerotiate, prepare and administer specific contracts covering the approved proposal.

\subsection*{9.3 Follow-up of Anproved Projects}

Follow-up activity for capital assistance and source establishment nrojects is carried out by the Branch officer by making periodic visits to the company and by evaluating export sales received. For develoment projects a formal review group, the Project Review Group (consisting of members from DDP, DOI, and other Government acencies) is formed to monitor the project, recommend changes if necessary, and report regularly to the IDC Committee through the Technical Advisory Group.
1.0. Expenditures
10.1 The Department expenditures on the Program have been:
\begin{tabular}{lr}
1960 & \(\$ 5,449,685\) \\
1961 & \(11,788,117\) \\
1962 & \(10,462,673\) \\
1963 & \(12,550,216\) \\
1964 & \(27,785,229\) \\
1965 & \(19,553,348\) \\
1966 & \(26,919,014\) \\
1967 & \(30,559,886\) \\
1968 & \(32,280,670\)
\end{tabular}

\section*{11. Results and Achievements}
11.1 Since the incention of the Program 165 projects have been supnorted and expenditures to date amount to \(\$ 148\) million. of the projects supported 117 costing \(\$ 99\) million have been completed. Seventy-eight of these projects were commercially successful

\title{
and are achieving sales. The value of sales resulting from these mojects is \(\$ 995\) rillion. The total value of sales resulting from these mrojects is expected to reach \(\$ 2.4\) billion during the sales Jife of the profects; the fraction of these sales in the civil sector of the export marlset is expected to rise to \(50 \%\) fron the nresent level of abont one third.
}

\title{



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\(\qquad\)

\section*{Industrial Research Institute Program}
1.0 Program Objectives
1.1 The objectives of the program are:
(a) to foster a closer relationship between universities and industry, thus assisting the universities to improve their understanding of of the problems of industry, and helping industry to become acquainted with the latest pertinent scientific and technical developments;
(b) to facilitate transfer of science and advanced technology to industry;
(c) to provide scientific services for industrial firms unable to maintain research facilities and personnel of their own.
2.0 Program Authority
2.1 Treasury Board Minute No. 662697 dated December 12, 1966.
3.0 History
3.1 During 1966, a formal request was submitted to the Department by the University of Windsor, for a grant to assist in the establishment of an Industrial Research Institute to serve local industry. A preliminary proposal, received during the previous year, had been endorsed by the Windsor Chamber of of Commerce.
3.2 In December of 1966, a recommendation to the Treasury Board resulted in the approval of a grant to the University of Windsor, as well as the approval to assist in the establishment of Institutes at Nova Scotia Technical College, McMaster University and the University of Waterloo. The Industrial Research Institutes formed at these four universities began the acquisition of staff; and made preliminary contacts with industry during 1967.
3.3 By January 1969, all of the institutes had completed some research contracts, and were actively conducting research with respect to others.

\subsection*{4.0 Eligibility Criteria}
4.1 To qualify for assistance under the Program, Industrial Research Institutes must be wholly owned by a Canadian university and must utilize the facilities of the university to conduct contract research on behalf of industry.

\subsection*{5.0 Forms of Assistance}
5.1 Under the Industrial Research Institute Program, assistance takes the form of a grant, payable in instalments, usually over the 3 year period following

\section*{5.1 (continued)}
the establishment of the Institute. The payments made in any one year are based on actual expenditures made by the university during the year for the following purposes:
(a) Salaries and wages, including fringe benefits, of the manager, and assistant manager (if any) of the Institute and of the secretarial and clerical staff of the Institute.
(b) Travel expenses incurred by the manager and assistant manager of the Institute.
(c) Rental of offices and office equipment, and the cost of office supplies, printing, telephone and telegraph services for the Institute.
(d) Other administrative expenses as may be approved by the Department.

\subsection*{6.0 Administration}
6.1 Each Institute is managed by a full-time manager (or director), usually with an assistant, and a small secretarial and clerical staff.

Each Institute operates with the guidance of an advisory board, or a board of directors. A representative of the Office of Science and Technology sits upon the board of each of the four institutes.
7.0 Expenditures
7.1 During the fiscal year 1967-68, expenditures made by the Department totalled \(\$ 84,206\), of which \(\$ 40,000\) was applied to the Atlantic Industrial Research Institute of Nova Scotia Technical College. The remainder, \(\$ 44,206\) was directed towards the three Ontario institutions.
7.2 During fiscal 1968-69, it is expected that expenditures will total approximately \(\$ 168,000\), of which the Atlantic Industrial Research Institute will receive \(\$ 40,000\). The remaining \(\$ 128,000\) will be applied to the operation of the three institutes in Ontario.

\subsection*{8.0 Results and Achievements}
8.1 All of the four institutes organized to date have acquired staff and have established widening contacts with industry. A number of research contracts have been completed by each, and each institute is engaged in ongoing research for industrial sponsors.
8.2 Although the size of contracts to date have been generally small, the response has been encouraging, and the volume appears to be growing at a

\section*{8.2 (continued)}
satisfactory rate. Supplementary educational programs have been arranged for industry by some of the Institutes, and these have been well received. These supplementary programs have taken the form of specialist training and technical seminars.
8.3 A number of other universities, contemplating the establishment of Industrial Research Institutes have been in contact with the Department. Several appear to be well advanced in their planning, and formal applications are expected early in fiscal 1969-70.

Program for Increasing Productivity and Efficiency
in the Manufacture and Use of Building Equipment Accessories and Materials (BEAM)
1. Program Objectives
1.1 The overall objectives of the BEAM Program are to increase productivity and efficiency in the manufacture and use of building equipment, accessories, and materials.
1.2 After a study of the industry in Canada, the United States and abroad and after numerous discussions with representatives of the industry, its associations, and institutes, it was determined and agreed that increases in productivity and efficiency could be best achieved by meeting the following specific objectives:
(a) The establishment of a comprehensive construction information system.
(b) The adoption of modular coordination.
(c) The greater industrialisation of the building process.
(d) The adoption of more uniform building regulations throughout Canada and the establishment of a means of assessing and approving new materials and techniques.
(e) The establishment of an awards program to foster improved design in new materials, methods, and techniques.
2. Program Authority
2.1 The BEAM Program was accepted for funding by Ministerial approval. The various projects were accepted for funding either on the approval of the Minister and Treasury Board or on the approval of the Deputy Minister and Treasury Board.
3. Expenditures
\begin{tabular}{ll}
\(1966-67\) & \(\$ 18,500\) \\
\(1967-68\) & \(\$ 160,000\)
\end{tabular}

1968-69 (10 mo ) \(\$ 100,000\)

\section*{4. Results and Achievements}
4.1 A prototype comprehensive construction information system for the collection, storage, retrieval and dissemination of information pertinent to building equipment accessories and materials is to be established in 1969.
4.2 The concept of modular coordination in construction in the dimensioning of products and the design of buildings has been accepted as standard practice by the Canadian government and has received support by several provincial departments of Public Works and various sectors of the Canadian construction industry. 4.3 Increased industrialization of building processes has taken place by utilizing new techniques, new materials, and new methods, and by adapting existing ones to changing conditions. 4.4 The economic benefits that result from the adoption of uniform building regulations such as the National Building Code have been generally realized by provinces and communities. 4.5 A more creative use of materials in the design and assembly of structures and construction products has been encouraged through design awards programs.










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\section*{Appendix R}

\section*{List of Typical Puhlications and Renorts \(\quad\) anope}

\section*{1. Publications}

Orr, T.L., "A Technological Stratery for Industrial Development", Science Forum, Vol. 1, No. 4, 1968.

Orr, J.L., "Government's Role in Stimulating the Innovation Process", Industrial Canada, 1966.

Orr, J.L., "Incentives for Industrial Research and Development

2. Peports

1964
Analysis of Scientific Pesearch and Development Activity in Canadian Industry.

A Proiected National Scientific Budget for the Expansion of
quondustrial Pesearch and Develomment.
Scientific Manpower for Industrial Research and Development. A Critique on Techniques of Direct Financial Assistance for Promoting Industrial Research and Development. 1965

Economic Aspects of the Pronosed NAE 30 -Foot Low Speed Wind Tunnel. Glass and Glass Products in Canada.

Commercial Metal Heat Treating Facilities in Canada.
Report on the Canadian Technical Wood Products Mission to the Western United States. \(1 \begin{array}{ll}\text { Whan }\end{array}\)

A Study of the Particleboard Industry as a Result of a Technical Study Tour of the Euronean Particleboard Industry. 1966

Current Status of the International System of Neasurement in Canadian Manufacturing Industry.

Ten Systems of Prefabricated Masonry.
Fenort of the Canadian Technical Mission on the Use of Prefahricated Structural Ceramics in Industrialised Building in Eurone.

The Current Status and Future Trends in the Powder Metallurgy Industry.
```

Die Casting in Canada.
Report on the Canadian Hardwood-Plywood Mission to Europe.
Aerospace Study. Vol 1 - The World Market for Aerospace Products.
1967
Statistical Data on Industrial Research and Development in Canada.
Report on the Canadian Technical Mission on the Use of Prefabricated
Steel Commonents in Industrialized Building in Europe.
BEAN Bulletin.
Report of the Canadian Powder Metallurgy Technical Mission to
Euronean Countries.
Advanced in the Manufacture of Powder Metallurgy Parts and
Components.
Die Casting in Canada.
R\&D Needs of the Canadian Furniture Industry (Woods, Gordon \& Co.)
Aerospace Study: - Canadian Aerospace Capabilities and Resources.
1968
Lectures and Proceedings on Six Regional Conferences on Modular
Coordination.
Lectures and Proceedings of a National Conference on a Systems
Anmroach to Building.
Beam Buljetin.
The Future of Powder Metallurgy Industry in Canada.
Report on the Maior Appliance Industry.
Report on the Tour of the Scandinavian Chemical Pulp Industry.
1969
Renort on Ontimum Household Furniture Manufacturing Facilities.

```

The following is a partial listing of conferences and seminars, organized by the Department, to disseminate information and to stimulate industrial discussion and interest.

1966
(1) Wood Products Seminar - Kelowna and Vancouver, B.C.
(2) Industrial Wood Products Seminar: The Future of Poplar Utilization in Alberta - Edmonton, Alberta
(3) Structural Steel Seminars - Montreal, Quebec; Calgary, Alberta and Toronto, Ontario
(4) Seminar on Automatic Process Control - McGill University
(5) Seminar on Technological Forecasting - Department of Industry, Ottawa.

1967
(6) International Symposium on Air Cushion Vehicles; to familiarize Canadian industry and potential users with international development on ACV's - Toronto
(7) Technical Seminar for the Canadian Wood Pallet and Container Association - Ottawa
(8) Regional Conferences on Modular Coordination - Halifax, N.S.; Montreal, Quebec; Toronto, Ontario; Winnipeg, Manitoba; Edmonton, Alberta: Vancouver, B.C.
(9) Seminar on Automatic Process Control - Universities of Laval, British Columbia, Alberta and Manitoba.

1968
(10) Foundry Management Improvement Seminars - Toronto
(11) National Conference on a Systems Approach to Building
(12) Seminars on Automatic Process Control - Universities of Toronto and Waterloo

\section*{TABLE 1}

\section*{Major Projects Punded or Performed by the Department}

\section*{1. PAIT Projects}

The following companies had entered into PAIT assistance agreements up to Dec 31st, 1968.
\begin{tabular}{lc} 
Abitibi Paper Co. Ltd., & Toronto, Ontario. \\
Acme Paper Products Co. Ltd., & Toronto, Ontario
\end{tabular}

Algocen Mines Limited, Sault Ste. Marie, Ontario.
Alexbow Limited, Ottawa 7, Ontario

Algoma Central Railway
Art Laboratory Furniture Ltd.,
ATCO Industries Ltd.,
Atlantic Forest Products Ltd.,
Atlas Chain Co. Ltd.,
Atlas Hoist \& Body Incorporated
Atlas Steels Limited,
Automatec Inc.,
Aviation Electric Limited,
Baker Talc Limited, Baldrive Company,

Balloon Transport Iimited,
Barringer Research Limited,
Bata Shoe Company of Canada Ltd., (8)
Ben's Limited,
Brant ford Cordage Co., The, Brockville Chemical Ind. Ltd., Brunswick of Canada Limited,
C.A.E. Industries Ltd., (2)

Canada Iron Foundries Ltd., Canada Malting Co. Ltd., Canada Wire \& Cable Co. Ltd., Canadair Ltd., Canadian Cane Equipment Ltd., (2) Canadian Car,

Canadian Forest Products Limited, Canadian General Electric, (2)

Canadian Industries Limited, Canadian Lady Corset Brand Co. Ltd.,

Sault Ste. Marie, Ontario.
Montreal 8, Quebec.
Calgary, Alberta.
Fredericton, N.B.
Victoria, B.C.
Montreal 9, Que.
Welland, Ortario.
Montreal, Que.
Montreal 9, Quebec.
Montreal 3, Que.
Galt, Ontario.
Vancouver 9, B.C.
Rexdale, Ontario.
Batawa, Ontario.
Halifax, N.S.
Brantford, Ontario.
Maitland, Ontario.
Cooksville, Ontario.
Montreal, Que.
Montreal 2, Que.
Toronto, Ontario.
Toronto 17, Ontario.
Montreal, Que.
Montreal, Que.
Fort William, Ontario.
Vancouver 1, B.C.
Peterborough, Ontario.
Montreal, Que.
Montreal, Que.

Canadian Stackpole Limited, Canadian Structural Clay Association, Canadian Technical Tape, Canadian Westinghouse Co. Ltd., (2)

Carbitron Development Ltd., Carey-Canadian Mines Limited, (2) Champlain Power Products Ltd., Chemech Engineering Limited, (2) Col Flo Process Limited, Collis Leather Co. Ltd., Column Flotation Co. of Canada Ltd., Cominco

Computing Devices of Canada Ltd., Corod Manufacturing Co., De Havilland Aircraft of Canada Ltd., Delmar Chemicals Limited, (2) Dickinson's Limited, Dominion Engineering Works Ltd., (2)
D. \& S. Engineering Ltd., (2) Dunlop of Canada Ltd., Dynacast Limited, anal ab oflty

Elastine Process \& Development Ltd., Eldorado Mining \& Refining Ltd., (2)

Electro Dynamics \& Telecom Ltd., Electrovert Manufacturing Corp. Ltd., Federal Pacific Electric, Ferranti-Packard Electric, (5)

Ferrodyne Corporation Limited, Field Aviation,

Fischer \& Porter (Canada) Ltd., Fisher Gauge Works Limited, Fortune Footwear Limited, Found Brothers Aviation Limited, Fritz Werner Limited, G \& B Industrial Project Consultants Ltd., General Concrete Geomet Reactors Limited, Glolok Co. Ltd.,

Toronto 14 , Ontario. Willowdale, Ontario. warthen Montreal 9, Que. chatran nath Hamilton, Ontario. \(\square+\frac{1}{2}\) Vancouver 6, B.C. East Broughton Stn., Quebec. Toronto 18, Ontario. Vancouver 9, B.C. Toronto 18, Ontario. Aurora, Ontario. \(\quad 2+2 \pi+2,4\) Dollard Des Ormeaux, Quebec. Montreal 2, Que. Ottawa, Ontario. Aal Edmonton, Alta. \(\quad\) a Toronto, Ontario . al aykal Montreal 3, Que. Blt Mand andal

 Montreal 11, Que. Mably mathat Toronto 8, Oritario. 1872
 Toronto 1, Ontario. Dund diater Ottawa, Ontario. way mand Chatham, Ontario. Montreal, Que. (S) . ©od 76-5al Toronto 16 , Ontario. Toronto 16, Ontario. 200 t ,
 Malton, Ortario. Downsview, Ontario. \(\begin{aligned} & \text { Ioctin }\end{aligned}\) Peterborough, Ontario. ath thant Burlington, Ontario. 4 at Rexdale, Ontario. wifl Cahal Montreal 9, Que. \(\begin{aligned} & \text { M } \\ & \text { M }\end{aligned}\) Downsview, Ontario. Tofsty , A, 0, A Gloucester P.O., Ontario. Montreal 38, Que, tsol 3rani-noubloff

Glulam Products Limited, (2)
Guildline Instruments Limited, (2)
Hamilton Hastings Co. Ltd.,
H. J. Heinz Co. of Canade Ltd., Hobrough Limited, Hughes Trim Limited, Huntec Limited, (2) Hydro Space Development, Interprovincial Steel \& Pipe Corp. Ltd., J. D. Irving Limited,

Kameco Limited, Lacasse Machinery Inc., Lamb-Cargate Industries Limited, Laurentian Concentrates Ltd., Leigh Instruments Limited, Maple Leaf Mills Ltd., Maranda \& Labrecque Ltet., Marb-0-Matic Corporation Limited, Maritime Industries Ltd., Maritime Television Ltd., Medico Rearings Limited, Mimik Limited, Montreal Locomotive Works Limited, MacMillan Bloedel Limited, McPhar Geo. (2)

National Sea Products Limited, Noma Lites Canada Limited, Noranda Mines, Nordic Biochemicals Ltd., Preci-Tools Limited, Pylon Electronic Development Co. Ltd., (2) Pyramid Machine Works Ltd., Radal Ltd.,

Rader Pneumatics
R.C.A. Victor Co. Ltd., Riley's Reproductions Ltd., Robson-Lang Leathers,

New Westminster, B.C.
Smith Falls, Ontario.
Downsview, Ontario
Leamington, Ontario.
Ottawa 4, Ontario
Montreal
Toronto 16, Ontario
Thornhill, Ontario
Regina, Sask.
St. John, N.B.
Montreal 12, Que.
Levis, Que.
New Westminster, B.C.
Ottawa 6, Ontario.
Carleton Place, Ontario
Toronto, Ontario.
Quebec City, Que.
Toronto 3, Ontario.
Vancouver 10, B.C.
Stellarton, N.S.
Ville de Lavalle, Que.
Galt, Ontario.
Montreal, Que.
New Westminster, B.C.
Don Mills, Ontario.
Halifax, N.S.
Scarborough, Ontario.
Toronto, Ontario.
montreal 12, Que.
Montreal, Que.
LaSalle, Que. North Vancouver, B.C. Montreal, Que.

Montreal, Que.
Montreal, Que.
Calgary, Alberta.
Oshawa, Ontario.
\begin{tabular}{ll} 
Rolland Paper Co. Ltd., & Montreal, Que. \\
Shanfield Industries Ltd., & Toronto, Ontario. \\
SIOC Limited & Toronto, Ontario. \\
Slater Steel Industries Ltd., & Hamilton, Ontario. \\
Solids Pipeline Research \& Development Assoc., Calgary, Alberta. \\
Solids Pipeline - Economic Study Assoc., & Calgary, Alberta. \\
Steep Rock Iron Mines Limited, & Steep Rock Lake, Ontario. \\
Stein-Hall Limited, & Westhill, Ontario. \\
Stone \& Webster Canada Limited, & Toronto, Ontario. \\
Sun-Rype Products Ltd., & Kelowna, B.C. \\
Susan Shoe Co., & Wurlington, Ontario. \\
Timberjack Machines Ltd., (2) & Kitchener, Ont. \\
Unitron Industries Limited, & Guelph, Ontario. \\
Valeriote Electronics Ltd., & Montreal 15, Que. \\
V-Mark Automation Ltd.,
\end{tabular}
N.B. - Number in parentheses after company name indicates the number \(n f\) projects.

The following companies have been granted DIP assistance
1964

Atlantic Films \& Development
Avian Aircraft Limited
Canadair Ltd.
Canadian Marconz
Central Dynamics
Collins Radio Company of Camada Limited

EMI Cossor Electronics Ltd.
Frigistor
Garrett Manufacturing Limited
Geo-Met Reactors Ltd.
Inter Tel Consultants
Leigh Instruments
McGill University
Northern Electric Co. Ltd.
Orenda Limited
TAMCO Limited
United Aircraft of Canada Limited

Varian Associates of Canada Ltd
York Gears Limited
1965
\begin{tabular}{ll} 
Aviation Electric Limited & Montreal, Quebec \\
CAE Industries Ltd. & Montreal, Quebec \\
Canadian Car & Fort William, Ontario \\
Canadian Marconi & Montreal 16, Ontario \\
\begin{tabular}{l} 
Computing Devices of \\
Canada Lti. (2)
\end{tabular} & Ottawa 4, Ontario \\
\begin{tabular}{l} 
de Havilland Aircraft of \\
Canada Limited
\end{tabular} & Downsview, Ontario \\
EMI Cossor Electronics Ltd. & Dartmouth, Nova Scotia \\
General Precision Industries Ltd. & Montreal, Quebec \\
Go-Tract Ltd. & Ste. Anne de Bellevue, Quebec
\end{tabular}

St. John's, Newfoundland Georgetown, Ontario

Montreal, Quebec
Montreal 16, Quebec
Pointe Clair, Quebec

Downsview, Ontario
Dartmouth, Nova Scotia
Montreal, Quebec
Rexdale, Ontario
Ottawa, Ontario

Carleton Place, Ontario
Montreal, Quebec
Montreal, Quebec
Malton, Ontario
LaSalle, Quebec

Longueuil, Quebec
Georgetown, Ontario
Toronto 19, Ontario

Montreal, Quebec
Montreal, Quebec
Fort William, Ontario
Montreal 16, Ontario

Ottawa 4, Ontario

Downsview, Ontario
Dartmouth, Nove Scotia

Ste. Anne de Bellevue, Quebec
\begin{tabular}{|c|c|}
\hline McGill University & Montreal, Quebec \\
\hline Ontario Research Foundation & thabetai asaituoll \\
\hline Orenda Limited & Malton, Ontario \\
\hline RCA Victor Limited & Montreal, Quebec molcreor \\
\hline REP & \\
\hline  & bes \\
\hline United Aircraft of Canada Limited & Longueuil, Quebec \\
\hline Westinghouse & Montreal, Quebec \\
\hline 1966 & \\
\hline ATCO Industries Ltd. & Calgary, Alberta \\
\hline Barringer Research Ltd. & Rexdale, Ontario \\
\hline Bowmar Canada Ltd. & Ottawa, Ontario \\
\hline Bristol Aerospace & Montreal, Quebec \\
\hline CAE Industries Ltd. & Montreal, Quebec \\
\hline Canadair Ltd. & Montreal, Quebec \\
\hline Collins Radio Company of Canada Limited & Downsview, Ontario \\
\hline Computing Devices of Canada Ltd. & Ottawa 4, Ontario \\
\hline de Havilland Aircraft of Canada Limited & Downsview, Ontario \\
\hline Edo (Canada) Limited & Vancouver, B.C. \\
\hline EMI Cossor Electronics Ltd. & Dartmouth, Nova Scotia \\
\hline ```
Ferranti-Packard Electric
Limited
``` & Toronto 15, Ontario \\
\hline FMC - Beloit - Sorel & \\
\hline Garrett Manufacturing Limited & Rexdale, Ontario \\
\hline \begin{tabular}{l}
Gulton Industries (Canada) \\
Limited
\end{tabular} & Gananoque, Ontario \\
\hline Hawker Siddley Canada Ltd. & Malton, Ontario \\
\hline Irvin Air Chute Ltd. \(\quad\) acal & Fort Erie, Ontario \\
\hline Leigh Instruments Limited & Carleton Place, Ontario \\
\hline Leitz, Ernst, (Canada) Limited & Midland, Ontario \\
\hline Litton Systems (Canada) Limited & Rexdale, Ontario \\
\hline
\end{tabular}

McGill University
Northern Electric Co. Ltd.
Okanagan Helicopters
Precision Electronic Components Ltd.

United Aircraft of Canada Limited

Westinghouse
1967
ATCO/ORF
Avian Aircraft Limited
Aviation Electric Limited
Bristol Aerospace
CAE Industries Ltd.
Canadair Ltd.
Canadian Marconi
Computing Devices of
Canada Limited
de Havilland Aircraft of Canada Limited.

Garrett Manufacturing Limited
Genaire Ltd.
Orenda Limited
REP
Timmins
Velan Engineerings Companies
1968
ATCO Industries Ltd.
Aviation Electric Limited
Canadair Ltd.
Canadian Marconi
Computing Devices of Canada Ltd.
de Havilland Aircraft of Canada Limited (2)
Fleet Aircraft
Garrett, John E., (Limited)

Montreal, Quebec
Montreal, Quebec

Toronto 15, Ontario

Longueuil, Quebec
Montreal, Quebec

Georgetown, Ontario
Montreal, Quebec
Montreal, Quebec
Montreal, Quebec
Montreal, Quebec
Montreal, Quebec

Ottawa 4, Ontario

Downsview, Ontario
Rexdale, Ontario
St. Catharines, Ontario
Malton, Ontario

Montreal 9, Quebec

Calgary, Alberta
Montreal, Quebec
Montreal, Quebec
Montreal, Quebwc
Ottawa 4, Ontario

Downsview, Ontario

New Glasgow, Nova Scotia

General Precision Industries Ltd. Montreal, Quebec
Irvin Air Chute Ltd. Fort Erie, Ontario
Leigh Instruments Carleton, Place, Ontario
Lucas Rotax
Northern Electric Co. Ltd. Montreal, Quebec
Norton (Canada)
United Aircraft of Canada Limited

Longueuil, Quebec
Velan Engineering Companies
Montreal 9, Quebec

\section*{3. Studies by the Office of Economics}
3.1 Economic Fesearch Studies

\subsection*{3.1.1 Investment Analysis}

Continuing efforts are made to improve and better cvaluate forecasts of canital spending through the study of biases in survey response, the relation of capital spending to such factors as capacity utilization and supply of funds and other such nroiects.

\subsection*{3.1.2 Market Analvsis}
3.1.2.1 International Market Commodity Studies - This proiect consisted of a number of detailed studies regarding international markets for selected resource-type commodities focussing attention on the European Continent. Specific commodity studies followed a detailed analysis of socioeconomic developments in Western Europe. This provided the rackerround for fudorients regarding probable patterns of economic erowth - necessary for deriving forecasts of consumption and trade in commodities. A detailed examination was then undertaken of national and international statistical sources in order to prepare a comprehensive set of compurative statistics on production consumption and trade for the selected commodities. Statistical techniques were then devised to relate demand and sunnly trends to future proapects and overall evaluations nrenared of Europe \({ }^{*}\) s changinc role in certain world commodity markets - along with the probable role in prosnect for Canada as a world supplier. 3.1.2.2 Foreirn Imnorts and Canadian Trade - This research proiect was devised in order to examine Canadais position as a supnlier relative to other supplier countries in world markets. To this end an extensive review was undertaken of the chancring imnort trade structure of some fifty comntries or areas to whom Canada exported about \(\$ 10\) million in \(1.96 \%\). The nroiect required thorough familiarity with the solmces and annlicability of international trade statistics and classification systems. It also involved the accumulation of detailed knowledre concerning the structure
and development of various foreign economies, so as to ensure the proper presentation of import profiles and meaningful comparative data. The conpleted project provides a useful descriptive and analytical framework for a broad assessment of Canada's position in foreign markets for selected commodity groups.
3.1.2.3 The Market Share Project - The "market share" project is designed to formulate a meaningful presentation of participation in the world market by country and by commodity group. The basic program was drawn up to cover 35 countries and 20 commodity groups over a 15 -year time span, modified to meet individual study requirements. In general three types of matrices - total imports, intercountry exports and total exports - comprise the computer input. Hypothetical assumptions that a given country maintains its base year share of world trade in commodity groups, sub-groups and country markets are tested against actual performance. The results indicate the manner in which total export growth is influenced by commodity and country trade dynamics and the ability or inability of a country to maintain or increase its share of a broad array of cormodities entering world trade. This project is now in the development stage with an initial pilot study comnleted.

\subsection*{3.1.3 Productivity}
3.1.3.1 Interfirm Comparisons - Plant productivity and cost effectiveness studies to reveal the causes and factors of variations and changes in industrial efficiency. This program is designed to yield information on such vital matters as specialization, product variety, standardization, capital intensity by type, capacity utilization, technical and economic life of fixed capital, etc.
3.1.3.2 Impact of plant size and capital intensity on production - These studies are based on statistical information generated from special DBS computer tabulations and are
designed to answer such policy questions as "Which industries need more capital in order to be more competitive" and "What is the impact of scale on efficiency, "Which are the industries where more concentration is necessary" and "What is the optimum scale of operation in specific industries". 3.1.3.3 Relationship between Productivity, Wages, and Prices This consisted of an analyses of cross-sectional and temporal statistical series to indicate the behaviour of these relationships across the various industries and regions of the country. It has been used by the government in developing its productivity and incomes policies.
3.1.3.4 Resources Utilization and International Cost Competiveness of the Canadian Chemical Industry - These studies are to be released shortly as part of a major departmenta]. study on the Chemical Industry. They identify the major cost and economic factors which determine the competitive position of the chemical industry and evaluate the utilization of resources by the Canadian industry. This information is intended to facilitate sound planning and dcision-making by rovernment and the Canadian chemical industry.
3.1.3.5 Comparative Analyses of the Performance of Canadian and United States Manufacturing Industries - This project serves to throw light on various factors and determinants of the competitiveness of Canadian industries in comparison with the behaviour of similar elements in United States economy. It deals with such matters as variations in industrial organization, cost structure, wages, process, profitability, labour-capital trade-offs in the production functions of various industries, impact of specialization, etc.

\subsection*{3.2 Economic Data Collection}

\subsection*{3.2.1 Investment Analysis}
3.2.1.1 Capital Expenditure Data - In September and October of each year the Branch personnel collect information by field interviews from about 200 of the largest companies and other spendine: apencies in Canada on plans for capital spending

\begin{abstract}
in the one to two year period immediately ahead. In addition to quantitative data information is collected on the factors that affect the decision making of companies in regard to capital spending.
3.2.1.2 Data on Foreign Subsidiaries in Canada - The Branch collects by questionnaire forms on an annual and quarterly basis certain information from the larger foreignowned companies in Canada which is not available from ot her sources. The data includes current and capital transactions with foreign affiliates and with others on a geographic basis.
3.2.1.3 Data on International Capital Flows - The Branch collects in considerable detail, on a quarterly basis, by questionnaire, information on the foreign asset and liability position of companies incorporated in Canada. In addition periodic surveys are made of foreign capital transfers made or planned by the same companies. This data is collected as part of a program to monitor overseas investment by Canadian companies as required pursuant to an arrangement with the United States exempting Canada from United States repulations affecting capital flows. 3.2.1.4 Information on Corporate Behaviour of Subsidiaries Qualitative information has been collected from some thousands of subsidiaries in Canada, by correspondence, on attitudes towards and conformity with certain principles of good corporate behaviour.
\end{abstract}

\section*{4. Industrial Sector and Technological Studies}
4.1 Aerospace Study - To assist the sound economic and technological growth of the Canadian aerospace industry the Department has undertaken A three phase study. The study deals with the world market for aerosnace products, the resources and capabilities of Canada's aerospace community, and the long term prospects for rationalisation and growth of aerospace activity in Canada.
4.2 Aerospace Pronulsion Study - The objective of the study is to assess the needs of industry in the mid-70's in terms of RED, production and suh-contracting capabilities, required to maintain a growth rate comnaralle to similar comnetitive industries or at least equivalent to the exnected crowth rate in GNP.
4.3 Advanced Materials Study - The objective of the study is to assess the effect of new material advances on the Canadian aerospace industry, and their implications for other industry sectors.
4.4 Aerospace Special Products - The primary purpose of this project is to conduct a series of studies and analyses to identify, fruitful technological areas, and to establish long-range plans for the support of industry in terms of marketing, R\&D, production and resources.
4.5 Snace Industry Project - The objectives are to identify the actual and potential technical, economic and management problem areas of the space industril sector and to identify the industrial development annortunities that will be created by the establishment of a co-ordinated natural space progran under a central agency.
4.6 Computerised Simulator Study - This study which involves develoning a computerised economic model of the Canadian ship building industry, is being initiated to establish if this method of analysing the comnlex socio economic problems of a total industrial sector is practical.

\subsection*{4.7 Education Requirements of Shin Building Industry - Phase 1 of this study has entailed an examination of the status of professional education levels in the Canadian ship building industry and will make recommendations on the need to establish university level education in naval architecture or marine engineering. Phase II of the study will give in detail a plan of integration and a means of selecting the university most suited to the defined needs. It will examine the the case for interration with an industrial research centre.}
4.8 Air Cushion Vehicles- The objectives of the Department are to analvse the implications of emerging air cushion technology, to nromote research and development in this field, and to encourage the dissemination of new research and development progress.
4.9 Oceanolomy and Marine Eeuiment - The Department is assisting the Marine Industry in establishine those formal organisations and institutions required to enable it to undertake more offectively an expanded role in this develoning technology of "oceanology".
4.10 Food Science Scholorshin Prorram - The Department has made a study of the employment of Food Scientists in the Food Industry.

Concurrent with that study, a consultant investigated the university prorrans in Canada related to Food Soience. These studies carried out in conjunction with the Canadian Institute of Food Technology, (CIFT), determined that a requirement existed for Food Scientists and several universities had or anticipated programs to develop people with this specialty. It was noted that a dearth of scholarships existed to attract students. The Branch, in cooperation with CIFT and the Food Industry had developed a scholarship program which will offer about \(14 \$ 1,000\) scholarships for the academic vear \(1969-70\) at a cost of \(\$ 5,000\) to the Department.
4.11 Fruit \& Veretable Study/Bakery Study - The purpose of each study has been to investigate each sector's structure, performance and to deternine the nature of the production function. In the course of these studies the Branch has evaluated the competitiveness of each sector through examination of the cost structure. These studies also have looked at the rricing policies practised, and have investigated the barriers to entry. Several other factors have been included in this work - these are the degree of oligopoly and a measure of the effective tariff rate, a measure of productivity and technological forecastinc.
4.12 Computer Simulation of a Manufacturing Facility - The project obiective is to develop a computer aided simulation of industrial develoment based on a method for projecting the economic future of an industrial manufacturing plant.
4.13 Canadian Major Appliance Industry Study - The purpose of the study and analysis is to determine if and how the performance of the Canadian Maior Annliance Industry can be improved.
4.14 Fuel Cell Power Sources - A technico-economic study of the market notential and economic advantages supporting an \(R \& D\), production and marketinc program.
4.15 Hich Voltare and High Power Research - The collection of data, and analysis of need for new research facilities.
4.16 Medical Electronics - A study to assess the potential of medical electronics as a growth area in electronics by means of studying the world marliet; the canabilities and activities of Canadian industry;
the extent and nature of research and development in Government
laboratories and institutions.
4.17 Process Automation - A study to determine to what extent the puln and paner mineral processing industries are applying advanced automation techniques.
4.18 R\&D Incentives in Relation to the Chemical Industry A study of the effect of R\&D incentives on the R\&D effects of the chemical industry.
4.19 Standards Activities - A study was carried out which led to the proposal to set up a National Standards Organisation.
4.20 Information for Industry - \(\Lambda\) study of the information problem facing Canada to-day was initiated by the Department. This study is fully discussed in Anvendix \(U\).
4.21 Canadian Satellite Communications System - The Department made a study of Canadian industrial capability in satellite communications technolofy. It is more fully discussed in Appendix \(U\).

\section*{1. Study on Technical Information for Industry}
1.1 The Canadian economy must develop at a rate which will provide employment opportunities for our expanding population and concurrently improve our standard of living relative to other industrialized countries. In order to accomplish this, industry must be encouraged to use new technology and innovations. The optimum use must be made of knowledge generated in all parts of the world to enable us to develop and produce new or improved products, processes and services. Existing means for making world-wide information available to Canadian managers, engineers, technologists and technicians in business, industry and commerce are inadequate and do not sufficiently reflect the advances that have taken place in communications and information handling technology during the past quarter of a century. As a consequence, the need and the opportunity exist for Canada to design and build a more suitable and advanced system for processing and disseminating knowledge acquired from all parts of the world, with the objective of incorporating this wealth of ideas, experience and know-how into the everyday activities of the nation. By so doing, we would have access to most of the results of the vast amount of research and development work performed around the world for the trivial cost of the information system.
1.2 A broad study embracing many facets of the information problem facing Canada today was initiated by Department of Industry in 1967 and undertaken in collaboration with, and under the general sponsorship of, the Science Secretariat (and, latterly, the Science Council). The DOI Industrial Research Adviser's Office contributed leadership, personnel, funds and office services in large measure to this study because it is believed that the timely comprehension and adoption by Canadian industry of new developments, wherever they may originate, are vital to the continued growth of Canadian industry and its international competitiveness and the creation of an environment in which innovation and entrepreneurial initiative can flourish.
1.3 The Study of Scientific and Technical Information in Canada was formally established on March 20, 1967, under the auspices of the Science Secretariat. The members of the Study Group were drawn from government, industry and universities, and were assigned responsibilities for examining the availability, demand for and use of scientific and technical information in these three sectors of the economy, and for appraising developments in information handling technology, assessing the

\section*{1.3 (continued)}
economic implications of the use of scientific and technical information, reviewing the involvement of foreign countries and international organizations with scientific and technical information, and examining the supply and demand of trained information personnel.
\(1.4 \quad\) Consultations with concerned Canadians were both written and verbal. Advertisements were place in the leading newspapers across Canada inviting briefs. Background information was sent to 80 English-language and 33 Frenchlanguage technical journals, primarily directed at. the individual scientist or engineer. A set of guidelines to assist in the preparation of briefs was distributed to over 500 agencies, including trade associations and technical societies, manufacturing establishments, educational and research institutions, and individuals. As a result 233 written briefs were received. Special surveys were conducted with the Canadian Research Management Association, the Agricultural Institute of Canada, and the Canadian Library Association.
1.5 In addition, approximately 2,500 individuals associated with industry, universities and government answered questionnaires to enable the Study Group to make some estimate of individual costs using present methods. Over 1,000 published documents were collected and evaluated, and the Information Systems Analysis Centre of the Department of Industry, containing extracts of another 1,000 items, was utilized.
1.6 Members of the Study Group held open meetings with industrial, university library and provincial government representatives across Canada, followed by private briefings as required. Visits were made to Victoria, Vancouver, Edmonton, Calgary, Regina, Saskatoon, Winnipeg, Toronto, London, Waterloo, Kingston, Montreal, Quebec, Sherbrooke, Halifax, Fredericton, Moncton, Charlottetown and St. John's.
1.7 Study Group members also contacted major international organizations, in many cases actively participating in meetings and seminar as well as visiting foreign institutions working on the STI problem. The Study Group was given verbal briefings by many visiting international experts, including the following:
\begin{tabular}{ll} 
Eugene Garfield & \begin{tabular}{l} 
Director, Institute for Scientific Information \\
Philadelphia, Pa.
\end{tabular} \\
P. J. Judge & \begin{tabular}{l} 
Directorate for Scientific Affairs, Organization \\
for Economic Co-operation and Development, Paris
\end{tabular} \\
R. A. Kennedy & \begin{tabular}{l} 
Information Retrieval Director, Bell Telephone \\
Laboratories, Murray Hill, N.J.
\end{tabular}
\end{tabular}
1.7 (continued)


\section*{2. Canadian Satellite Communications System}
2.1 In July 1967, the Departnent of Industry was requested by the Task Force on Satellites of the Science Secretariat to undertake a study in support of a Satellite Communication System.
2.2 Specifically, the Department was asked to determine Canadian industrial capability in satellite communications technology and the extent to which Canadian industry could design, develop and manufacture a complete satellite communication system. To achieve this, it was necessary to specify the system and estimate costs and schedule.
2.3 The study was carried out by a small group of departmental officers under the Industrial Research Adviser with the assistance of personnel from government departments, notably the Department of Transport. The group visited four U.S. companies engaged in space technology and received a great deal of assistance. From these visits and on the basis of reports from earlier studies carried out for the Department of Transport, the group was able to define the required system and make the necessary estimates of cost and schedule.
2.4 Subsequently the group visited ten Canadian companies to obtain the necessary information which led to the assessment of Canadian industrial capability and interest.
2.5 The details of the study and the conclusions reached were set down in the report "Canadian Industrial Capability for the Development of Domestic Satellite Communication Systems" which subsequently became an appendix to the Report of the Task Force on Satellites to Cabinet.
2.6 Amongst other things, this study provides a substantive basis for maximizing Canadian content of any communication satellite which may be procured by Canada.

\section*{3. DIP Case History - United Aircraft Limited - PT6 Engine}
3.1 United Aircraft Ltd. (UACL) has been engaged in original design and development since 1957. Engineering activity has included resnonsibility for the concept and preliminary design of the JT12 (J60) turbojet engine; design, construction and qualification of the accessory gearbox used on the Tyne engine installed in the Canadair CL-44 aircraft, and design, development and manufacture of the PT6 turboprop/turboshaft engine and its derivatives.
3.2 Since the first jointly-funded development contract was signed in March of 1960 , UACL's PT6 development has been a most successful venture; for example, engines delivered up to December 1968 totalled 2,689 representing sales of approximately \(\$ 90 \mathrm{M}(80 \%\) export). The engineering team has expanded from a nucleus in 1957 to some 500 in 1967.
3.3 Versions of the PT-6 are flying in many types of aircraft. The shaft-turbine version powers several helicopters. The engine has also been developed in several marine and industrial engine versions and has comnleted a U.S. Bureau Ships \(1,000 \mathrm{hr}\) marine qualification nrorram. Interestine applications of these engines include amphibious landing craft, yachts, hydrofoils, high-speed trains (C.N. Turbo-Train) electrical generators and total energy plants.
3.4 Prior to significant PT-6 sales UACL's market was largely in repair and overhaul and provision of spare parts for Pratt and Whitney's recinrocatine engines. The PT-6 is now entering as a significant element of this market. Total sales over the past five years have risen at an annual rate of \(22 \%\). Employment now stands at 5300 people.

\section*{4 4 4. PAIT Case History - Glulam Products Ltd.}

Glue-1aminated Wood Beams
4.1

Laminated structural wood beams have been used extensively since
the close of World War II. They are superior to natural timbers in strength, size, resiliency and functional beauty. Such beams can be expected to increase in importance with the growing scarcity of dimension lumber in the larger sizes.
4.2

The conventional method of manufacture of laminated beams was
to lay down a board, spread it with glue, add a second board, spread it with glue and so on. Finally, the sandwich is clamped together and the pressure kept on until the glue dries.
\(1.3 \quad\) Canadian industry improved the early method by devising jigs to accommodate more than one beam at a time, and by heating the beams in ovens to hasten curing of the glue. Unfortunately, the batch cycle time of this process is prolonged, and the associated costs are relatively high.
4.4

Glulam Products Ltd. of New Westminster, B.C. conceived an entirely new system by bringing the gluing operation up to the speed and standard of the other stages in the laminating process. By means of a machine of their own invention they proposed to reduce the curing time - the length of time it takes the glue to bond the laminates together - from about 16 hours to between 12 and 30 minutes.
4.5

Glulam applied for PAIT assistance in May 1966 and aid under the program was granted in July. An experimental section of the new machine was built by the company at a cost of \(\$ 40,500\) of which \(\$ 20,250\) was advanced by the Department through the PAIT program.
4.6

The process is now in successful commercial operation in a new \(\$ 200,000\) capital facility. It is estimated that sales attributable to the project will amount to over \$2 million over the next five years.

\section*{5. PAIT Case History - Barringer Research Ltd. \\ Air Pollution Monitor}
5.1

Air pollution has in recent years become a matter of vital public
interest and concern. In some cases it has already become a serious health hazard. To successfully combat air pollution it is necessary to be able to define and measure the sources of noxious gases. Sulphur dioxide is one of the major gaseous pollutants. For this gas no entirely satisfactory method of measurement existed. The main measurement approaches have been direct, e.g., a sample of gas is drawn by pumps, vents or captured volumes. These direct methods are inconvenient and in some cases not reliable.
5.2 Barringer Research Ltd. of Rexdale, Ontario, proposed the development of a rugged instrument for detection and sensing sulphur dioxide. The principle suggested was that of correlating the spectra of gases in the field of view of the instrument with the spectrum of the particular gas whose pressure it is desired to determine. The spectrum of the desired gas is previously stored in the instrument.
If this gas is present, then correlation occurs and an electrical output results that indicates its presence and concentration.
5.3 Barringer Research applied for PAIT assistance to develop two instruments based on the above principle of correlation spectrometry. One for detection using remote sensors and the other for station monitoring and control. The application was received in October 1966 and approved in November. The amount of the PAIT loan was \(\$ 122,000\).
5.4

The development of the instrument was successfully concluded, and there is an active interest in the instrumentation in the export markets. Sales over the next five years are estimated at \(\$ 6\) million.

\section*{6. PAIT Case History - National Sea Products Atlantic Queen Crab}
6.1 The development of a commercial queen crab fishing industry in Nova Scotia would provide an additional income and a welcome hedge against the possible decline of the lobster and scallope fisheries.
6.2 The existence of the queen crab in the waters off Nova Scotia has been known for many years. It was only about three years ago that the commercial potentialities were recognized. As a first step it was necessary to determine the extent of this resource and to study the characteristics of the queen crab, which Es quite different from the Alaskan king crab. This preliminary work was a cooperative venture of the Federal Department of Fisheries, the Nova Scotia Department of Fisheries, fisheries departments in other Maritime provinces, National Sea Products Ltd. and Fishermen's Co-operatives.
6.3 Following the preliminary work, National Sea Products of Halifax, N.S. proposed to exploit this substantial potential new fishery. The unique characteristics of the queen crab, particularly its low tolerance to warm surface water required development of new handling and processing methods. Live entry into processing is a prerequisite for quality output. On-ship and land holding facilities, with controlled environmental conditions approximating the natural ones are required.
6.4 National Sea Products applied for PAIT assistance to develop the handling and processing equipment. The application was approved in May of 1968 and assistance in the amount of \(\$ 40,125\) was authorized.
6.5 It is not yet possible to evaluate the success of the project, but all indications are favorable. It appears likely that annual sales of \(\$ 2\) million will be realized beginning in 1970.
7. PAIT Case History - Riley's Reproductions Ltd. Automatic Digitization of Oil Well Logs
7.1 The research efforts of the logging service companies and the major oil exploration companies during the past decade have resulted in a proliferation of geophysical logging devices for use in oil well drill holes. This has resulted in a great improvement in the accuracy of predictions on hydrocarbon reservoirs. The properties that are recorded are temperature, resistance to fluid erosion, natural electric currents, and natural radio-activity.
7.2 It is estimated that geologists are using less than \(25 \%\) of the total information contained in their \(\log\) files, because of the difficulty and expense in recognizing, separating, and correlating the relevant data in the many \(\log\) covers recorded for each well bore.
7.3 Riley's Reproductions Ltd. of Calgary, Alberta, a company active in the oil well logging field recognized, therefore, the value which would accrue if an accurate, inexpensive method of analysis could be developed.
7.4 Riley's Reproductions applied for PAIT assistance to develop a device capable of accepting a graphical analogue record (specifically an oil well \(\log\) ) and converting the information to digital form on manetic tape within the accuracy limits and standards acceptable to the oil industry.
7.5 PAIT assistance for this project was authorized in September 1966. The amount of the approved PAIT loan was \(\$ 347,000\).
7.6 The project was brought to a successful conclusion and the instrument is in commercial use. It is anticipated that the market in the first five years will amount to approximately \(\$ 10\) million of which a substantial amount will be export business.

\section*{8. PAIT Case History - RCA Victory Company}

Communications Satellite Earth Stations
8.1

RCA Victor of Montreal, P.Q., was granted PAIT assistance of \(\$ 200,000\) for the engineering development work associated with the operational requirements of commercial type communications satellite earth stations in the international market. The work involved the development of certain networks and sub-systems as well as the performance of necessary systems engineering studies and earth stations systems integration planning.
8.2

The work was brought to a successful conclusion and over sales to date of the earth station amount to some \(\$ 8\) million. The total market for such equipment over the next decade is estimated as up to \(\$ 450\) million, and the RCA Victor equipment looks well placed to win a substantial share of it.
9.1 In the ten-year period from 1953 to 1962 , some 58,900 forest
fires wrought destruction on \(20,044,000\) acres of Canada's forests, excluding those of the Northwest Territories and the Yukon. Since the industries based upon forest resources rank first among Canadian producers in value of capital invested, wages paid and exports, these fire losses are a serious threat to the economy. The total loss or damage to the forests for the period in question, \(\$ 130,630,000\), represents only an estimated market value of the standing timber in the forest; it does not take into account other forest values such as watershed, recreation, wild life or future productivity.
9.2 All provinces recognize the many advantages provided by aircraft, either fixed wing aircraft or helicopters, in fighting fires and the majority believe the most promising method of controlling most fires is by water bombing. Water bombing aircraft have not only enabled faster and more effective initial action to be taken on many fires but they have also enabled many more fires to be attacked. This is particularly true in the northern, more inaccessible forest areas. The water bomber also has provided an extension of available manpower enabling crew size to be effectively doubled or tripled because, when assisted by water bombers, a small ground crew is able to control fires ordinarily requiring crews two or three times as large.
9.3

Canadair, with PAIT support, undertook to develop a new water bomber/ utility aircraft to assist in the advancement of Canadian forest fire fighting technology. It will be the first aircraft in history specifically designed for this purpose. The water bomber will be capable of carrying 1200 Imp. gallons of water which can be picked up while the aircraft is planing at 70 knots on the surface of a lake, river or ocean, which is \(50 \%\) greater in capacity than conventional water bombers. It will incorporate the latest advances in fire fighting techniques, including chemical additive equipment.

The versatility of the design will allow the aircraft to be exploited in a variety of roles and missions not associated with water bombing, thereby creating a far broader market potential. A number of these alternate uses would include Utility Transport, Agricultural Spraying, Passenger/Cargo, Air Sea

Rescue/Military Amphibian and Executive Transport.
9. PAIT Case History - continued
9.5

The development is nearing a successful conclusion. The Province of Quebec and the Government of France have placed firm orders for quantities of 20 and 10 water bombers respectively. Sales of the Water Bomber/Utility and Transport aircraft are estimated at \(\$ 90\) million over the next three years.

\section*{PART III}

\section*{DEPARTMENT OF INDUSTRY, TRADE AND COMMERCE}

\section*{Department}
13. (1) There shall be a department of the Government of Canada called the Department of Industry, Trade and Commerce over which the Minister of Industry, Trade and Commerce appointed 25 by commission under the Great Seal of Canada shall preside.
(2) The Minister of Industry, Trade and Commerce holds office during pleasure and has the management and direction of 30 the Department of Industry, Trade and Commerce.
14. The Governor in Council may appoint an officer called the Deputy Minister of Industry, Trade and Commerce to be the deputy head of the Department of Industry, Trade and Commerce and to hold office during pleasure.
15. The duties, powers and functions of the Minister of Industry, Trade and Commerce extend to and include all matters over which the Parliament of Canada has jurisdiction, not by law assigned to any other department, branch or agency of the Government of Canada, relating to
(a) manufacturing and processing industries in Canada;
(b) tourism; and
(c) trade and commerce generally.
16. The Minister of Industry, Trade and Commerce shall
(a) promote the establishment, growth and efficiency of manufacturing, process- 1 ing and tourist industries in Canada, contribute to the sound development and productivity of Canadian industry generally and foster the expansion of Canadian trade;
(b) develop and carry out such programs and projects as may be appropriate to
(i) assist manufacturing and process-
ing industries to adapt to changes in technology and to changing conditions 25 in domestic and export markets,
(ii) assist manufacturing and processing industries to develop their unrealized potential, to rationalize and restructure their productive facilities 30 and corporate organizations and to cope with exceptional problems of adjustment, and
(iii) promote and assist product and process development and increased 35 productivity, the greater use of research, the application of advanced technology and modern management techniques, the modernization of equipment, the utilization of improved 40 industrial design and the development and application of sound industrial standards in Canada and in world trade;

\section*{PARTIE III}

\section*{MINISTERE DE LINDUSTRIE ET DU COMMERCE}
13. (1) Est établi un ministère du gou- Greation vernement du Canada, appelé ministère 20 du ministerre de l'Industrie et du Commerce, ayant a sa tête le ministre de l'Industrie et du Commerce nommé par commission sous le grand sceau du Canada.
(2) Le ministre de l'Industrie et du 25 Ministre Commerce occupe sa charge à titre amovible; il a la gestion et la direction du ministère de l'Industrie et du Commerce.
14. Le gouverneur en conseil peut nom-

Sousmer un fonctionnaire, appelé sous-ministre 30 minintre de l'Industrie et du Commerce, qui est le sous-chef du ministère de l'Industrie et du Commerce et qui occupe sa charge à titre amovible.
15. Les fonctions et pouvoirs du ministre de l'Industrie et du Commerce englobent toutes les questions qui sont du ressort du Parlement du Canada et que les lois n'at5 tribuent pas à quelque autre ministère, 5 département, direction ou organisme du gouvernement du Canada, concernant
a) les industries de fabrication et de transformation au Canada;
c) le commerce en général.
16. Le ministre de l'Industrie et du Commerce doit

Fonctions
du ministre
a) favoriser l'établissement, le développement et l'efficacité des industries de 15 fabrication, de transformation et de tourisme au Canada, contribuer au développement rationnel et à la productivité de l'industrie canadienne en général et encourager l'expansion du commerce au 20 Canada;
b) mettre au point et réaliser les programmes et les projets qui peuvent être propres à
(i) aider les industries de fabrication 25 et de transformation à s'adapter à la fois aux changements technologiques et à l'évolution des conditions des marchés intérieurs et internationaux,
(ii) aider les industries de fabrication 30 et de transformation à développer leur potentiel latent, à rationaliser et à restructurer leurs installations de production et leurs organisations corporatives, et à faire face à des problèmes 35 exceptionnels d'adaptation, et
(iii) favoriser et aider la mise au point des produits et des procédés et l'augmentation de la productivité, l'utilisation plus poussée de la recherche, 40 l'application de techniques perfectionnées et de méthodes modernes de gestion, la modernisation de l'équipement, l'utilisation de conceptions industrielles améliorées ainsi que l'élaboration 45 et l'application de normes industrielles rationnelles, au Canada et dans le commerce mondial;
(c) improve the access of Canadian produce, products and services into external markets through trade negotiations and the promotion of trade relations with other countries and contribute to the improvement of world trading conditions;
(d) promote the optimum development of Canadian export sales of all produce, products and services;
(e) provide support services for indus- 10 trial and trade development, including information, import analysis and traffic services;
(f) analyze the implications for Canadian industry, trade and commerce and 15 for tourism of government policies related thereto in order to contribute to the formulation and review of those policies;
(g) compile and keep up to date detailed 20 information in respect of manufacturing and processing industries in Canada and of trends and developments in Canada and abroad relating to Canadian industrial development and trade; and
\((h)\) promote the optimum development of income from tourism and compile and keep up to date detailed information in respect of the tourist industry and of trends and developments in Canada and 30 abroad relating to tourism.
17. The Minister of Industry, Trade and Commerce, in exercising his powers and carrying out his duties and functions under this Part,
(a) shall, where appropriate, make use of the services and facilities of other departments, branches or agencies of the Government of Canada;
(b) may, with the approval of the Gov- 40 ernor in Council, enter into agreements with the government of any province or any agency thereof respecting the carrying out of programs for which the Minister is responsible; and
(c) may consult with, and organize conferences of, representatives of industry
and labour, provincial and municipal authorities and other interested persons.
18. The Governor in Council may establish advisory and other committees to advise or assist the Minister of Industry, Trade and Commerce or to perform such duties and exercise such powers as the Governor in Council may specify, and may fix the remuneration and expenses to be paid to the members of the committees so 10 established.
19. The Minister of Industry, Trade and Commerce shall, on or before the 31st day of January next following the end of each fiscal year or, if Parliament is not then 15 sitting, on any of the first five days next thereafter that Parliament is sitting, submit to Parliament a report showing the operations of the Department of Industry, Trade and Commerce for that fiscal year. 20
c) faciliter l'entrée des denrées, produits et services canadiens sur les marchés extéricurs, par voie de négociations commerciales et en favorisant les relations commerciales avec les autres pays, et 5 contribuer à l'amélioration des conditions du commerce mondial;
d) favoriser l'accroissement optimum des exportations canadiennes de tous les produits et services et de toutes les denrées; 10 e) fournir les services de soutien pour le développement industriel et commercial, y compris les services d'information, de trafic et d'analyse des importations; f) analyser la portée, pour l'industrie et 15 le commerce canadiens et pour le tourisme, des politiques gouvernementales y relatives, de manière à aider à formuler et à revoir ces politiques;
g) compiler et tenir à jour des renseigne- 20 ments détaillés sur les industries de fabrication et de transformation au Canada et sur les tendances et l'évolution, au Canada, et à l'étranger, en ce qui concerne la mise en valeur de l'industrie ca- 25 nadienne et le commerce canadien; et h) favoriser la croissance optimum des revenus du tourisme, compiler et tenir à jour des renseignements détaillés relatifs à l'industrie touristique ainsi qu'aux ten- 30 dances et à l'évolution du tourisme au Canada et à l'étranger.
17. Le ministre de l'Industrie et du Commerce, dans l'exercice de ses pouvoirs

\section*{Fonctionn} supplémen\(5^{\text {taires }}\) et fonctions en vertu de la présente Partie, 35
a) doit, lorsqu'il y a lieu, utiliser les services et installations d'autres ministères, départements, directions ou organismes du gouvernement du Canada;
b) peut, avec l'approbation du gouver- 40 neur en conseil, conclure des accords avec le gouvernement de toute province ou avec tout organisme d'un tel gouvernement en ce qui concerne la réalisation des programmes qui relèvent de sa com- 45 pétence; et
c) peut consulter des représentants patronaux et ouvriers, des autorités provinciales et municipales et d'auties intéres-
sés et organiser des réunions de ces représentants, autorités et autres intéressés.
18. Le gouverneur en conseil peut créer des comités consultatifs et autres, chargés 5 5 de conseiller ou de seconder le ministre de l'Industrie et du Commerce ou d'exercer les fonctions et pouvoirs que peut spécifier le gouverneur en conseil, et il peut fixer le traitement et les dépenses qui seront payés 10 aux membres des comités ainsi créés.
19. Le ministre de l'Industrie et du Commerce doit, après la fin de chaque année financière et au plus tard le 31 janvier 5 suivant ou, si le Parlement n'est pas alors 15 en session, l'un des cinq premiers jours où il siège par la suite, présenter au Parlement un rapport exposant l'activité du ministère de l'Industrie et du Commerce au cours de cette année financière.

Rapport
ennuel

Canadian Federal Government Expenditures in Industry for Research \& Development, 1958-59 to 1967-68
compared with Gross National Product

Gross National Product
Research \& Development Contracts:
Department of National Defence
\% Gross National Product
Other Departments and Agencies
\% Gross National Product
Total R\&D Contracts
\% Gross National Product

\section*{Industrial R\&D Assistance Programs:}

Industrial Research \& Development Incentives Act
\% Gross National Product
Industrial Research Assistance Program
\% Gross National Product
Program for the Advancement of Industrial Technology
\% Gross National Product
Defence Industrial Research Program
\% Gross National Product
Defence Industry Productivity Program
\% Gross National Product
Total R\&D Assistance Programs
\% Gross National Product

\section*{Total Expenditures in Industry}
\% Gross National Product
Office Of Science \& Technology
Department of Industry, Trade \& Commerce, Ottawa.

Fiscal Year
\begin{tabular}{lllllllllll}
\(1958-59\) & \(1959-60\) & \(1960-61\) & \(1961-62\) & \(1962-63\) & \(1963-64\) & \(1964-65\) & \(1965-66\) & \(1966-67\) & \(1967-68\) \\
\hline
\end{tabular}
\$ millions
\begin{tabular}{|c|c|c|c|c|c|c|c|c|c|}
\hline 33,093 & 35,324 & 35,800 & 38,225 & 41,025 & 44,125 & 48,450 & 53,457 & 59,183 & 63,084 \\
\hline 47.5 & 9.9 & 10.2 & 9.4 & 5.8 & 8.5 & 13.4 & 27.9 & 16.4 & 13.1 \\
\hline 0.1435 & 0.0283 & 0.0285 & 0.0246 & 0.0141 & 0.0193 & 0.0277 & 0.0522 & 0.0277 & 0.0207 \\
\hline 0.1 & 3.9 & 4.5 & 6.1 & 4.7 & 4.2 & 5.5 & 7.2 & 7.8 & 7.7 \\
\hline 0.0003 & 0.0110 & 0.0126 & 0.0160 & 0.0115 & 0.0095 & 0.0114 & 0.0135 & 0.0132 & 0.0122 \\
\hline 47.6 & 13.8 & 14.7 & 15.5 & 10.5 & 12.7 & 18.9 & 35.1 & 24.2 & 20.8 \\
\hline 0.1438 & 0.0391 & 0.0411 & 0.0405 & 0.0256 & 0.0288 & 0.0390 & 0.0657 & 0.0409 & 0.0330 \\
\hline - & - & & - & - & - & - & - & - & 2.1 \\
\hline - & - & - & - & - & - & - & - & - & 0.0033 \\
\hline - & - & - & - & 0.5 & 1.6 & 2.2 & 3.3 & 4.2 & 5.1 \\
\hline - & - & - & - & 0.0012 & 0.0036 & 0.0045 & 0.0062 & 0.0071 & 0.0081 \\
\hline - & - & - & - & - & - & - & 0.4 & 4.6 & 6.4 \\
\hline - & - & - & - & - & - & - & 0.0007 & 0.0078 & 0.0101 \\
\hline - & - & - & - & 1.2 & 2.6 & 3.8 & 5.3 & 4.7 & 4.5 \\
\hline - & - & - & - & 0.0029 & 0.0059 & 0.0078 & 0.0099 & 0.0079 & 0.0072 \\
\hline - & 1.9 & 2.9 & 4.4 & 8.0 & 19.0 & 20.1 & 21.5 & 21.2 & 22.8 \\
\hline - & 0.0054 & 0.0081 & 0.0115 & 0.0195 & 0.0431 & 0.0415 & 0.0402 & 0.0358 & 0.0361 \\
\hline - & 1.9 & 2.9 & 4.4 & 9.7 & 23.2 & 26.1 & 30.5 & 34.7 & 40.9 \\
\hline - & 0.0054 & 0.0081 & 0.0115 & 0.0236 & 0.0526 & 0.0539 & 0.0571 & 0.0586 & 0.0648 \\
\hline 47.6 & 15.7 & 17.6 & 19.9 & 20.2 & 35.9 & 45.0 & 65.6 & 58.9 & 61.7 \\
\hline 0.1438 & 0.0444 & 0.0492 & 0.0521 & 0.0492 & 0.0814 & 0.0929 & 0.1227 & 0.0995 & 0.0078 \\
\hline
\end{tabular}

DEPARTMENT OF PUBLIC WORKS

BRIEF
T0
SPECIAL COMMITTEE ON SCIENCE POLICY

\section*{WAVE CLIMATE STUDY}

\section*{1. Organization}

Chart 1 outlines the organizational structure of the Department of Public Works in accordance with the re-organization of the Department implemented during 1967. The Design Directorate, of which the Marine, Engineering Division forms a part, is subdivided in chart 2.

As shown on chart 2 the Marine Engineering Division comprises three sections, namely, the Marine Standards, Marine P1ant and Marine Structures Sections. A new group is being appended to the latter for a study of the wave climate along the coasts and major lakes of Canada.
2. Organizational Functions.

The basic objective of the Design Directorate is the provision of a central unit of significant engineering experience and skills in the design and construction of roads, bridges, marine structures and plant. This body of experience is available in an advisory capacity and on a request basis, to other areas of the Department as well as to client Departments.

Accordingly, the prime functions of the Marine Engineering Division may be outlined to be :
(1) Engineering Services - The provision of engineering advice and design and supervision services where these may be requested from within or outside the Department.
(2) Promulgation of Standards - The development of functional, structural and operational standards.
(3) Design Evaluation - The evaluation of the design of marine works developed in Regional and District offices of the Department.
(4) Information System - The development and operation of an efficient information retrieval system, training seminars, conferences, post-graduate studies, etc.
(5) Consultants Index - The development and operation of an effective information system concerning the technical capacity of consulting engineering firms interested in Departmental marine works.

The Department of Public Works does not possess direct statutory functions and powers regarding scientific activities. Its scientific activities arise from its efforts to perform its functions in the most efficient way.
3. Research Oriented Projects.

During the period 1962 and 1967 inclusive, the following research oriented marine projects were underway in the Marine Engineering Division and the Harbours and Rivers Engineering Branch of which the Marine Engineering Division formed an integral part prior to re-organization of the Department.
(1) Completion of Littoral Drift Survey on Great Lakes The purpose of this project was to develop means of reducing sediment deposition in harbour entrances and channels, with a view to establishing criteria for minimizing maintenance dredging which so often plagues harbour resources. The project was carried out in co-operation with the National Research Council and the Universities of Queen's and Toronto.
(2) Investigation of the Erosive Effects of Ship Generated Waves in the St. Lawrence -

This project is aimed at establishing standards for the evaluation of federal responsibility for shore erosion caused by navigation and federal structures.
(3) Study of Performance of Floating Breakwaters In the constant search for effectively and economically combatting wave energy man has devised many means. Not all these means have general application. The purpose of this study was to evaluate application of floating type breakwaters. It entailed a series of model studies which were carried out through Queen's University.
(4) Study of Wave Induced Erosion Under Breakwaters This investigation was initiated as a result of partial collapse of a breakwater and carried out in the laboratory of a private consultant.
(5) Wave Climate Study -

An immediate objective of this study is to collect data on wave conditions on the east and west coast, and major lakes of Canada; and to develop proposals to obtain supplementary wave climate details for areas in which these are lacking. The long term aim of the study is to extend the wave climate data into major sea inlets such as Bay of Fundy, the lower St. Lawrence River and Queen Charlotte Strait.

\section*{4. Expenditures Associated with Scientific Activities}

Estimates of expenditures incurred on the scientific activities described under 3 - Research Oriented Projects, were as follows. In the case of project No. 5, Wave Climate Study, which is currently being organized, the estimated figure quoted below is that which is anticipated will be incurred.
(1) Completion of Littoral Drift Survey on Great Lakes \(\$ 75,000\)
(2) Investigation of the Erosive Effects of Ship Generated Waves in the St. Lawrence.
\begin{tabular}{ll} 
(3) Study of Performance of Floating Breakwaters & \(\$ 10,000\) \\
(4) Study of Wave Induced Erosion Under Breakwaters & \(\$ 10,000\) \\
(5) Wave Climate Study (1968-74) & \(\$ 750,000\)
\end{tabular}
5. Personnel in Research Oriented Projects.

The Marine Engineering Division is constituted of permanent officers
of a high degree of expertise in Marine Engineering. Casual
engineers are employed as the work load may require their quality
or quantity. For the Wave Climete Study which is just being
started two engineers are being employed on term basis. These
two engineers will be headed by Mr. L. Draper of the National
Institute of Oceanography of the U.K. who has an established repute in the field of Wave Climate studies for engineering purposes. Mr.

Draper is expected to stay with the study group for approximately
one year. Particulars of the group are detailed in the following
table.
\begin{tabular}{lcrccccc} 
Name & \begin{tabular}{c} 
Sountry of \\
Birth
\end{tabular} & \begin{tabular}{c} 
Country of Education \\
Secondary
\end{tabular} & \begin{tabular}{c} 
Date of \\
Employment
\end{tabular} & \begin{tabular}{c} 
Age \\
(Ave.)
\end{tabular} & Language \\
\hline L. Draper & U.K. & U.K. & U.K. & U.K. & Oct. 68 & & English \\
H.J. Wu & Formosa & Canada & Canada Canada & Sept.68 & & English \\
W.F.Baird & U.K. & U.K. & U.K. & Canada & Sept. 68 & 30 & English \\
\hline
\end{tabular}

\section*{6. Research Output}

The research output of the Marine Engineering Division is implicit in its function as an advisory body. Apart from this direct output to agencies seeking consultation from the Division, information of general application is disseminated in the form of papers at seminars which are conducted annually between the District and Regional offices of the Department and the Marine Engineering Division. Opportunities are also taken of addressing national and international conferences on subjects of scientific value.

DEPARTMENT OF PUBLIC WORKS
ORGANIZATION CHART 1


\section*{ORGANIZATION CHART 2}

DESIGN DIRECTORATE


\title{
SCIENTIFIC ACTIVITIES IN THE CANADA EMERGENCY MEASURES ORGANIZATION
}

\section*{A BRIEF PREPARED FOR}

THE SENATE SPECIAL COMMITTEE ON SCIENCE POLICY

\section*{ORGANIZATION OF EMERGENCY PLANNING}
1. The Canada Emergency Measures Organization is a separate identity component of the Department of National Defence within the Deputy Minister's branch. Its prime responsibility is the planning and coordination of all nonmilitary defence measures.
2. World War II showed that major war has a profound effect upon many aspects of the social, economic and governmental organization of a combatant country even when that country is not under direct attack. In the event of a future full scale armed attack upon the North American continent the survival of any part of the nation and its eventual recovery would be dependent upon the ability of the whole national structure to perceive and react to the threat, to take such actions as would minimize the overall vulnerability to the effects of attack and to reorganize for recovery. The overall planning and coordination of all measures essential to these objectives is the responsibility of Canada EMO.
3. It is basic to modern systems organization that the ability for emergency reaction and adaptation must be developed by the agency or authority which has the normal non-emergency responsibility. Thus each federal department, each provincial authority and each municipal government has a defence responsibility for civil emergency planning. Canada EMO is designed to assist, support and coordinate these emergency measures.
4. At the federal level the civil emergency planning responsibilities of departments are set forth by Orders in Council. (Annex "A") Canada EMO is charged with the overall responsibility of coordination and financial management.
5. Canada EMO has a staff of approximately 100 persons orgarized as

6. There are three main areas in emergency planning where scientific support and research are essential. The first of these is concerned with determining the probable direct physical effects of modern weapons and weapons systems used against the North American continent. The second concerns the more complex problems of the indirect effects of attack upon the various systems and components in our complex social, economic and governmental structure. The third area is concerned with the examination of various options in passive defence and the determination of their individual and overall costs and effectiveness.
7. For some years a list of problem areas and research requirements has been widely circulated by Canada EMO within Canadian industry and universities. This is attached as Annex "B".

PROVISION OF SCIENTIFIC SUPPORT TO EMERGENCY PLANNING
8. The Defence Research Board has continued to provide a broad base of scientific support for Canada EMO and the various parts of the federal emergency planning community. This has ranged from projects in various DRB laboratories to operational and analytical research studies by headquarters groups. A Scientific Adviser has been provided from DRB to the Director General of Canada EMO and a branch of the Defence Scientific Information Services is located in Canada EMO headquarters.
9. In order to provide a balance capability to develop a national program of emergency measures it has been necessary to provide certain engineering and economic support services which were not already axailable within the emergency planning community. These are the Protection Division and the Economic Planning Division of Canada EMO. Reports from these groups are attached at Annex "C" and Annex " \(D\) ". Both groups have undertaken and sponsored research studies which are within the areas of interest to the Senate Committee.

\section*{INTERDEPARTMENTAL RESEARCH COORDINATION}
10. There is a further Canada EMO research coordination activity which might be of real intrinsic interest because of its applicability to extramural research in general. This is the contingency funding arrangement provided by the Scientific Adviser.
11. After an initial general examination of both intramural and extramural research undertaken in support of emergency planning it was concluded that in many areas where data and understanding were urgently needed there was in fact latent support available both within universities and industry. However, this potential support seldom materialized for a variety of reasons; the two main ones arising from the very smallness of some departmental emergency planning groups and the general lack of flexibility in financial planning and budgeting.
12. Small groups are usually unable to solicit needed extramural support because of their inability to obtain recognition and priority within large existing departmental extramural research programs or because of their lack of time and travel funds needed to become acquainted with university and industrial research potential.
13. Lack of financial flexibility has resulted in some emergency planning groups in the federal departments being out of touch with academic research support opportunities. Quite often a university department head in pianning his graduate program becomes aware of a need for financial support or of an opportunity to assign a competent graduate research student to a particular investigation during the three or four months preceding the academic year. When he then approaches a government agency he finds that all funds available from the government's current year's appropriations have been committed and possibly that it is even too late to include funds in the following year's budget. So he is then told to go away and come back in a year to two. Of course by then the capability for undertaking the research may well have disappeared.
14. In order to avoid both of the above problems the office of the Scientific Adviser in Canada EMO sought and obtained a small unassigned research coordination fund which could be used on an opportunistic basis to initiate research programs. Certain ground rules evolved. These were:
a. The office of the SA/Canada EMO would acquaint industry and universities with the research interests of the entire emergency planning community.
b. All proposals would be referred to the SA/Canada EMO who would be responsible for their appraisal and for the determination of whether one or more departmental groups would be willing to undertake funding at the first budgeting opportunity.
c. The SA/Canada EMO would also determine whether the potential funding agency would undertake responsibility for sponsorship and project supervision.
d. If it was decided that a particular research proposal was in the real interest of emergency planning, and if it was found that one or more departmental emergency planning authorities would undertake immediate supervision and future funding at the first budgeting opportunity, a financial encumbrance was transferred to the sponsoring department to provide the funds necessary to initiate the project and carry it until departmental funds were available. A number of projects have been handled in this manner and details are provided at Annex " \(E\) ". Past funding and anticipated future requirements are indicated below:
\begin{tabular}{lcc} 
Year & \begin{tabular}{c} 
Projects \\
Initiated
\end{tabular} & \begin{tabular}{c} 
Funds \\
Transferred
\end{tabular} \\
\(1964-65\) & 1 & \(\$ 7,500\) \\
\(1965-66\) & 2 & 7,200 \\
\(1966-67\) & 2 & 7,450 \\
\(1967-68\) & 4 & 58,050 \\
\(1968-69\) & Nil to date & \begin{tabular}{c} 
Funds antic \\
10,000
\end{tabular} \\
& &
\end{tabular}
15. The possible advantages of a central clearinghouse with a substantial unencumbered research fund might well be examined on a much broader functional basis within all the government departments and agencies.

\section*{EVOLVEMENT OF A SCIENTIFIC POLICY FOR CANADA EMO}
16. Policies within the various departmental emergency planning groups reflect the rules and practices of the parent department to a great extent. However, there are certain fundamental principles which Canada EMO attempts to observe. These are as follows:
a. Canada EMO will not normally provide any funds for research \(y\) zants. These will eventually form a more significant part of the DRB extramural program.
b. Canada EMO will normally negotiate short term extramural applied research contracts in support of specific planning, programing and coordinating needs.
c. Canada EMO will not normally provide capital equipment to research contractors.
d. When research support is required it will normally be sought first from DRB, NRC or other federal departmental research facilities. Universities may be invited to offer proposals but care will be taken to avoid preferential treatment.
e. Wherever possible, extramural projects will be of a joint Canada EMO - departmental nature with joint project planning.
f. All research contract proposals will be reviewed in the first instance by the departmental emergency planning groups with related interests.
\begin{tabular}{cl} 
e.g.: & Structures \(-\ldots\) \\
& Economics \(-\ldots\) ESP B1dg. Res., DPW, CMHC \\
& Biology
\end{tabular}
g. Canada EMO will maintain a research contingency fund on behalf of the emergency planning community. Project direction and subsequent funding will rest with the sponsoring department or departments.
h. All research contract final reports must be accepted before contract close-out. All reports will normally be released to NATO and Commonwealth countries without delay.

\section*{FUNCTIONAL ANALYSIS OF EMERGENCY PLANNING}
17. During the first six months of 1968 an interdepartmental federal-provincial study group completed a functional analysis of emergency planning and outlined a complete plan of planning programming and budgeting for the overall effort. This has been identified as Project Phoenix. Appended to the Project Phoenix report was a list of 51 study areas. This is attached at Annex " \(F^{\text {" }}\).

\section*{SCHOLASTIC SUPPORT}
18. The office of the Scientific Adviser Canada EMO administers a fellowship program at the Ohio State Disaster Research Center. (See Annex "G") A \(\$ 5,000\) per year, three year award is made each year to an MSc level Canadian sociologist. The award is designed to carry selected students to the PhD level and to give them actual research experience in the response of social systems to disaster stress. This program of zwards began in 1966. Past and future funding is indicated below:
\begin{tabular}{l|lllll}
\hline \(1966-67\) & \(1967-68\) & \(1968-69\) & \(1969-70\) & 1970 to 1975 \\
\(\$ \$ 5,000\) & \(\$ 5,000\) & \(\$ 10,000\) & \(\$ 15,000\) & \(\$ 15,000\) per year
\end{tabular}

SUMMARY
CANADA EMO SCIENTIFLC PROGRAM 1962-1975 AREA OF APPLICATION - DEFENCE.
\begin{tabular}{|c|c|c|c|c|c|c|c|c|c|c|c|c|}
\hline FISCAL YEAR & INTKAMURAL & RESEARCH & & & & EXTRAM & & & & & & \\
\hline & equipment \& & supplies) & \[
\begin{aligned}
& \text { Indust } \\
& \text { Consult }
\end{aligned}
\] & & Other Fede Department & and Agencies & & Academ & & & & OTALS \\
\hline & \[
\begin{array}{|c}
\hline \begin{array}{c}
\text { Engineering } \\
\text { and } \\
\text { Development }
\end{array} \\
\hline
\end{array}
\] & Economics & Engineering and Development & Economics & \begin{tabular}{l}
Engineering and \\
Development
\end{tabular} & Economics & Engineering and Development & Geography & Sociology & Biology & General & \\
\hline 1962-63 & 25.000 & 14,000 & 9,000 & - & & & - & & & & & 48,000 \\
\hline 1963-64 & 29,000 & 22,000 & 2,000 & 13,500 & - & 41,300 & - & & & & & 107,800 \\
\hline 1964-65 & 52,100 & 23,500 & 6,000 & 9,000 & - & 53,500 & 1,500 & - & & & & 145,600 \\
\hline 1965-66 & 44,600 & 29,000 & 28,000 & 30.000 & & 46,000 & 39,600 & - & 5,000 & - & & 222,200 \\
\hline 1966-67 & 65,000 & 30,000 & 38,000 & 51,500 & 6,000 & 56,000 & 41,900 & - & 5,000 & 4,000 & & 297,400 \\
\hline 1967-68 & 48,600 & 25,000 & 44,500 & 65,000 & 6,000 & 118,000 & 98,600 & 18,000 & 10,000 & 7,550 & - & 441,250 \\
\hline 1968-69 & 52,600 & 19,000 & 15,500 & 60,000 & 16,000 & 30,000 & 180,800 & 20,500 & 15,000 & - & & 409,400 \\
\hline TOTALS & 216,900 & 162,500 & 143,000 & 229,000 & 28,000 & 344,800 & 362,400 & 38,500 & 35,000 & 11,550 & & 664,650 \\
\hline
\end{tabular}

\section*{P.C. 1965-1041}

\section*{at the government holse at ottawa \\ TUESDAY, the 8 th day of JUNE, 1965.}

PRESENT:
HIS EXCELLENCY
the governor general in council. .

His Excellency the Governor General in Council, on the recommendation of the Minister of Defence Production, pursuant to paragraphs (g) and (h) of subsection (1) of section 2 of the Civil Service Act, to paragraphs (a) and (f) of Section 2 of the Financial Administration Act, to the Public Service Rearrangement and Transfer of Duties Act and to any enactment of the Parliament of Canada for defraying the several charges and expenses of the public service from and after 1st Apri1, 1965, that provides for payments in respect of the planning of civil emergency measures and the continuity of government in a national emergency, is pleased hereby to revoke Civil Defence Order, 1959 made by Order in Council P.C. 1959-656 of 28th May 1959, as amended, by Order in Council P.C. 1963-993 of 27 th June 1963, and to make the annexed Civil Emergency Measures Planning Order in substitution therefor.

CERTIFIED TO BE A TRUE COPY
R.G. Robertson

Clerk of the Privy Council

\section*{HIS EXCELLENCY}

THE GOVERNOR IN COUNCIL:

The undersigned has the honour to recommend that your Excellency in Counci1, pursuant to paragraphs (g) and (h) of subsection (1) of section 2 of the Civil Service Act, to paragraphs (a) and (f) of section 2 of the Financial Administration Act, to the Public Service Rearrangement and Transfer of Duties Act and to any enactment of the Parliament of Canada for defraying the several charges and expenses of the public service from and after 1st Apri1, 1965, that provides for payments in respect of the planning of civil emergency measures and the continuity of government in a national emergency, be pleased to revoke Civi1 Defence Order - 1959 made by Order in Counci1 P.C. 1959-656 of 28th May 1959 as amended by Order in Council P.C. 1963-993 of 27 th June 1963 , and make the annexed Civil Emergency Measures Planning Order in substitution therefor.

Minister of Defence Production

\section*{CIVIL EMERGENCY MEASURES PLANNING ORDER}
1. This Order may be cited as the Civil Emergency Measures Planning Order.
2. In this Order, the expression "civil emergency powers, duties and functions" includes powers, duties and functions relating to "preparation for civil defence against enemy action" mentioned in section 4 of the National Defence Act.
3. Each Minister of a department, agency or Crown corporation of the Government of Canada which is listed in the Schedule shall henceforth exercise and perform and, while Sections 3 to 5 of the War Measures Act are not in force, shall continue to exercise and perform, in conjunction with the powers, duties and functions that such Minister is ordinarily expected or required to exercise and perform, the following powers duties and functions, namely:
(a) make such preparations as are required to enable him to exercise and perform the civil emergency powers, duties and functions set out opposite his name in the Schedule:
(b) provide necessary assistance and advice to provinces and through the provinces, as requested, to municipalities either to enable those governments to plan emergency measures which lie within their constitutional responsibilities or to supplement the measures being planned by the Minister.
4. Each Minister referred to in Section 3 sha11 ensure that, where preparations for the exercise and performance of civil emergency powers, duties and functions are to be made in conjunction with agencies or departments of foreign governments, the plans therefor are co-ordinated by the Minister of Industry through the Emergency Measures Organization, with the concurrence of the Secretary of State for External Affairs.
5. The Minister of each department, agency or Crown corporation of the Government of Canada shall
(a) at all times, provide the minister of any department, agency or Crown corporation who is assigned emergency planning responsibilities under Section 3 with such assistance as may be required, having regard to existing commitments, to enable him to plan for and to exercise and perform those powers, duties and functions, including the provision of services and the loan of personnel who have been assigned emergency duties;
\(\qquad\) (b) be responsible for the preparation and implementation of plans that will provide for the resumption of the normal functions of that department, agency or Crown corporation in the event that such functions are suspended as a result of acts of war;
(c) prepare and implement plans for the warning and dispersal of employees at the time of a National Alert or when so ordered by the Governor in Counci1; and
(d) inform all employees of departmental plans for both peace and war emergencies, including informationoon personal survival measures.
6. Notwithstanding section 3, the Minister of

Transport shall not be responsible for making preparations for the control of road transport.
7. The Minister of National Defence shal1, in addition to making preparations and providing assistance and advice as prescribed by section 3, perform the duties and functions set out in subitems (1) to (3) of section 8 of the Schedule.
8. The Minister of Industry sha11, through the Emergency Measures Organization,
(a) develop policies and a programme to ensure the continuity of government in an emergency;
(b) co-ordinate civil emergency planning and training by departments, agencies and Crown corporations of the Government of Canada;
(?) Manage any governmentsponsored stockpile of supplies, except military and medical supplies.
3. External Affairs

\section*{ \\ 12. hlwotkucat talsmanti}
(1) Assess the international situation and report to Cabinet on international developments.
(2) Conduct relations with foreign governments and international organizations.
(3) Protect Canadian interests in other count ies
(4) Participate in information activities abroad in consultation with other interested government departments and agencies, including the provision of general policy guidance to the International Service of the Canadian Broadcasting Corporation.
(5) Maintain and operate communications facilities for purposes described in subitems (1) to (4)
(6) Assist and advise other departments on matters having international implications.
(7) Interpret, in consultation with other departments as appropriate, treaties and other international agreements to which Canada is a party.
(1) Through the Department of Finance,
(a) provide and control the use of funds to cover normal and emergency federal expenditures, including emergency financial assistance to provinces and emergency financial assistance to essential business operations;
(b) advise Cabinet respecting the imposition of emergency taxes and other fiscal measures;
(c) advise Cabinet of the priorities to be given to competing demands on the financial and economic resources of the country, in collaboration with other departments;
(d) advise Cabinet on and take measures to implement financial moratoria if required; and
(e) assess the financial situation generally in the country and propose such further emergency controls and operations as appear to be required.
(2) Through the Bank of Canada,
(a) assess the availability of and restore and direct the operation of banking and related facilities and services;
(b) advise Cabinet on the need for and, if directed so to do, establish and operate a foreign exchange control system; and
(c) perform those normal functions of the Bank of Canada that are required in the circumstances, including serving as the fiscal agent of the Government.

\section*{5. Fisheries}
(1) Assume control over all fish catching, landing and processing operations up to the point where consumable fishery products enter into storage or directly into distribution channe1s.

\section*{SCHEDULE}

COLUMN I

Item Minister

COLUMN II

Civil emergency powers, duties and functions
1. Agriculture
(1) Be responsible for farm production including the provision of advice and guidance to farmers on the protection of farms, crops and livestock against wartime hazards such as radiation.
(2) Be responsible for inspection and regulatory functions relating to
(a) the quality and wholesomeness of food, except fishery products;
(b) the freedom of such food from an unacceptable degree of radioactive contamination; and
(c) plant, animal, insect and disease control.
(3) Make post-attack assessments of the availability of farms, crops and livestock.
(4) Provide assistance and advice to provincial governments respecting the establishment of a combined federal-provincial organization to carry out the civil emergency powers, duties and functions set out in subitems (1) to (3)
2. Defence Production
(1) Establish a War Supplies Agency to
(a) make post-attack assessments and determine the availability of surviving resources of food, energy, ready-to-use survival materials, production facilities and raw and
\begin{tabular}{ll} 
& \begin{tabular}{l} 
semi-processed materials; \\
(b) \\
assess supply requirements \\
based on claims submitted \\
by other departments and
\end{tabular} \\
& agencies at all levels of \\
& government, compare \\
requirements with
\end{tabular}
(c) in conjunction with provincial authorities, develop policies and a programme for the control of civil road transport resources in an emergency;
(d) plan civil emergency measures in respect of matters that are not the responsibility of any department, agency or Crown corporation of the Government of Canada or recommend to the Governor in Council the assignment of such responsibility to a Minister;
(e)
provide assistance and guidance to provincial governments and municipalities in respect of the preparation of civil emergency measures in matters that are not the responsibility of any department, agency or Crown corporation of the Government of Canada;
(f) with the concurrence of the Secretary of State for External Affairs, provide general liaison with other countries and with the North Atlantic Treaty Organization on matters relating to civil emergency measures including the co-ordination of planning of those matters by other departments, agencies and Crown corporations; and
(g) be responsible for the direction and administration of the Canadian Civil Defence College.
9. The Emergency Measures Organization is designated a "Department" for the purpose of the Civil Service Act and the Financial Administration Act.
10. The Director of the Emergency Measures Organization is designated the Deputy Head of the department for the purposes of the Civil Service Act and the Financial Administration Act and shall act as deputy for the appropriate Minister.
11. The Minister of Industry is the appropriate Minister with respect to the Emergency Measures Organization for the purposes of the Financial Administration Act.
12. Where, in the Public Service Superannuation Regulations, a responsibility is placed on a deputy head, that responsibility sha11, in respect of the Emergency Measures Organization, be exercised by the Director.
13. Where any matter set out in the Schedule would but for this Order, be a power, duty or function of a Minister other than the Minister to whom it is assigned in the Schedule, that power, duty or function is hereby transferred to the Minister to whom it is assigned in the Schedule.

6. Justice
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(2) Make post-attack
assessments to determine the extent of survival of fishermen, fishing vessels and gear, fish processing plants and fishery products in storage.
(3) Requisition or appropriate, or procure by contract or agreement as required the services of fish producers, fishery products, fishing vessels and gear used in catching fishery products, fish plants, fish processing equipment and dockside facilities, other than government wharves and piers, required for landing such products.
(4) Carry out inspection procedures to determine
(a) whether a fishery product is suitable for consumption; and
(b) the extent, if any, of radioactive contamination of fishing vessels, plant and equipment and fishery products.
(5) In collaboration with other agencies of government, control the movements of and protect Canadian fishing vessels in the territorial sea of Canada, the fishing zones of Canada and on the high seas.
(1) Through the Department of Justice,
(a) formulate and
implement emergency
measures and advise
Cabinet in connection therewith;
(b) advise other departments and agencies on legal problems that
federal statutes and
emergency legislation; and
(c) assist provincial and
municipal governments and
their police forces, as
requested, in all matters
pertaining to the co-
ordination of emergency
police planning and
operations.
(1) Establish a National Emergency Manpower Authority to
(a) formulate emergency manpower policies and recommend any necessary legislation relating thereto;
(b) control and allocate all civilian manpower, except those persons exempted from the authority of the Minister of Labour;
(c) establish and maintain schedules of manpower priorities and of critical occupations, in coordination with related priority policies of other departments and agencies;
(d) control rates of remuneration of employees;
(e) regulate and control labour-management relations and conditions of employment; and
(f) provide estimates of the surviving population, as well as collect and make available data on manpower supply and demand, wage rates and other matters relating to manpower.
(1) Provide technical facilities and operate a system to give warning to the public of the likelihood and imminence of an attack.

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(2) Provide technical facilities and operate a system to determine the location and yield of nuclear explosions together with the predicted and actual patterns of fallout and, in conjunction therewith,
(a) give the necessary warnings of fallout to the public;
(b) prepare preliminary estimates of casualties and weapons effect data from which physical damage or other hazards may be estimated; and
(c) co-ordinate and collate nuclear activity data from other available sources.
(3) Provide, maintain and operate a communications system for the national emergency government.
(4) At the request of the Regional Commissioner or, if communications are not available, as may be necessary, control, direct and co-ordinate all survival operations in areas damaged by nuclear explosions or seriously contaminated by radioactive fallout, including
(a) the conduct of necessary operations, including rescue, first aid to the injured and decontamination;
(b) the maintenance of law and order, the control of traffic, and the movement of people;
(c) the allotment of firefighting and police tasks;
(d) the allotment of tasks for the restoration and maintenance of essential public utilities and services;
(e) in conjunction with provincial emergency
(i) casualty sorting and initial emergency medical care; and (ii) casualty evacuation; and
(f) during operations, the co-ordination of such support as may be required by civil agencies working under the direction or control of the Canadian Forces.
(5) Provide, as requested, and having regard to other commitments at the time, emergency support to provincial and municipal authorities in the conduct of any survival operations that may be undertaken by these authorities during an emergency.
(1) Be responsible, through an Emergency Health Services organization, for
(a) assistance and advice to provincial and municipal governments and other agencies in the operation of emergency medical, nursing, hospital and public health services, and in the health aspects of the provision of potable waters;
(b) assistance to provincial and municipal governments in the provision of medical and health supplies from the national medical stockpile;

(c) the inspection and regulation of health standards for drug and pharmaceutical manufacture;
(d) advice to the War Supplies Agency in the manufacture, procurement and distribution of medical and health supplies;
(e) the establishment of regulations covering the health standards for food and food products, including the permissible leve1s of radioactive contaminations;
(f) the control and allocation of medical professional manpower, other than members of the Canadian Forces, including physicians, dentists and nurses, and the direction or supervision of allied health manpower allocated to Emergency Health Services;
(g) medical advice to departments and agencies on the health hazards of radiological, biological and chemical warfare and on general health problems;
(h) detailed medical estimates of traumatic and radiation injuries;
(i) an estimate of damage to medical installations and an assessment of surviving medical manpower; and
(j) the co-ordination of medical mutual support action between the provinces and between


Canada and the United States of America.
(2) Be responsible, through an Emergency Welfare Services organization, for
(a) assistance to provincial and municipal governments in the operation of emergency welfare services consisting of emergency feeding, clothing, lodging, registration and inquiry and personal services, including
(i) the control and allocation of federal welfare material and assigned personne1 resources, and
(ii) in consultation with other departments, advice, on priority use of essential survival resources, both material and personne1, available throughout the country;
(b) operating emergency welfare services within a province or provinces where adequate services are not being provided, including the priority requisitioning of accommodation for emergency lodging purposes during the immediate survival phase following a nuclear attack; and
(c) co-ordinating welfare mutual support action between the provinces and between Canada and the United States of America.
(1) Operate postal services under emergency conditions.
(2) Distribute and handle emergency change of address and safety notification cards.

(1) Estab1ish, in conjunction with the provincial authorities, a wartime organization responsible through central, regional, zonal and local authorities for the control of all accommodation, except accommodation under the control of the Canadian Forces, including
(a) the use of all existand unseable accommodation, including the requisitioning, appropriation and procurement of property, dwellings, commercial and industrial accommodation, except that during the shock phase these controls may be exercised also by Emergency Welfare Services and other emergency government services delegated such authority;
(b) rent and sale controls; and
(c) the allocation of rehabilitated or newly constructed accommodation.
(2) Through Central Mortgage and Housing Corporation assist the provincial authorities in the general co-ordination and implementation of emergency housing construction programmes, including the provision of the associated water, sewage and other utility services.
(3) Assist the provincial authorities with wartime maintenance and construction programmes for roads and road bridges, and co-ordinate the inter-regional and international aspects of such programmes.

(4) Establish in conjunction with the provincial authorities a wartime organization responsible through central, regional, zonal and local authorities for the control of all engineering and construction resources, except those under the control of the Canadian Forces, or other excempted emergency government services including
(a) The direction, control and regulation of the engineering resources represented by the equipment, material and assigned manpower of engineering and construction contractors, including the various subtrades and consultant and other engineering services, and of government at all levels, except that during the shock phase, these controls may be exercised also by the Canadian Forces and other emergency government services delegated such authority;
(b) the co-ordination of demands for engineering and construction resour ces and the allocation of those resources to meet priorities that are approved by the executive authority at the appropriate level of government; and
(c) the co-ordination of demands on the War Supplies Agency and the National Emergency Manpower Authority for engineering and Construction equipment and manpower.
(5) Arrange, in conjunction with other departments and agencies concerned, for the provision of technical support and assistance to the General Transport Controller in the maintenance, repair, reconstruction and construction of

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ports, harbours and inland Waterway facilities.
(1) Place under federal government control all transportation, meteorological and tele-communications resources facilities and services in Canada, except those operated by the Xanadian Forces, those vessels, facilities and services under the control of the Minister of Fisheries, and the tele-communications facilities operated by the Department of External Affairs.
(2) Establish and operate an emergency transportation control organization capable of functioning under national, regional, zonal and municipal authorities, as appropriate, to
(a) control all types of transportation facilities and services in Canada, including ports, harbours and inland waterways and including the direction of fishing vessels in Canadian waters under the control of the Minister of Fisheries if required for survival operations, but excluding transportation facilities operated by the Canadian Forces; and
direct the employment of all types of transportation to essential tasks for the survival of Canada as a nation.
(3) Establish, in collaboration with the Department of Nationa1 Defence, an organization capable of functioning on the basis of decentralized authority during the period of an emergency,
(a) until the N.A.T.O. Defence Shipping Authority is activated, to provide civilian direction and naval control to national and N.A.T.O. shipping in Canadian waters and national shipping on the high seas; and
(b) after the Defence Shipping Authority has been activated, to control canadian shipping and form an element of the Defence Shipping Authority in support of national requirements and N.A.T.O.
(4) Establish and operate an Emergency National Tele-
communications organization capable of functioning on the basis of decentralized authority to control all forms of tele-communications, including broadcasting.
(5) Assess available transportation, meteorological and telecommunications resources, except those operated by the Canadian Forces.
(6) Provide maximum support to tasks accepted by Canada as a member of the North Atlantic Treaty Organization and co-ordinate mutual transport, telecommunications and meteorological action between Canada and the United States of America.
(7) Tbrough the Canadian Broadcasting Corporation provide an emergency broadcasting service on an internationa1, nationa1 and provincial basis over the facilities of the Canadian Broadcasting Corporation and privately-owned stations, including the operation of such facilities as required, such broadcasting to be co-ordinated to meet the general requirements of Canadian and N.A.T.O. civil emergency plans.

\section*{FOR}

EMERGENCY PLANNING

The Canada Emergency Measures Organization recently distributed a list of subjects and areas of research which are of current interest in emergency planning. There have been numerous enquiries concerning the availability of financial support and it has been decided to give a more detailed description of the Canadian organization for emergency planning and the circumstances under which financial support might be obtained.

In the various government structures of Canada there are a number of services and functional responsibilities which are considered essential to the maintenance of organized society. It is the stated policy of the Canadian government that each and every department or agency which has a peacetime responsibility for one or more of these essential services or functions also has the full responsibility to plan how these will be carried out effectively under emergency conditions. This principle is considered to apply to all levels of government from municipal to federal.

In many of the departments of the federal government, relatively small emergency planning groups have been established; all of the Provinces have set up emergency planning offices; many municipal authorities have appointed emergency planners. Canada EMO was established 1957 to provide coordination and essential support to the overall emergency planning effort.

Most emergency planning sections in the federal government are relatively small and have to plan their financial requirements a year in advance. Therefore research opportunfties have sometimes been neplected because departmental funds were not avallable on an opportune basis. Canada EMO has attempted to correct this situation - at least to some degree - by establishing a small research contingency fund which is at the disposal of all emergency planning authorities. The conditions for aid from the contingency fund are that one or more emergency planning authorities must be willing to accept sponsorship, direction and control of the profect concerned and that they must provide funds for continued support at the first budgetary opportunity. In effect this arrangement helps bridge the discrepancy between the academic and the fiscal year.

During 1965 the Scientific Adviser to Canada EMO consulted all emergency planners to determine which areas of science and technology were of direct and immediate concern to their particular responsibilities. These were listed and the list distributed in 1965. A revised edition was issued in 1967.

The following may be said about each item on the list:
(a) There is a direct interest by one or more emergency planning authorities at some level of government;
(b) There may be an existing fund of relevant scientific literature;
(c) There may be an existing program of research either in Canada or in an associated country;
(d) There may be a need to undertake research where capability and opportunity exist.

Researchers should review the list (as attached) with the above points in mind. If they have competence in a particular subject and particularly if they have an existing research program they should know that one or more planning authorities have an active parallel interest. Information on this point may be obtained from Canada EMO. Under similar circumstances they should also know that there is a possibility that the Scientific and Technical Information Centre of Canada FMO might be able to provide background literature which might not normally be available. Furthermore Canada EMO might be able to advise them on similar or related research efforts in Canada or abroad.

Finally there is always a possibility that financial support might be provided for specific projects. On this point it is well to remember that most of the federal departments involved in emergency planning are not able to make benevolent grants in general support of a research area. They are however able to enter into specific research contracts in which finite objectives are defined and the work is quite definitely applied research. In a few instances a somewhat more general contract might be negotiated to explore a particular area in which there is a serious lack of knowledge. With these points in mind it can be seen that researchers seeking financial support should be specific and defimitive in outlining any proposal.

Further information and advice on all aspects of research for emergency planning may always be obtained from Canada EMO, 400 Laurier Avenue West, Ottawa 4.

A.F.B. Stannard, (Scientific Adviser),








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\section*{SUBJECTS OF RESEARCH AND DEVELOPMENT INTEREST IN EMERGENCY PLANNLNG}

\section*{MEDICINE \& PHYSIOLOGY}
(1) The physiological effects of ionizing radiation inciuding injury recovery mechanisms.
(2) Epidemiology in emergency environments (natural disasters and war).
(3) The development of mass immunization techniques.
(4) Methods for the rapid assessment of casualties in severely damaged areas (natural disasters and war).
(5) Studies of minimum levels of austere medical care.

\section*{CHEMISTRY \& BIOLOGY}
(6) The development of emergency food sources and domestic substitutes for imported basic foods.
(7) The production of balanced protein foods from new sources.
(8) Methods for increasing the yield of protein food from ocean sources.
(9) Methods for increasing the harvesting efficiency of ocean food resources.
(10) Fish pond culture.
(11) Algal and microbial food culture.
(12) Synthesis of low cost food supplements.
(13) Long term storability of foods.
(14) Sensitivity of plant and animal life forms to radiation following a \(t\) to the minus 1.2 decay curve.
(15) The behaviour of radioactive substances in soil exchange systems and fixation processes.
(16) The assimilation of radiosctive substances by aquatic organisms and ultimate effects.
(17) Studies and applications of primitive decontamination techniques.
(18) Removal of soluble isotopes from water.
(19) Internal combustion engine fuel substitutes.
(20) Methods for increasing the shelf life of pharmaceutics.

PSYCHOLOGY \& SOCIOLOGY
(21) Studies of social systems under stress.
(22) Individual and group effects of recurrent and extended periods of international tension.
(23) Individual and group effects of natural disasters and extreme emergency environments.
(24) Studies of persuasion and attitude change.
(25) The effectiveness of preconditioning for disaster (including planning, training and exercises).
(26) Public attitudes towards emergency planning.
(27) Public attitudes towards compulsory direction and control.
(28) Rluman response to warning.
(29) The effects on students and workers of a windowless environment.
(30) Adaptation and sensitization to emergencies.
(31) Troblems in confinement under extreme crowding.
(32) The translation of attitudes into action.
(33) Tublic information requirements in an emergency environment. ECO:OMICS
(34) Economic effects of a nuclear war.
(35) Lconomic effects of major natural disasters.
(36) Energency measures of economic control.
(37) The effects of a major war on domestic transportation systems.
(38) The vulnerability of Canadian distribution systems for essential commodities.
(39) The stability of the monetary system in the environment following a major nuclear attack.
(40) The determination of critical civilian occupations in wartime environments.
(41) The development of manpower inventories.
(42) The analysis of inter-dependencies between essential sectors of the economy.
(43) The economic effects of regional isolation and the capabilities for regional self-sufficiency.

METEOROLOGY, GEOGRAPHY \& GEOPHYSICS
(44) Studies of air pollution (general).
(45) Nuclear cloud trajectory forecasting.
(46) Heavy particle dry fallout.
(47) Precipitation scavenging.
(48) Natural processes of exchange and decontamination:
a. Transfer mechanisms from the stratosphere to the troposphere.
b. Transfer mechanisms in the surface boundary layer.
c. Transfer mechanisms at the earth-atmosphere interface.
(49) Meteorological effects in shock and blast wave propagation.
(50) Earthquake energy transfer mechanisms.
(51) Studies of natural and man-made hazards to life and property.

\section*{PHYSICS \& ENGINEERING}
(52) The reaction of structures and structural components (including electric power and telecom transmission equipment) to dynamic loading.
(53) The effects of high energy radiation on electronic systems and components.
(54) The behaviour of soils under dynamic loading.
(55) Fire protection (general).
(56) Storable and inert fire extinguishing materials (including powders).
(57) Methods of extinguishing small fires.
(58) Methods of protection against intense thermal radiation.
(59) Shielding against nuclear radiation - including makeshift methods.
(60) Instrumentation techniques related to nuclear weapon effects.
(61) Decontamination techniques for radioactive contaminants.
(62) Air filtration - including makeshift methods.
(63) Methods of providing group austere accommodation in climatic extremes.
(64) Emergency sewage disposal methods.
(65) Emergency power sources including rechargeable devices.
(6:1) Collap \(=\).ble containers for buik liquid storage.
167) The adaptation of phots-interpretive rechniques to urban damage assessment.
(68) Aerial monitoring of ground level radiation intensities.
(69) Location of living persons trapped in debris.
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\section*{RESEARCH PROGRAM CANADA EMO}

PROTECTION DIVISION

Comments related to Part II of the Senate Committee guideline is as follows:
II. 2.4 (a) Distribution of agency spending.
Ontario - \(\$ 125,000\) p.s.
Quebec - 25,000 p.a.
Alberta - \(\quad 25,000\) p.a. \(\$ 35,000\) this fiscal

year only (Suffield Trial)
(b) Funding is according to institution interest and competence in specific EMO engineering problems.
(c) Nil.
(d) N11.
(e) Contract research is most profitable at Institutions
where a competence and interest in the problem exists or can be developed. This is the only criteria for distribution currently used.
2.5 Personnel associated with scientific activities:
(a) One Engineer, Two Technicians.
(b) One Engineer.
(c) Bachelor Level One.
(i) Canada
(ii) Canada
(iii) Canada
(iv) 8 years of which 2 years were in EMO
(v) 31 years
(vi) Nil
(d) 62-68 - One \(1 \frac{1}{6}\) Engineers (Bachelor Level)
(e) o\% turnover 62-67
(f) \(100 \%\) worked in industry
\(0 \%\) worked in universities incumbent worked for Province of Ontario. previous worked for DPW
(g) - 0 -
(h) Summer Students.
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2.6 (a)
(i) 20,000 p.a.
(ii) Nil
(iii) N11
(iv) Nil
(v) Nil
(vi) \(\$ 190,000\) this year and following; \(\$ 140,000\) p.a. previously
(vii) Nil except that in (6) support is given to graduate students on project.
2.6 (a) Engineering and technology.
2.6 (a) (iii) War and Defence \(\$ 60,000\) p.a.
(v) Construction - Note that this expenditure is to reduce vulnerability of peacetime construction to effects of war.
\(\$ 150,000\) this year - \(\$ 100,000\) other years.
2.6 (b) Capital fund is \(\$ 75,000\) p.a. balance operating.
2.6 (c) \(\$ 100 / y \quad-64-65\) to \(67-68\)
2.8.1. Two patents are pending - (1) beadblast valve
(2) fibre-glass blast door

No licences, no production except for items used in testing.
2.8.2. Journal articles - about 10
2.8.3. Reports from agency and units 3 published 10 in process of publication.
2.8.4. N11.
2.8.5. Use of STIC - Canada EMO.
2.8.6. None - duration of program too short as yet.
2.8.7. Nil.
2.8.8. A semi-automatic spot welder to build models of reinforcing steel cages, has been developed.
2.8.9 Funding of dynamic simulator at MacMaster and encouragement of simulator construction at University of Calgary. Use of simulators on other projects will allow previously impossible work to be done in Canada.

\subsection*{2.9.1. PROJECTS}

Blast Protection Program
(See attached 11st of projects)
Vulnerability Reduction Program
(See attached list of projects)
2.9.2. Since the Programs are young, no project is fully complete. The Mark I Shelter became the Mark II and will not be finished until 1970. The Blast Valve will be complete in six months.

\section*{BLAST}
1. Development, design and testing of family blast shelters and specialized components
a. Development of MK I fibreglass blast shelter.
b. Development of MK II fibreglass blast shelter.
c. Development of FRP hatch covers.
d. Development of interference blast valves (family shelter size).
e. Development and testing of shock mounted furniture for family shelters
f. Development and testing of FRP membrance blast door.
8. Analysis of dynamic response of thin rectangular plates in the membrane range.
h. Basic research of soil structure interaction.
1. Water recovery from internal combustion engines.
f. Cost-effectiveness analysis of protective systems for family shelters.
k. Publication of papers, and lectures to disseminate the information.
2. Comparative evaluation of structural systems for dual-purpose community facilities designed to act as blast shelters
a. Comparative structural analyses of different systems.
b. Comparative cost-effectiveness analyses of structural systems.
c. Detailed theoretical analysis of the selected optimum system.
d. Perspex model study to determine validity of theoretical study in elastic range.
e. Development of fabricating techniques for small concrete structures.
f. Evaluation, by static test on concrete model, of the validity of theoretical analysis.
g. Dynamic tests of concrete models.
h. Prototype study of optimum systems.
i. Publication of engineering and cost data.
3. Development and testing of methods to enhance the blast resistance of existing buildings or parts of buildings, to protect their occupants against blast and associated effects
a. Development and testing of large capacity blast valves.
b. Development and testing of hardware and systems for large-size blast doors.
c. Development and testing of methods to enhance the strength of existing columns.
d. Development and testing of methods of increasing the ductillty of existing joints.
e. Development and testing of methods for increasing the strength of existing floor systems.
f. A cost-effectiveness study to determine the relative effectiveness of different methods of strength enhancement.
4. Preparation of cost analyses for all the above to provide the necessary basis for the formulation of a blast protection policy
a. Comparative cost studies of family shelters and public shelters.
b. Comparative cost studies of dual-purpose fallout protection with blast protection.
c. Comparative cost studies of protection in existing buildings against either form of new construction.
d. Detailed analyses of entire program in relation to existing risk of blast effect.

\section*{VULNERABILITY RBDUCTION}

Studying the response of structures and services to the direct effects of nuclear weapons and other dynamic loads.
1. Investigation of typical building components
a. Investigating the behaviour of steel columns under blast.
b. Investigating the characteristics of bolted steel connections.
c. Investigating the characteristics of welded steel connections.
d. Investigating the ultimate strength of at or below grade concrete structures.
2. Studies of the dynamic response and ultimate lateral strength of typical buildings
a. Investigating the behaviour of multi-storey steel buildings with semi-rigid connections and composite floor systems.
b. Investigating the behaviour of steel framed buildings with welded connections.
c. Investigating the behaviour of reinforced concrete shear wall buildings.
d. Investigating the blast resistance of earthquake resistant and non-earthquake resistant reinforced concrete buildings.

\section*{3. Studies on new construction materials}
a. Investigating the use of foam concrete as an energy absorbing backfill material.
b. Investigating the use of foam concrete as a construction material.
c. Investigating the increased ductility of concrete by means of fibrous reinforcement.
4. Studies of laboratory dynamic loading systems
a. Feasibility study of multi-degree of freedom vibration system.
5. Developing methods for assessing the vulnerability of Canada to the direct effects of nuclear weapons and other dynamic loads

\section*{a. Buildings}
(1) Developing a classification system for the vulnerability of typical buildings to dynamic loads.
(2) Preparing a suitable manual or manuals to carry out a survey based on this classification system.
(3) Training inspectors in the methods required for the survey.
b. Essential services
(1) Developing a classification system for the vulnerability of utilities such as sewer, water, electric power, gas, etc., to blast and other dynamic loads.
(2) Preparing a suitable manual or manuals to carry out a survey based on this classification system.
(3) Training inspectors in the methods required for the survey.
c. The statistical study of energy released by earthquakes in Canada
(1) An analysis of the earthquake history of Canada.
(2) Developing a planning system based on rational assumptions of an acceptability of risk.
(3) Predicting extreme value probabilities for earthquakes at different forecasting periods.
d. Provision of data on which a rational system of damage prediction may be based
(1) Collecting, analysing and publishing of data from the vulnerability surveys.
(2) Publishing data regarding the risk of earthquakes and other peacetime disasters.
(3) Preparing and publishing data regarding areas subjected to risk of blast.

\section*{ECONOMIC DIVISION}
1. This refers to the letter from the Director of Research of the Committees Branch of the Senate to the Director General of August 12, 1968, and your request of August 23 for information on research by this Division, carried out since 1962, and to be carried out up to and including 1973.
2. The format used is that provided in the "Guide for Submission of Briefs" which was attached to the letter of August 12, and outlined in Part II 2, "Content of Submissions". Comments are as follows:
2.3 Personne1 policies-

Because of severe shortage of economist positions on staff, much of research work has been carried out under contract, either with other federal departments and/or private consultants.
2.4 Distribution of activities -

In hiring consultants, close proximity to Ottawa is very desirable, to ensure coordination of detailed work. However field work for the urban analysis series of maps, carried out for Canada EMO by the then Department of Energy, Mines and Resources), was subcontracted out in the summers of 1963 to 1966 to geographers at local universities in the case of Vancouver, Toronto, Montrea1, Hamilton and Windsor.
2.5 Personne1 associated with scientific activities (Economic Planning Division) -
a. one economist (Division Chief);
b. about \(1 / 4\) of economist's time devoted to nonresearch and administrative duties;
c. the economist has a masters degree in economics, with most of the requirements for a Ph,D. completed;
(i) he was born in Canada;
(ii) he took his secondary education in Canada;
(iii) he did all his university work in Canada;
(iv) he has worked 13 years since graduation with his M.A.; he has worked with Canada EMO for 5 years;
(v) his age is 43;
(vi) he is able to operate effectively in Eng1ish;
he is not bilingual, but has some capability of operating in French;
d. total number of professional staff in each degree category for each of the years 1962 to 1968 inclusive, and estimates for each of the years 1969 to 1973; and
e. percentage of turnover;
\begin{tabular}{|c|c|c|c|c|}
\hline Year & B.A. & M.A. & \(\underline{\text { Ph, }{ }^{\text {, }} \text {, }}\) & Turnover \\
\hline 1962 & 1 & -- & -- & 0 \\
\hline 1963 & 1 & 1 & -- & 0 \\
\hline 1964 & 1 & 1 & -- & 0 \\
\hline 1965 & 1 & 1 & -- & 0 \\
\hline 1966 & 2 & 1 & -- & 0 \\
\hline 1967 & 1 & 1 & -- & 0 \\
\hline 1968 & -- & 1 & -- & 0 \\
\hline 1969 & -- & 1 & -- & 0 \\
\hline 1970 & -- & 1 & -- & 0 \\
\hline 1971 & -- & 1 & -- & 0 \\
\hline 1972 & -- & 1 & -- & 0 \\
\hline 1973 & -- & 1 & -- & 0 \\
\hline
\end{tabular}
f. percentage of current professional personne 1
who, since graduation, have been employed by:
(i) industry at one time - nil;
(ii) universities - nil;
(iii) provincial departments or agencies - nil;
(iv) other federal agencies - \(100 \%\);
g. number of staff in each degree category on education leave - ni1;
h. number of university students given summer employment in the field of scientific activities for the year 1962 to 1968 are as follows:
\begin{tabular}{cc} 
Year & Number of Students \\
1963 & 11 \\
1964 & 27 \\
1965 & 11 \\
1966 & 10 \\
1967 & 7 \\
1968 & 2
\end{tabular}

A11 were employed by those agencies to whom work was contracted out by Canada EMO, i.e., the Department of Energy, Mines and Resources and an Ottawa firm of economic consultants.
2.6 Expenditures associated with scientific activities
(a) Total funds spent by agency on scientific activities broken down as in table (the scientific discipline is in all cases "economics" and the area of application is "war and defence");
(b) operating funds are as shown in colum 2 of table; this division made no capital expenditures:

(c) Funds expended to further professional university education of staff for each of the fiscal years from 1962-63 to 1968-69 inclusive - nil.
2.7 Research Policies
a. Units concerned with intramural research activities
(1) Programs and projects are selected, initiated and monitored through the Branch Director and through the Management Committee of Canada EMO. Other federal agencies which have an interest are fully consulted before and during each stage.
(2) Priorities between programs and project are established as in (1) above, with costs and benefits being assessed as fully as possible.
(3) CPN and PERT have not been used to plan and monitor research programs or projects, as time or cost choices have not been sufficiently complex. However the Economic Planning Division is aware of CPN and PERT and is prepared to make use of these. PERT has, nevertheless, been used to plan and monitor 16 operational projects and programs which are carried out by other departments but coordinated by the Economic Planning Division, in the course of a recent examination of the activities involved in civil emergency planning.
(4) Because of staff shortages in the Economic Planning Division, all economic research projects which are unclassified from a security point of view have been contracted out;
(i) one project has involved the collecting of unclassified production, storage or other relevent quantitative date by a firm of economic consultants on various sectors of the Canadian economy on a "resource point" basis (i.e., each factory, grain elevator, mine, population centre, etc.), the locating of each point by map coordinates, and the listing and punching onto cards of the resultant data in a form which could be utilized for computer studies into the effects of nuclear attack on Canada's economy;
(ii) another project, which was contracted out to the Federal Government's Central Data Processing Service Bureau and largely subcontracted out to U.S. and Canadian computer software firms, was the conversion of the complicated U.S. computer programs, which analyze effects of nuclear attack on resources, to run on the Central Data Processing Service Bureau's computer;
(iii) another study, contracted out to the Department of Energy, Mines and Resources and subcontracted out to geographers at the Universities of British Columbia, Toronto, McMaster, Montreal and Windsor, involved the gathering, and in some cases, compiling and printing of urban characteristic data on Vancouver, Toronto, Hamilton, Montreal and Windsor.
(iv) another project, contracted out to a firm of economic consultants, was the appraisal of a U.S. dynamic input-output model and a consideration of the feasibility of adapting this model for use in Canada.
(5) There has been no funding of extramural research programs for the Economic Planning Division in universities and industry. Subjects in which we would like to see economic research carried out have been submitted to the Scientific Adviser and circulated by him to universities, but none have indicated interest in the economic subjects concerned.
(6) Research resources are shifted from one program (possibly even terminating it) to a new program by re-allocating funds in the departmental estimates. Before such re-allocation is carried out, discussions take place with other interested federal departments or other parties. There are no particular difficulties involved in this process.
b. Units exclusively concerned with extramural research activities

Not applicable.
2.8 Research Output
(1) No patents arose from the research activities.
(2) No books or journal articles arose from the research activities.
(3) Reports issued:
(a) "The Parm System - An Appraisa1; a Report

Prepared for Canada Emergency Measures Organization", by D.W. Carr and S.J. May, March 1967;
(b) 'Resources in Canada 48 Hours After a Hypothetical Nuclear Attack", Economic Planning Division, Canada EMO, November 1963;
(c) "The EMO Resource Data File", Economic Planning Division, Canada EMO, May 1965;
(d) other reports and papers classified as Secret.
(4) (a) The annual Map Users ' Conferences held by the Department of Energy, Mines and Resources have disseminated information to extramural groups on the urban characteristics series of maps, prepared for Canada EMO.
(b) An exposition of the coding system for aggregating resource data on a metropolitan area, county or census division, emergency government zone, province and Canada-wide basis was made to the interdepartmental Subcommittee on System for Standard Statistical Areas in September 1965.
(c) Interdepartmental working groups and committees of interested persons with a need-to-know have been used to disseminate information which is classified from a security point of view.
(5) Interdepartmental working groups and committees have been used to transfer scientific and technological data obtained from outside Canada by the Economic Planning Division. The majority of such data is classified from a security point of view.
(6) The two individuals, who have been trained in a quantitative approach to economic analysis by use of computers and who have since left the Economic Planning Division of Canada EMO, are making use of the techniques learned while at Canada EMO in their present employment in other Federal Government Departments. They are not known to have made important contributions in their new fields as yet.
(7) The individuals concerned have made up sma11 research teams with unique and valued abilities in the field of analysis of economic problems likely to occur in the case of nuclear attack on Canada.
(8) Unique or valuable research tools, facilities or processes added or developed during the period concerned include the following:
(a) analysis of urban characteristics of the metropo1itan areas of Vancouver and Toronto by a series of 32 maps of the former and 42 maps of the latter, as well as data in manuscript form for Montreal, Hamilton, Ottawa and Windsor, done for Canada EMO by the Department of Energy, Mines and Resources;
(b) conversion of complex U.S. computer programs, which analyze effects of nuclear attack on an economy, to run on a Canadian computer.
(9) Impact of scientific activities and research output on the advancement of scientific knowledge and Canadian economic development in peacetime has been, in the case of 8 (a) above, to advance the frontier of urban economic geography studies. In the case of 8 (b) above, the impact has been that of the introduction into Canada of the most sophisticated computer system now being run by the Federal Government's Central Data Processing Service Bureau (according to the Bureau's Acting Director) and one of the most sophisticated being run in Canada as a whole. However the impact in wartime of the Division's scientific activities and research output would be much more far-reaching. The research carried out by the Division could, if acted upon through Government policy, have wide-ranging effects on the survivability of the Canadian economy and population in the event of major warfare which this country might be involved.
(10) Other measures or indications of research output It might be mentioned that a considerable amount of know-how is being accumulated in Canada towards a capability of assessing, with a good degree of accuracy, the effects of major warfare, especially nuclear warfare, on the Canadian economy. By keeping up on U.S. technology in this regard, adapting it to suit Canadian conditions, and applying a relatively small amount of research particular to Canada, a capability has been built up in Canada to analyze quantitatively the effects of such warfare which is second only to that of the United States, at least in the Western world.

\subsection*{2.9 Projects}
(1) Titles or other brief descriptions of projects conducted during each of the years from 1963 to 1967, with indication and description of program of which they are a part:
N.B. All projects mentioned are part of the economic planning program which is designed to study the probable effects of nuclear warfare on the Canadian economy, including population, and to recommend measures to lessen such effects.

\section*{FY 1962-63}

Planning commenced on a. Urban Characteristics map project, and
b. the assembly of data on resource points throughout Canada for computer analysis.

\section*{FY 1963-64}
a. Field work and much of compilation for Urban Characteristics map project for Vancouver completed;
b. Canada-wide resource data processed as computer input for the following categories coal mines, minerals and mineral products, petroleum and natural gas, 1961 population of Canada, land by land use, farms by type of farming, professional personne1 of Department of Agriculture.

FY 1964-65
a. Field work and much of compilation for Urban Characteristics map project for Toronto completed. Compilation and drafting of Vancouver maps completed.
b. Canada-wide resource data processed as computer input for the following categories livestock on farms, artificial insemination centres, food processing and storage, inland waterways, terminal and mill grain elevators, airports by runway length.
C. Interdepartmental study completed on the effects of nuclear warfare on a number of resource categories, down to a provincial and emergency government zone level.

\section*{FY 1965-66}
a. Field work and some compilation for Urban Characteristics map project for Windsor and Ottawa completed. Twenty-nine out of 32 maps for Vancouver printed.
b. Canada-wide resource data processed as computer input for the following categories clothing and textiles, electric generating stations, port facilities, coke, iron and steel plants, airports by geographic areas.

\section*{FY 1966-67}
a. Field work for Urban Characteristics map project for Hamilton completed. Compilation and drafting of Toronto maps completed. Printing of three remaining maps of Vanco ver completed.
b. Canada-wide resource data processed as computer input for̂ the following categories field crops, vegetable and fruit crops, branches of chartered banks, agencies of the Bank of Canada, branches of the Industrial Development Bank, hospitals and nursing homes, civil air navigation aids.
c. Study made, using computer meth ods, of the effects on the Canadian economy of
(i) a nuclear attack directed at U.S. military targets, but with fallout effects on Canada,
(ii) a nuclear attack, involving a number of weapons on Canada. Probability study on the survivability of the Canadian economy under nuclear warfare commenced.
d. Examination of complex U.S. PARM dynamic input-output system carried out, and assessment made of its adaptability to Canada to analyze both a post-attack economy and the present peacetimt economy.

\section*{FY 1967-68}
a. Field work and compilation for Urban Characteristics map project for Montreal completed. Printing of 42 Toronto maps completed.
b. Canada-wide resource data processed as computer input for the following categories country grain elevators, 1966 population of Canada, municipal water supply systems, refractory plants. Work commenced on data for fish processing plants and road transport resources.
c. Computer analysis carried out on the effects of nuclear attack on several Canadian resource categories, particularly population and hospital facilities.
d. Conversion of U.S. computer programs, for analysis of effects of nuclear attack on resources, commenced and largely completed.
e. Analysis of effects of potential flooding on resources in the Fraser River Valley completed.
f. Analysis of the effects on Canada's Gross National Product producing potential of a nuclear attack, and benefit-cost stady of economic planning program based on this analysis.
g. Analysis, using PERT, of the 16 activities of a largely economic nature which contribute towards Canada's civil emergency planning objective.

\section*{FY 1968-69 (to date)}
a. Urban Characteristics Analysis mapping project terminated because of shortage of funds. Arrangements made with the Department of Energy, Mines and Resources to transfer all unpublished map manuscripts to Public Archives.
b. Canada-wide resource data processed as computer input for the following categories municipal sewer systems and pulp and paper mills.
c. Benefit-cost study of the maintenance of a clothing stockpile in Canada for the eventuality of a major war was largely completed.
d. Conversion of U.S. Computer programs for analysis of effects of nuclear attack on resources tested out.
(2) Case histories of the most significant completed projects of the last five years (basic research, applied research, or development):

\section*{a. Primarily applied Research (with some basic research invo1ved in each project)}
(i) Interdepartmenta1 Study of Effects of Nuc1ear Attack on Canada - 1964
This project was carried out as resource background for a national civil defence exercise. An interdepartmental working group was set up and departmental representatives analyzed attack effects on resources by non-computer means in their areas of responsibility, with breakdowns by the geographic-administrative regions of Canada. The resultant portions of narrative were collated and edited by the Economic Planning Division and were printed up as the first detailed, integrated examination of what the Canadian economy might be like after what might be a typical nuclear attack.
(ii) Compilation of Resource Data - 1963-68 This project involved the compilation of resource date on thirty categories of resources in a form which can be analyzed by a computer to assess likely nuclear attack effects on their productive capabilities. The project was largely carried out under contract with a firm of economic consultants, with cooperation in the searching out of suitable data being extended by several federal departments.
(iii) Computer Study of Effects on Canada of Nuclear Attack - 1966 This was a joint Canada-U.S. study of the effects of nuclear attack on the economies of the two nations. Two different types of attack were gamed in. The first type was an attack a1most entirely on U.S. military targets; the second type was an attack on a balanced selection of military, population, industrial and government targets. An overall write-up for the two types of attack was completed, but a detailed write-up took place only for the attack on military targets.
(iv) Urban Characteristics Project - 1963-68 This project, carried out by the Department of Energy, Mines and Resources for Canada EMO, analyzed metropolitan areas by a series of maps, each map considering the area from the point of view of a single characteristic, e.g., building heights, structure of building, land use, port facilities, food processing plants, etc. Thirty-two maps were published for Vancouver and 42 for Toronto, with data for Ottawa, Windsor, Hamilton and Montreal reaching only the manuscript stage before the project had to be abandoned for lack of funds. The maps were specifically for use in civil emergency planning and operations, and were to have been completed for the sixteen areas thought to constitute the most likely targets in Canada in 1963. However, the maps attracted interest far beyond the field of civil emergency planners, particularly among those interested in urban studies.
(v) Analysis of Probable Effects of Nuclear Warfare on Canada's Potential for Producing GNP - 1967.
This project arose out of a need for a benefit-cost approach to economic planning. The cost of such planning was clear, but the benefits could not be assessed until some quantitative study could be completed of the effects, on Canada's ability to produce its Gross National Product, of a nuclear attack. This study was successfully concluded, based on previously completed studies of the probability of damage to various sectors of the Canadian economy.

Development
(i) Conversion of U.S. Computer Programs -1966-68
The computer programs concerned are very complex ones which gave the United States, alone in the Western World at least, the capability of swiftly analyzing, in great detail, the effects of any given hypothetical (or actual) nuclear attack on their economy by means of aggregating the effects on the individual resource locations within
each resource category. Commercially unclassified resource data was processed and fed into the U.S. system in order to assess effects on the joint U.S.-Canadian economies. However by 1966 work began on converting the U.S. programs to run on the Central Data Processing Service Bureau \({ }^{\text {t }} \mathrm{s}\) computer in Canada, in order to give Canada an independent analytical capability, and, in particular, to enable the processing of commercially confidential data. These programs are now converted, to the extent that results from the same input produce the same outputs in both contries.
(ii) Appraisal of PARM Dynamic Input-Output Mode1 System - 1967
The PARM system enables the checking out of economic objectives as much as one year after a nuclear attack, to see if those objectives are feasible in view of damage done, either hypothetically or actually, by a nuclear attack. The PARM system is very sophisticated in comparison with the static input-output models much more generally used in Canada and elsewhere. PARM was subjected to critical examination by a group of mathematical economists employed under contract by Canada EMO and recommendations regarding its adaptability were made in a 99-page appraisal.

PROPOSALS AND ACTIONS
\begin{tabular}{|c|c|c|c|c|c|}
\hline SOURCE & RESEARCHER & SPONSORING OR
INTERESTED AGENCIES & RESEARCH PROPOSAL & ACTION & DATE \\
\hline MoGill Univ. & Dr. McCutcheon & Canada EMO Public Works & Reaction of underground structures to blast & Funded \$7,500. Sponsored by EMO & 1964 \\
\hline MoGill Univ. & Dr. Gersovitz & Canada EMO Public Works & Structural Models & Funded \$4,500. Sponsored by EMO & 1965 \\
\hline University of Alberta & Dr. Panar & Canada EMO & Recovery of water from engine exhaust & Funded \$2,700. Sponsored by EMO & 1965 \\
\hline Univ. of Saskatchewan & Mr. Deckker & \[
\begin{aligned}
& \text { Canada EMO } \\
& \text { Pub1ic Works }
\end{aligned}
\] & B1ast wave mechanics & Referred to DRB and funded by them at \(\$ 3,900\). & 1965 \\
\hline Laval University & Dr. Mehran & Fisheries & Zn 65 aquatic environments & Funded \(\$ 4,000\). Sponsored by Fisheries & 1966 \\
\hline Univ. of Water100 & Dr. Sherbourne & Canada EMO Public Works & Blast door design & Funded \(\$ 3,450\). Sponsored by EMO & 1966 \\
\hline Univ. of Toronto & Dr. Burton & Canada EMO EHS \& EWS & National hazards & Funded \(\$ 14,000\). Sponsored by EMO & 1967 \\
\hline Univ. of Toronto & Dr. Hewitt & Canada EMO EHS \& EWS & Man-made hazards & Funded \(\$ 3,500\). Sponsored by EMO & 1967 \\
\hline Research Triang1e Institute & Mr. Brooks & Canada EMO & Analytical study of zone concept & Funded \(\$ 23,000\). Sponsored by EMO & 1967 \\
\hline Univ. of Alberta & Dr. Royal & \[
\begin{aligned}
& \text { Canada EMO } \\
& \text { EHS }
\end{aligned}
\] & Radiation physiology & Not supported & 1965 \\
\hline Univ. of Saskatchewan & Dr. Lee & Dept. of Agriculture & SR 90 in soils & Under consideration but delayed & 1965 \\
\hline Univ. of Saskatchewan & Dr. Rennie & Dept, of Agriculture & Cs 137 in soils & Under consideration but delayed & 1965 \\
\hline Perdue University & Dr. Devenny & Public Works Canada EMO & Shock characteristics of soils & Funded \(\$ 10,000\). Sponsored by Public Works & 1967 \\
\hline Mount Allison Univ. & Dr. Chandra & Dept. of Agriculture & ```
Radiation microbiology
    (soils)
``` & Under consideration but delayed & 1965 \\
\hline Univ. of British Columbia & Dr. Tregunna & Agriculture Forestry & Photosensitivity of plants & Referred through OEP to ABC in the United States & 1964 \\
\hline Univ. of Saskatchewan & Prof. Gibson & \begin{tabular}{l}
EHS \\
EWS \\
Department of Agriculture
\end{tabular} & Recovery of protein & Funded \(\$ 7,550\). Sponsored by Agriculture & 1967 \\
\hline MacDona1d College & Prof. MacFarlane & \begin{tabular}{l}
ESPB \\
Agriculture
\end{tabular} & \[
\begin{aligned}
& \text { Regional self- } \\
& \text { sufficiency (food) }
\end{aligned}
\] & Under consideration & 1967 \\
\hline
\end{tabular}

\section*{LIST OF STUDIES IDENTIFIED IN PROJECT PHOENIX}

\section*{Public Protection Sub-Program}
1. Continuing study of the potential threat from nuclear, biological and chemical weapons.
2. Annual review of scientific and technological developments which have either an offensive or defensive potential.
3. Continuing study of potential defensive measures against all known or potential enemy weapons.
4. Studies to relate the methods of detecting, measuring and recognizing the potential hazards of various enemy weapons to appropriate protective measures.
5. Studies to determine the optimum combination of self-help, shelter and dispersal to produce the maximum saving of lives at the most economical rate; and to relate this to the most effective hazard monitoring and associated public control systems.
6. Studies to determine the best methods of managing and evaluating the effectiveness of such systems.
7. The maximum degree of protection that it is possible to achieve by individual and family protective measures. How far is community and/or local government assistance necessary to achieve this level? How can agencies in being assist? How much can be achieved in a period of strategic warning? And what would this imply?
8. All aspects of dispersal, including:
a. likely public reactions;
b. feasibility;
c. problems associated with dispersing various categories of the labour force;
d. implications of industrial dispersal;
e. effects on national economy;
f. options and possible phasing of dispersal during a period of strategic warning.

\section*{Public Information Sub-Program}
9. Technical studies to develop best low cost means of communicating tactical warning to the public.
10. Studies to reveal the extent to which education of the public, relative to the hazards of war and to the appropriate protective
measures, is a factor in reducing casualties.
11. Studies of public reaction to official guidance at times of crisis, and of the best means of accelerating and intensifying the flow of public information during an emergency.

\section*{Essential Societal Services Sub-Program}
12. A study to determine what parts of the educational system are critical and vulnerable and, therefore, require special attention in the development of emergency plans; and to indicate what those plans should incorporate with respect to educational systems.

\section*{Continuity of Government Sub-Program}
13. The problems of reaching maximum possible national readiness under varying conditions including:
a. the public and key officials have not been fully educated in their emergency roles;
b. the public have been well educated, and key officials well trained in their emergency roles;
c. strategic warning is received and acted upon;
d. no strategic warning is received;
e. varying Canadian climatic conditions.
14. The full implications of what will be required of government at all levels during an emergency; and of the support and input which governments will require from their own agencies and from organizations in the private sector.
15. A study to indicate which Emergency Operating Centres must be completed with respect to structure, facilities and equipment in peacetime, and those which can be brought to a required state of readiness during a period of strategic warning.
16. Further study of the possibilities of introducing duality of purpose into the designs and potential uses of Emergency Operating Centres.
17. A review and study of all international agreements which have a bearing on the planning and implementation of civil emergency measures.
18. The nature and scope of all government operations from the beginning to the end of the emergency.
19. The likely impact of various controls on the public and on organizations in the private sector.

\section*{Essential Utilities and Special Services Sub-Program}
20. Studies of the vulnerability of all essential utilities to various weapon effects.
21. Studies of the problems in, and best methods of, restoring essential utility services by emergency substitution and/or repair.
22. The extent to which the vulnerability of essential utilities might be reduced in a period of strategic warning by carrying out appropriate and feasible measures.
23. A study to identify the criticality of essential utilities and services in terms of:
a. national requirements;
b. local requirements;
c. location relative to potential targets.
24. Studies and development to indicate practical and low-cost fire prevention measures.
25. Studies to determine how far fire prevention measures can be implemented during a period of warning; and their potential effectiveness.
26. Continuing study of the potential effectiveness of rescue operations with regard to increased enemy capability, in terms of attack pattern and weight of attack, and the increasing urbanization of Canada.

Economic Planning and Resource Control Sub-Program
27. Studies of the vulnerability to various weapon effects of key installations essential to the following activities:
a. energy and fuel
b. agriculture
c. fisheries
d. water
e. industry
f. food and feed production
28. The dependence of essential activities on money.
29. The methods of maintaining and/gr improving agricultural yields under emergency conditions.
30. The methods of maintaining and/or improving the yield from fishing under emergency conditions.
31. The best methods of influencing production and applying controls in:
a. an accelerated state of emergency;
b. a period of strategic warning or slow escalation.
32. The effects of delay in imposing the necessary controls on essential resources
33. Water as a national resource, as an industrial requirement, as a utility and as an essential commodity for life, with a view to determining which of a number of authorities should be in a position to determine priorities and to impose controls in an emergency.
34. A study to determine if and where there are potential critical shortages of water during an emergency.
35. The effects and ramification, relative to the national economy, of regulating trade.
36. The best methods of regulating trade in:
a. an accelerated period of emergency;
b. a period of strategic warning or slow escalation.
37. The implications or potential implications on Canada's external trade pattern of a war emergency, and the identification of essential items the supply of which could become critical.
38. The entire field of industrial preparedness with a view to determining:
a. the benefits, if any, resulting from planning for the emergency on an industry basis rather than on a plant basis;
b. what advantages can be taken of a period of strategic warning.
39. A study, which is reviewed at regular intervals, to analyse the potential requirements of the nation in terms of commodities and essential materials throughout the emergency; and to identify those which could from time to time become critical.
40. Potential sources of supply of critical items among Canada's allies or other countries, relative to the potential war situation.
41. A study to develop analytical procedures which will facilitate the making of sound and rapid decisions relative to the availability and allocation of essential national resources.
42. The potential food and feed situation with respect to:
a. seasonal variations
b. vulnerability
c. work force requirements and availability
d. the implications of war on the external trade pattern.
43. The relationship of the potential availability of food and feed to the dietic and health requirements of:
a. humans
b. animals.

\section*{Service Activities}
44. An analysis of the total communications requirements for civil emergency purposes.
45. Continuing study of the implications of new technology.
46. Studies of the vulnerability to various weapon effects of key installations and components of :
a. the communications systems
(6) b. the transportation systems
c. the postal services.
47. The implications of new technology on the methods and evaluation of damage determination.
48. The basic requirements and progressive stages of damage determination.
49. A study to develop procedures for evaluating the vulnerability of systems and system components.
50. Transportation as a total system in an emergency, rather than four separate systems.
51. The most effective and economic means of developing within provinces an emergency capability which can be rapidly expanded during a warning period to assume control, if necessary, of all emergency activities.

\section*{Notice of Award}

CANADA EMERGENCY MEASURES ORGANIZATION RESEARCH FELLOUISHIPS

FIELD OF
STUOY: Sociological effects of major disasters.
VALUE: \(\quad \$ 5,000\) (Can.) per annum for maximum of three years.
NUMBER: One, offered annually.
DURATION: To complete the graduate degree for which the award is made.

CONDITIONS: Preference will be given to Canadian residents who hold a Master's degree in Sociology. However Candidates with a first degree major in Sociology will also be considered.

WHERE Disaster Research Centre, Ohio State University, TENABLE: Colombus, Ohio.

CLOSING
DATE: 31st. March.
FURTHER Director of Awards, AUCC
INFORMATION: 151 Slater St., Ottawa 4, Ontario.

APPENDIX 56

\section*{BRIEF}
to

SPECIAL COMMITTEE ON SCIENCE POLICY

\section*{from}

DOMINION COAL BOARD

Ottawa, Ontario

\section*{Notice of Award}

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The statutory functions of the Dominion Coal Board with respect to research and investigations are contained in Section 7 of the Dominion Coal Board Act, a copy of which is attached to this Brief.

In discharge of these functions, it has been Board's policy not to create its own laboratories but rather to make use of existing Federal facilities, thereby avoiding duplication. A second policy, which recognized the scarcity of coal-oriented research talent, has been to encourage the development of non-federal centers of knowledge in the provinces. When appropriate, assistance has been given to individual coal companies which exhibited sufficient interest and capacity to undertake meaningful study projects.

The Board's assistance has been on a modest scale, amounting in total to \(\$ 50,000\) per year, distributed among approved recipients. In \(1967-68\), these numbered eight. In every case, the recipient contributed the major share of the cost of his study project. The Board's contributionhhas been in the nature of a catalyst to promote action rather than a principal source of funds. This co-operative approach has been found useful and an important factor in winning the necessary co-operation and interest has been the Board's practice of regularly obtaining the views of the Canadian Advisory Committee on Coal Research before deciding on the yearly allocation of its available funds.

To assist in the dissemination of knowledge related to coal, the Dominion Coal Board has organized and administered the Federal-Provincial Conferences on Coal. The 20th Conference was held in Quebec City in September, 1968.

In view of government's intent to dissolve the Dominion Coal Board, the latter will no longer be able to discharge the above functions but wishes to recommend that the Federal Government continue to pay adequate attention to coal research and development for the following reasons:
(a) The associated industry is financially unable to support, by itself, a research and development program but can continue to participate in centrally administered programs by federal or provincial governments.
(b) Fundamentally, research and development are of more significance to the state, with its longer-term need to meet its escalating energy and metallurgical demands, than it is to the current coal mining industry with its passing interests and problems.

\section*{Recommendations}

Toward establishing in Canada a more constructive and perhaps more realistic attitude toward coal research and development, it is recommended that this be based on the concept of coal as a massively-present resource of large potential rather than on the concept of curing the problems of the industry as it now exists. It is believed that research people would welcome this longer-term and broader approach because it would allow moreconsistent planning of investigations and, in the process, help attract a larger number of qualified personne1 on career basis.

It is further recommended that research and development for all our energy resources, including coal, be more closely co-ordinated. In the face of our rising energy demands, it appears advisable to adopt a total energy concept and to modify materially the present pattern of compartmented efforts among our several energy sources. A combining of research skills could prove beneficial in making best use of available personnel and could assist materially in promoting the orderly and optimum use of all energy resources.

The key organization in Canadian coal research is the Fuels Research Centre of the Department of Energy, Mines and Resources. It is recommended that this Centre be given continued strong support so that it can continue to act as the senior scientific body in Canada on matters related to coal and give leadership and co-ordination at national level to industrial and provincial investigations.

It is further recommended that support be continued and strengthened toward establishing co-operative studies with provincial institutions including the universities. These co-operative programs make excellent use of existing skills within the provinces that can be most effectively employed only within the context of broad programs. In the Board's experience, a modest outlay of funds is sufficient catalyst to promote useful studies. Further to such co-operative efforts, the above mentioned Fuels Research Centre could act as a Federal base for scientific control and co-ordination.

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bRIEF TO SPECLAL COMMITTEE ON SCIENCE POLICY
by
Dominion Coal Board, Ottawa, Ontario

The following reply has been arranged in the order
presented in Part II of "Guide for Submission of Briefs and Participation in Hearings".

\subsection*{2.1 Organization}
(a) An organizational diagram of the Dominion Coal Board is attached.
(b) A block diagram is attached showing parliamentary reporting channels, connections with other Federal agencies, and advisory committees.
(c) This block diagram has not been prepared for the Dominion Coal Board because of the compact size of our organization. It is believed that diagrams provided under (a) and (b) above should be sufficient.
(d) The Dominion Coal Board has no formal agreements regarding scientific activities with organizations outside of Canada.
(e) A "nil" reply also because the Board has no overseas offices.
2.2 Organizational functions
(a) The statutory functions and powers of the Dominion Coal Board are precisely stated in Section 7 of the Dominion Coal Board Act, a copy of which is attached.
(b) It has been the policy of the Dominion Coal Board, from its inception, that it would not set up its own laboratories but rather to use and support existing laboratories engaged in coal research. A second over-all policy, which recognizes the scarcity of research relating to mining in general, is to encourage and promote the development of centres of knowledge on matters related to coal. These centres exist not only within the Federal Government but also within Provincial organizations such as research councils and in universities. When appropriate, assistance is also provided to individual coal mine operators who give evidence of interest and capacity to undertake development related to coal.
(c) With respect to the Board's functions and responsibilities relative to other Federal Agencies, the Board is required, under its Act, to advise on all matters related to coal. It has done so since its inception.




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With respect to industry, a function of the Board is to determine areas of research and development that are important to the industry and which require promotion and support. This assistance is provided after consultation with the industry and normally is conducted in co-operation with the coal mining industry. It is also a Board function to help disseminate information by reports, by conferences, etc.

With respect to educational institutions it is, as indicated under (b) above, a continuing interest of the Board to develop, promote and support centres of knowledge on matters related to coal.

Regarding international representation and monitoring of outside scientific activities, the Board has kept in touch with coal research and development organizations in other countries. In addition, the Board attracts foreign authors to annually-held coal conferences supported by the Board.

The Board also carries certain responsibilities with respect to government agencies of coal producing provinces. For example, the Board advises such agencies on the operational problems and economic status of the mines within their provincial jurisdiction and also assists such provincial agencies in the initiation of technical/economic studies related to their coal mining industries.

A11 the above co-operative efforts are initiated and promoted by the Dominion Coal Board only after full consultation with the outside parties involved. For example, some of our responsibilities to other Federal agencies are conducted by means of the Interdepartmental Fuel Committee. Similarly, our contribution to other Federal agencies is conducted through Committee work such as the Interdepartmental Comnittee on Energy Statistics, the Canadian Government Specifications Board, etc. The Board's association with industry and educational institutions is promoted partly through the Canadian Advisory Committee on Coal Research. Essentially, the Board has found the committee approach to be a most useful method toward achieving our over-all aims.
(d) Effectiveness, duties and goals related to research and developmen t are reviewed and revised (controlled) as follows:
(1) A11 recipients of research funds from the Dominion Coal Board are required to submit each year a technical report on progress as we11 as a financial statement on expenditures made. From time to time, also, the Board seeks outside views, particularly those of the Canadian Advisory Committee on Coal Research, with respect to the acceptability of specific subject matters.
(e) An example of an outside study commissioned during the past five years was the one conducted in co-operation with the New Brunswick Department of Mines to determine the practical economical life of the Minto coal field in New Brunswick. This study was assigned by the Board to an outstanding mining expert, Mr. T.G. Gerow, whose report has subsequently been employed to excellent effect by the Province of New Brunswick in its rationalization program for that coal field.
(f) Although the Board has been reasonably effective in discharging its responsibilities with respect to research and development, it muṣt be stated that these powers have not been fully exploited.
(g) The major hindrance to the effective discharge of responsibilities related to the promotion of research and development has been an erroneous but broadly held belief that coal has little place in the future energy requirements of Canada. This misconception is now being dissipated largely because of the growing realization of the importance of coal to our export trade and to our basic industries in the thermal-electric and metallurgical fields.
(h) A major change that is currently being considered for the Dominion Coal Board is its dissolution and absorption in an over-all energy organization of the Federal Government.
2.3 Personne1 Policies
(a) Research workers are screened for effectiveness with the help of the Canadian Advisory Comnittee on Coal Research. This Committee is comprised of research workers (knowledgeable of coal) in Federal and Provincial government agencies.
(b) We have developed no unique criteria for identifying those of creative minds.
(c) As indicated, the Dominion Coal Board opexates no laboratories of its own but supports those already established. Consequently, we have not taken direct steps toward identifying researchers of high potentiality as research administrators but we do take note of, and encourage, the outstanding individuals of co-operating research organizations. For example, people with promise in the Fuels Research Centre of the Mines Branch, Ottawa.
(d) For distinguishing between administrators and researchers, we follow practices established within the Federal Civil Service.
(e) We have not had to adopt such a policy for our own staff members.

\subsection*{2.4 Distribution of activities}
(a) Although we adhere to no rigid pattern, nevertheless, our support
research activities tends to be concentrated in coal producing provinces.
(b) We do not find that any region is more particularly suited for any given scientific activity than any other region.
(c) With respect to activities carried out to assist in specific regional phenomena, these are as follows:
(1) The reduction of sulphur in Nova Scotia coals to make them more suitable for metallurgical purposes.
(2) Improving the coking qualities of western metallurgical coals.
(3) Promoting the use of 1 ignite as a future Saskatchewan energy resource.
(d) The Board's role in contributing to regional development has been an indirect one through support and encouragement of a region's coal industry. For example, the Board took a leading part in developing the coal export trade to Japan which is very significantly adding to the economy of British Columbia and Alberta, The Board also provided much of the basic information required in the Federal planning that led to the formation of the Cape Breton Development Corporation.
(e) In the Board's experience there is a distinct benefit in a regional distribution of \(R\) \& D studies. The principal benefit is that use can be made of provincial skills and facilities to supplement Federal strength during specific studies, thus avoiding a permanent addition to the Federal establishment.

A necessary condition for the success of regional and, indeed, of Ottawa based studies is that the Federal and Provincial governments, in association with industry, should be prepared to develop study results up to the stage of commercial application. This is a vital step in the completion of a project requiring business experience not normally possessed by research scientists.

\subsection*{2.5 Personnel associated with scientific activities}

This query about personnel associated with scientific activities is not applicable to the Dominion Coal Board because, as indicated above, it has been the Board's policy and practice to utilize and support existing organizations.

\subsection*{2.6 Expenditures}

Following is a tabulation of expenditures made on research and development during the period requested.
\begin{tabular}{ll} 
Functions invo1ved: & \begin{tabular}{l} 
Support of R \& D in Industry, Universities, \\
and Provincial Research agencies. \\
The research is applied research.
\end{tabular} \\
Scientific discipline: & Engineering \& Technology. \\
Area of Application: & Industry.
\end{tabular}

\section*{Table of Expenditures in Period Requested}


Forecasting beyond 1968-69 is impossible because a probability exists that the Board may be dissolved.

No funds have been spent on furthering professional university education of staff

\subsection*{2.7 Research Policies}
(a - 1) Project proposals are invited by the Board from organizations and individuals engaged or interested in coal studies. These proposals are examined for suitability by the staff of the Board in co-operation with the Canadian Advisory Committee on Coal Research. This process results in a formal recommendation to the members of the Dominion Coal Board who have powers for accepting, rejecting or modifying proposals.

Following acceptance of a proposal, the approved funds are forwarded to the head of the organization concerned, not to the researcher himself. For example, funds are issued whenever possible to the chief treasury official of the organization concerned or, failing that, to the president or managing director of the organization.

The recipient of each grant is required to submit to the Board an annual report on technical progress and an annual statement of expenditures incurred. In addition, the researcher is required to re-apply each year for continuation of assistance even though he had received approval for the same subject during the preceding year.

An instruction booklet has been prepared for the advice of all applicants with respect to the conditions and limitations governing these grants. This booklet also contains a form for annual financial reporting to the Board. A copy is attached.

Money for grants is obtained through annual submission of a
budgetary item by the Board.
(2) Priorities are established in co-operation with the Canadian

Advisory Committee on Coal Research and in accordance with the instructions of the members of the Dominion Coal Board.

Fundamentally, priority is given to those study proposals which appear to offer earliest benefit in the utilization of Canada's coal resources. Consequently, there is a strong bias toward applied research. However, reasonable attention is paid to proposals of a basic research nature and, very approximately, about \(10 \%\) of our efforts are directed toward such basic studies.
(3) Critical path techniques are not employed for monitoring programs because of the limited scope of our efforts and our firsthand contact with the individual study groups.
(4) As part of the Board's responsibilities to the coal mining industry of New Brunswick, a project was contracted out to Mr. T.G. Gerow, Consulting Engineer of Minneapolis, U.S.A. This contract called for a measurement of the reserves of the Minto coal field and a technical evaluation of the realistic future of the mining operations in that area.
(5) The policies behind Board funding of research in universities and industries are:
(a) to promote research and development related to coal.
(b) to utilize existing personnel and equipment wherever these exist in Canada.

We believe these policies to be in line with traditional Federal attitudes.

In addition, the Board is required to perform these functions by virtue of the requirements of its founding Act.
(6) Periodically, need has arisen in the past for changing, curtailing or eliminating certain study proposals. In such cases, the matter was discussed beforehand with the researcher concerned and also with the Canadian Advisory Committee on Coal Research. Out objective was to obtain a broad and informed concensus before taking action. Unilateral action by the Board itself has been avoided whenever possible.
(7) The results of investigations are transmitted directly to organizations and individuals we know to be interested in these results. Papers are also
published in technical journals and there are reports by Federal departments.
(b - 1 to \(b-7\) ) See note (2) above for methods of accepting and funding study projects, for monitoring programs and for dissemination of results.
(b - 8) 100 per cent.
(b - 9) On average, about \(70 \%\) of the funds requested were ultimately granted in each of the years in which the Board has given such aid.
2.8 Research Output
(1) No patents have arisen.
(2) \& (3) Approximately 15 reports have arisen from these study projects.
(4) A coal conference has been held in each of the years concerned, as well as an annual meeting of the Canadian Advisory Committee on Coal Research.
(5) The Board sponsors and administers the annual Dominion-Provincial Conference on Coal, to which foreign experts are invited as authors and as delegates. The prime objective of the conference is to disseminate information of Canadian and foreign origin.
(6) Nil report.
(7) We believe that our limited participation in funding research and development has assisted modestly in maintaining and enlarging teams that now make valuable contribution to coal knowledge.
(8) It is difficult and perhaps inappropriate to claim precise benefits or achievements that have arisen as a result of our partial financing of study projects.
(9) Same as for (8) above.
(10) An outside assessment of results of the Board's efforts is included in the report "Coal Research in Canada - 1967" by Dr. N. Berkowitz, Research Council of Alberta. This report deals with all coal research conducted in Canada. A copy is attached, with pertinent points related to the Board indicated for convenience.

\subsection*{2.9 Projects}
(1) The following list of studies represents only those that were accepted by the Dominion Coal Board as warranting support. A number of others were not accepted usually on the grounds of duplicating similar work in other countries.

\section*{1964-65}

Technical/Economic Evaluation of the Minto Coal Field, New Brunswick.

\footnotetext{
Conducted in co-operation with the Department of Mines of New Brunswick, the objective was to make a realistic estimate of the life remaining to this coal field. This estimate was based not only upon an independent study of the remaining coal reserves but also of the economic viability of the mining operations.
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Technica1/Economic Evaluation of the Minto Coal Fie1d, New Brunswick.
The study was comple ted this year and a report submitted to Provincial authorities with recommendations. These have been incorporated in a Provincial rationalization program for phasing out this coal field.

Reduction of sulphur and Ash in Canadian Coals.
This laboratory study is directed toward establishing new techniques for reducing deleterious sulphur and ash contents of Canadian coals to improve their acceptability for metallurgical and other industrial uses.

Techniques for Carbonizing Coal for Metallurgical Purposes.
This laboratory study has the objective of improving the carbonizing qualities of Canadian coals to upgrade their marketability in the steel making and other metallurgical industries.

1966-67
Coal as a Cleaning Medium for Industrial Waste Water.
A potentially large use for coal is as a cleaning medium for industrial wastes and sewage. These possibilities were studied in a Canadian university. An attractive factor is that coal, after being used for such purpose, can be recovered and used for steam raising purposes. This appears particularly attractive with respect to the pulp and paper industries which are substantial contributors to stream pollution as well as large users of fuel.

Reactions of Coal in Presence of Active Atomic Species.
In this study pulverized coal is reacted with atomic hydrogen and nitrogen to determine if chemical alteration occurs. This is part of an over-all study being conducted in the Research Council of Alberta into the structure and properties of coal that might lead to new processes for converting coal into chemicals and for new methods for coal gasification and hydrogenation.

Reduction of Su1phur and Ash in Canadian Coa1s.
(See above for 1965-66)
Lignite as Prime Energy Source for Saskatchewan Industrial Development.
In this study assistance was provided to the Saskatchewan Research Council as part of their over-all program for making optimum use of provincial resources. The study project comprised a technical/economic study to determine the feasibility of several alternatives involving the use of large quantities of lignite coal in a multipurpose industrial complex which would combine the solution mining and refining of potash, the manufacture of ammonia, and the production of electricity. In this study an attractive factor is the very low cost of lignite as an energy source.
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This study was contracted to a consulting firm of qualified metallurgists who operated in close co-operation with metallurgists of the Federal government. The study comprised the evaluation of the coals concerned and the determination of methods for upgrading them. The economic objective was to replace one-half million tons of imported coal with the native product. This volume of imported coal is now being consumed annually in the steel works at Sydney, N.S.

Improvement of Automation for Coal-Fired Boilers.
The objective of this study is to improve the automation involved in feeding coal to boilers. A serious disadvantage for coal is that much labour is involved in handling and this is a significant cost reason why oil and gas are displacing it in steam raising plants. Improvement in automation would substantially increase coal's competibility in this important market.

1967-68
The 1966-67 studies were continued throughout 1967-68.

1968-69
Reduction of Sulphur and Ash in Canadian Coals.
(See description above)
Improvement of Automation for Coal-Fired Boilers.
(See description above)
The studies in 1968-69 were curtailed in line with the over-all reduction in Federal spending.
(2) Case Histories: A completed and effective project was the determination of a realistic life for the coal mining operations of New Brunswick. This determination has allowed a rational program to be established for the phasing out of these publicly-supported operations. Earlier estimates had been unrealistically high, giving rise to undue optimism as to future possibilities and hindering a rational solution to a chronic industrial/social problem, Former studies had been devoted largely to geological factors only, but the latter study included the more significant parameters of operational costs, mining procedures, evaluation of possible improvements, as well as the employment factor and provincial responsibility. This study has formed a significant base for the current rationalization program of that coal field.

A second completed project was concerned with the upgrading of Nova Scotia coal to a metallurgical quality acceptable to the steel making industry of that province. The completed report, with recommendations, has been submitted to the
coal mining industry and steel company concerned. The first of the recommendations has been adopted, with acceptance of others awaiting industry's decision.
2.10 Organizations not currently engaged in scientific activities

Not applicable to Dominion Coal Board,


Fuels Research Centre
Energy, Mines \& Resources
Atlantic Development Board
National Energy Board
Department of Trade \& Commerce
Department of Industry
Dominion Bureau of Statistics
Energy, Mines \& Resourc
Chairman \& Members
\(\frac{\text { Executive Director }}{\text { Dominion Coal Board }}\)
Dominion Coal Board

Canadian Advisory Committee on Coal Research Nova Scotia Research Foundation Saskatchewan Research Council Research Council of Alberta Coal Producers - Canadian
Coal Importers

Dominion Coal Board
Parliamentary reporting channel and association with other Federal agencies, committees, etc.

CHAPTER 86.
An Act to establish the Dominion Coal Board.

\section*{SHORT TITLE.}
1. This Act may be cited as the Dominion Coal Board Short title. Act. 1947, c. 57, s. 1.

\section*{INTERPRETATION.}
2. In this Act, Definitions.
(a) "Board" means the Dominion Coal Board established "Board." by this Act;
(b) "Chairman" means the Chairman of the Board; "Chairman."
(c) "coal" includes coke, briquettes and all other pro- "Coal." cessed forms of coal;
(d) "member" means a member of the Board; "Member."
(e) "Minister" means the Minister of Resources and "Minister." Development. 1947, c. 57 , s. 2; 1949 (2nd Sess.), c. \(18, \mathrm{~s} .9\).
3. (1) There is hereby constituted a body corporate, Corporation to be known as the Dominion Coal Board, for the purposes \({ }^{\text {established. }}\) set out in this Act.
(2) The Board is for all its purposes an agent of Her Agency of Majesty, its powers may be exercised only as an agent of Her Majesty. Her Majesty, and it is responsible to and subject to the direction of the Minister.
(3) The Board shall consist of not more than seven Members. members appointed by the Governor in Council and who shall hold office during pleasure.
(4) One of the members shall be appointed by the Chairman of Governor in Council to be the Chairman of the Board who shall be paid such salary as the Governor in Council may fix.
(5) The Chairman shall be the chief executive officer of Idem. the Board, shall have supervision over and direction of the work of the Board and of the officers, clerks and employees appointed to carry on the business of the Board.
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\end{equation*}
\]
R.S., 1952.

\section*{2 Chap. 86. Dominion Coal Board.}

Remuneration.

Board to contract in name of Her Majeaty.
(6) Each member, other than the Chairman, shall be paid such remuneration for his services as the Governor in Council may fix and is entitled to be paid his travelling and other expenses in connection with the work of the Board.
(7) The Board may on behalf of Her Majesty contract in the name of Her Majesty and property acquired by the Board is the property of Her Majesty and shall be vested in the name of Her Majesty.
In case of
absence. (8) When any member by reason of any temporary incapacity is unable at any time to perform the duties of his office, the Governor in Council may appoint a temporary substitute member upon such terms and conditions as the Governor in Council may prescribe.
Quorum. (9) A majority of the members appointed constitutes a quorum.
Vacancy. (10) A vacancy in the Board dues not impair the right of the remaining members to act.
Rules. (11) The Board may make rules for the regulation of its proceedings and the performance of its duties and functions under this Act.

Oath.
(12) Before any member enters upon the execution of his duties, he shall take and subscribe, before the Clerk of the Privy Council, an oath, which shall be filed in the office of the said Clerk, in the following form:

I, ..................... solemnly and sincerely swear that I will faithfully and honestly fulfil the duties which devolve upon me as a member of the Dominion Coal Board. So help me God.
Head office. (13) The head office of the Board shall be in the City of Ottawa, in the Province of Ontario, but meetings of the Board may be held at such other places as the Board may decide. 1947, c. 57, s. 3.

Officers, clerks and employees.

Professional and technical advisers.
4. (1) Except as provided in subsection (2), the officers, clerks and employees necessary for the proper conduct of the business of the Board shall be appointed in the manner authorized by law.
(2) The Board may, with the approval of the Governor in Council, employ professional and technical advisers and assistants for temporary periods or for specific work and with such approval may fix the remuneration of the persons so employed.
(3) The Board and all persons employed pursuant to this Board to constitute a department of the
Government. section constitute a department of the Government of Canada over which the Minister shall preside, and for the 2460
purposes
R.S., 1952.
purposes of the Civil Service Act the Chairman is the deputy or deputy head of the department. 1947, c. 57, s. 4.
5. (1) Notwithstanding any other statute or law, where Contributors a person who is appointed a member of the Board was immediately prior to his appointment a contributor under the Civil Service Superannuation Act, he continues while he is a member of the Board to be a contributor under the Civil Service Superannuation Act.
(2) For the purposes of the Civil Service Superannuation Service as a Act the service of a member of the Board to whom subsec- member of tion (1) applies, as a member of the Board, shall be counted be counted. as service in the civil service and he, his widow, children or other dependants, if any, or his legal representatives, may be granted the respective allowances or gratuities provided by the Civil Service Superannuation Act.
(3) The retirement of a member of the Board to whom Retirement. subsection (1) applies upon expiration of his term of office shall, for the purposes of the Civil Service Superannuation Act, be deemed to be retirement by reason of abolition of office. 1947, c. 57, s. 5.
6. The Board shall study, review and recommend to Board to the Minister from time to time such policies and measures \(\begin{gathered}\text { reoommen } \\ \text { policies. }\end{gathered}\) as it considers necessary respecting the production, importation, distribution and use of coal in Canada. 1947, c. 57 , s. 6 .
7. The Board may undertake or cause to be undertaken Powers of reser \({ }^{2} c^{2}\) es and investigations with respect to:
the Board.
(a) the systems and methods of mining coal;
(b) the problems and techniques of marketing and distributing coal;
(c) the physical and chemical characteristics of coal produced in Canada with a view to developing new uses therefor;
(d) the position of coal in relation to other forms of fuel or energy available for use in Canada;
(e) the costs of production and distribution of coal and the accounting methods adopted or used by persons dealing in coal;
(f) the co-ordination of the activities of Government Departments relating to coal; and
(g) such other matters as the Minister may request or as the Board may deem necessary for carrying out any of the provisions or purposes of this Act. 1947, c. 57, s. 7.

\section*{Duties of the Board.}

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Powers, etc., of Dominion Fuel Board transferred.

Members of the staff transferred. committees.

Living and travelling expenses.

Duties and functions of committees.

Regulating and controlling production, distribution and use of fuel.
8. The Board shall:
(a) administer, in accordance with regulations of the Governor in Council, any subventions or subsidies relating to coal voted by Parliament;
(b) exercise and perform on behalf of the Minister such powers, duties and functions of the Minister relating to coal as the Minister may require; and
(c) exercise and perform any other powers, duties and functions conferred on or required to be performed by the Board by or pursuant to any other Act or order of the Governor in Council. 1947, c. 57 , s. 8.
9. (1) The powers, duties and functions of the Dominion Fuel Board, established by order of the Governor in Council made on the 25th day of November, 1922, are hereby transferred to the Dominion Coal Board.
(2) Notwithstanding section 4, the Governor in Council may by order designate persons who, prior to the 25 th day of October, 1947, were members of the staff of the Dominion Fuel Board, to be members of the staff of the Dominion Coal Board and upon such designation such members shall be deemed to have been transferred to the Dominion Coal Board at that date, but no person by reason only of such designation is eligible to be certified as permanent by the Civil Service Commission. 1947, c. 57 , s. 9 .
10. (1) With the approval of the Minister, the Board may establish and appoint the members of such committee or committees as it deems advisable to confer with and advise the Board with respect to any matter within its jurisdiction.
(2) No person appointed by the Board to serve on any committee is entitled to or shall receive any fee or reward for any service rendered in connection with the duties of the committee, but each such person is entitled to his reasonable living and travelling expenses while engaged on any such service in any place other than his ordinary place of residence.
(3) The Board shall prescribe the duties and functions of each such committee and may make rules for the regulation of its proceedings. 1947, c. 57 , s. 10.
11. (1) Where the Governor in Council is of opinion that by reason of conditions or events within or outside of Canada there is or is likely to be a shortage of fuel in Canada of such dimensions or nature as to imperil the welfare or national life of Canada as a whole or so as to 2462
R.S., 1952.
concern Canada as a whole, he may do and authorize such acts and things and make such orders and regulations as he may deem necessary or advisable to conserve the available supply of fuel and to regulate and control its production, distribution and use.
(2) The issue of a proclamation of the Governor in Fuel Council declaring that a national fuel emergency exists emergency. in Canada is conclusive evidence that by reason of conditions or events within or outside of Canada there is or is likely to be a shortage of fuel in Canada of such dimensions or nature as to imperil the welfare or national life of Canada as a whole or so as to concern Canada as a whole, until by the issue of a further proclamation by the Governor in Council or by a joint resolution of the Senate and House of Commons it is declared that the national fuel emergency no longer exists in Canada.
(3) The Governor in Council may prescribe a fine not Offences exceeding five thousand dollars or a term of imprisonment \({ }_{\text {penal }}^{\text {and }}\), not exceeding five years or both fine and imprisonment : penalty for violation of an order or regulation made un uer or pursuant to this section and may also prescribe whether, and the circumstances in which, the penalty shall be imposed upon summary conviction or upon conviction under indictment or upon either summary conviction or conviction under indictment, but in the case of summary conviction the term of imprisonment prescribed shall not exceed three months.
(4) Any goods, wares or merchandise dealt with contrary Goods, etc., to any order or regulation made under or pursuant to this mayed be and section may be seized and detained and are liable to detained. forfeiture at the instance of the Minister of Justice, upon proceedings in the Exchequer Court of Canada, or in any superior court of a province, and any such court may make rules governing the procedure upon any proceedings taken before such court or judge thereof under this section.
(5) In this section "fuel" includes coal, light and heavy "Fuel." fuel oil including bunker "C" fuel oil, kerosene, range oil, gas oil, diesel oil and any other hydro-carbon fuel used for the same purposes as the above designated grades. 1947, c. 57 , s. 11 .
12. Subject to the provisions of this Act, the Board Board is subject to the provisions of the Financial Administration sibinentiol Act. 1947; c. 57, ธ. 12.
13. All expenses under this Act shall be paid out of Payment moneys appropriated by Parliament for the purpose. 1947, c. 57 , s. 13 .

6 Chap. 86. Dominion Coal Board.

Receipts and expenditures to be audited.

Annual report.

To be laid before Parliament.
14. All receipts and expenditures of the Board are subject to examination and audit by the Auditor General. 1947, c. 57, s. 14.
15. The Board shall as soon as possible after the 31st day of March in each year and in any event within three months thereof submit to the Minister an annual report in such form as the Minister may prescribe of its affairs and operations during the twelve-month period ending on the 31st day of March, and the Minister shall lay the said report before Parliament forthwith if Parliament is then in session, or, if Parliament is not then in session, within the first fifteen days of the next ensuing session. 1947, c. 57 , s. 15 .

EDMOND CLOUTIER, C.M.G., O.A., D.S.P. QUEEN'S PRINTER AND CONTROLLER OF STATIONERY OTTAWA, 1952

GRANTS IN AID
RESEARCH AND DEVELOPMENT RELATED TO COAL

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DOMINION COAL BOARD
} OTIAWA, ONIARIO

January, 1966

GRANTS IN AID
RESEARCH AND DEVELOPMENT REIATED TO COAL

\section*{DOMINION COAL BOARD \\ otTAWA, ONTARIO}

The Dominion Coal Board supports studies related to the production, marketing, transportation and utilization of coal by grants made available annually to Canadian institutions engaged in such studies or which are considered capable of undertaking effective work of this nature.

The Dominion Coal Board has enlisted the services of the Canadian Advisory Committee on Coal Research in examining and judging applications for grants. The decisions reached are influenced by three main factors:
1. the merits of the proposal;
2. the amount of funds available for making grants;
3. the capabilities of the institution.

\section*{GENERAL CONDITIONS}

The following general conditions apply to grants made by the Dominion Coal Board in aid of coal research and development at Canadian institutions:
1. Grants are made subject to the annual appropriation of funds to the Dominion Coal Board by Parliament.
2. Grants are made only to applicants holding or otherwise enjoying the privileges of staff appointments in their institutions; the concurrence of the Executive Head of the applicant's institution is required in all cases; therefore if a grantee transfers from one institution to another, his grant at the first lapses and he must reapply in the normal way for continuation of support for his research.
3. Grants are not intended to cover the entire costs of the studies proposed; space and basic facilities at the institution of tenure are a pre-requisite to the award of a grant.
4. The amount of a grant provided is intended as a contribution toward the cost of a grantee's research program between Apri1 1, and March 31 ; an unspent balance at March 31 does not lapse,* but remains available while the grantee remains at the same institution, for the original purpose of the grant or, with prior approval, for an alternative purpose.

\footnotetext{
* Except for coal research groups employed in the Federal Service.
}
5. The grantee (or the institution on his behalf) shall, if the need arises, immediately notify the Dominion Coal Board of an
inability for any reason to carry out or complete the purpose for which a grant has been made.
6. Grant funds may be used for: the employment of assistants; the purchase of equipment, materials and supplies; certain travel; and activities undertaken to increase the institutions capabilities in coal research and/or development.
7. Grant funds must not be used for the remuneration of a grantee, his relatives or other staff members of his institution whose status would make them eligible for grants; the employment of all assistants under grants must be in accordance with normal policies of the institution; assistants paid from Dominion Coal Board grant funds are NOT Dominion Coal Board employees; salaries and wages paid to such assistants are subject to normal income tax and pension regulations for the category of normal income tax and pension regulations for the category of having the responsibilities of employer.
8. Title to equipment purchased under a grant remains with the institution at which the grant is held.
9. Grantees must make such reports of progress as the Dominion Coal Board may from time to time request.
10. The grantee and the institution in accepting a grant agree to follow the procedures established by the Dominion Coal Board for the administration of its grants.
11. In any publication arising out of investigations supported by Dominion Coal Board grants, acknowledgement of Dominion Coal Board assistance is requested.

19 APPLICATION FOR GRANTS
1. Applications for grants in aid should be made to the Chairman, Dominion Coal Board, Ottawa, not later than March 1. Appendix A is the form of application required.
2. Acknowledgement of Applications: The Dominion Coal Board acknowledges every application for a Grant. If an acknowledgement is not received within fifteen days of the date of submission of the application, the applicant should notify the Dominion Coal Board immediately.
3. Notification of Decisions: Successful applicants are sent official award letters informing them of the types and amounts of their grants immediately following their approval by the Dominion Coal Board and the Canadian Advisory Committee on Coal Research.

The Dominion Coal Board gives careful consideration to every application for a grant but reasons are not given for refusal to make a grant. Unsuccessful applicants are so advised immediately following consideration of their requests by the Dominion Coal Board and the Canadian Advisory Committee on Coal Research.

\section*{PAYMENTS OF GRANTS AND PROCEDURES}

\section*{FOR THEIR ADMINISTRATION}

Funds to cover the grants are sent to the institution business officer who will administer them through the business offices of the grantee's institution. Expenditures from each grant must be authorized by the grantee for the purposes described under "items of expenditures".

Disbursements for expenditures authorized by a grantee from a grant will be made by the institution business officer from the Grant Account.

At the close of each fiscal year (March 31) the Dominion Coal Board requires the submission of an annual statement of expenditures on the form provided, signed both by the grantee and the institution business officer. Grantee \({ }^{2}\) s statements of expenditures should be submitted to the Chairman, Dominion Coal Board, as soon as possible after March 31st each year and NOT LATER THAN APRIL 15TH.

In most institutions, the preparation of the expenditure statement is the responsibility of the business officer; grantees are asked to cooperate throughout the year in whatever manner is required to facilitate their preparation. Appendix B is the form to be employed when making the annual statement of expenditures to the Dominion Coal Board.

\section*{ITEMS OF EXPENDITURES}

\section*{1. Employment of Assistants}

Employees under grants in aid can normally be classified in one of the following two broad categories:

Category 1 - Individuals who participate in a grantee's research for
the main purpose of obtaining research experience that will advance their knowledge and status as scientists, rather than for financial gain.

The Dominion Coal Board considers Category 1 to cover graduate students.
A graduate student is classified as an individual who works under the direction of an experienced investigator, and in collaboration with him, for the purpose of obtaining training and experience in research. him, for the purpose of obtaining training and experience in research
\begin{tabular}{ccc} 
& \(\frac{\text { 1st }}{\$}\) & \(\frac{2 \text { nd-3rd-4th }}{\$}\) \\
Rate per month & & \\
Academic Term (Oct-May) & 162.50 & 212.50 \\
Summer Term (June-Sept) & 250.00 & 250.00
\end{tabular}

Category 2-Individuals working mainly for normal salary, rather than for advanced training.

Employees in Category 2 consist mainly of technical and nonprofessional assistants. These are classified as individuals who are employed by grantees to do routine or semi-routine work associated with research projects, with varying degrees of supervision.

In this category, it is expected that employees under grants (other than short term casuals) will be employed in accordance with policies similar to those of the institution at which the grant is held, and that they will be paid in accordance with rates prevailing at the institution.

\section*{2. Equipment, Materials and Supplies}

Grant funds may be used for the purchase of equipment, materials and supplies, etc., essential to the studies and not normally provided by the grantee's institution.

\section*{3. Travel for Field Trips}

Grant funds may be used for travel for field trips essential to the study, without prior approval of the Dominion Coal Board.

\section*{4. Incidenta1s}

Grantees may require funds for minor expenses other than those covered by (1), (2) and (3) above; such expenses should, where applicable, be listed under this heading in reasonable detail.

\section*{REPORTING ON RESEARCH}

A brief progress report will be submitted to the Chairman, Dominion Coal Board with the statement of expenditures not later than APRIL 15 TH . Expenditures to be reported in the form shown in Appendix B.

A full report of study projects supported by Dominion Coal Board grants will be submitted when the investigation has been completed.

To the Chairman, Dominion Coal Board, 140 Wellington Street, Ottawa.

APPLICATION FOR GRANT IN AID OF COAL RESEARCH AND DEVELOPMENT *

\section*{Date:}
1. Name

Position
2. Department
3. Institution
4. Short title of proposed research \(\qquad\)
5. Briefly out1ine the proposed research, guided by the following headings: (i) background, (ii) capabilities, (iii) objectives, (iv) approach to be used, (v) estimated number of years to complete project:

SDod天

 a


* A separate application should be submitted for each proposed research project. If not sufficient space for 5 , use reverse side.
6. Amount requested for fiscal year ending March 31, 196 for:

(a) employment of assistants
graduate students
professiona1s
others
(b) equipment, materia1s, supplies, etc.
(c) trave1
(d) other (specify)

TOTAL:


Give particulars of Item 6 on reverse side

Particulars of 6 (a) (b) (c) and (d):
(a) assistants (name and previous associations)
(b) equipment and materia1s
(c) travel
(d) others
7. Give particulars of other applications for support of coal research and developnent or related fields from departments or other agencies of the governuent of Canada, or other organizations, for the current or coming year.

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\section*{DOMINION COAL BOARD}

\section*{GRANTS IN AID OF COAL RESEARCH AND DEVELOPMENT}

\section*{GRANTEE'S STATEMENT OF EXPENDITURES}

Year ending March 31, 196
GRANTEE
INSTITUTION
DATE
GRANT No.
GRANT TITLE

\section*{GRANTS}

Unspent balance at close of previous year
Current year's grant
NET GRANT FUNDS AVAILABLE

\section*{EXPENDITURES}
(show details on reverse side)
(2) Equipment, Materials, and Supplies
(3) Travel and Subsistance (show details on reverse side)
(4) Other expenditures

TOTAL (not to exceed Net Grant Funds Available
UNSPENT BALANCE OF GRANT AT CLOSE OF YEAR
\$ \(\qquad\)
.................
\$ \(\qquad\)
(1) \(\qquad\)
\$ ............
\(\qquad\)
\(\qquad\)
\(\qquad\)

\section*{INTENDED USE OF UNSPENT BALANCE}
(Indicate by "X"
Is required for the purpose for which the grant was made.
Is not required for the purpose for which the grant was made, but a proposal for its alternate use has been, or will be, submitted.

Is not required and should be refunded.
I hereby certify that the above statement is correct and that the expenditures shown were for the purpose(s) for which the grant was made.

\section*{Grantee}

I hereby certify that the expenditures summarized above were incurred wholly and paid on behalf of the grantee, and that vouchers are available for audit purposes.


THE CANADIAN INSTITUTE OF MINING AND METALLURGY - 1898

> COAL RESEARCH IN CANADA - 1967*
N. BERKOWITZ, Head, Coal Research Division,

Research Council of Alberta,
Edmonton, A1ta.
* Contribution No. 415 from the Research Council of Alberta. Prepared on behalf of the Canadian Advisory Committee on Coal Research, this Review is one of a series which began to appear annually in the CIM Bulletin in 1964.

THE PAPER WAS SUBMITTED: on July 11, 1968.
KEYWORDS IN THIS PAPER: Carbonization, Petrography Pollution, Desulphurization, Analysis, Storage, Solids Pipelining, Coal Research, Research.
(CIM) BULLETIN FOR AUGUST, 1968

\section*{ABSTRACT}

Developing markets for western mettalurgical coal have continued to stimulate considerable exploration activity in the Rocky Mountain foothills and to influence major segments of a wide-ranging carbonization R\&D program. Adjunct studies have included expanded petrographic investigations.

Coal preparation has been principally directed toward utilization of prepared small coal and was, like much of the year's combustion work, strongly influenced by concern over atmospheric pollution. Particular attention has been given to desulphurization and to the suppression of pollutants in combustion systems.

In the area of non-fuel utilization of coal, interest has centered on plant nutrients and on a series of coal-based carbons which, inter alia, possess utility as filtration media.

Other projects included the development of improved sampling and analytical methods, investigations into the effect of storage on coal properties and R\&D in solids pipelining. In addition, a significant volume of basic "uncommitted" research has been maintained.

\section*{INTRODUCTION}

With expenditures on coal R\&D substantially unchanged from the 1966 level of approximately \(\$ 0.6\) million, no major expansion of the over-all research effort has \(b\) e e n possible. However, in response to industrial needs - largely defined by public concern over pollution and by developing overseas markets for Western Canadian metallurgical coal - some significant program changes have been effected. Also notable is the oil industry's much more active interest in coal and coal processing, which appears in part to be a consequence of last year \({ }^{\dagger}\) s Middle East crisis. Several oil majors have been engaged in coal conversion studies (notably hydrogenation) for many years, and all indications now point to a much heavier commitment in this area, and to a growing number of companies so engaged.

For all practical purposes, coal R\&D is still heavily dominated by government-affiliated agencies. Only two Canadian universities report any coal research activity. Private industry, aside from fin ncially supporting certain beneficiation and carbonization programs in government institutions, continues to center its attention almost entirely on aspects of coal winning. Within the major research centers, however, a significant (and, in this reviewer's opinion, welcome) trend toward more integrated programming - i.e., to programming in which the close inter-relation between the three fossil fuels is more overtly recognized and acted upon - seems to be emerging. Rather than likely to cause a progressive scaling-down of current coal research efforts, this trend could go far toward removing the remaining (quite artificial) barriers between coal, petroleum and natural gas and thus allow better deployment of Canadian fuel science capabilities than the traditional "compartmentalization" permits.

\section*{EXPLORATION AND GEOLOGY}

Spurred by the emergence of major markets for Canadian metallurgical coal, a number of western coal producers - as well as some newcomers to the coal industry - have continued to carry forward vigorous exploration programs in the Rocky Mountain foothills as far north as the Smoky river. With stress now on establishing mineable reserves and coal quality in selected areas, drilling activity was commonly followed up with careful sampling, analysis and beneficiation test programs; and, in some instances, tonnage quantities of prepared coal were also shipped to Japan for coke-making tria1s. No results of these investigations have so far been published, but the measure of success that has evidently accompanied them is indicated by announcements of three long-term coal export contracts and by the disclosure of plans for a \(\$ 3.5-\mathrm{million}\) coal washing plant which Luscar Ltd., Edmonton, intends to errect in the Luscar region. Reportedly in the offing are at least two more contracts for coal export to Japan.

Meanwhile, the Research Council of Albert (RCA) has continued its industry-supported coal survey in the plains regions of Alberta. Unlike exploration activity in the foothills, which seeks to prove up local coal deposits, the RCA program is only intended to detect potentially strippable major coal occurrences, and drilling is therefore carried out on a widely spaced 'grid' - that is, where necessary, it is freely modified to minimize terrain and access problems. The principal effort is currently concentrated in the Grande Prairie area where, in the summer of 1967, some 130 holes with an aggregate depth of \(13,400 \mathrm{ft}\) were drilled and logged. Of the coal showings so far reported, however, most are unpromisingly thin and geologically complex, and it is anticipated that at least two more field seasons will be necessary to complete an assessment of \(t\) he area's coal resources.

In Eastern Canada, the only systematic exploration work has been undertaken by the Nova Scotia Research Foundation (NSRF) in the Pictou coalfield. The objective of this (essentially geophysical) study is elucidation of the basic geology of the region. Plans for extending investigations to a portion of the Mabou coalfields have been deferred.

As a corollary to earlier geological investigations, but also partly in support of present work, the Coal Research Section of the GSC has undertaken some important paleoecological studies. The paleogeography and facies of New Brunswick's Minto coal seam have been examined in depth (1). A detailed study of the petrographic make-up and coking properties of the \(50-\mathrm{ft}\)-thick 'Balmer' or No. 10 seam of British Columbia's Fernie Basin has been completed (2). Also, substantial progress is reported in concurrent investigations of the Fernie Basin's No. 1 seam and of the 11ft -thick No. 4 seam of the Smoky River field. Because variations in coking propensities along or across a seam are, in many instances - as, for example, in the No. 1 seam near Natal, B.C. - connected with variable petrographic compositions rather than with systematic rank changes, petrographic seam profiles are being amplified with more detailed measurements of microlithotype and reflectance changes.

During the summer of 1967, Hacquebard and his associates also surveyed 'uraniferous' Tertiary lignites in southern Saskatchewan. Insitu scintillometer readings were, where warranted, supplemented with laboratory analyses for \(\mathrm{U}_{3} \mathrm{O}_{8}\) but, with the exception of a few specimens collected south of the Frenchman river near Eastend (which showed "above background" scintillometer readings of up to 0.160 millroentgen \(/ \mathrm{hr}\) and yielded ashes containing \(350-650 \mathrm{ppm} \mathrm{U}_{3} \mathrm{O}_{8}\) ), uranium contents were generally negligible. Over-all, the findings confirm the results of earlier GSC surveys.

Finally, both GSC's Hacquebard and RCA's Campbell have continued their respective use of fossil pollen and spores to determine the age of sedimentary rocks and establish seam correlations. A summary of Hacquebard's work on a Permian section near the Tatonduck river (Yukon Territory) and on some ) ower Mississippian type sections of Cape Breton Island has been included in a recent GSC publication (3).

\section*{MINING}

Aside from examining possibilities for the local stripping of metallurgical coal - which private companies did in connection with their exploration work at several sites in the Rocky Mountain foothills - active work was mostly centered on matters related to strata control.

In cooperation with the Mines Branch's Mining Research Centre, Ottawa, the Nova Scotia Research Foundation has thus continued investigations into the deformation of various types of loaded steel arch supports, and made further measurements of minimum pillar sizes necessary for the maintenance of stable transport roadways in mines. The Foundation also completed a program of monitoring level openings of roadways in the Bras d'Or Company's Four Star mine in which a \(300-\mathrm{ft}\) longwall- half carried on Gullick supports and half on Wild supports - is being worked with an Ander-ton-Shearer mining machine fitted with self-advancing hydraulic supports. Similar studies of strata movements have now been initiated in new development areas of the Evans coal mine on Cape Breton's west coast.

The Mining Research Center (MRC) has meanwhile carried forward a cooperative program with two western coal companies in whose mines factors governing the stability of rock bolting are being explored. A1so, in its laboratories, further progress has been made in studies directed toward the development of more meaningful techniques for measuring dust concentrations in mine atmospheres. The experimental methods adopted for that purpose have been briefly described in last year's review (4).

At the University of Alberta's Department of Mining and Metallurgy, Patching is nearing completion of an investigation into the rates (and total quantities) of gas release from selected Western Canadian coals. The results of this study, which are thought to bear on gas outbursts in mines, are being compared with corresponding data for a range of equivalent European coals and will be presented in a graduate thesis before being published elsewhere.

As an aid to significant coal analysis, Visman of the FRC's Western Regional Laboratory, Edmonton, has described an application of general sampling theory which permits advance evaluation of sampling precision (5). The method has now also been published as ASTM method D 2234 ('Sampling coal for coal ash analyses'). A new sampling procedure for float-sink analysis, which has been developed by the Laboratory and should command particular interest in connection with the development of new coal deposits, has also been submitted for consideration as an ASTM standard.

FRC's Solid Fuels Laboratory, Ottawa, has at the same time completed studies in which 'classical' and spectrophotometic techniques of coal ash analysis were compared. Experimental findings are being incorporated into a draft proposal for an ASTM standard. Also drafted was a 'referee' method for determining the total moisture content of coal in cases where established tests yield divergent results.

In response to growing industrial interest in Canadian coking coal, the laboratory further reports having carried out an extensive analytical evaluation of western coals. As in past years, regional laboratories of the FRC have again undertaken sampling and analysis of commercially prepared coals produced at all principal Canadian mines. In Western Canada, this work was accepted by the Western Regional Laboratory, Edmonton; in Eastern Canada, it was carried on by the Coal Resource Evaluation Unit at Glace Bay (which now occupies new quarters at the former Point Edwards Naval Base in Sydney, N.S.). In many instances, routine analyses were supplemented by determinations of washability characteristics.

At the Research Council of Alberta, analytical work has included the development of improved direct titration methods for estimating the concentration of functional groups in coal and coal products; in addition, a simple temperature control for gas chromatographs operating at subambient temperatures has been described (6).

A11 Canadian coal laboratories have once again participated in a cooperative test program designed to ensure the reliability of coal analyses and, through \(\mathrm{FRC}^{\mathrm{t}}\) s Solid Fuels Laboratory, close liaison has been maintained with all relevant working committees of ASTM and ISO.

\section*{TRANSPORTATION}

As noted in last year's review, an agreement between the Department of Industry and a consortium of companies - the latter joined together in the Solids Pipeline Research and Development Association (SPRDA) and the Solids Pipeline Economic Study Associaion (SPESA) - has enabled the Research Council of Alberta to build a 3,600-ft-long, 4-in.-diam. pipeline loop and, in this facility, to test the transmission of rigid capsules and coal-paste slugs on a larger scale than had previously been possible.

The field installation (7) was commissioned in the fall of 1967, and trials in which both water and oil were used as carrier fluids were carried on throughout the winter. The tests were principally concerned with determining the flow characteristics of different capsule (and slug)
configurations at flow velocities of up to \(12 . \mathrm{ft} / \mathrm{sec}\). , and with elucidating the effects of capsule densities and dimensions under various flow regimes. In addition, however, considerable attention was also directed to such matters as capsule fabrication, injection and retrieval, abrasion, pump bypass systems and the behaviour of long capsule or slug 'trains* during extended flow.

A report covering this first phase of the pilot operations, which was completed in March of 1968 , has been submitted to SPRDA-SPESA. (Companion reports, compiled by SPRDA-SPESA consultants, deal with associated engineerings aspects and pipeline economics and are expected, in conjunction with the RCA report, to afford a basis for establishing the scope of a possible Phase II program).

\section*{}

Because weathering of coking coal during storage will freque ntly cause serious deterioration of coking properties, FRC's Metallurgical Fuels Engineering Section has begun a detailed study of oxidation phenomena. Of the two experimental approaches used for this purpose, one involves examination of the loss of dilation upon progressive mild oxidation of the coal, and the second (which attempts to develop a sensitive direct method for detecting coal oxidation) is based on pyrolyzing the coal sample and quantitatively converting all evolved water, CO and \(\mathrm{CO}_{2}\) to carbon monoxide over a suitable catalyst. The laboratory reports that initial oxygen determinations by this latter technique compare favourably with oxygen measurements made on mineral-matter-free coal samples by neutron activation analysis, and has therefore concluded that the method is sufficiently promising to warrant further development.

As an adjunct to studies of weathering, the Metallurgical Fuels Engineering Section has also initiated an investigation into the composition of pyrolysis gases evolved from coking coals after more or less extended low-temperature oxidation.

\section*{PREPARATION}

The Western Regional Laboratory's work on coal cleaning by compound water cyclones and other devices has now reached a stage at which emphasis has shifted to the design of flexible modular beneficiation plants. For this purpose - and partly in response to specific enquiries and industrial problems - the Laboratory has begun to evaluate the performance of jigs, separators, cyclones and tables, and to analyse difficulties posed by such matters as build-up of recirculating slimes. With the enforcement of more stringent polution controls, and in the light of the expected increasingly large production of cleaned metallurgical coal in Western Canada, this aspect of coal beneficiation is thought to require rather more attention than has so far been given to it.

An interesting novel development is the Laboratory's use of computer programs to obtain yields and ash contents at various cutpoints and, in this manner, to facilitate the calculation of plant performance from coal washability characteristics.

The Western Regional Laboratory and FRC's Metallurgical Fuels Engineering Section in Ottawa also report important further progress in coal desulphurization through the use of modified conventional cleaning techniques. Following studies in which pyrite distributions in coal were examined, it has now been established that compound water cyclones can reduce sulphur contents to \(>1\) per cent in the Cape Breton coal studied (cf. Coal Research in Canada, 1966). Equally significant, however, is the confirmation of earlier observations that the moisture contents of cleaned, desulphurized fine coal can, in most cases, be lowered to \(>6\) per cent by adding hydrocarbons (including coke-oven light oils) to the prepared coal and then centrifuging the mixture. It is considered that this procedure eliminates relatively expensive thermal drying processes to which the desulphurized coal would otherwise have to be submitted before it could be charged to coke ovens. The Dominion Coal Board, which has provided financial support for the work and also retained a firm of consulting engineers to keep it under continuous review, has now received proposals for the installation of a semi-commercial pyrite separation unit. If built, this plant also could play a major role in exploiting a potential market for low-iron-content coke which is developing in Newfoundland.

\section*{CARBONIZATION}

FRC's active interest in "spherical agg1omeration", to which reference was made in last year's review, has been carried several steps forward to eventual development in a continuous pilot-plant unit.

In essence, spherical agglomeration represents an attempt to make cleaned and/or desulphurized small coal, which would generally be too finely comminuted for conventional carbonization practices, amenable to commercial coke production. The process accordingly consists of two distinct stages. In the first, a coal"water slurry is balled with coke oven tars or light oils to form low-ash \(1 / 16\) - to \(3 / 16-i n\). spheres with moisture contents between 1 and 3 per cent; in the second, the spheres are hardened by a 'preheat' treatment, which promises to be a feasible method for the preheating of coke oven charges to achieve gains in productivity. The finished product can then either be directly charged into coke ovens or blended with other coals before being charged.

\footnotetext{
Aside from directing some further attention to agglomeration per se, FRC has, therefore, throughout the year under review, carried out 500-1bscale coking tests with blends containing agglomerates; in addition, a number of trials were run in the Laboratory's BM/AGA oven in order to assess the by-product (tar and oil) yields obtainable from the blends. Coke quality of 'conventional' cokes, and roughly 50 per cent of the tars used for coal agglomeration was recovered. A balanced over-all operation, requiring no additional (extraneous) tar, is therefore possible as long as tar consumption for the production of the spheres is held to below 10 per cent. The Laboratory is now engaged in developing a continuous agglomeration pilot unit. The Dominion Coal Board has supported this work as well as related research by the Nova Scotia Research Foundation. The National Research Council (Ottawa) has also conducted related studies.
}

Because of the expected rapid expansion of the coking coal industry of Western Canada, a growing need for petrographic (and related) studies is now manifesting itself, and FRC's Metallurgical Fuels Engineering Section has, accordingly, also devoted considerable attention to these matters. Of particular importance is the Laboratory's observation that the Gray-Shapiro method for predicting coke strength from petrographic measurements on coal - a method which has gained wide use in the United States must be modified when applied to coals containing substantial proportions of granular micrinite. Unlike massive micrinite, which remains esssentially unaltered by low-temperature heat treatment or fuses only slightly (and which will consequently form distinct centers of weakness in a coke), granular micrinite tends to break up into rod-like aggregates at \(440^{\circ} \mathrm{C}\) and to lose its separate identity at \(450^{\circ} \mathrm{C}\). It has consequently been inferred that this coal constituent can make significant positive contributions to coke strength.

Details of these studies - and a discussion of the visual and chemical changes which other coal macerals undergo at elevated temperatures have been presented in a series of papers to the 7 th International Conference on Coal Science (Prague, June, 1968) and are expected to be published later this year.

The Research Council of Alberta has meanwhile further advanced a broad basic study of coal pyrolysis mechanisms. The results of an enquiry into the kinetics of CO and \(\mathrm{CH}_{4}\) evolution from coals at temperatures between \(550^{\circ}\) and \(650^{\circ} \mathrm{C}\) - i.e., at temperatures at which these gases are the only major pyrolysis products - have been published (8); and progress is reported in a similar investigation in which attention centers on the kinetics of tar formation and discharge at \(550^{\circ} \mathrm{C}\). The experimental methods used for this purpose are special adaptations of gas chromatographic techniques which have been described in earlier papers dealing with the program.

A concurrent adjunct study of coking coals at RCA has also provided evidence for the view that chloroform-solubility, which some coal chemists tend to connect with coal plasticity, may not play a direct role in this phenomenon. It has been shown that although mild treatment of a coking coal with boron trifluoride at \(200^{\circ} \mathrm{C}\) will destroy coking properties, it does not measurably affect the quantity and i,r. spectra of the extracts; neither does it alter the i.r. absorption spectra of the reacted residue between 700 and \(900 \mathrm{~cm}^{-1}\), where three 'aromatic bands' have also been regarded as characteristic of coking coals (9).

Industrial carbonization in Canada has been discussed by Botham (10), and Walsh and Drake have recently also offered an outline of the objectives and current activities of the Canadian Carbonization Research Association (11).

\section*{COMBUSTION}

Combustion research, centered at \(\mathrm{FRC}^{\boldsymbol{y}} \mathrm{s}\) Canadian Combustion Research Laboratory, Ottawa, has been heavily influenced by increasing recognition of the need to control atmospheric pollution. Considerable stress has therefore, during 1967, been laid on the design and performance of combustion systems that promise to minimize the formation of \(\mathrm{SO}_{3}, \infty\), unburned hydrocarbons and carbon soot at the source.

Of particular interest, in this connection, is the Laboratory's confirmation of its ear1ier discovery (cf. Coal Research in Canada, 1966) that magnesia-alumina additives can effectively neutralize \(\mathrm{SO}_{3}\) and control the build-up of acid soots. Trials with a 2.5 per cent sulphur-bearing oil, which was burned under a small research-type boiler with 5 per cent \(0_{2}\), in the flue gas, established that such additives will not only neutralize all acid soot and acid condensed on boiler surfaces, but also remove 13 to 30 per cent of all nitrogen oxides, 11 to 19 per cent of a11 \(\mathrm{SO}_{2}\) and 71 to 80 per cent of all \(\mathrm{SO}_{3}\) in the free gas stream (12).

When burning coal, additives appear to be rather less effective; but promising results can, in many cases, be brought about by cations contained within the coal's own ash. During pulverized-fuel test firings of a high-sulphur Eastern Canadian coal, it was thus repeatedly observed that cations in its ash neutralized 74 per cent of total absorbed \(\mathrm{SO}_{3}\) which was analyzed at 640 ppm (13). Further attention to the role of coke ash in combustion and pollution control appears therefore to be fully warranted.

Concurrently with its work on additives, the Combustion Laboratory has also focused attention on the dispersion of combustion gases in the atmosphere and developed a control standard which is intended to assist designers in calculating dust separator efficiencies and stack heights. Publication of this standard is expected shortly.

Investigations into aspects of pulverized coal firing have been mainly concerned with the behaviour of Onakawana (northern Ontario) and Saskatchewan lignites in the Laboratory's research boiler, and have involved detailed analysis of boiler-fouling by the heavy, sintered ash of the Saskatchewan lignite. Somewhat unexpectedly, the Onakawana lignite did not create similar problems, and efforts are now in progress to determine whether this difference is connected with the distinctly different flame characteristics of the two lignites.

With respect to its Dominion Coal Board-supported work on the Wil1-Burt stoker, to which reference was made in last year's review, the Laboratory reports that levelling of the grate - which originally sloped to the rear and promoted wind-rowing - resulted in a significant improvement of the stoker's 'hold firet characteristics. Other design changes involved provision of an automatic coal-fired igniter - a small vibrating grade which burns normal stoker coal and functions as an ignition source during long 'hold fire' periods of the main stoker grate.

Finally, the Combustion Laboratory has commenced the design of a tunnel furnace that will permit more comprehensive research into flame hydrodynamics. It is expected that this unit will become a vital ancillary to further combustion studies.

\section*{NON-FUEL USES}

Long-range basic and applied investigations directed toward the use of coal as a source of chemicals and carbons have again been centered at the Research Council of Alberta, Edmonton, and covered a fairly wide spectrum (ef. Annual Review for 1966).

In connection with a broad study of coal-based nitrogenous plant nutrients (14), it has now been established that products of the coal-ammonia-oxygen reaction (15) are generally incapable of releasing nitrogen to a soil at useful rates. That they are rather effective nitrogen sources (comparable to urea of ammonium nitrate; ref. 14) after further processing with nitric acid and ammoniun hydroxide appears to be mainly due to the fact that such treatment converts a portion of the mineral matter into watersoluble nitrates. From observed plant responses, however, it has also been inferred that these (essentially physical) mixtures of nitrogenenriched coal and inorganic nitrogen source may display synergystic behaviour - i.e., that nitrogen from the enriched coal may become 'available* to soil microorganisms because of the presence of small quantities of ammonium nitrate (or urea). To explore this possibility, and the physical variables of mixtures that govern nitrogen release rates, a carefully planned series of test mixtures has been prepared and is currently undergoing laboratory and greenhouse evaluation. At the same time, attention has been focused on some novel humic acid derivatives that have shown promise in preliminary nitrogen-release measurements and greenhouse tests. The preparation and properties of these substances are currently the subject of more detailed studies.

Further bench-scale work is also reported on the preparation of potentially useful phosphorus-bearing coal derivatives which are under test by the University of Alberta's Department of Soil Science.

Sulphomethylation of coal and coal humic acids (16) has entered active pilot-plant development under the terms of an agreement between a prive sponsor and RCA's Product R\&D Division. Additional performance tests in 1967 have confirmed earlier indications that the sulphomethylated products serve as excellent drilling mud additives and that they might, inter alia, also be of considerable practical value as controls over slurry viscosities.

With respect to coal-based carbons, further work on the utility of sized coke fines as water purification media has now established a clear superiority of coke over conventional sand and gravel beds. A summary of the investigations, which had hitherto only been available in two theses of the University of Alberta's Faculty of Graduate Studies, has been published by Bouthiliier (17). Good progress is also reported in a related Dominion Coal Board-supported study in the University of Waterloo's Department of Chemical Engineering which is concerned with the ability of coal chars to remove dissolved 'chemical oxygen demand' from waste waters.

In order to assess the possible roles of carbons in the processing of raw waters and (liquid and gaseous) industrial effluents, the Research Council of Alberta has also expanded an enquiry into the ion-exchange properties of oxidized (or otherwise chemically treated) coals, and commenced a study of the sorption of acidic organic compounds by carbonaceous solids from aqueous solutions. In the former case, present interests focus on the exchange of water-carried Na and CA against H ; in the latter, special attention is being directed to molecular degradation reactions at carbon surfaces. Both projects are being pursued as long-range investigations.

RCA's high-temperature chemistry work with gas plasmas, to which brief reference was made in last year's review, has mainly centered on metal oxide and chloride reduction reactions; but it is relevant to record that several of these studies have involved the use of carbon electrodes and/or carbon-1ined reaction chambers as sources of reductants.

A study of interactions between carbonaceous solids and dischargegenerated excited hydrogen species - for which the Dominion Coal Board has again provided partial support - has reached the point at which data for reaction kinetics and product distributions can be published. A paper on these topics is in press (18).

19th DOMINION-PROVINCIAL CONFERENCE ON COAL
The annual Dominion-Provincial coal conference was, in 1967, held in conjunction with INDEX \({ }^{\top} 67\) in Regina, Saskatchewan. Papers presented at the conference have been published in \({ }^{\text {t }}\) Index 67 Proceedings \({ }^{\text { }}\) and are, for convenience, also listed in the bibliography appended to this review.

The 20th (1968) conference will be held at the Chateau Frontenac, Quebec City, P.Q., on September 12-13, and will be preceded by a one-day colloquium on 'Coal and Coal Products' which will feature discussion of coal conversion processes and non-fuel uses of coal. An announcement of the colloquium and of its proposed scope has appeared in the CIM Bulletin.

ACKNOWLEDGEMENTS
The reviewer is once again indebted to Messrs. A Brown (Dominion Coal Board), H.D. Smith (Nova Scotia Research Foundation), T.E. Warren (Saskatchewan Research Counci1), H.A. Hacquebard (GSC, Ottawa), J. Visman (Western Regional Laboratory) and T.A. Patching (University of Alberta) for providing notes from which this summary has been compiled. Apologies are extended for any inadvertent omissions.

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\section*{INTRODUCTION AND SLMMARY}
1. Parliament is the most important operation in Canada. Its fatt decisions affect all Canadians and millions of other
 . Obviously, it is essential that Parliamentarians have up-to-date, relevant information, whenever needed.
3.

The Library of Parliament is the only operating agency specifically established to provide information of all kinds, and at all times, to all Federal Parliamentarians.
4. The Parliamentary Librarian is responsible to the Speakers of the two Houses of Parliament assisted by the Joint Committee on the Library of Parliament.
5. The Library of Parliament's three branches, Reference, Research, and Cataloguing, are primarily organized to collect in anticipation of need, organize and store, retrieve, rework (if necessary), and disseminate, the information requested by Parliamentarians.
6. Roughly one-third of the Library's nearly 300,000 volumes are government documents. The remainder are largely in the field of the social sciences and related areas economics, history, law, political economy, and sociology. A rapidly decreasing proportion of the collection is literature, religion, and unwanted books received on copyright deposit.
7. As the National Library has increasingly assumed our older storage function (in addition to its more vital and important roles) the Library of Parliament has been able to improve its services to Parliamentarians. A clipping service was established in 1963, the Research Branch, and Committee indexing in 1965.
8. - 2 tatice for information of a highly technical and purely scientific nature, and there is no need for large-scale duplication.
9. Nevertheless, the Library of Parliament remains free to build its collection to suit the needs of Parliament, and this independence is necessary to its proper function.
10. Because of the quality and accessibility of its collection, the Library of Parliament feels obligated to serve "strangers", when service to Parliamentarians does not prohibit this, and is rewarded in turn by the co-operative assistance of others.
11. The chief future requirement of the Library of Parliament is more space to acconmodate even better and more numerous Research Officers, Librarians, and their assistants.

INTRODUCTION AND SUMMARY continued -
12.
13.
14.

Science and automation presently affect the Library indirectly, but in the near future should offer ad considerable possibilities for improved service. We have requested an outside survey of automation potential to assist us in planning for the future.

The ready availability of material likely to be required is a matter of good judgment, intuition, space, and money. The ability to evaluate the usefulness of material to Parliamentarians, or re-work it into useful form, is a matter of training, experience and judgment, and should be well-rewarded.
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Beyond Parliament, as the Library of Parliament does not work in isolation, the roles of the National Library and the National Science Library should be carefully re-examined together and each clearly assigned a complementary, co-equal role, within its own disciplines. Both National Libraries serve distinctively useful functions.

\footnotetext{

}

1. Adequate, convenient accommodation must be secured for increased numbers of Research Officers, 3van Librarians, and their assistants. This space must be in new buildings on Parliament Hill or immediately adjacent to it if readily available service is to be maintained with little wasted effort. The South side of Wellington Street between Metcalfe and \(0^{\prime}\) Connor should be purchased, and possibly the entire block through to the Mall excluding only a living conmercial façade on the Sparks Street Mall itself. This would, of course, provide adequate room for all Parliamentary activities and ensure that the space problem would not hobble future operations.
2. Provision should be made for higher salaried Research Officers of graduate faculty calibre and Librarians with more specialized training in order to secure the finest quality service to Parliamentarians.
3. Extra funds should be reserved to hire experts for short-term employment or to produce special studies when required. The concentration of "retired brains" in Ottawa would make this most rewarding.

\section*{RECOMMENDATIONS continued-}
4. Consideration might be given to the formation of committees to help develop friendly, effective, and prompt formal co-operation between both Houses of Parliament and the Library of Parliament in the matter of Information Services on Parliament Hill. A Policy Conmittee on Information Services, and a Management Conmittee on Information Services are both recommended. The ultimate goal might well be greater co-ordination for all services.
5. Beyond Parliament, as the Library of Parliament does not work in isolation, the roles of both the National Library and the National Science Library should be carefully re-examined together and each clearly assigned a complementary, co-equal role within its own disciplines.

There should be a greater rationalization of federal government expenditure on Library/Information. The new National Library Act should help in this regard, but careful consideration should also be given to preparing a special National Science Library Act.

\section*{Special Committee}

PART II 2.1 ORGANIZATION
2.1.a. ORGANIZATION OF THE LIBRARY OF PARLIAMENT
(Diagram 2.1.a.) page 7.
2.1.b. PARLIAMENTARY REPORTING CHANNELS

The activities of the Library of Parliament are reported by the Parliamentary Librarian "to both Houses, through Mr. Speaker, at the opening of each session". (Appendix 1, Library of

Parliament Regulations, \#2).

In addition, "The Joint Committee on the Library of Parliament shall meet at the call of the Joint Chairmen at least once in each Session".
(Appendix 1, Library of Parliament Regulations, \#1)
2.1.c. \(\frac{\text { ORGANIZATION OF UNITS RESPONSIBLE FOR }}{}\) SCIENTIFIC ACTIVITIES
(Three diagrams 2.1.c.) pages \(8,9,10\).

\section*{2.1.d. FORMAL AGREEMENTS WITH AGENCIES OUTSIDE CANADA}

These agreements concern the exchange of official and/or scientific publications.
(A) Exchanges of governmental publications, principally parliamentary, between this library and foreign agencies. Many of these agreements were made

Diagram 2.1.a
LIBRARY OF PARLIAMENT


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Diagram 2.1.c
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2.1.c

LIBRARY OF PARLIAMENT REFERENCE BRANCH


Diagram 2.1.c


2.1.d. FORMAL AGREEMENTS WITH AGENCIES OUTSIDE CANADA continuedbefore Confederation or shortly afterwards, and have resulted in a good research collection for study of the development of parliamentary government in the older Commonwealth countries. For example, exchanges with the Australian states and South African provinces began before these colonies united into Federations. (Most of these state/provincial publications have now been transferred to the National Library, however). Exchanges still conducted by the Library of Parliament include those with Australia, Britain, France, New Zealand, the U.S.A., and the Union of South Africa. The shipment of Canadian material is normally done by the Queen's Printer, but some items, like THE CANADIAN PARLIAMENTARY GUIDE are purchased and mailed directly.
(B) Exchanges of scientific material between government (federal and provincial) departments, agencies and institutions in some foreign countries. In these exchanges the Library of Parliament receives bulk shipments and forwards them to individual institutional recipients in Canada. Most of this material is now received from the Institut Danois des Échanges Internationaux (I.D.E.).

\section*{\(\underline{2.2}\) ORGANIZATIONAL FINCTIONS}
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\section*{2.2.a. STATUTORY FUNCTIONS AND PONERS:}

LIBRARY OF PARLIAMENT ACT

The statutory functions and powers of the Library of Parliament derive from its own Act in relation to the Library of Parliament (S.C. 1871, c. 21 - now the Library of Parliament Act. R.S. 1952, c. 166, as amended by S.C. 1955, c. 35. See Appendix 2.)

The Library, as such, was formed initially by the amalgamation of the legislative libraries of Upper and Lower Canada some time after these two provinces were united into the Province of Canada in 1841.

Its functions are not defined by statute except to make it responsible, in the Queen's name, for "all books, paintings, maps, and other effects that are in the joint possession of the Senate and House of Conmons of Canada, or are hereafter added to the existing collection...".
bani (R.S. 1952, c. 166, s.2. Appendix 2). This relatively
al 2tmassive activity, collecting and maintaining, is the only
wath legally defined function of the Library of Parliament.

Fortunately, however, "The Speakers of the two Houses of Parliament, assisted by the joint committee, may, from time to time, make such orders and regulations for the

\section*{2.2.a. STATUTORY FUNCTIONS AND POWERS: \\ LIBRARY OF PARLIAMENT ACT continued-}
government of the Library, ... as to them seem meet, subject to the approval of the two Houses of Parliament." (R.S. 1952, c. 166, s.4. Appendix 2).

Furthermore, 'The Parliamentary Librarian, the Associate Parliamentary Librarian and the other officers and servants of the Library of Parliament are responsible for the faithful discharge of their official duties, as those duties are defined by regulations agreed upon by the Speakers of the two Houses, and concurred in by the joint committee on the Library." (R.S. 1952, c. 166, s.9-as amended by S.C. 1955, c. 35, s. 2. Appendix 2 ) Thus it appears that the functions of the Library of Parliament may be expanded indefinitely to serve the needs of Parliament, or, if need decreases, contracted to the original more passive role.
"The direction and control of the Library of Parliament, and of the officers and servants connected therewith, is vested in the Speaker of the Senate and the Speaker of the House of Commons for the time being, assisted, during each session, by a joint committee

\section*{2.2.a. STATUTORY FUNCTIONS AND POWERS:}

LIBRARY OF PARLIAMENT ACT continued-
to be appointed by the two Houses." R.S. 1952, c. 166,
s. 3. Appendix 2).

The Parliamentary Librarian who "has the rank of a deputy head of a department" has the direct "control and management of the Library" (R.S. 1952, c. 166, S. \(5(2)\), as amended by S.C. 1955, c. 35, s. 1. Appendix 2) under the Speakers of the two Houses and the joint committee on the Library.
2.2.b. ORGANIZATIONAL POLICIES

Our "science policy" is, of course, only a part of our over-all policy of helping Parliamentarians \(\underline{1 /}\) be well-
informed by providing relevant facts and background material to help them perform their duties in a knowledgeable manner.

In order to provide the required printed and other information, special papers, and staff, we:

1/ Broadly speaking, this term includes all those to whom we must lend under our Regulations - "the Governor General, members of the Privy Council, Members of the Senate and of the House of Commons, officers of the two Houses, Justices of the Supreme Court of Canada and of the Exchequer Court, members of the Press Gallery". (Appendix 1 Library of Parliament Regulations \#3).

\section*{2.2.b. ORGANIZATIONAL POLICIES continued-}
- select and acquire materials giving all
facts and opinions likely to be needed;
- organize and maintain this voluminous material for ready availability;
- select and recommend the appointment of qualified staff;
- fight for space to house, and funds to pay for, the staff and materials essential for our work.

The Library of Parliament is organized into three main operational branches:
1. The REFERENCE BRANCH whose professional librarians (assisted by clerks) provide answers to requests for information, select and provide source material for speeches and letters, maintain a vertical file and clipping service, prepare bibliographies, indexes, and abstracts, lend library material, and operate copying facilities;
2. The RESEARCH BRANCH, established in 1965, whose lawyers, economists, and other professional personnel prepare requested research paners and notes for speeches, and provide staff consultation to procedure committees of the House of Commons, parliamentary associations, and individuals;

\section*{2.2.b. ORGANIZATIONAL POLICIES continued-}
3. The CATALOGUE BRANCH whose professional
librarians and assistants order and then organize for use, by established methodical classification and cataloguing procedures, the materials received.

The Library of Parliament's main interest in the field of scientific activities has always been the collection and dissemination of information. Until quite recently the activity most strenuously pursued was the collection and organization of published monographs, serials and official reports. Especially during the Library's earlier years relatively little was done to make the information in these publications more readily accessible. Efforts were made simply to set un requesting and receiving procedures, and after receint, organize materials in such a manner that a document, monograph, or article in a serial could be produced to answer a specific request. As the interests of parliamentarians change, the duties of the library staff also change, and more intensive use is now being made of the collection, aided by such techniques as abstracting, indexing, and photocopying. Paralleling a growing interest in

\section*{2.2.b. ORGANIZATIONAL POLICIES conṭinued-}
science and technology, economics, finance, and world affairs, and a lessening of parliamentary requests relating to literature and history, has come a change in materials added to the library's collection.

The establishment of the National Library and the National Science Library to act as national repositories and to provide national service is making it possible for the Library of Parliament to direct the growth of its collection and to concentrate its services into areas of immediate and continuing interest to Canadian parliamentarians. At the same time, it is possible for the Library of Parliament to use the collections and services of the two National Libraries and the many specialized libraries within government departments in areas of peripheral or highly technical interest in which it would be wasteful to attempt to maintain an independent collection. No single institution can now encompass all fields.

Even in its very early years, while still the Legislative Library of the Province of Canada, the Library was aiding scientific publishing and research. In 1853, for instance,
2.2.b. ORGANIZATIONAL POLICIES continued-
monetary assistance was given to the Journal of the Canadian Institute which published scientific papers, and also directly to a M. Morin who was engaged in copying, in the Paris Archives, various maps relating to the geography of Canada. And in the same year the Library was promised, on exchange, the publications of the Smithsonian Institution. An early instance of the purchase of important and expensive works of science was the 1857 purchase of Audubon's THE BIRDS OF AMERICA and THE QUADRUPEDS OF NORTH AMERICA for \(\$ 1,100\). By 1857, arrangements for the exchange of official documents with the United States had been established and this exchange resulted in the deposit in the Library of many scientific publications.
2.2.c. FUNCTIONS AND RESPONSIBILITIES/

ASSISTANCE TO NON-PARLIAMENTARIANS
1. GENERAL

Because of the quality, size and ready availability of the Library's collection, our Reference Branch sometimes provides substantial assistance to Royal Commissions, government departments, the academic community, and other non-parliamentary groups and individuals when such service does not interfere with parliamentary priority.

\section*{2.2.c. FUNCTIONS AND RESPONSIBILITIES/}

ASSISTANCE TO NON-PARLIAMENTARIANS continued-
2. IN RELATION TO OTHER AGENCIES
(i-iii) Federal Agencies, Industry, Educational Institutions

The Library assists federal employees by providing research materials for use in connection with their work. This is done either by providing individual access to the Library's facilities or by lending material on Inter-Library Loan to the Agency involved. This function can be filled only to the extent it does not interfere with the Library's prime purpose of serving Parliament, of course.

In addition, the Library's internal responsibilities frequently lead to the production of work which is useful to other federal agencies, industry, and educational institutions.

For example, our staff prepared a translation into French of the subject-headings required for our French cardcatalogue. This was published in 1963 as REPERTOIRE DES VEDETTES-MATIERE/SUBJECT HEADINGS USED IN THE FRENCH CATALOGUE, and sold by the Queen's Printer. Similarly, we prepared our own classification scheme for the Library's collection of law materials, and this, too, is used by other libraries.
2.2.c. FUNCTIONS AND RESPONSIBILITIES/

ASSISTANCE TO NON-PARLIAMENTARIANS
2. IN RELATION TO OTHER AGENCIES
(i-iii) Federal Agencies, Industry,
Educational Institutions continued-
The bi-monthly annotated SELECTED ADDITIONS LIST/ LISTE D'ACQUISITIONS RECENTES prepared by the Library's Reference Branch is distributed not only to Senators and Members, but also to the National Library, Canadian provincial legislative libraries, and other selected libraries.

In recent years a number of selected special bibliographies, e.g. CAPITAL PUNISHMENT/LA PEINE DE MORT, CONSUMERS AND CONSUMER PROBLEMS/LE CONSOMMATEUR ET SES PROBLEMES, CRIME AND CRIMINAL JUSTICE/CRIME ET JUSTICE which had been prepared for internal use by the Reference Branch have been made available to other libraries.

Our most recent project is the preparation of detailed indexes to the Minutes of Proceedings of Committees of the Senate and House of Commons of Canada.

The Parliamentary Librarian and his staff have given advice regarding other library matters to denartments and organizations, and have also served as technical advisers on selection boards of the Public Service Commission.

\section*{2.2.c. FUNCTIONS AND RESPONSIBILITIES/}

\section*{ASSISTANCE TO NON-PARLIAMENTARIANS}
2. IN RELATION TO OTHER AGENCIES
(iv) International Representation

The Library of Parliament takes an active interest in such international organizations as the International Federation of Library Associations. For the past three years the Parliamentary Librarian has served as the senior Canadian voting representative to the annual conference of IFLA, and is presently Canadian Correspondent for its Parliamentary and Administrative Libraries. He is also Canadian Correspondent for the Inter-Parliamentary Union's International Centre for Parliamentary Documentation at Geneva.

The Research Branch has also supplied information on Canada for inclusion in the Cormonwealth Parliamentary Association's publication REPORT ON WORLD AFFAIRS
(formerly REPORT ON FOREIGN AFFAIRS). Specialists from the Research Branch have served such organizations as the Commonwealth Parliamentary Association, the Canada-France Parliamentary Association, 1'Association internationale des Parlementaires de langue française, and the InterParliamentary Union by preparing background papers relating to conference items, or articles for publication relating to Canadian affairs, and by providing advisory assistance to their Canadian representatives.

\section*{2.2.c. FUNCTIONS AND RESPONSIBILITIES/}

ASSISTANCE TO NON-PARLIAMENTARIANS
2. IN RELATION TO OTHER AGENCIES
(v) Others
(A) Our relationship with Canadian provincial legislative libraries is particularly good as we return their assistance by providing priority attention to their needs.
(B) The Library is becoming the public's Information Centre for Parliamentary Information. Letters addressed directly to the Library, letters addressed to the House of Commons (formerly answered by the Clerk's Office), and letters to Senators and Members, are either answered directly or the information provided for their answer.

We are listed in the CANADA YEAR BOOK as a source of information under the following entries CONSTITUTION, ELECTIONS, GOVERNMENT, LEGISLATION, and PARLIAMENT. The Senate, and the House of Commons will no longer be listed in future under LEGISLATION and PARLIAMENT.
(C) Library Associations (in Canada)

Librarians on the staff frequently serve as officers or members of the executives of the federal, provincial and

\section*{2.2.c. FUNCTIONS AND RESPONSIBILITIES/}

ASSISTANCE TO NON-PARLIAMENTARIANS
2. IN RELATION TO OTHER AGENCIES
(v) Others
(C) Library Associations (in Canada)
local library associations or of sections of these associations. The Parliamentary Librarian and the Assistant Librarian each served for several years on the Board of the Institute of Professional Librarians of Ontario, and each was President'for a one-year term. Both, also, have served on the Council of the Canadian Library Association, and as Chairmen of Sections or Comnittees, and they and other staff members have assisted in the Association's projects. The Chief Reference Librarian, for example, helped with the preparation of a bibliography of reference works for use in Canadian libraries. A number of staff members have served at different times as members of the Executive of the Library Association of Ottawa, and of the Librarians' Group of the Professional Institute of the Public Service of Canada.

\section*{2.2.d. REVIEW OF EFFECTIVENESS, DUTIES AND GOALS}

Our "operational effectiveness, duties, and goals are reviewed and revised" yearly during the period of budget preparation. In addition, the meetings of the Joint Committee on the Library of Parliament provide a-sounding board for complaints or praise, suggestions or questions. Furthermore, as we serve a small clientele, and are readily accessible to them, improvements may be initiated promptly. The deputy minister status of the Parliamentary Librarian helps as he holds effective administrative power with direct access to his two 'Ministers", the Speaker of the Senate and the Speaker of the House of Commons. The Library budget and significant changes in duties and goals are, of course, approved by both Speakers.

\section*{2.2.e. OUTSIDE STUDIES TO IMPROVE OPERATING PROCEDURES}

The most important study commissioned during the last five years was the ORGANIZATION STUDY OF THE LIBRARY OF PARLIAMENT completed by the Organization Division, Advisory Services Branch, Civil Service Commission, in December, 1964. Its twelve recommendations are attached as Appendix 3. The other study commissioned within this period was CLASSIFICATION SURVEY OF THE LIBRARY OF PARLIAMENT, 2965, and it dealt with each individual staff position at that time.

\section*{2.2.f. RESPONSIBILITIES AND POUFRS IN REIATION TO ACTIVITIES AND PROGRAMMES}

This agency's main responsibility 'helping Senators and Members of Parliament to be well-informed" is somewhat awesome, but fortunately, we do not assume full responsibility for this, and we naturally lack any "powers" to cormel those we serve to use our facilities. Our activities remain low-key though we work to inform Parliamentarians of our services. We write directly to each new Senator on appointment, and each new Member on election, telling him of our services, including samples of our book lists, and our booklet THIS IS YOUR LIBRARY/VOICI VOTRE BIBLIOTHEQUE. Last year, for the first time, we obtained invitations to visit party caucuses and outline our services. This has proved to be the most effective means yet found of establishing contact with both new and experienced Members.

The programme of offering written research assistance to Parliamentarians has been the most significant improvement of service inaugurated since 1960, and was \({ }^{2}\) made possible by the complete freedom of the Parliamentary Librarian in preparing his budget for consideration by the Speakers.

\section*{2.2.f. RESPONSIBILITIES AND POWERS IN RELATION TO}

ACTIVITIES AND PROGRAMMES continued-

Additional activities undertaken since 1960:
the vertical file and clipping service; indexing
of both Senate and House of Commons Conmittee
Proceedings and Reports, Bills, and Ministers'
speeches (when received); more frequent selected
bibliographies; monthly abstracts of periodical articles during the session.

The preparation of Parliament's Centennial Project, compilation in English and in French of a Hansard for both Houses from 1867 to 1874 , the first volumes of which were recently presented to the Governor General, represents another programme underway.

In addition, the acknowledged expertise of certain staff members, particularly in the Research Branch, has made it possible for the staff to offer increased verbal counsel to Parliamentarians.
2.2.g. MAJOR HINDRANCES TO EFFECTIVE PERFORMANCE
"The major hindrances to the effective performance" of our "functions", the honouring of" our 'responsibilities and powers" have been, are, and may continue to be:
2.2.g. MAJOR HINDRANCES TO EFFECTIVE PERFORMANCE
continued-
- lack of adequate, convenient space;
- lack of adequate, expert staff;
- lack of effective policy-making machinery.

In the matter of space (an historic struggle) the only long-term, obvious solution is to build office space on a site overlapping that of the old Supreme Court Building (now two parking lots), or South of Wellington Street (expropriation eventually, why not now?), or on the river bank (an unsightly despoiling of the setting). That more space is needed to enable Parliament to function properly is beyond dispute; that it must be convenient is equally obvious. The need for scientific and other information is urgent and is required in convenient, non-"departmenta1" hours. For this our Library location is ideal, but we need more space for research officers, librarians and clerks, and were only able to obtain temporary space at 10 Metcalfe Street following a personal appeal to the then Minister of Public Works. The South side of Wellington Street between Metcalfe and \(0^{\prime}\) Connor streets should be purchased, and a new Parliamentary office building erected to ensure planned space for all Parliamentary services including the Library.
2.2.g. \(\frac{\text { MAJOR HINDRANCES TO EFFECTIVE PERFORMANCE }}{\text { cont inued- }}\)

Regarding staff, once we have adequate, convenient space, a major recruiting drive should be undertaken to provide even more expert staff; reference librarians with subject specialities and research officers of graduate faculty calibre. This means higher salaries for the people required. For example, the Chief of our Research Branch, an acknowledged authority on Parliament, co-author of AN ENCYCLOPAEDIA OF PARLIAMENT and author of THE OFFICE OF SPEAKER has a top salary of only \(\$ 14,600\).

Our present staff is surprisingly capable, qualified, hard-working, and loyal, for what they are paid, but we need to attract in addition people who can (and have) undertaken original research. We are altogether too dependent on the research of others at present.

Additionally, if this Library is to serve Parliament in the most effective way, it is necessary that a small corps of experts on automation be added to improve library performance, maintain contact with other automated sources of information, and to advise both Houses in this area. Computer expertise is needed on Parliament Hi11, and the logical place for it is in the only central, jointly controlled agency, the Library.

\section*{2.2.g. \(\frac{\text { MAJOR HINDRANCES TO EFFECTIVE PERFORMANCE }}{\text { continued- }}\)}

Regarding effective policy-making, careful consideration should be given to the reconmendations of the 1964 ORGANIZATION STUDY OF THE LIBRARY OF PARLIAMENT regarding the establishment of a Policy Committee on Information Services "to be composed of the Chairman of the Internal Economy Committee of the Senate, the Speaker of the House of Commons and the Parliamentary Librarian, to be chaired by the Speaker of the House of Commons". (Appendix 3, \#3). The recommendation "that a Management Committee on Information Services be established, to be composed of the Clerk of the Senate, the Clerk of the House of Commons and the Parliamentary Librarian, to be chaired by the Parliamentary Librarian". . also deserves careful examination. (Appendix 3, \#4). The body of the organization report explains that the Policy Committee on Information Services "would concern itself with the organizational location of those functions in which the services of the two Houses, on the one hand, and the Library of Parliament, on the other, now have a common interest. These would include the

\section*{2.2.g. MAJOR HINDRANCES TO EFFECTIVE PERFORMANCE}
indexing of Debates, Journals, Committee Reports and Committee Minutes, the provision of research assistance, the provision of reading room facilities and the extension of the clipping service."

The proposed Management Committee on Information Services "would direct the fact-finding required to assist the Policy Conmittee, would make recommendations to it and would direct the implementation of policy decisions."

To help ensure that all three "departments" on Parliament Hill advance equally and knowledgeably in the "utilization" of "recent scientific and technical developments" for scientific (and other) information services, improved co-operation is needed and these two proposed committees or similar ones might prove the answer.

In order to carry out the policies decided upon, administrative efficiency would be improved (especially as the staff expands and quick action becomes more necessary to secure scarce subject-trained librarians and faculty-type research officers) if recommendation \#12

\section*{2.2.g. MAJOR HINDRANCES TO EFFECTIVE PERFORMANCE continued-}
of the organization study of the library or
PARLTAMENT 1964 were accepted. (Appendix 3, \#12).
It reads 'That appointments to staff the Library of Parliament be delegated, both in form and in substance, to the Parliamentary Librarian" because (page 23) "the Parliamentary Librarian is a deputy head and as such should have control....".

\section*{2.2.h. GHANGES IN ORGANIZATIONAL FUNCTION}

The major change in "organization function" recently forecast is the tentative agreement of both Speakers to staff the Library of Parliament, if necessary, with one Research Officer for each committee of the Senate and the House of Commons requiring one in addition to the thirty-five "free" research officers already approved. In short, if the need seems justified, there might within five years be an establishment of some sixty research officers and thirty secretaries to serve Parliamentarians. (At present, March 3, 1969, we have 11 research officers and 5 secretaries in our Research Branch).

\section*{2.2.h. CHANGES IN ORGANIZATIONAL FUNCTION continued-}

Additionally, or in conjunction with this, extra funds should be provided for outside researchers or contract research (when required) as it is obviously cheaper to hire seldom-used specialists for shortterm assignments than to have them on full-time duty.

Another most desirable change would be the organization of the systematic dissemination of information to individual Parliamentarians who have clearly stated their needs. This would consist of the rapid provision of accurate abstracts of articles, theses, books, etc., available in the Library, and would be prepared by the Reference Branch. Careful selection would have to be made here, of course, for it is now generally realized that the problem is not often insufficient information, but too much irrelevant information. The principle was approved, however, when, in our budget for 1965-1966, provision was made for two abstractors, but these became research officers in 1967, as pressure on the Research Branch increased.

Automation, must, of course, be carefully considered, and it is hoped that when the need is clearly identified, the small, but highly trained staff required will be forthcoming, and training provided for all others involved.

\section*{2.2.h. CHANGES IN ORGANIZATIONAL FUNCTION}

Certainly, the Library of Parliament must use science for the benefit of those we serve.

\subsection*{2.3 PERSONNEL POLICIES}
2.3.a. UNIVERSITY RECRUITMENT
1. LIBRARIANS

The Library endeavours to maintain close contact with Canadian Schools of Librarianship. Since there are few schools in Canada and the total number of librarians is not large, it is still possible, through active participation in librarians' organizations and attendance at meetings and conferences, to maintain personal contacts helpful in assessing prospective employees. Since the Library accepts students from Schools of Librarianship for periods of practice work, it is also possible, by this means, to contact and evaluate prospective employees. Furthermore, a number of our staff have lectured both regularly or occasionally at most of the Canadian Schools of Librarianship.

\section*{2.3.a. UNIVERSITY RECRUITMENT continued-}
2. RESFARCH OFFICERS have so far been obtained by direct advertising through the Public Service Conmission and newspapers, and by unsolicited inquiries or applications to staff members, Parliamentarians, academic friends, the Public Service, or in some cases, by direct approach. If any large expansion is undertaken, recruiting visits to universities would likely be increased

\section*{2.3.b. CRITERIA FOR PREDICTION OF RESEARCH ABILITY}

So far, fortunately, all but two of our research officers have had previous related experience.
2.3.c. POTENTIAL AS REFERENCE/RESEARCH ADMINISTRATORS

Performance of new staff members is scrutinized and graded as to originality, work organization, thoroughness, comprehension of objectives, initiative and resourcefulness. Knowledge of work and the ways in which the employee increases knowledge are also considered.

\subsection*{2.3.C. POTENTIAL AS REFERENCE/RESEARCH ADMINISTRATORS continued-}

New professional librarians are given an opportunity to supervise one or more clerical employees in specific areas or tasks, and their responsibilities increase gradually as they become more experienced and demonstrate their ability and interest.
2.3.d. RESEARCH/REFERENCE ADMINISTRATORS and RESEARCHERS/LIBRARIANS

The increasing depth and complexity of the inquiries being received makes it necessary that the professional staff be more specialized. The Research Branch will be employing an increasing number of subject specialists, and the librarians recruited for the Reference Branch should have useful subject specialization in addition to their training as librarians in order that they may provide adequate information and be able to select new materials to be added to the Library \({ }^{\dagger}\) s collection.

At present all senior staff have some administrative responsibility, but as the staff expands it should be possible to pay deserving researchers or specialist

\section*{2.3.d. RESEARCH/REFERENCE ADMINISTRATORS and RESEARCHERS/LIBRARIANS continued-}
librarians salaries equal to those who are research/reference administrators. On Parliament Hill it is not necessary to be an administrator to be well-paid.
2.3.e. INTRAMURAL AND EXTRAMURAL EDUCATION AND TRAINING

The Policy of the Library follows that of the federal government. Educational leave and monetary assistance are provided on the basis of past performance and possible capability, and in accord with the regulations of the Public Service Commission, to professional and other staff members who request them.

Staff members are able to participate in Public Service Commission and other programmes relating to management, finance, developments in automation and data processing, language courses, and speed reading.

In addition, professional staff members also attend seminars, workshops, and conferences held under the auspices of professional associations or universities.

\section*{2.3.e. INTRAMURAL AND EXTRAMURAL EDUCATION \\ AND TRAINING continued-}

Conference participation provides a valuable means for exchanging information, learning new developments, and establishing and maintaining contact with others of the same or related professions. Active participation in professional and 1ibrary organizations is encouraged, and attendance at meetings is arranged whenever reasonable. Conference attendance expenses will be found listed in Table 2.8.4. (page 55)

An important informal means of extramural education for the librarian consists of working visits to other libraries with similar interests. Some of these are enumerated under 2.8.4., and expenses in Table 2.8.4. (page 55)

Insofar as non-professional staff are concerned, those who successfully complete evening courses which further their general education or improve a particular competence, receive partial reimbursement of tuition (T.B. Minute 620135).
2.3.e. INTRAMURAL AND EXTRAMURAL EDUCATION AND TRAINING continued

LANGUAGE COURSES
STAFF MEMBERS ATTENDING PUBLIC SERVICE COMMISSION LANGUAGE COURSES (Beginning in February, 1965)
\(1964 / 65-2\)
\(1965 / 66-2\)
\(1966 / 67-4\)
\(1967 / 68-7\)
\(1968 / 69-11\)

In some cases attendance was for only part of the year, and types of courses varied (1-hour per day; 2-1 \(\frac{1}{2}\) days per week; 3-week inmersion course). In a number of cases staff members attended partly on their free time.
2.5 PERSONNEL ASSOCIATED WITH LIBRARY OF

PARLIAMENT INFORMATION ACTIVITIES (As of December 1, 1968)
2.5.a. CURRENT PERSONNEL ESTABLISHMENT: NUMBER OF PEOPLE ON STRENGTH IN BRACKETS
\begin{tabular}{|c|c|c|c|}
\hline & Scientific \& Professional & Administrative Support & Operational \\
\hline Cataloguing Branch & 7 (7) & 10 (10) & \\
\hline Reference Branch & 10 (10) & 23 (22) & 4 (3) \\
\hline Research Branch & 11 (11) & \(5(6)^{1 /}\) & \\
\hline
\end{tabular}

II One secretary on strength in the Research Branch is occupying a position on the establishment of the Reference Branch until March 31, 1969.

\section*{2.5.b. PROFESSIONAL STAFF ON ADMINISTRATIVE DUTIES \(1 \frac{1}{2}\)}

This figure assumes that the heads of the Cataloguing, Reference, and Research Branches each spend approximately one-half time on administrative duties. It does fiot, obviously, take into account the Parliamentary Librarian, Associate Parliamentary Librarian, Assistant Librarian or Library Administrative Officer.
2.5.c
Bachelor

PROFESSIONAL STAFF OF THE LIBRARY OF PARLIAMENT
AS OF DECEMBER 1, 1968

No. of Professional Staff

16

11

Doctorate
\begin{tabular}{lr}
\multicolumn{1}{l}{ Country } \\
of Birth
\end{tabular}\(\quad\)\begin{tabular}{lr} 
\\
Canada & 14 \\
China & 1 \\
Czechoslovakia & 1 \\
& \\
Canada & 10 \\
Great Britain & 1
\end{tabular}
C

Secondary Education

\section*{Chin}

China
Czechoslovakia

Canada
Great Brita
Canada 8
United States

Morocco

Universit Education

14 Canada
China \& Canada
Great Britain \& Canada

Canada
Great Britain Canada \&
United States
1 Morocco, France \& Canada

PROFESSIONAL STAFF OF THE LIERARY OF PARLIAMENT


TABLE 2.5.d
2.5.d

PROFESSIONAL STAFF - LIBRARY OF PARLIAMENT
AS OF MARCH 31 *
\begin{tabular}{lccccccc} 
& 1962 & 1963 & & 1964 & & 1965 & \\
& 1966 & & 1967 & 1968 \\
Bachelor & 10 & 9 & 11 & 10 & 14 & 14 & 13 \\
Master & 4 & 4 & 5 & 5 & 8 & 9 & 11 \\
Doctorate & 0 & 0 & 0 & 0 & 1 & 1 & 1
\end{tabular}
\begin{tabular}{lrrrrrr} 
& \(\frac{1969}{}\) & \(\frac{1970}{}\) & & 1971 & & 1972 \\
& & \(\frac{1973}{}\) \\
Bachelor & 17 & 17 & & 17 & 17 & 17 \\
Master & 13 & 16 & 19 & 22 & 24 \\
Doctorate & 2 & 2 & 2 & 3 & 3
\end{tabular}
N.B.: It is obviously impossible to forecast the increase accurately because no firm decision has yet been made regarding the provision of research assistance to Parliamentary Committees.
* Table prepared as of December 1, 1968.
2.5.e. PERCENTAGE OF TURNOVER OF PROFESSIONAL STAFF IN EACH OF DEGREE CATEGORIES:
\begin{tabular}{lcccc} 
& \(\frac{\text { Bachelor }}{}\) & \multirow{2}{c}{ Master } & & Doctorate \\
\(1962 / 63\) & \(10 \%\) & 0 & \(\mathrm{~N} / \mathrm{A}\) \\
\(1963 / 64\) & \(30 \%\) & 0 & \(\mathrm{~N} / \mathrm{A}\) \\
\(1964 / 65\) & \(13.6 \%\) & 0 & \(\mathrm{~N} / \mathrm{A}\) \\
\(1965 / 66\) & \(3.6 \%\) & 0 & 0 \\
\(1966 / 67\) & \(21.4 \%\) & 0 & 0 \\
\(1967 / 68\) & \(13.3 \%\) & 0 & 0
\end{tabular}
2.5.f. PERCENTAGE OF PROFESSIONAL STAFF EMPLOYED AT ONE TTME IN:
I. Industry
17.9\%
II. Universities
14.3 \%
III. Provincial Agency

0
IV. Other federal Agency
42.9 9

\subsection*{2.6. EXPENDITURES ASSOCIATED WITH SCIENTIFIC ACTIVITIES}
2.6.a. TOTAL FUNDS BY FUNCTION, DISCIPLINE AND

AREA OF APPLICATION

The only function in which the Library of Parliament spends a measurable proportion of its funds is that of scientific information.

It is not practicable to break down the total expenditures on a scientific discipline basis. Disciplines of primary interest are economics, political science, and sociology. Those of secondary but increasing interest are the agricultural sciences, engineering and technology. Similarly, no financial breakdown on the basis of area of application has been attempted since the Library's prime objective is to provide information to Parliament, and other areas are of secondary and minor importance.

In fact, all but a negligible percentage of the Library's operating funds are expended on "scientific" activities.
2.6.b. OPERATING AND CAPITAL EXPENDITURES BY UNITS

Table 2.6.b. \({ }^{\frac{17}{\prime}}\) gives the operating expenditures of each of the three Branches engaged in the area of information. These expenditures and projected estimates of expenditures

\section*{TABLE 2.6.b.}
I) CATALOGuing branch Reference branch-
i.e. Books, Periodicals (Salaries only) (Salaries only) (Salaries only) \(\qquad\) Microfilms, etc.

1962/63
1963/64
1964/65
1965/66
1966/67
1967/68
1968/69
3/ 1969/70
1970/71
1970/71
1971/72
1972/73 1973/74
\$101, 299
90,343
92,147
98,564
117,413
131,007
138,815
138,815
147,000
156,000
165,000
175,000
185,000
1/2/Catalogu
2/ Estimate
3/ Figures beginning with 1969/70 are estimates. Salary figures have been estimated on the basis of a \(6 \%\) annual increase to cover increments, promotions, and general salary increases. It has been assumed that expansion in number of professional personnel will be confined to the Research Branch.
4/ These figures do not include the salaries of the Parliamentary Librarian, Associate Parliamentary Librarian, Assistant Librarian, and their secretaries, nor the salaries of persons employed in the Library's Administrative Section.
\$ 64,577
60,880
63,966
64,637
73,444
74,854
2/ 82,000
86,000
80,000
90,000
90,000
94,000
94,000
98,000
98,000
100,000
2.6.b. OPERATING AND CAPITAL EXPENDITURES BY UNITS continued-
do not include the expenditures for accormodation, furniture, office supplies and stationery, but do include professional and supporting staff, and the materials of research. Expenditures are for all information activities, not merely those connected with scientific information since, as indicated earlier, these constitute a rapidly increasing sector of the work and the research materials. In 1966, for example, it was estimated that approximately one-quarter of the Library's total collection was-in the fields of economics, political science, pure science, and technology. However, purchases in these fields are increasing steadily while purchases of literature, religion, and philosophy are decreasing. At the same time older and less-used material in these latter fields is being withdrawn and given to the National Library. The proportion of the total budget spent on periodicals of scientific interest has grown from less than one-fifth to somewhat more than one-third during the last five years.

Although not feasible to indicate by a financial breakdown, the Library in several ways supports higher education in Canada, particularly in political science. The Library's

\section*{2.6.b. OPERATING AND CAPITAL EXPENDITURES \\ BY UNITS continued-}
resources are made available for consultation to students and scholars, and material from the collection is available through inter-library loan to other libraries.

In 1966 , a total of 573 volumes were lent to other libraries; in 1967, 545 volumes; in 1968, 365 volumes.

The Library has also made and continues to make a substantial contribution to the building up of research collections of Canadian parliamentary papers in the newer universities. We provide material from a large duplicate collection. During 1966, 970 volumes were provided in this way; during \(1967,1,430\) volumes; during 1968 , 757 volumes.

Some assistance has been provided also to under-developed areas, particularly in the field of library science. During 1966-67, the Parliamentary Librarian of Ceylon gained practical half-time experience in the Library while studying librarianship at the University of Ottawa. Now, one of our Reference Librarians, experienced in government documents, is spending a year at the Library of the University of the West Indies in Jamaica helping to organize their documents collection. Although difficult to quantify, these various services are valuable to other organizations and countries.
2.6.c. FUNDS EXPENDED TO FURTHER PROFESSSIONAL UNIVERSITY EDUCATION OF STAFF

Table 2.6.c. shows the funds expended to cover further professional university education of staff. See also 2.3.c.

TARLE 2.6.c.
Funds Expended on University Education of Staff
\begin{tabular}{rr}
\(1966 / 67\) & \(\$ 3,535.00\) \\
\(1967 / 68\) & 268.00 \\
\(1968 / 69\) & 112.00
\end{tabular}

\subsection*{2.7 RESEARCH POLICIES}
2.7.a. UNITS CONCERNED WITH INTRAMURAL RESFARCH ACTIVITIES
1. As already indicated, the Library of Parliament
has one basic programme - that of obtaining, organizing, retrieving, and (when necessary) re-working the information required and requested by Parliamentarians.

The three Branches directly contributing to this programme engage in projects, some long-term and renetitive, others short-term. Although some selection takes place, projects are primarily initiated by the Library's users or dictated by the necessity to obtain, organize and make optimum use of the Library's resources.
2. Priorities are based on the day-to-day requirements of the Library's users, but requirements vary greatly and unpredictably, and priorities must be flexible enough to allow alteration and modification in response to the
2.7.a. UNITS CONCERNED WITH INTRAMURAL RESEARCH ACTIVITIES 2. Priorities continued-
pressure of demand. Frequently, also, a project will have a.very definite time allowance for its completion, and the production aim has to be realistically related to the time available. Certain continuing projects necessary to maintaining the library's effectiveness can be delayed or temporarily suspended while staff work on urgent requests, but these projects cannot be abandoned entirely. For example, the library's book collection requires systematic examination to ensure that older, little-used material is withdrawn to make space for current purchases. At present staff levels, little of this can now be done during parliamentary sessions. Generally speaking, whenever a new continuing project is being selected, it is necessary to consider the greatest number of users, the known need, and its likelihood of improving staff effectiveness. It is necessary also to determine if there are better services obtainable elsewhere more reasonably and more quickly. There is no point in setting up indexing, abstracting, or current awareness services which are satisfactorily available from cormercial or other sources.

\subsection*{2.8 RESEARCH OUTPUT}

The greater part of the "output" of the three Branches of the Library engaged in "scientific" activities does not lend itself readily to direct measurement.

Muantitative measurement of the output of the Cataloguing Branch, for example, is through the compilation of statistics indicating number of books catalogued and classified, cards prepared and filed. Unfortunately, this is no real indication of effective performance as the effectiveness of the Catalogue can only be measured by its directing researchers quickly to the material they require.

Similarly, a large proportion of the "output" of the Reference Branch is ephemeral in nature, consisting of answers to specific inquiries, provided verbally or by the provision of printed source material. However, a number of special bibliographies of continuing use internally and to other libraries have been prepared, and a list of the more important appears in Table 2.8.8. \({ }^{\frac{1 /}{\prime}}\) Table 2.8.8. also lists some reference compilations which are of continuing use to researchers.

Of the queries received by the Reference Branch during November, 1968 , over \(80 \%\) of those requiring considerable 17 pages 56-57
research were in economics, political science or science and technology, while from \(50 \%-60 \%\) of the shorter, information-type queries belonged to these
fields. At least \(90 \%\) of the inquiries received by
the rapidly expanding Vertical File and Clipping
Service are estimated to be of a "scientific" nature.
2.8.2 BOOKS OR JOURNAL ARTICLES ARISING FROM

RESEARCH ACTIVITIES

Canada. Library of Parliament. Research Branch. THE CANADIAN WHEAT BOARD: ORDERLY MARKETING OF CANADIAN GRAIN. Printed in the Minutes of Proceedings and Evidence of the House of Commons Standing Committee on Agriculture, Forestry and Rural Development, No. 27, Appendix 1, 1st Session, 27th Parliament, Feb. 5, 1967. p. 1034-1037.

Canada. Library of Parliament. Research Branch. CRIMINAL INSANITY (FROM M'NAGHTEXN TO DURHAM). Printed in the Minutes of Proceedings and Evidence of the House of Conmons Standing Committee on Justice and Legal Affairs, No. 19, Appendix 12, 1st Session, 27th Parliament, Nov. 29, 1966. p. 673-687.

Canada. Library of Parliament. Research Branch. GOD SAVE THE QUEEN. Paper prepared by the Research Branch and presented by the Parliamentary Librarian before the Special Joint Committee of the Senate and the House of Commons on the National and Royal Anthems, March 2, 1967. No. 1, 2nd Session, 27th Parliament, June 8 and October 5, 1967. p. 11-16.
2.8.2. BOOKS OR JOUTRNAL ARTICLES ARISING FROM

RESEARCH ACTIVITIES continued -

IMMARIGEON, H. LA RESPONSABILITE EXTRA-CONTRACTUELLE DE LA COURONNE AU CANADA* Montréal, Wilson \& Lafleur, 1965. (forthcoming publications include a chapter dealing with liability 'in tort' in DPOIT ADMINISTRATIF CANADIEN ET QUEBECOIS, and a chapter LES FRONTIERES DE LA PROVINCE DE QUEBEC to be included in a book sponsored by the University of Montreal's Institute of Public Law).

LAUNDIY, P. A. C. ENCYCLOPAEDIA OF PARLIAMENT* (in collaboration with Norman Wilding). 3d rev. ed., N.Y., Praeger, 1968. 912 p .

LAUNI)Y, P. A. C. THE OFFTCF OF SPEAKER* London, Casse11, 1964. 488 p.

LAUNITY, P. A. C. Canada's Speakership Attains Independence. THE PARLIAMENTARIAN 49:72-75 Jan. 7.969.

LAINNY, P. A. C. Procedural Reform in the Canadian House of Commons. THE TABLE \(34: 20-301965\).

LAUNDY, P. A. C. Procedural Reform in the Canadian House of Commons. CONSTITUTIONAL AND PARLIAMENTARY INFORMATTON 3rd ser. 49-62 Apr. 1966.

SPICER, E. J. Report to C.L.A. On Need For Professional Librarians 1962-1967/Rapport présenté à 1'A.C.B. sur le besoin de bibliothécaires au Canada. CANADIAN LIBRARY 17:158-165 Jan. 1964.

\footnotetext{
* The "research activities" leading to these publications were personal, of course, and preceded appointment to the Library of Parliament staff.
}

\section*{TABLE 2.8.3.}

\section*{LIBRARY OF PARLIAMENT - RESEARCH BRANCH}

SUBJECT ANALYSIS OF PAPERS PREPARED
\begin{tabular}{lrrrr} 
& 1965 & 1966 & 1967 & 1968 \\
\cline { 2 - 3 } Agriculture & & 2 & 5 & 6 \\
Civil Law & & 8 & & 3 \\
Constitutional Law & 1 & 33 & 21 & 34 \\
Economics & 3 & 1 & 3 & 2 \\
Education & & 5 & 12 & 7 \\
External Affairs & 5 & 12 & 22 & 20 \\
General & & 6 & 3 & 5 \\
Health & & 2 & 13 & 2 \\
History & 31 & 27 & 14 \\
Other Legal projects & 7 & 22 & 22 & 22 \\
Parliamentary Procedure & 7 & 25 & 19 & 29 \\
Political Science & & 28 & 16 & 3 \\
Public Administration & & & & 7 \\
Science & & 6 & 6 & 1 \\
Science Policy & & 4 & 13 & 10 \\
Social Science & 3 & 1 & & \\
Technology & & & 189 & 200 \\
\hline
\end{tabular}

EXAMPLES OF PAPERS PREPARED BY RESEARCH BRANCH
Water Pollution Control: Summary of Current Federal \&
Provincial Programmes
Development of Nuclear Power in Canada
Health Insurance in Canada
Abortion
Homosexuality
State Lotteries
2.8 .3
2.8 .4

REPORTS

Table 2.8.3 indicates by subject area, the research papers prepared during the years \(1965-68\) by the staff of the Research Branch. In the same table will be found a listing by title of some of the more widely used research papers. (page 53)

CONFERENCES

Participation in seminars and study groups at Conferences is an important way in which professional personnel may learn of recent developments in their professions and exchange ideas with their fellows. A related manner for

\section*{.8.4 CONFERENCES continued}
informal education of professional staff is by visits (exchange or one way) to institutions engaged in similar activities. During the past five years these include the Library of Congress, Washington, the libraries of the House of Conmons and House of Lords, London, the libraries of the Senate and Chamber of Deputies, Paris, and the provincial legislative libraries in Canada.
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(See also 2.3.e.)

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Table 2.8.4. indicates the expenses on conference participation, and in working visits to other libraries during the current and preceding five fiscal years.

\section*{TABLE 2.8.4.}

MONEY EXPENDED ON CONFERENCE PARTICIPATION
\begin{tabular}{cc}
\hline AND VISITS TO OTHER LIBRARIES \\
\hline \(1963-64\) & \(\$ 707.27\) \\
\(1964-65\) & \(\$ 1,110.90\) \\
\(1965-66\) & \(\$ 1,403.62\) \\
\(1966-67\) & \(\$ 1,542.70\) \\
\(1967-68\) & \(\$ 816.08\) \\
\(1968-69\) & \(\$ 1,315.21^{*}\)
\end{tabular}
* to February 15, 1969

1962 - Oct. BACKGROUND TO PARLIAMENT/LE DOMAINE PARLEMENTAIRE. 17 p .

1963 - Aug. CANADIAN DUALISM/LA DUALITE' CANADIENNE 3 p.
- Nov. SELECT BIBLIOGRAPHY ON PROCEDURE/ SÉLECTION BIBLIOGRAPHIQUE SUR PROCEDURE. 7 p .

1965 - Feb. HEALTH INSURANCE/ASSURANCE-SANTÉ. 14 p.
- Mar. CAPITAL PUNISHMENT/LA PEINE DE MORT. 10 p. (also published in Canada. Dept. Justice. CAPITAL PUNISHMENT: MATERIAL RELATING TO ITS PURPOSE AND VALUE. 1965. p. 136-141.)
- May SELECT BIBLIOGRAPHY ON PARLIAMENTARY PROCEDURE/ BIBLIOGRAPHIE SÉLECTIVE SUR LA PROCEDURE PARLEMENTATRE. 29 p.
- Oct. CANADIAN BOOKS, PAMPHLETS AND DOCUMENTS ON GERONTOLOGY/OUVRAGES CANADIENS SUR LA GERONTOLOGIE. (This appeared also as part of Canadian Library Association Occasional Paper No. 64)

1966 - Mar. BACKGROUND TO PARLIAMENT/LE DOMAINE PARLEMENTAIRE. 35 p .
- Mar. CAPITAL PUNISHMENT (Supplement) / LA PEINE DE MORT (Supplément) 3 p.
- Oct. inflation 5 p.

1967 - Mar. ELECTIONS. 27 p.
- Apr. CRIME AND CRTMINAL JUSTICE/CRIME ET JUSTICE. 25 p .
- July THE CABINET MINISTER AND ADMINISTRATION. 5 p.


\subsection*{2.9 PROUECTS}
2.9.1. The titles or brief descriptions of projects requested in this section have already been largely given in Tables 2.8.2. 2.8.3., and 2.8.8. It seems redundant to repeat them here.

Briefly, however, the Cataloguing Branch main project of cataloguing has continued, and from 1962 to 1967, inclusive, some 88,370 books, periodicals, and other items have been processed, some 564,220 cards added to the separate French and English catalogues.

The work of the Reference Branch has been shown sufficiently, and it would obviously be onerous to list the questions asked and answers given.

The work of the Research Branch is, of course, like that of the Reference Branch, almost entirely confidential, but elaboration is given in 2.9.2.
2.9.2 SELECTED SPECIAL PROJECTS OF THE RESEARCH BRANCH Perhans the "most significant" though necessarily uncompleted project of the last five years concerns work on parliamentary procedure, and work with Parliamentary Associations.


\subsection*{2.9.2. SELECTED SPECIAL PROJECTS OF THE RESEARCH BRANCH continued-}
1. WORK WITH HOUSE OF COMMONS COMMITTEES ON PROCEDURE

The Chief of the Research Branch has assisted various Procedure Committees in a secretarial and advisory capacity since 1964.

In the Second Session of the 26th Parliament (1964 to 1965), he was attached to the Special Committee on Procedure and Organization whose recommendations gave rise to a number of procedural changes on a provisional basis.

In the Second Session of the 27th Parliament (1966 to 1967), he was attached to the Special Committee on Procedures of the House. This Conmittee was re-established in the Third Session of the same Parliament (1967 to 1968), and the Chief of the Research Branch accompanied the Committee on a visit to London, England, in February, 1968, which was made for the purpose of studying the procedures of the House of Conmons at Westminster.

During the First Session of the 28th Parliament, he assisted the Special Cormittee on Procedure of the House which submitted reports in December, 1968, which led to the adoption on a permanent basis of far-reaching procedural changes
2.9.2. \(\frac{\text { SEIECTED SPECIAL PROJECTS OF THE RESEARCH BRANCH }}{1 . \frac{\text { Work With House of Conmons Comnittees on }}{\text { Procedure continued - }}}\)
by the House of Cormons. The reports of this Conmittee reflected the experience gained by the previous Connittee during the Westminster visit.

This continuing project relating to the Reform of Parliamentary Procedures is an example of the substantial results to which the work of the Research Branch may lead.

\section*{2. WORK WITH PARLIAMENTARY ASSOCIATIONS}

Since the establishment of the Research Branch, the service to both Houses of Parliament has included assistance to delegations attending international and national Parliamentary conferences. This assistance has taken two distinct forms: the preparation of research papers relating to the various items on the agenda of such conferences; direct participation on the part of research officers in Parliamentary delegations in a secretarial and advisory capacity.

For example:

During the 12th Conference of the Commonwealth Parliamentary Association, Ottawa, September, 1966, the Chief of the Research Branch acted as Secretary to a

\subsection*{2.9.2. SELECTED SPECIAL PROJECTS OF THE RESEARCH BRANCH \\ 2. Work With Parliamentary Associations continued-}

Conference of Commonwealth Speakers and presiding officers, and prepared the report arising from that conference.

In April, 1967, he attended the Spring meeting of the Inter-Parliamentary Union in Majorca and assisted the Canadian delegation in a secretarial capacity. On his return to Ottawa, he reported to the Speaker of the House of Commons on the results of the Conference.

In July, 1968, he attended the Canadian Area Council Meeting of the Commonwealth Parliamentary Association in Ottawa: in September, the subsequent Canadian Area Conference in British Columbia. During these meetings the question of research service to Members of Parliament was one of the main items on the agenda. The Chief of the Research Branch prepared a paper on this subject which was discussed at both conferences. He introduced the paper and answered questions directed to him by delegates. In British Columbia, he also presented a paper on the REFORM OF FINANCIAL PROCEDURE and initiated the discussion on this topic.

In December, 1968, the Chief of the Research Branch went to London, England, on behalf of the Speaker of the House of

\subsection*{2.9.2. SELECTED SPECIAL PROJECTS OF THE RESEARCH BRANCH 2. Work With Parliamentary Associations continued- \\ Commons for discussions at Westminster relating to the forthcoming conference of Commonwealth Speakers and Presiding Officers to be held in Ottawa in September, 1969. The Chief of the Research Branch will be responsible for the secretarial organization of the Conference, and the preparation of the Conference Report. \\ In addition, a Research Officer acts as secretary to the Canadian Sections of the following two Interparliamentary associations: 1'Association internationale des Parlementaires de langue française and 1'Association interparlementaire Canada-France. Duties involve correspondence, preparation of meetings, and drafting of reports following such meetings.}

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\subsection*{2.10 THE FUIURE}
2.10.1 POSSIBLE EFFECTS OF TECHNOLOGICAL CHANGES likely to affect our "operations, functions, and responsibilities" during the next five years are primarily those directly affecting other sources of information beyond our own collection. For example, if the National Library promptly and effectively catalogues all federal government publications prior to issue (which is possible), and if the same can be done for provincial publications (which is unlikely), then our cataloguing staff may be reduced and the office space thus freed made available to research officers. If cataloguing in advance of publication became general for all publications within ten years, and if other advances are made, then the space made available within the library for research officers could be significant.

Within the next ten years, as more relevant material becomes available in computer banks, through facsimile transfer, and/or through miniaturization, more space should be released for staff rather than books. It may become unnecessary for us to maintain periodical files; articles may be analyzed, abstracted, and placed in a
2.10 .1 POSSIBLE EFFECTS OF TECHNOLOGICAL CHANGES continued-
computer memory when published by a commercial (or government) service, and any required article retrieved here in print-out form.
Generally speaking, the application of computer technology to indexing, abstracting and cataloguing operations should speed up and generally facilitate literature and information searches. Files of Law reports may become unnecessary if they are indexed as issued and stored in a computer installation. This may develop fairly soon as law is a well-defined field with repetitive and time-consuming, but most necessary, searching.
In time, the importance of well-chosen, well-trained staff may increase over the importance of well-chosen, well-organized materials, if instant availability is assured from remote locations.

\subsection*{2.10.2 STUDIES OF POSSIBLE AUTOMATED IMPROVEMENTS}
At the next to last meeting of the Joint Committee on the Library of Parliament (November 19, 1968), the Parliamentary Librarian proposed a preliminary study "to determine what system, if any, should be installed to improve the abstracting, indexing, storing, and retrieval

\subsection*{2.10.2 STUDIES OF POSSIBLE AUTOMATED IMPROVEMENTS \\ of information, and to provide a rough estimate of the costs of any progranme recommended", but this was referred back to him for further information. Final approval to proceed was given by the Joint Committee February 26, 1969, and the survey should be well underway by the time this brief is received.}

\subsection*{2.10.3 TECHNICAL/SCIENTIFIC ADVICE SOUGHT DURING THE LAST FIVE YEARS}

Much reading has been done by the Parliamentary Librarian and his staff, meetings have been attended, and short courses on automation have been taken by professional librarians in the Cataloguing and Reference Branches.

One staff member has completed her Master's Degree at the University of Toronto Library School with a thesis entitled RECORDS AND PROCEDURES IN THE TECHNICAL SERVICES DEPARTMENT OF THE LIBRARY OF PARLIAMENT.

Discussions were held with Mr. K. J. Radford, then Director of the federal government's Central Data Processing Service Bureau, and also with representatives of the IBM company who kindly arranged two very interesting demonstrations with their SDI system which some staff but few Members of Parliament attended. Some four years were spent working with IBM representatives to prepare a demonstration to be held in the Library, but initial information was incorrect, and the project was suspended early in 1968.

\subsection*{2.10.3 TECHNICAL/SCIENTIFIC ADVICE. SOUGHT DURING THE LAST FIVE YEARS continued-}

The Assistant Librarian went to Queen's University, a3. Kingston, for the conference on Computers and the Law Imaid in June, 1968, and the Parliamentary Librarian to a 551 Toronto symposium on Microfilm and the Law, November, 1968. 4.nrow The Assistant Librarian also attended a Data Processing Conference in Ottawa, February, 1969.

\subsection*{2.10.4 FUIURE PLANS TO UTILIZE RECENT SCIENTIFIC/} TECHNICAL DEVELOPMENT
ancturd Any plans for the future await the preliminary survey Trod of the areas in which automation may usefully be introduced on the Hill, and must not be limited to the


5062 It is also hoped that a senior automation expert will baltilu bl be appointed to the Library to help improve its utilization of these methods, its contacts with other automated sources of information, and to serve both Houses in an advisory capacity.


LIBRARY OF PARLIAMENT

\section*{REGUIATIONS}
\[
\begin{aligned}
& \text { Adopted by the Joint Committee on the Library of Parliament } \\
& \text { December } 21,1967 \text {, and approved by the Senate February } 14 \text {, } \\
& 1968 \text {, and the House of Commons February } 16,1968 \text {. }
\end{aligned}
\]
1. The Joint Committee on the Library of Parliament shall meet at the call of the Joint Chairmen at least once in each Session.
2. The Parliamentary Librarian shall report the state of the Library to both Houses, through Mr. Speaker, at the opening of each Session.
3. Persons entitled to horrow books from the Library are the fovernor General, Members of the Privy Council, Members of the Senate and of the House of Commons, officers of the two Houses, Justices of the Supreme Court of Canada and of the Exchequer Court, members of the Press fallery, and other persons in accordance with the written authorization of either Speaker or of the Parliamentary Librarian.
4. The Library of Parliament may lend books to other libraries, and to government agencies, at the discretion of the Parliamentary Librarian.
5. An adult member of the public authorized by a Senator, a Member of the House of Commons, or the Parliamentary Librarian, may consult books and periodicals in the Library, but shall not be allowed to borrow them.
6. Use of the Library's main Reading Room beyond normal working hours may be granted in writing to certain individuals at the discretion of the Parliamentary Librarian.
7. Excent with the written approval of either Speaker, or of the Parliamentary Librarian, books of special value may not be removed from the Library.
8. During the Session the Library shall be open as follows:

Mondays, Tuesdays and Thursdays, from 9 in the morning until son foren and the House rises in the evening;
Wednesdays and Fridays, from 9 in the morning until 9 in the evening;
Saturdays, from 9.30 in the morning until 5 in the afternoon.
When the House sits in the evening on Wednesdays, Fridays or Saturdays, the Library shall remain open until the House rises.
9. During the Recess of Parliament, the Library shall open, Monday through Friday (holidays excepted), not later than 9.30 in the morning, and shall close not earlier than 4 in the afternoon.
10. The Reading Room of the House of Conmons shall be open during the same hours as the Library of Parliament, with the exception that, during the Session, it shall be open on Sundays from 12 to 4 in the afternoon.

December 21, 1967.


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\section*{CHAPTER 166.}

An Act respecting the Library of Parliament.

SHORT TITLE.
1. This Act may be cited as the Library of Parliament short title. Act. R.S., c. 146, s. 1.
2. All books, paintings, maps, and other effects that are Books, ete., in the joint possession of the Senate and House of Com- vested in mons of Canada, or are hereafter added to the existing col- Majesty. lection, are vested in Her Majesty, for the use of both Houses of Parliament, and shall be kept in a suitable portion of the Parliament buildings appropriated for that purpose. R.S., c. 146, s. 2.
3. The direction and control of the Library of Parlia- Adminment, and of the officers and servants connected therewith, istration. is vested in the Speaker of the Senate and the Speaker of the House of Commons for the time being, assisted, during each session, by a joint committee to be appointed by the two Houses. R.S., c. 146, s. 3.
4. The Speakers of the two Houses of Parliament, Regulatious. assisted by the joint committee, may, from time to time, make such orders and regulations for the government of the Library, and for the proper expenditure of moneys voted by Parliament for the purchase of books, maps or other articles to be deposited therein, as to them seem meet, subject to the approval of the two Houses of Parliament. R.S., c. 146, s. 4.
5. (1) There shall be two librarians, one of whom shall Librarians be called the General Librarian and the other of whom shall be called the Parliamentary Librarian, who shall be appointed by joint commission under the Great Seal as Librarians of Parliament to hold office during pleasure.
(2) The librarians each have the rank of a deputy Rank of head of a department with equal powers as respects the Librarians. control and management of the Library. R.S., c. 146, s. 5.

\section*{2 Chap. 166. Library of Parliament.}

Officers and servants, appointment of.
6. Such other officers, clerks and servants as are authorized by law and requisite for the service of the Library may be appointed in the manner prescribed by law to hold office during pleasure. R.S., c. 146, s. 6.

Salaries.

How paid.

Responsibilities of officers and servants.

Stationery. 10. The supply of stationery required for the use of the Library shall be furnished by the Department of Public Printing and Stationery, and charged to the Houses of Parliament. R.S., c. 146, s. 10.

EDMOND CLOUTIER, C.M.G., O.A., D.S.P. QUEEN'S PRINTER AND CONTROLLER OF STATIONERY OTTAWA, 1952

\section*{APPENDIX 2}

\section*{3-4 ELIZABETH II.}

CHAP. 35.

An Act to amend the Library of Parliament Act.
[Assented to 28th June, 1955.]
HER Majesty, by and with the advice and consent of the r.s. o. 100.
Senate and House of Commons of Canada, enacts as follows:
1. Section 5 of the Library of Parliament Act, chapter 166 of the Revised Statutes of Canada, 1952, is repealed and the following substituted therefor:
"§. (1) The Governor in Council may by commission Librarian. under the Great Seal appoint a Parliamentary Librarian to hold office during pleasure.
(2) The Parliamentary Librarian has the rank of a deputy Rank and head of a department and, subject to section 3, has the con- dutios. trol and management of the Library.
(3) The Governor in Council may by commission under Aseociate the Great Seal appoint an Associate Parliamentary librarian. Librarian to hold office during pleasure who, in addition to any duties defined in respect of his office under section 9 , shall execute and perform the duties and functions of Parliamentary Librarian during his absence, illness or other incapacity or during a vacancy in the office of Parliamentary Librarian."
2. Section 9 of the said Act is repealed and the following substituted therefor:
"9. The Parliamentary Librarian, the Associate Parliar Dutirs of mentary Librarian and the other officers and servants of the librarians Library of Parliament are responsible for the faithful dis- and otaf. charge of their official duties, as those duties are defined by regulations agreed upon by the Speakers of the two Houses, and concurred in by the joint committee on the Library."
3. Paragraph (c) of subsection (1) of section 2 of the Civil Serrioe Civil Service Act, chapter 48 of the Revised Statutes of \(4 d\).

Canada, 1952, is amended by striking out the expression "Librarians of Parliament" and substituting the expression "Parliamentary Librarian" therefor.

Coming into loroe.
4. This Act shall come into force when a vacancy in the office of either the General Librarian or Parliamentary Librarian under the Library of Parliament Act first occurs after the passing of this Act, and the General Librarian or Parliamentary Librarian, as the case may be, then in office, shall be deemed to have been appointed Parliamentary Librarian under the Library of Parliament Act as amended by this Act.

\section*{APPENDIX 3}

\title{
ORGANIZATION STUDY \\ OF THE \\ LIBRARY OF PARLIAMENT
}

Decembar, 1964

ORGANIZATION DIVISION, ADVISORY SERVICES BRANCH, CIVIL SERVICE COMMISSION

\section*{LIST OF RECOMMENDATIONS}
Page
I. That the Speaker of the Senate and the Speaker of the House of Commons continue to act as joint chairmen of the Joint Committee, each with the
power to call a meeting on his own initiative.

6
2. That the Speaker of the House of Commons be designated as the executive head to whom the Parliamentary Librarian would report on the implementation of policy and on the administrative decisions taken with in the approved budget.

6
3. That a Policy Committee on Information Services be established to be composed of the Chairman of the Internal Economy Committee of the Senate, the Speaker of the House of Commons and the Parliamentary Librarian, to be chaired by the Speaker of the House of Commons.
4. That a Management Committee on Information Services be established, to be composed of the Clerk of the Senate, the Clerk of the House of Commons and the Parliamentary Librarian, to be chaired by the Parliamentary Librarian.
5. That the proposed Policy Committee on Information Services consider the establishment of a single Reading Room in the Library of Parl lament to serve members of both Houses.
6. That the proposed Policy Committee on Information Services consider the establishment of a single indexing service so that references to the content of all parliamentary papers will be prepared with equal efficiency for the use of members of the Senate and the House of Commons.
7. That negotiations respecting the establishment of a Central Indexing Service take place on the understanding that the unit will be located in a jointly-controlled agency, the Library of Parliament.
Page
8. That if a decision is taken to establish a Central Indexing Service, a study be requested of the Management Analys is Division of the Civil Service Commission to determine the most efficient mechanical processes by which the indexes can be reproduced. ..... 13
9. That the questions of if, how and where researchassistance should be provided for members of thetwo Houses be decided, after due consultation,by the proposed Policy Committee on InformationServices, and that these decisions be implementedby the proposed Management Committee onInformation Services.14
10. That the proposed Management Committee on Information Services ascertain the space require- ments of the Library of Parliament and make recommendations thereon to the Policy Committee. ..... 22
II. That the Parliamentary Librarian request advice from the Management Analysis Division on procedures for processing newspaper subscriptions and book invoices. ..... 22
12. That appointments to staff the Library of Parl iament be delegated, both in form and in substance, to the Parliamentary Librarian. ..... 23

Brief from the Public Archives of Canada
to the Senate Special Committee on Science Policy

\begin{abstract}
Although the Public Archives of Canada is not essentially a research institution its relationship with historical research is so close that it seems worth while to indicate to your Committee the nature of its activities. The major functions of the Public Archives - the acquisition of material which provides the basis for research, the classification and preparation of finding aids which makes it accessible, and the provision of reference services and research facilities - can be considered as essential support for research in history, political science and other disciplines.
\end{abstract}

Under the Public Archives Act, the Dominion Archivist has the care, custody and control of the Public Archives, which are defined as "public records, documents and other historical material of every kind, nature and description". Actually, the Public Archives has a dual role: 1) as an agency which provides services to the Government of Canada in regard to its own records and 2) as an agency which ensures the preservation of research material and provides reference services and facilities for research. The essential unity of paperwork management - for current and dormant records and archives - is generally recognized. The financial savings which result from the records management programme, including records centres and central microfilm services, offsets the cost of the conventional archival programme which is directly related to research.

The functions of the Public Archives are carried out by three branches. The Administration and Technical Services Branch, in addition to providing for the administrative and material requirements of the department, looks after the preservation, restoration and copying of documents of all kinds in the custody of the Public Archives. It includes a Central Microfilm Unit for the Government of Canada and provides advisory services in regard to microfilm. The Records Management Branch has a wide range of activities which are designed to improve the efficiency and economy of records management in the government under the authority of the Public Records Order of 1966. They include storage and reference services for dormant records in a central and regional records centres, advisory services, training and reports on the adequacy of classification, scheduling and provision for the selection of records which have value for research. The Historical Branch with its four divisions dealing respectively with manuscripts, maps, pictures and printed material provides for the acquisition and selection of documents, arranges and describes them, makes them available to qualified researchers and provides information in response to inquiries directed to the Public Archives. In addition, small offices in London and Paris are engaged in the location, acquisition and copying of archival material relating to Canada in Great Britain and France. Finally, a publication section looks after the publication of inventories, guides and selected documents. The functions of the Historical Branch, the London and Paris offices and the Publication Section
tend to provide researchers with the documentary material relating to Canadian history which they require and the tools (research rooms, finding aids, photoduplication, etc.) which facilitates their work.

At present the budget of the Public Archives is approximately \(\$ 2,250,000\), of which about \(\$ 300,000\) is spent for services to the National Library; two-thirds of the remainder is devoted to the archival program and related administrative costs, and one-third to the records management program, including related administrative costs. The total staff of the Public Archives is 278, of whom approximately 50 are classified as Historical Research Officers. About half of them have the degree of B.A. with Honours in History, the remainder hold a licence, M.A. or Ph.D. In recent years increases in staff and budget have been necessary because of
1. Unprecedented increases in research requirements. Registration of researchers, circulation of material, written inquiries, interlibrary loans of microfilm, orders for photoduplication and other aspects of research have been increasing at a rate of from \(15 \%\) to \(50 \%\) annually.
2.

Increases in acquisitions. There have been increases in all types of archival material whether of public or private origin. Recent accessions of private papers of Mr. Diefenbaker and Mr. Pearson alone amounted to 2500 cu. ft. The chief increase, however, has been in public records, the result of the development of procedures for scheduling, selection and transfer. The volume of public
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        records will increase greatly in 1969, since the Public Records Order requires all records to be scheduled by May 1 and a Cabinet decision on access is expected to require most records thirty years or older to be transferred to the Public Archives.
    A greater variety of materials acquired. Until recently most emphasis was placed on the acquisition of textual materials such as private papers, government files or microfilm copies of material from abroad. Recently the volume of acquisitions of photographs (now nearly 1,000,000 items), maps (now nearly 500,000 ) has increased and attention is being given now to the development of national collections of motion pictures, sound recordings, architectural drawings and other materials.
Areas of activity which are directly related to research are:
1.
Acquisition of material of archival value with a view to providing adequate documentation on all aspects of national development.
(a) Public records. With improvements in records management, the authority of the Public Records Order and cooperation with the Treasury Board, procedures for the destruction of useless records and the preservation of records of potential research value is becoming a smoothly functioning operation as far as textual

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records are concerned in government departments. There is a need for improvement in two respects: 1) the application of the Public Records Order to crown corporations (at present it is optional) and 2) the application of the scheduling procedure to maps, drawings, photographs, tape records and motion picture films and also to computer products.
(b) Private records and papers. Since there is no obligation to deposit private papers in the Public Archives they must be sought and acquired by individual negotiations. The Public Archives should acquire material which is of national significance from individuals, associations and corporations. There is increasing competition from university archives and although attempts are being made to define boundaries for archival repositories there is an increasing need for thorough, systematic and intensive searches for original material, for preventing destruction of papers, the erasing of tapes and for intensified activity in oral history.
2. Appraisal and selection. This is an important function of the Public Archives requiring high professional qualifications, broad knowledge, and experience. Archivists cannot be limited by current research trends since their aim is to select material which documents all significant aspects of Canadian life, to anticipate the requirements of
future as well as present researchers. If significant material for research is not saved from destruction there will be permanent gaps in wide areas of knowledge. Successful selection depends upon the employment of a high calibre of archivist and on salary and other elements in a career which will enable the government to retain him and profit from his experience, the continued development of selection standards and an adaptation to technological changes, e.g., it is becoming feasible to retain a larger volume of records in machine readable form than has been possible when the information was on paper. At present there is a large backlog of records requiring additional staff for selection.
3. Arrangement and description. Material which has been selected for permanent retention is only accessible for research purposes after it has been properly classified and described. A variety of finding aids are prepared ranging from brief collective descriptions to detailed lists and indexes. Increasing demands for reference tend to occupy more staff time at the expense of the necessary preparation of finding aids, which are basic research tools. More effective use of the Public Archives for research can be promoted by the preparation of internal finding aids and by the publication of inventories and guides which will inform potential researchers and directors of research concerning the material which is available.

Research services and facilities. The research services and facilities provided by the Public Archives of Canada can be compared favorably with those of any similar repository anywhere. Some services are unusual if not unique for national archives - the preservation of material of private origin as well as government records, the 24-hour-a-day access to documents by accredited researchers, interlibrary loans of microfilm, etc. The relationship between professional staff and researcher has been particularly close at the Public Archives and this relationship has extended to professional organizations, particularly the Canadian Historical Association. At present the two Secretaries, the Treasurer and two Editors of the Association are on the staff of the Public Archives while another member is Chairman of the Archives Section of the Association and another prepares the annual Register of Dissertations in History and Related Subjects. It has been necessary to set limits on the length of time spent in answering inquiries, on the amount of photoduplication, etc. The effectiveness of reference services would be greatly improved by the preparation and dissemination of more information in the form of guides and inventories. The relationship of reference and automated information systems has been studied and limited use has been made of automation in the preparation of detailed finding aids. The use of computers for information retrieval does
not seem to be feasible at present. The role of the Public Archives and social science data banks is being examined and it appears that the major role of the Public Archives should be as a source of information found in records and not as a location for a data bank. More widespread use can be made of the documentation at the Public Archives, particularly in the field of education, for example, for educational T.V. programmes and other audio-visual systems.

The following recommendations indicate areas in which the effectiveness of the Public Archives in regard to research can be improved:
1. An increase in staff is required to permit the department to pursue energetically the tasks of acquiring and making available to researchers documentation relating to the development of Canada.
2. A more liberal policy regarding access to public records should be announced without delay.
3. The terms of the Public Records Order of 1966 should be extended to include all types of records for all agencies supported by government funds.
4.

A limited number of scholarships should be available for distribution by the Public Archives for pre- or post-doctoral reserch in administrative history, particularly the preparation of histories of government departments and agencies.
5.

Continued cooperation with other government departments and agencies, including crown corporations, should attempt to eliminate duplication of archival functions.
6.

Additional funds should be used to disseminate information concerning Canadian history based on documentation in the custody of the Public Archives.

APPENDIX 59






Brief
Presented To
THE SPECIAL COMMITTEE ON SCIENCE POLICY
OF THE SENATE OF CANADA
Prepared By
THE ST. LAWRENCE SEAWAY AUTHORITY
On Request
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    Brief
    Presented To
    THE SPECIAL COMMITTEE ON SCIENCE POLICY
            OF THE SENATE OF CANADA
            Prepared By
            THE ST. LAWRENCE SEAWAY AUTHORITY
            On Request
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This brief on scientific activities of the St. Lawrence Seaway Authority has been prepared for the Special Committee on Science Policy of the Senate of Canada. In the preparation of this brief the sequence of subject matter corresponds to that set out in Part II of the Senate Committee guidelines. The information herein pertains to the St. Lawrence Seaway Authority as a Crown Corporation of the Federal Government of Canada and to the Construction, Economics and Research, and Engineering Branches as units of the Authority. These branches are responsible for scientific activities within the Authority.

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\subsection*{1.1 Organization}

An organizational block diagram of the
St. Lawrence Seaway Authority is included in Appendix 'A' of this report. Each unit conducting or funding scientific activities is indicated with an asterisk.

The St. Lawrence Seaway Authority reports directly to the Minister of Transport and has no formal connection with other Federal agencies.

There are three branches within the Authority involved to some degree in scientific activities. Block diagrams of the organization of Construction, Economics and Research, and Engineering branches are included in this report in appendices ' B ', ' C ', and ' D ' respectively.

The Authority, to date, has not entered into any formal agreements with other foreign governments or their agencies, nor does the Authority maintain overseas offices concerned with scientific activities.
1.2 Organizational Functions

Statutory functions and powers regarding scientific activities within the St. Lawrence Seaway Authority are not formally defined since the involvement in such activities is minimal. As a result, no organizational policies have evolved that could be described as this agency's "science policy".

The Authority has no functions nor responsibilities of a science nature to other Federal agencies, industry, educational institutions, etc.

With respect to outside studies, the firm of Kates, Peat, Marwick \& Co. of Toronto, Ontario were commissioned by the St. Lawrence Seaway in 1964 to determine the causes of delays and lengthy average transit times on the Welland Section of the Seaway. The consultants were given the task of determining means of improving operational procedures with a view to maximizing efficiency of canal operations. The results obtained were excellent.

The St. Lawrence Seaway Authority is
responsible for the maintenance and operation of the Seaway Canal system. In fulfilment of its responsibilities, it has built up the required staff to undertake on its own, studies into means of operating at maximum efficiency. There are, at present, no foreseen hindrances to the effective performance of these functions and responsibilities.

No. major changes in the Authority's functions or responsibilities are contemplated during the next five years.

\subsection*{1.3 Personnel Policies}

No specific policies regarding the hiring of graduates for research activities have been developed since the Authority's demand for this type of personnel has been limited. Such professionals are recruited on an individual basis when their particular skills become necessary for research or related assignments. No unique criteria have been developed to identify those who will be creative and effective researchers, although a personnel audit which is to be undertaken shortly, will facilitate this task.

At present, with the small number of personnel involved in research activities, the task of identifying research administrators is left to the supervisors through employee appraisal. Within the Authority there are no special distinctions made between administrators of research and researchers, and such personnel are subject to the same regulations in respect to salaries, promotions etc., as are other employees.

It is Authority policy, regarding the education of staff members conducting or administering research, to participate in meeting the cost of tuition fees as a means of enhancing the efficiency of the organization.

Reimbursement requires that the course is related to the function of the employee, that it will improve his level of qualification and will be mutually beneficial to the Authority and the employee.

Where government sponsored courses are available employees are encouraged to participate; in such cases the Authority absorbs all necessary costs.

\subsection*{1.4 Distribution of Activities}

All research expenditures are confined to those parts of Quebec and Ontario in which the St. Lawrence Seaway Authority operates. All scientific activities are, therefore, restricted to the st. Lawrence Seaway System which extends from Montreal to Lake Erie.

Over the past five years, investigations have been made into the canal system capacity and the development of means of optimizing canal operations on both the Welland and Montreal-Lake Ontario sections of the Seaway.

In general the construction of the Seaway has provided an economical mode of transportation which facilitates industrial development within its hinterland. Efforts and expenditures have been directed toward the objective of improving the efficiency of this water transportation service. Thus all scientific activities carried out by the St. Lawrence Seaway Authority benefit the area served by the Seaway system.
1.5 Personnel Associated with Scientific Activities

Note that the following personnel information pertains to each of Construction, Economics and Research, and Engineering Branches individually.
(A) Construction Branch

The current Construction Branch establishment numbers 211 employees of the following categories:
\begin{tabular}{ll} 
Engineers & 34 \\
\begin{tabular}{l} 
Technical Officers, \\
Technicians, and \\
Draftsmen
\end{tabular} & 150 \\
\begin{tabular}{l} 
Administration, \\
Clerical and \\
Stenographers
\end{tabular} & 27
\end{tabular}

From this total establishment there are six professionals associated with scientific research and one of this group is involved in administrative duties.
atsucta0 Information regarding the six professional staff of the Construction Branch involved in scientific activities is as follows:

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    The percentage of turnover of professional
    staff in the three degree categories for each of the years
    1 9 6 2 \text { to } 1 9 6 7 \text { is nil. Since graduation none of the six}
    professional staff have been employed with industry, while
    20% have been on a university staff, 20% on the staff of
    provincial departments, and 20% on the staff of a federal
    agency.
    At present none of the above staff are on
    education leave from the Authority.
    Following is a listing of the number of
    university students given summer employment by the
    Construction Branch in the field of scientific activities
    for the years 1962 to 1967:
    | 1962 | - | Nil |
| :--- | :--- | :--- |
| 1963 | - | Nil |
| 1964 | - | Nil |
| 1965 | - | One |
| 1966 | - | One |
| 1967 | - One |  |

(B) Economics and Research Branch
The present establishment of the Economics and Research Branch numbers 12 employees which fall into the following categories:

| Director of Economics and Research | 1 |
| :--- | :--- |
| Chief of Economics | 1 |
| Chief of Research | 1 |
| Research Officers | 7 |
| Secretaries | 2 |

```

Two of the above staff are devoting most of their time to administrative duties. Information regarding the ten professional staff of the Economics and Research Branch involved in scientific activities is as follows:
(i) (ii) (iii) (iv)(a) (iv) (b) (v) (vi)

\begin{tabular}{clllrllll} 
Masters & & & & & & & & \\
1 & Canada & Canada & Canada/USA & 20 & 3 & & \\
1 & China & Hong Kong Canada & 1 & 1 & & \\
& & & & & 37 & Nil
\end{tabular}

Doctorate
Nil


The total number of professional staff in each degree category for each of the years 1966 to 1968 inclusive and estimates for each of the years 1969 to 1973 are as follows:


Since its inception in 1966 the Economics and Research Branch has given summer employment in the field of scientific activities to the following number of university students:
\begin{tabular}{ll}
1966 & 2 \\
1967 & 2
\end{tabular}
1968 Nil
(C) Engineering Branch

There are at present 184 employees in the Engineering Branch of the St. Lawrence Seaway Authority. This establishment is broken down into the following categories:

Engineers 74
Technical Officers,
Technicians, and Draftsmen 74

Administration,
Clerical, and
Stenographers

Twenty-five of the above professional staff devote most of their time to administrative duties Information regarding the professional staff of the Engineering Branch involved in scientific activities is as follows:
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(iii)
(iv) (a)
(iv) (b)
(v)
(vi)
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No. For & \\
Each & Country \\
Degree & of \\
Category & Birth \\
\hline
\end{tabular}
\begin{tabular}{cl} 
Country & Country \\
of & of \\
Secondary & University \\
Education & Degree \\
\hline
\end{tabular}
\begin{tabular}{lll} 
No. Yrs. & & \begin{tabular}{l} 
Percentage \\
Effective
\end{tabular} \\
Working & SLSA Avg. \begin{tabular}{l} 
In Two
\end{tabular} \\
\begin{tabular}{ll} 
Since \\
Graduation & Service Age \\
(Years) & Languages
\end{tabular} \\
\hline
\end{tabular}

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\end{tabular} & .) (i) & (ii) & (iii) & (iv) (a) & (iv) (b) & (v) & (vi) \\
\hline & & & & & & & Percentag \\
\hline No. For & & Country & Country & No. Yrs. & & & Effective \\
\hline Each & Country & of & of & Working & SLSA & Avg. & In Two \\
\hline Degree & of & Secondary & University & Since & Service & Age & Languages \\
\hline Category & Birth & Education & Degree & Graduation & (Years) & (Yrs) & of Canada \\
\hline 1 & Canada & Canada & Canada & 15 & 4 & & \%ourlimat \\
\hline 1 & & & " & 6 & 3 & & \\
\hline 1 & \multirow[t]{2}{*}{China} & \multirow[t]{2}{*}{China} & China \& & \multirow[t]{2}{*}{13} & \multirow[t]{2}{*}{- 2} & \multirow[t]{2}{*}{Sbana} & \multirow[t]{2}{*}{} \\
\hline & & & Germany & & & & \\
\hline 1 & China & China & Canada & 16 & 4 & & - \\
\hline 1 & Canada & Canada & Canada & 27 & 5 & & \multirow[b]{3}{*}{-} \\
\hline 1 & \multirow[t]{2}{*}{Canada} & \multirow[t]{2}{*}{Canada} & \multirow[t]{2}{*}{Canada} & \multirow[t]{2}{*}{5
12} & 3 & \multirow[t]{2}{*}{\%} & \\
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\hline 1 & \multirow[t]{2}{*}{Poland} & " & " & 11 & 4 & \multirow[t]{2}{*}{40.0.04 - 195} & \\
\hline 1 & & England & England & \multirow[t]{2}{*}{12
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\hline 1 & Canada & \multirow[t]{2}{*}{Canada Turkey} & Canada & 20 & \multirow[t]{2}{*}{r 14} & \multirow[t]{2}{*}{" \({ }_{4}\)} & \multirow[b]{2}{*}{1} \\
\hline 1 & Turkey & & \multirow[t]{2}{*}{Turkey} & 8 & & & \\
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\hline 1 & Lithuania & a Canada & Canada & & & & \\
\hline 1 & Turkey & Turkey & \multirow[t]{2}{*}{Turkey} & (a) \(\begin{array}{r}6 \\ 12\end{array}\) & (2a 6 & Sbanis
YPEpam & \(\frac{1}{1}\) \\
\hline 1 & Canada & \multirow[t]{3}{*}{Canada} & & 12
18 & 14 & \multirow[t]{3}{*}{\begin{tabular}{l}
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\]} & \multirow[t]{2}{*}{} & & \multirow[b]{3}{*}{\(\overline{20 \%}\)} \\
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\begin{tabular}{|c|c|c|c|c|c|c|}
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No. For \\
Each \\
Degree \\
Category
\end{tabular}} & (i) 23 & (ii) & (iii) & (iv) (a) & (iv) (b) (v) & \begin{tabular}{l}
(vi) \\
Percentage
\end{tabular} \\
\hline & & Country & Country & No. Yrs. & & Effective \\
\hline & Country & of & of W & Working & SLSA Av & In Two \\
\hline & of & Secondary & University & Since & Service Age & Languages \\
\hline & Birth & Education & Degree & Graduation & (Years) (Yrs) & of Canada \\
\hline \multicolumn{7}{|l|}{MASTERS} \\
\hline 1 & Canada & Canada & Canada & 32 & 14 & \\
\hline 1 & China & China & China \& USA & 22 & 5 & \\
\hline 1 & Ireland & Ireland & Ireland & 3 & 2 & \\
\hline 1 & China & China & China \& Can & 6 & 4 & \\
\hline 1 & India & India & India \& Can & 14 & 3 & \\
\hline 1 & Russia & Austria & Austria & 32 & 3 & \\
\hline \multirow[t]{2}{*}{1} & Poland & Poland & Poland \& & 26 & 2 & \\
\hline & & & England & & & \\
\hline 1 & Canada & Canada & Canada & 4 & 4 & \\
\hline 1 & China & China & China \& Can & 13 & 3 & \\
\hline 1 & Poland & Poland & Poland & 33 & 2 & \\
\hline 1 & Estonia & Estonia & Canada & 2 & 4 & \\
\hline \multirow[t]{2}{*}{1} & Pakistan & Pakistan & Pakistan \& & 18 & 8 & \\
\hline & & & Canada & & \({ }_{5} 9780041\) & \\
\hline 1 & Scotland & Scotland & Canada & 23 & 5 & \\
\hline 1 & China & China & China \& USA & 28 & \(4 \quad 42\) & 20\% \\
\hline
\end{tabular}

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The total number of professional staff in each degree category for each of the years 1962 to 1968 inclusive and the estimates for the years 1969 to 1973 as well as the percentage of turnover for the years 1962 to 1967 inclusive are not available.

Fifteen percent of the above professional staff, were at one time, employed by industry, eight percent were employed by universities, two percent were employed on provincial department staffs and fifteen percent have been employed by other federal agencies. There are no professional staff of the Engineering Branch on education leave. The number of university students given summer employment in the field of scientific activities is not available.
1.6 Expenditures Associated With Scientific Activities The total funds spent by the St. Lawrence Seaway Authority on scientific activities, as well as the operating and capital funds expended by those units of the Authority involved in research, are included in Appendix 'E'. The Construction, Economics and Research and Engineering Branches are involved in such functions.
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    Information concerning funds expended to
    further professional university education of staff
associated with scientific activities is not available.
1.7 Research Policies
(a) Units Concerned With Intramural Research Activities
Various projects and programmes are selected
and initiated according to the requirements of the shipping
industry for an efficient and economical transportation
artery. A preliminary study is carried out to define the
problem, its scope and magnitude, and the cost and possible
payoffs. Initiation is dependent on cost benefit considera-
tions indicated by a feasibility study. Progress of
programmes is monitored against a critical path method (CPM).
Advice is sought from other government agencies,
principally the National Research Council.
Priorities between programmes and projects are
determined through cost benefit analysis. Two general
criteria are used: (a) reduction in transit times through
the system benefiting the shipping industry; and (b) extension
of the capacity and life of the present system.
Critical Path networks are used on extensive
programmes and projects; plans are being made to use this
system on lesser projects when computer software is available.

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    Where special expertise is required and such
    talents are not available within the organization, consult-
ants are retained on a project basis. If special laboratory
facilities are required, contracts are issued to cover the
scope of necessary testwork. As noted earlier a system
study of the traffic congestion on the Welland Canal, which
included the development and implementation of procedural
changes and traffic control system was contracted out to
Kates, Peat, Marwick, \& Company. Other examples of \& Namen
contracting out are as follows:
Windbreak Design Welland Canal - Dilworth
Secord \& Meagher Consulting
Engineers, Toronto, Ontario.
Hydraulic Model Studies Lasalle Hydraulic Laboratories,
Montreal.
Tunnel - Welland H G. Acres,
Niagara, Ontario.
Specification for Hydraulic Dowty, Toronto, Ontario.
Oil System
Buildings

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Architects and consultant Engineers, Montreal, Quebec.
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    The Seaway has not developed any policies
    regarding the funding of extramural research programmes in
the universities and industry since requirements of this
nature are very limited.
Intramural and contracted external research
relating to the Seaway are of such a specific nature that
they are of little importance to external interests. When
reports are produced that are relevant to other agencies
or departments of government, copies of such publications
are provided to these entities on a routine basis.
1.7 (b) Units Exclusively Concerned With Extramural
Research Activities
The St. Lawrence Seaway Authority is not
concerned with the funding of extramural research activities.
1.8 Research Output
To date there are no patents arising from
research activities, nor licences granted to the St. Lawrence
Seaway Authority as a result of these activities. As well,
there are no books or journals arising from such research.
Reports issued from the St. Lawrence Seaway concerning its
research activities are as follows:
(a) Computer Feasibility Report on the Seaway's data processing needs and the selection of a medium-sized momsonac computer.

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(b) Expansion of the St. Lawrence Seaway Facilities: a two volume report edited by the Economics and Research Branch (contributing to the cargo forecast, traffic, capacity, benefit-cost analysis and traffic control sections).
(c) Report on the 'Economic Implications Associated With the Closing of the Lachine and Cornwall Canals.'
(d) Reports on 'Data Collection and Traffic Control Systems'.
(e) 'Soil Stratigraphy' - Welland Bypass.
(f) Preliminary zoning of Soils - Thorold to Lake Ontario (New Canal Alignment).
(g) The Properties of the Queenston Shale Areas of Lock 1, 2, and 3, Welland Canal.

One means of transferring information
regarding the results of a project or programme to extramural groups is the presentation of a paper at a conference. For example, the Authority presented a joint paper at the 1967 Canadian Operational Research Society on Simulation of a St. Lawrence Seaway System. This transfer pertains to information obtained in Canada, for the Authority has not had the occasion to communicate scientific and technological data obtained outside of Canada.

There are no known individuals who had the opportunity to train themselves in a specialized field while employed with the Seaway and subsequently left and made important contributions to their field.

Within the St. Lawrence Seaway the Traffic Control System Study Team has unique and valued abilities in marine traffic control as applied to canal systems, data collection equipment, computer system design, computer display systems and canal system simulation.

Between 1966 and 1967 the Authority has developed a Seaway Simulation Language (SEASIM) which is a FORTRAN IV oriented general purpose language, permitting the simulation of a canal system. This provides the capability of varying parameters individually or in combinations to obtain the optimal solutions.

Present developments in Traffic Control and Ship Alignment and the Mooring System programme are expected to result in a more efficient inland transportation system in Canada. The automatic data collection system and microwave sensors for detecting vessel passages on the MontrealLake Ontario Section of the Seaway is the first application of its kind. This installation is intended to provide the data required to improve canal operations and possibly extend its capacity.

The development of positive traffic control for the Welland Section of the Seaway has permitted continued growth of Seaway traffic, increased efficiency to the shipping industry and an extension of the Seaway hinterland.

By maximizing the capability of existing seaway system facilities, large capital expenditures may be postponed for several years. These developments contribute to expansion in the primary sectors of the economy, principally agriculture and base metal mining.

\subsection*{1.9 Projects}

Following are brief descriptions of projects which were conducted during the years from 1962 to 1968 :
(a) Welland Canal Traffic Capacity Study (1966 - 1968)

An in-depth examination through a system simulation of the present and future capacity of the Welland Canal has been carried out. As a result of this study, various changes in the demand forecast, cargo flow patterns, and opersting parameters have been implemented.

\section*{(b) Data Collection System}

The installation of a Data Collection System, a project of the Traffic Control Programme on the MontrealLake Ontario section of the Seaway, required the development of an on-line real time computer system. This system uses 48 on-line digital sensors, a 4,000 word computer, teletype sensors, 12 loop detectors, gate and ship arrestors, and lock filling and dumping machinery.
(c) Traffic Control System (1967-1968)

Conceptual design of the Traffic Control System for the Montreal-Lake Ontario section of the Seaway has been completed and detailed design and implementation are now in progress. This system will be aided by a centralized on-line real time computer using automatic data collection, extensive communications, surveillance, and an electroluminescent display system.
(d) Extension to the Navigation Season (1964-1968)

In 1964 the St. Lawrence Seaway Authority established a committee of Authority personnel to study the extension of the navigation season. Numerous experiments, tests, and observations have been made with regard to deicing of canals and locks. These works involve the study of weather, water velocity and temperature, and ice formation both in the shipping channels and on locking equipment. This project and its many contingent programmes is being continued.

The most significant projects completed during the past five years by units of the St. Lawrence Seaway engaged in scientific activities are as follows: \(\begin{aligned} & \text { and } \\ & \text { sum }\end{aligned}\)
(e) Applied Research - Welland Canal Capacity Study

Between 1964 and 1967 the Welland Canal suffered serious congestion, requiring the ships to form queues and operate below maximum efficiency. An Operations Research consultant was employed to study the system and recommend improvements. This resulted in extending the life of the present facilities and demonstrated that a new system was more advantageous than a twinning of the existing facilities. Therefore, during the period between 1965 - 1967 the Seaway Authority prepared plans to extend the system. In 1968 a re-evaluation was carried out of present and future capacity using the most up-to-date data.
(f) Applied Research - Soil Cement

Applied research in the field of soil-cement has been carried out in the Materials Laboratory, Construction Branch, during the period extending between October 1966 and October 1968. This construction material is being evaluated for use as slope protection from Port Robinson, Ontario to Port Colborne, Ontario.

Various granular materials available in the Niagara Peninsula area have been studied for suitable use in soil-cement and a laboratory program has been carried out to investigate the effect of sulphate laden soil and groundwater on this construction material.

Applied research in the field of concrete aggregates and concrete mix designs has been carried out on a continuing basis to evaluate the performance of local materials in concrete mixtures.

As a part of the modernization programme of the existing Welland Canal and the building of new sections of the canal, both preliminary and detailed studies have been made of the soils and rock formations found in the area. These projects have necessitated the sampling, logging and testing of materials encountered in the various construction projects. The data obtained is passed on to the Engineering Branch in Montreal where it is used in the design of new facilities.
(g) Development: Montreal - Lake Ontario Capacity Study.

In 1966 a capacity study similar to that performed on the Welland Section of the Seaway was carried out on the Montreal - Lake Ontario Section. This study revealed the need for more comprehensive data on vesse \({ }^{7}\) movements. In 1967 a data collection system was designed and implemented. The installation of the automatic system was completed by mid-June of 1968 .
(h) Development: Ship Alignment and Mooring System

The Authority is presently engaged in the development of a ship alignment and mooring system. Mathematical model testing, computer run, and hydraulic model testing will establish the magnitude of forces acting on a vessel entering a restricted area ( \(80^{\prime}\) wide). Design of the system will incorporate all the latest technology in oil hydraulics and electronic sensing.

\subsection*{1.10 Organizations Not Currently Engaged in Scientific Activities}

Due to the economics of scale, increased automation of vessels and generally rising costs, sophistication of the Seaway system will be demanded by the water transportation industry. The traditional methods of handling vessels and policies of traffic control must be constantly adapted to changing conditions if water borne transportation is to compete as an efficient mode of transportation.

Major programmes being developed and implemented by the Seaway are directed toward a more efficient transportation system. Applied research and development will be carried out on a continuous basis.

Scientific and technical advice has been sought from technical societies, National Research Council, U.S.Corps of Engineers, as well as consultants on subjects ranging from canal capacity to windbreaks for vessels.

In general all programmes are designea in
such a way as to take into account and accommodate any
technological breakthroughs that are possible. Continuing
efforts are made to stay abreast of developments in related disciplines.



APPENDIX "D"
ENGINEERING BRANCH


APPENDIX ' \(E\) '
2.6) EXPENDITURES ASSOCIATED WITH SCIENTIFIC ACTIVITIES





First Session-Twenty-eighth Parliament 1968-69

\title{
THE SENATE OF CANADA
}

PROCEEDINGS
OF THE
SPECIAL COMMITTEE ON

\section*{SCIENCE POLICY}

\title{
The Honourable MAURICE LAMONTAGNE, P.C., Chairman The Honourable DONALD CAMERON, Vice-Chairman
}
\[
\text { No. } 43
\]

WEDNESDAY, MAY 21st, 1969

\section*{WITNESSES:}

Dr. L. B. Macdonald, Executive Vice-President, Committee of Presidents of Universities of Ontario; Dr. J. Stefan Dupré, Director of the Centre for Urban and Community Studies, University of Toronto; Dr. Ernest Sirluck, Vice-President and Graduate Dean, University of Toronto; Dr. Erich W. Vogt, Professor, Physics Department, University of British Columbia.

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\section*{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 wasResolved in the affirmative.

ROBERT FORTIER, Clerk of the Senate.

\section*{MINUTES OF PROCEEDINGS}

Wednesday, May 21st, 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, Cameron, Grosart, Haig, Kinnear and McGrand (9).

In attendance:

> Philip J. Pocock, Director of Research (Physical Science)
> Gille Paquet, Director of Research (Human Science)

The Committee questioned four of the eight authors of Special Study No. 7 entitled "The Role of the Federal Government in Support of Research in Canadian Universities" prepared for the Science Council of Canada and the Canada Council:

Dr. L. B. Macdonald, Executive Vice President, Committee of Presidents of Universities of Ontario; Dr. J. Stefan Dupré, Director of the Centre for Urban and Community Studies, University of Toronto; Dr. Ernest Sirluck, Vice-President and Graduate Dean, University of Toronto and Dr. Erich W. Vogt, Professor, Physics Department, University of British Columbia.
(A curriculum vitae of each witness follows these Minutes)
At 12.30 p.m. the Committee adjourned until 2.30 p.m. this day.

\section*{AFTERNOON SITTING}

The Committee resumed at 2.30 p.m., the Chairman, Senator Lamontagne, presiding.
Present: The Honourable Senators Lamontagne (Chairman), Blois, Bourget, Cameron, Carter, Grosart, Haig, Kinnear and Yuzyk (9).

In attendance:
Philip J. Pocock, Director of Research (Physical Science)
Gille Paquet, Director of Research (Human Science)
The witnesses at the morning sitting were further questioned.
At 5.00 p.m. the Committee adjourned to the call of the Chairman.
ATTEST:
Patrick J. Savoie, Clerk of the Committee.


\section*{CURRICULUM VITAE}

Dupré, J. Stefan. Born Quebec, Que., November 3, 1936. Married 1963. B.A. (University of Ottawa), 1955; A.M. (Harvard University), 1957; Ph.D. (ibid.), 1958. Teaching Positions: Harvard University: Teaching Fellow in Government, 1956-57; Instructor in Government, 1958-59; Assistant Professor of Government, 1961-63; University of Toronto: Associate Professor of Political Economy, 1963-66; Professor of Political Economy, 1966-. Academic Administration: Secretary of the Graduate School of Public Administration, Harvard University, 1960-63; Director of the Centre for Urban and Community Studies, University of Toronto, 1966-. Other Positions: Research Fellow, The Brookings Institution, Washington, D.C., 1957-58; Ford Foundation Law Fellow, University of Wisconsin, 1959; Editorial Director, The Ontario Committee on Taxation, 1964-67; Member, Ontario Civil Service Arbitration Board, 1965-; Member, Science Council - Canada Council Study Group on Federal Support of University Research, 1967-68; National Vice President, Institute of Public Administration of Canada, 1967-; Member, National Research Council of Canada, 1969-. Author: Intergovernmental Finance in Ontario (1968); Science and the Nation (with S. A. Lakoff, 1962); many articles on public administration, public finance and intergovernmental relations.

Macdonald, John Barfoot. Born: February 23, 1918, Toronto, Ontario. 1942, D.D.S., University of Toronto (with honors); 1948, M.S., University of Illinois (Bacteriology); 1953, Ph.D., Columbia University (Bacteriology); 1955, F.A.C.D., 1956, A.M., Harvard University (honorary); 1962, LL.D., University of Manitoba (honorary); 1965, F.I.C.D., (honorary); 1965, LL.D., Simon Fraser University (honorary); 1967, D.Sc., The University of British Columbia (honorary); 1942-44, Lecturer, Preventive Dentistry, University of Toronto, and private practice; 1944-46, Canadian Dental Corps (released as Captain); 1946-47, Instructor, Bacteriology, University of Toronto, and private practice; 1947-48, Research Assistant, University of Illinois; 1948-49, Kellogg Fellow, and Canadian Dental Association Research Student, Columbia University; 1949-53, Assistant Professor of Bacteriology, University of Toronto.

1953-56, Associate Professor of Bacteriology, University of Toronto; 1953-56, Chairman, Division of Dental Research, University of Toronto; 1956, Professor of Bacteriology, University of Toronto; 1955-56, Consultant in Dental Education, University of British Columbia; 1956-62, Director, Forsyth Dental Infirmary; 1956-62, Professor of Microbiology, Harvard School of Dental Medicine; 1958-62, Consultant to Dental Medicine Section of Corporate Research, Division of Colgate-Palmolive Company; 1960-62, Director of Postdoctoral Studies, Harvard School of Dental Medicine; 1961-65, Member, Dental Study Section, National Institutes of Health; 1962, Consultant in Bacteriology, Forsyth Dental Infirmary; 1962-67, President, The University of British Columbia; 1967, Consultant to the Donwood Foundation, Toronto, 1967, Consultant to Science Council and Canada Council on Support of Research in Canadian Universities; 1967, Chairman, Commission on Pharmaceutical Services, Canadian Pharmaceutical Association; 1968, Consultant, National Institutes of Health; 1968, Executive Vice-

Chairman, Committee of Presidents of Universities of Ontario; 1968, Professor of Higher Education, University of Toronto; 1968, Consultant, Addiction Research Foundation, Toronto.

1949-54, Member, Canadian Dental Association Research Committee (Chariman 1951-54); 1949-52, Member, Ontario Dental Association Public Health Committee; 1950-60, Member, Canadian National Research Council Committee on Dental Research (Chairman 1954-57); 1956, Member, Canadian Dental Association Research Committee; 1957-58, Member, Scientific Commission on Dental Research of the Federation Dentaire Internationale; 1958-62, Member, Advisory Board of Massachusetts Dental Hygienists Association; 1959-63, Member, Medical Advisory Board of Iran Foundation; 1963, Councillor-at-Large of the International Association for Dental Research; 1958-61, Associate Editor of Journal of Dental Research; 1958-62, Regional Editor, Archives of Oral Biology; 1958-63, Editor, International Series on Oral Biology; 1962-63, Member, Honorary Editorial Advisory Board, Archives of Oral Biology; 1963, Consulting Editor, Archives of Oral Biology; 1968, President, International Association for Dental Research, Honor Award Key, University of Toronto, 1942, (President of Student Government Faculty of Dentistry 1941-42) Charles Tomes Lecturer, Royal College of Surgeons (Eng.) 1962.

Memberships: International Association for Dental Research; Canadian Dental Association; New York Academy of Sciences; American Association for Advancement of Science; American Society of Microbiologists; Honorary Member, Harvard Odontological Society; Honorary Member, New England Dental Society; Honorary Fellow, American Academy of Dental Science; Canadian Council of Christians and Jews, Member, Pacific Region Board of Directors; Honorary Member, Vancouver Dental Society; Vancouver Board of Trade; The Men's Canadian Club of Vancouver.

Honorary Offices: 1962, Honorary President, The Vancouver Institute; 1963, Honorary Director, Muscular Dystrophy Association of Canada; 1963, Honorary Vice-President, The Canadian Red Cross Society; 1963, Honorary President, Vancouver Public Aquarium Association; 1963, Honorary President, The University Club of Vancouver; 1963, Honorary President, Alumni Association of the University of British Columbia; 1964, Honorary Director, British Columbia Civil Liberties Association; 1964, Honorary Chairman, Vancouver Civic Unity Association; 1964, Convocation Founder, Simon Fraser University; 1965, Honorary Governor, Shawinigan Lake School; 1965, Member of Board of Honorary Governors, Canadian Association for Retarded Children.

Married Liba Kucera: two sons (John Grant, Scott Arthur) and three daughters (Kaaren Campbell, Vivian Jane, Linda Rosemarie).

Sirluck, Ernest. M.B.E., B.A. (Man.), M.A. and Ph.D. (Toronto), Ll.D. (Queen's), F.R.S.C. 1918, born, Winkler, Manitoba; 1940, B.A., University of Manitoba; 1941, M.A., University of Toronto; 1941-42, Ph.D. student, University of Toronto; 1942-45, Canadian Army (Overseas 1943-45: 1 Battalion Royal Regiment of Canada; HQ 2 Canadian Division, 4 Canadian Armoured Division; discharged with rank of major); 1945, Member of the Order of the British Empire (Military Division); 1945-46, Ph.D. student, University of Toronto, and Teaching Fellow, Department of English, University College; 1946-47, Lecturer,

University College, Toronto; 1947-62, University of Chicago, Department of English (1947-53 Assistant Professor, 1953-58 Associate Professor, 1958-62 Professor); 1948, Ph.D., University of Toronto; 1951-52, President, Midwest (now Newberry Library) Renaissance Conference; 1953-54, Guggenheim Fellow (year spent in British Museum); 1957, Chairman, Section 4, Modern Language Association of America; 1958-59, American Council of Learned Societies Fellow (year spent in British Museum).

1959, Chairman, Section 6, Modern Language Association of America; 1959-65, Founding President, Renaissance English Text Society; 1960-62, Board of Directors, Centre for Continuing Education, Chicago; 1962 ff., Professor of English, University College, University of Toronto; 1962-64, Associate Dean, School of Graduate Studies, University of Toronto; 1964 ff., Dean, School of Graduate Studies, University of Toronto; 1969 ff., Vice President and Graduate Dean, University of Toronto; 1962 ff., Chairman, Ontario Committee of Graduate Deans (now Ontario Council on Graduate Studies); 1963 ff., Fellow of the Corporation of Massey College; 1963-65, Board of Directors, Midwest Inter-Library Centre (Chicago); 1963-65, Final Review Committee, Canada Council; 1964-68, Woodrow Wilson Dissertation Fellowship Selection Committee; 1964-67, Canadian Committee for Commonwealth Scholarships and Fellowships; 1964-66, Committee on International Education, Association of Graduate Schools (U.S.); 1965 ff., Board of Governors, Ontario Institute for Studies in Education; 1966, Overseas Fellow, Churchill College, Cambridge; 1966-, Policy Committee, Association of Graduate Schools (U.S.); Chairman, 1968-69; 1966-, Member, Universities Committee on the St. Lawrence Centre for the Arts; 1967, Elected a Fellow of the Royal Society of Canada; 1967-69, Science Council - Canada Council Study of Research in Canadian Universities; 1967-68, Vice-Chairman, Advisory Joint Council Ontario Graduate Deans and Librarians; Chairman, 1969; 1967-69, Member, Ontario Graduate Appraisals Committee; 1968, L1.D., Queen's University (Kingston).

Married Lesley Caroline McNaught (1942) (2 children).
Societies: Royal Society of Canada; Modern Languages Association; Association of Canadian University Teachers of English; Canadian Association of University Teachers; Association of American University Professors; Canadian Civil Liberties Association; Renaissance English Text Society.

Bibliography: A. Books and Pamphlets: Complete Prose Works of John Milton Vol. II (New Haven: Yale University Press, 1959). Paradise Lost: A Deliberate Epic (Cambridge: Heffer, 1967).
B. Articles: "A Note on the Rhetoric of Spenser's 'Despair'" Modern Philology, XLVII, 1 (1949), 8-11. "Milton Revises The Faerie Queene," Modern Philology, XLVIII, 2 (Nov. 1950), 90-96. "The Faerie Queene, Book II, and the Nicomachean Ethics," Modern Philology, XLIX, 2 (Nov. 1951), 73-100. "Milton's Critical Use of Historical Sources: An Illustration," Modern Philology, L, 4 (May, 1953), 226-31. "Eikon Basilike, Eikon Alethine, and Eikonoklastes," Modern Language Notes, LXIX, 7 (Nov. 1954), 497-502. "The Eikon Basilike: An Unreported Item in the Contemporary Authorship Controversy," Modern Language Notes, LXX (1955), 331-32. Letter to Review of English Studies, New Series VI, 24 (Oct. 1955), 401-2. "Shakespeare and Jonson among the

Pamphleteers of the First Civil War: Some Unreported Seventeenth-Century Allusions," Modern Philology, LIII (Nov. 1955), 88-89. "Howells' A Modern Instance: Title and Theme," Manitoba Arts Review, X (April 1956), 66-72. "To Your Tents, O Israel: A Lost Pamphlet," Huntington Library Quarterly (May 1956), 301-5. "Milton's Criticism of Hall's Grammar," Modern Language Notes, LXXIII (Jan. 1958), 8-9. "Milton" in American Peoples Encyclopaedia, 1958 ed. "Areopagitica and a Forgotten Licensing Controversy," Review of English Studies, New Series, XI, 43 (1960), 260-74. "Milton's Idle Right Hand." Journal of English and Germanic Philology, LX, 4 (Autumn 1961), 749-85. Republished (in part) in John Milton's Samson Agonistes, (San Francisco: Chandler, 1966). "Milton's Political Thought: The First Cycle", Modern Philology, LXI (1964), 209-24. "Emergent Nation Status in Higher Education," Varsity Graduate, XI, 3 (Dec. 1964), 11-17. "Universities in Crisis, " Manitoba Alumni Journal, Winter, 1965, 7-13. "A No-Title Address," American Journal of Pharmaceutical Education, vol. XXIX (1965), 781-84. Encyclopedia Americana, 1966 new edition; article on "Areopagitica" "Recent Studies in the English Renaissance," Studies in English Literature, VI, 1 (Winter, 1966), 159-92. "The Future Development of Graduate Programmes in Ontario," Queen's Quarterly, LXXV, No. 2 (May, 1968).
C. Review Articles and Reviews: "Canadian Army, 1939-1945", University of Toronto Quarterly, XIV (1965), 205-212. "Bigot," University of Toronto Quarterly, XV, 4 (1946), 433-42. "Tolstoy," Canadian Forum, XXVI, 312 (1947), 238. G. G. Simonds, Maple Leaf Up, Maple Leaf Down, Canadian Forum, XXVI, 314 (1947), 282-3. Milton Shulman, Defeat in the West, Canadian Forum, XXVII, 319 (1947), 115. Alan H. Gilbert, On the Composition of Paradise Lost, Modern Philology, XLV, 4 (1948), 273-75. C. P. Stacey, The Canadian Army, 1939-45, International Journal, Autumn 1948, 366-69. E. M. Pope, Paradise Regained: the Tradition and the Poem: Modern Philology, XLVI, 4 (1969), 277-9. F. Michael Krouse, Milton's Samson and the Christian Tradition, Modern Philology, XLVIII, 1 (Aug. 1950), 70-72. Ruth Mohl, Studies in Spenser, Milton, and the Theory of Monarchy, Modern Philology, XLVIII, 1 (Aug. 1950), 60-64. J. Milton French, Life Records of John Milton, vols. 1 and 2: Modern Philology, XLVIII, 4 (May 1951), 273-4. Virgil K. Whitaker, The Religious Basis of Spenser's Thought, Modern Philology, XLIX, 1 (Aug. 1951), 65-7. T. F. Kinloch, The Life and Works of Joseph Hall 1574-1956, in Church History, XXI, 3 (Sep. 1952), 279-80. "Certain Editorial Tendencies Exemplified: A New Edition of Milton's An Apology," Modern Philology, L, 3 (Feb. 1953), 201-5. D. G. James, The Dream of Learning: An Essay on The Advancement of Learning, Hamlet, and King Lear, Modern Language Notes (April 1953), 262-64. Margaret L. Wiley, The Subtle Knot: Creative Scepticism in Seventeenth-Century England, Modern Philology, LI, 1 (Aug. 1953), 68. George F. Sensabaugh, That Grand Whig Milton, Modern Philology, LII, 1 (Aug. 1954), 63-67. William Haller, Liberty and Reformation in the Puritan Revolution. William P. Holden, Anti-Puritan Satire 1572-1642. Modern Philology, LIII, 4 (May, 1956), 278-82. Howard Schultz, Milton and Forbidden Knowledge, Church History, XXVI, 2 (June, 1957), 1-4. The Diary of John Evelyn. Edited by E. S. de Beer. Modern Philology, LV (Aug. 1957), 58-61. Roland M. Frye, God, Man, and Satan: Patterns of Christian Thought and Life in Paradise Lost, Pilgrim's Progress, and the Great Theologians. Modern Philology, LIX (1961), 68-69. L. Proudfoot, Dryden's Aeneid and its Seventeenth-Century Predecessors, Seventeenth-Century News, XIX, 3 (Autumn 1961), 40-41. "How Good is Our Library? " Review article on Edwin E.

Williams, Resources of Canadian University Libraries for Research in the Humanities and Social Sciences. Varsity Graduate, X, iiii, (Spring 1963), 2432.
D. With Others: Graduate Studies in the University of Toronto: Report of the President's Committee on the School of Graduate Studies, 1964-1965 (Toronto: University of Toronto Press, 1965). Patterns of Literary Criticism, 1965 ff. I Olson, Elder, Aristotle's Poetics and English Literature (1965). II Leech, Clifford, Shakespeare: The Tragedies (1965). III Davie, Donald, Russian Literature and Modern English Fiction (1965). IV Downer, Alan S., American Drama and Its Critics (1965). V Gross, Seymour L., and Hardy, John Edward, Images of the Negro in American Literature (1966). VI Bentley, Gerald Eades, The Seventeenth-Century Stage (1968). VII Corrigan, Beatrice, Italian Poets and English Critics, 1755-1859 (1969). University of Chicago Press and University of Toronto Press. The Role of the Federal Government in Support of Research in Canadian Universities (Ottawa: Queen's Printer, 1969).

Vogt, Erich Wolfgant. Born Steinbach, Manitoba, November 12th, 1929. Educated in Manitoba, B.Sc. 1951, M.Sc. 1952 (University of Manitoba), Ph.D. in theoretical physics at Princeton University (1955), NRC Postdoctoral Fellow at the University of Birmingham in England 1955-56; Assistant Research Officer at Chalk River Nuclear Laboratories 1956-58, Associate Research Officer 1958-60, Senior Research Officer, 1960-65, visiting Associate Professor in Physics at the University of Rochester 1958-59; Professor at the University of British Columbia 1965; Associate Director of the TRIUMF project (a four-university accelerator project in Western Canada, funded in 1967) 1967-; Vice-president-elect, Canadian Association of Physicists; author of numerous papers on the theory of nuclear reactions and in theoretical physics; married to Barbara Mary Greenfield of Winnipeg, Manitoba on August 27th, 1952; five children; Edith Susan, Elizabeth Mary, David Eric, Jonathan Michael, Robert Jeremy.

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SPECIAL SENATE COMMITTEE ON SCIENCE POLICY
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\section*{EVIDENCE}

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Ottawa, Wednesday, May 21, 1969
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The Special Senate Committee on Science Policy met this day at 10 a.m.

Senator Maurice Lamontagne (Chairman) in the Chair.

The Chairman: We are beginning this morning the third and last phase of our public hearings, during which we will receive representations form the socalled private sector including universities, industries, and national organizations interested in science policy. We have already received over 200 briefs from that sector, and we are now in the process of organizing our hearings for the latter part of this month and the month of June with the hope that the committee will terminate its public hearings at the end of June. Some members of the committee are senators for life and others until age 75 , and we do want to publish a report. Before that report can be published it must be prepared, and in order to prepare it we shall have to terminate our public hearings at some stage. So, it is the intention of the committee to conclude its public hearings by the end of June, and to have its report ready by October.

At the commencement of this last phase we shall hear from the university sector. Next week there will be a series of hearings during which most of the Canadian universities will make presentations. On Tuesday afternoon we will hear from the universities in the Atlantic provinces, and on Wednesday from the universities in Quebec and Ontario, and on Thursday morning from the universities in the western provinces. For Thursday afternoon we are contemplating a meeting with all the universities, which will be a kind of a "jam session." This will be the first meeting of its kind, and we hope that we shall be able to obtain some kind of a national view from the universities at that time.

To begin this exercise we are very happy to have with us this morning Dr. John B. Macdonald who, with his colleagues, worked on this very extensive report that was prepared at the joint request of the Canada Council and the Science Council of Canada. This report is entitled, "The Role of the Federal

Government in Support of Research in Canadian Universities". We think that this discussion today will provide a wonderful background for our discussions with the individual universities next week.

This morning we have with us Dr. John B. Macdonald, executive Vice-President to the President of Universities of Ontario and Professor of Higher Education at the University of Toronto; Dr. Stefan Dupré, Director of the Centre for Urban and Community Studies at the University of Toronto, and Professor of Political Economics at that same university, and Dr. Ernest Sirluck, Professor of English and Vice-President and Graduate Dean of the University of Toronto.

As you can see, there is a heavy representation from that university. I do not know if it is fair or if it is typical of the Canadian scene, but fortunately we have an exception, Dr. Erich W. Vogt of the Physics Department, University of British Columbia. I understand that Dr. Dugal of Sherbrooke University was invited to be part of this group, but he has not been able to attend the meeting because of illness.

I think that the members of the committee will want to concentrate on the latter part of your report, Dr. Macdonald, starting with chapter 5 and on. Although there might be questions on the first part as we go along, we do understand that this is the substantive part of your report. Before doing this, I would invite you to make an opening statement to the Committee.

Dr. John Macdonald, Executive Vice-President to the President of Universities of Ontario: Thank you. Mr. Chairman, and honourable senators, I would like to begin by expressing, on behalf of the members of the study group, our appreciation for this invitation to come as witnesses before this committee. I would also like to thank you for waiting until we had completed our assignment before inviting us here. You were making such rapid progress in your hearings and we were a little uneasy at one stage that we might be called upon before we were, indeed, ready to report. At the same time I am personally sorry, Mr. Chairman, that we are appearing before your
committee after my predecessor, Dr. Larry MacKenzie, has left the Senate. It would have been a great pleasure for me to have appeared before this committee with him still serving as a member. He was my predecessor at the University of British Colombia and was President for a remarkably long period of 18 years, and at a time when presidents took on that kind of post for a lifetime. It is not so long these days, as all of us know. I was at Harvard a week ago and I learned that the question being asked by United States university presidents these days is, "Why not quit while you are behind?"

Mr. Chairman, I would like to introduce the remainder of my colleagues, since it does happen that those who are present today, three out of four of us, do represent the University of Toronto. That was somewhat accidental. The membership of the committee, as shown on the cover of the report, indicates that, in addition to those who are here today, there is Dr. Dugal, Vice-Rector of Administration and Research, University of Sherbrooke, and Dr. Bruce Marshall, National Research Council. We also have Dr. J. Gordon Parr, Dean of Engineering at the University of Windsor, and Dr. Guy Rocher from the University of Montreal, Department of Sociology. He worked with us throughout most of the study, but because he went on a leave of absence to the University of California, he was not actually engaged in the authorship of the report.

The reason for the choice of members of the study group, who are attending the meeting this morning, is to ensure that you have before you representatives of the sciences, in Dr. Vogt, and the social sciences, in the person of Dr. Dupré, and humanities, in the person of Dr. Sirluck, It just happened that that worked out to the University of Toronto, which I think from the standpoint of most other parts of the country, would be looked upon as an unfortunate coincidence.

I would like, Mr. Chairman, to make only a brief introductory statement of an informal nature on the assumption that you will consider the report itself as our formal statement. We began the study about two years ago under the sponsorship of the Science Council and the Canada Council, and our terms of reference are set forth in the report itself. They were to examine the present level sources and conditions of federal support and the pourposes, principles, policies, organization and management, which will serve to improve the quality of research in the universities through the efforts of the federal support program. The report itself is not a package which has to be accepted in total or rejected in total. Nevertheless, there is a theme to it and I think the principal theme is that we see the performance of research in universities as an enterprise involving three principal partners: the federal Government, provinces
and the universities. Each of these partners has its own purposes and responsibilities.

I might briefly indicate the ways in which we see those responsibilities dividing. The provinces, of course, provide direct support for universities, as educational institutions and they are reimbursed for 50 per cent of the ordinary expenditures through the federal fiscal transfer arrangement. The support which the provinces provide includes salaries of academics, the indirect cost of research, whether the direct costs are supported by the province or the federal Government or by, other agencies. The provinces also provide graduate education, again because it is education and they pay the cost of that and provide some of the graduate students' support, actually, approximately 50 per cent of the total graduate students' support now available that is 50 per cent of about \(\$ 42\) million. They have, in general, provided most of the buildings for research, although in earlier years, the Canada Council was supporting the construction of buildings in the social sciences and humanities areas, which did relate to research, but the fund for that purpose has now expired. Currently, the health resources fund is used to provide some support for buildings on the campuses but that is a small part of the total building required and in general it is fair to say that the provinces themselves have been responsible for providing the buildings which are required for research purposes.

In addition, the provinces do provide some direct support of research, but the amount is not large. In 1966-67 it was only \(\$ 11.7\) million but that amount we would expect is likely to grow over the years ahead.

We argue in our report that the provinces should continue to pay salaries of academics and that the federal Government should not provide this particular component of the requirements of research. The reason for this is that we feel it important that the universities retain control over the destiny of the university.

In the United States there are many instances in which agencies will pay the salaries of academics working in the universities and doing research and this leaves open the opportunity for entrepreneurs to engage large numbers of faculty through funds which they bring into the university and for the universities to develop a balance of program which is perhaps not what they initially intended to do.

We believe that balance of program is a matter which should lie in the hands of the university and should be exercised by the university and that one of the best ways of seeing this accomplished is to see that the balance of program is the university's responsibility and not something subject to grants,
agreements or contracts with federal agencies or outside agencies.

We feel that the provinces should continue to support graduate education-again, because it is education-and in respect to graduate students we see an important role for the province to play-again, because it is education-but it is clear that there is a federal interest here, too.

The support of graduate students does relate to the training of manpower for research. The universities are the source of virtually all of the trained manpower for research, both for their own purposes and for industry and for government. If there is to be a viable research support program it does have to involve the training of manpower for research. We suggest, therefore, that the federal role at this level be exercised through permitting the support of graduate students coming through provincial sources to be allowed in the fiscal transfer arrangements. This would automatically involve the federal Government in 50 per cent of the cost of the support of graduate students.

The federal Government, for its part in this partnership, we believe has two main interests. The first one, and the one which we would hope would not be overlooked, is that the federal Government itself have an interest in strong universities in Canada as a goal in itself. That interest has been expressed principally through the work of the National Research Council, the Medical Research Council and the Canada Council who, in 1967-68 provided about \(\$ 77\) million in support, including student support, as well as the direct support of research.

The second interest of the federal Government is in the procurement of research which relates to the other goals of the federal Government-in industry, fisheries, agriculture, health, whatever they may be. We see no reason why the federal interest in this area should not be expressed by the procurement of research from the universities which does relate to the work of Government itself.

In this case, it is the mission-oriented agencies of Government which in general would provide the support. In 1967-68 they provided about \(\$ 20\) million in support-a very small portion of course of the total research supported by the federal Government, that is, a very small portion compared to the intra mural research of the Government itself. In short, the federal Government has provided about \(\$ 100\) million in 1967-68 by way of direct support.

Traditionally the federal Government, through the councils, has supported some areas, some disciplines, and not others. We are inclined to feel, Mr. Chairman, that the decision about areas to support is not being exercised on the basis of any clearly developed policy,
but has been ad hoc responses to particular situa-tions-with the result that there are many areas within universities, many areas within disciplines, which have not been eligible for support from the federal Government through the councils. I think this is brought out clearly in the context of our report.

We therefore recommended that the policy should be that all disciplines within the universities should be eligible for support through the councils because of the federal Government's concern to have strong universities in Canada and strong universities suggests of course the need for a balanced research program in the universities.

I should say a word or two-although I am sure this will come up in the course of the day-about the role of the federal Government in providing indirect cost. Since we have concluded that having strong universities is a goal of the federal Government and that having strong universities requires a balanced program of research, for this reason alone we think it important that the federal Government pay the indirect costs of the research which it supports. Failure to do so has already distorted budgetary processes in universities because these indirect costs are real costs and they have to be borne by the universities out of their general revenues.

This means that in those disciplines or those areas where research activity is strong, the universities are having to divert general revenues to the support of these areas and do not have those funds available for the support of other areas where research is not being undertaken vigorously. This is clearly a distortion of the budgetary processes and one which was drawn to our attention by the universities across the country in the course of our visits.

We have suggested that there could very well be a role for the federal Government in the provision of buildings for research. It is clear to us, from our studies and from the reports given to us by university administrators and academics, that one of the principal bottlenecks in the strengthening of research in universities is the lack of adequate buildings for research purposes.

A survey which we undertook in this area indicates that the requirements for buildings for research alone-that is, not teaching purposes, but research-is about \(\$ 120\) million per year up to \(1974-75\), or about 40 per cent of the total building requirements up to that period. This is a crucial bottleneck, and we have suggested a mechanism by which we think it could be resolved. We have called for a federal-provincial conference to consider the establishment of a research facilities corporation which would administer a research facilities fund and allocate funds to universities on the basis of application, the judgment of merit, need for balance among regions and need
for balance among French-speaking and Englishspeaking universities.

I turn briefly, Mr. Chairman, to the role of universities. I would first like to emphasize that the universities do have, always have had and we hope always will have a fundamental responsibility to support basic research in Canada.

The home of most basic research we believe should be in the universities-this kind of research is the responsibility of universities. This is not to say that basic research should not be done outside the universities; it is clear and it is so stated in the report that applied missions do require basic research and the amount of basic research depends on the particular mission. Experience has shown in general that this runs from 10 to 15 per cent of the total research even where there is a clear specific applied mission involved. We see that continuing, but we do see the universities having an important role to conduct basic research where there is no application in sight, research which has cultural value and educational value to our society and without which our society would be destitute from a cultural and educational standpoint.

Nevertheless, while we feel that this kind of research is important and should not be forgotten, it is in fact too easily forgotten in an age when technology and innovation surround us. Even though this kind of research should continue and indeed should be strengthened, we see additional roles for the university in the areas of applied research.

There is no doubt in our minds that the interest in conducting applied research in the universities is growing, particularly in the professional schools. Beyond the area of applied research we would like to see and urge on both the universities and the federal Government a greater involvement by the universities in research which is related to important Canadian goals in whatever field they may be, crime, mental health, urban problems, pollution, transportation, or wherever they may be.

Most of the research which has been conducted in Canadian universities might be called "little science", using the vernacular of the day. There has been very little by way of "big science" in the universities in which groups of investigators in the sciences or the social sciences or both have tackled major problems in an organized way. We feel there is a place for this; we feel that the trained resources in the universities could be used to good advantage in conducting research of this kind of interest to the country as a whole. We propose ways by which, through the initiative of either the government or its agencies, or through the initiative of the universities, these major proposals of the kind which I am suggesting could be undertaken by the universities.

I might say in passing that we see an important educational role in this respect too; much of the research of the future will be in the category of big science, that is, large scale organized research which requires the skills of many disciplines. We think that training for small scale individual research is inadequate for the scientist and social scientist of the future. They do need to learn the methods of big science and they should have the opportunity to learn these in the universities.

Finally, the role for the universities to which I referred earlier is the role in production of manpower. Virtually all of the trained manpower for research purposes for the country's needs must come and traditionally has come from the universities, although to a considerable extent from universities outside Canada.

The graduate enrolment has grown considerably: 1967-68, 25,000 full-time graduate students in Canadian universities; the projection from 1975-76 is 64,000 full-time graduate students in Canadian universities. So it seems clear that there is going to be a demand for training at the graduate level which is large; some people are suggesting that perhaps it is too large. We do not feel that there is evidence to support that fear at the present time. We do feel that the provision of a large pool of highly qualified manpower can and will change the economy of this country in an upward direction.

Mr. Chairman, I think I should stop at this point: without referring to the question of the organization of the councils or the kinds of grants or supports which we propose, or a number of other areas which I am sure will come up in the course of the morning and the afternoon session. What I have tried to say in these few minutes is simply enough to illustrate some of the underlying theme of our report, that the support of research in universities is a partnership and that it does involve the federal government, the provinces and the universities themselves.

I have made some passing remarks to the effect that policies require assessment of merits and I hope we will have an opportunity of expanding on that during the morning period.
We have indicated in our report and I have indicated briefly in my remarks that we feel there is a need to create opportunities to achieve a healthy balance within the country's universities in respect to research.

Finally, we feel that Canadian university research can and should be broadened to include greater attention to problems related to Canadian goals.

The Chairman: Thank you very much, Dr. Macdonald. I suppose we could now start the discussion period, with the intention of adjourning around 12.30.

If we have to continue, I think we should start again at 2.30 , rather than at 3.30 as announced.

\section*{Hon. Senators: Agreed.}

The Chairman: Just before we start the discussion period from the floor I would like to ask a brief question which intrigued me when reading your report: Why did you not pay more attention to the industrial sector in relation to universities and research in universities?

Dr. Macdonald: Primarily, Mr. Chairman, because it was not included in our terms of reference. We were charged with examining the role of the federal government in support of research in Canadian universities. There were many times when we were very much tempted to make exceptions with respect to the relationship of industry to the universities. It is very important; every member of the committee feels that this is important and there should be greater opportunities for improvement of the interface between industry and universities, but it was simply beyond our terms of reference.

The Chairman: Thank you, now we will start, as agreed, with chapter 5 . Senator Grosart?

Senator Grosart: Mr. Chairman, I should like to make a short general comment on the impression that the report makes on me. It is understandable that the recommendations have been made from the point of view of what is best for the universities of Canada, and that, of course, is a very important approach to the solution of the problem with which this committee is charged. However, I do get the impression that the main theme is: More political money and less political control. I agree with the first entirely, but not entirely with the second. There seemed to me to be some contradictions-and perhaps understandable contradic-tions-in the philosophy presented throughout the report in this connection.

I find some of this in chapter 5 where certain recommendations in respect to the funding councils are found. The general theory seems to be that there should not be any kind of centralized council to bring together the in-put of advice into the political deci-sion-making, which I think is the main concern of this committee. The report is more concerned with the out-put of money-the funding support-than it is with this very essential problem of in-put of advice. I am concerned by this suggestion, and the almost cavilier way in which the report seems to brush aside this concept of a centralized research council.

There was once a famous statement that what was good for General Motors was good for the United States. I think there is probably some truth in the
statement that what is good for the universities is good for Canada, but that is not entirely so. There is another viewpoint, and that is the one with which we are charged.

I wonder, Dr. Macdonald, if you would indicate what you and your committee would see as the balance between the use of federal public funds to support the university concept, as you see it-and with which I agree-and, on the otehr hand, the use of the universities to support R \& D in terms of public goals? These are obviously two different, but not necessarily opposite, concepts. Where is the balance? Do you see public funding merely as a way to upgrade the whole research effort in the universities, or do you see the universities having a responsibility to undertake projects orientated to public goals which they may not even like? I am not talking now about the defence situation, because that is a particular case, but there are others. Where do you see the balance here?

Dr. Macdonald: Mr. Chairman, I would like to adress myself to these comments of Senator Grosart, and I think that Dr. Dupre would also like to make some comments about them. He began by commenting that he interpreted the report as suggesting we are seeking for the universities more money and less control.

Senator Grosart: No, I said more political money and less political control. There is a difference.

Dr. Macdonald: Very well. Actually, throughout the report, I think, we do indicate that we see a need for a great deal more control of the dispensation of money than in the past. In a sense, we are calling for an adjudication of all funds that are distributed, and for an end to the provision of general funds to universities, such as the \(71 / 2\) per cent grant that has been traditionally provided to the president of the university from the National Research Council, and such grants as those from the Department of Forestry to the deans of forestry schools and from the Medical Research Council to the deans of medical schools. We are suggesting that these funds could be used more effectively on the basis of an adjudicated proposal in which the merit of the proposal, not only from the standpoint of its intrinsic merit but its meaning and usefulness to the whole field of research in Canada, is reviewed.

So, our approach to this has been to provide additional and better means of control over the expenditure of these funds.

The Chairman: But they were relatively small amounts, as compared with the sums of money made available in the form of grants?

Dr. Macdonald: Yes, that is quite true. For example, the \(7 \frac{1}{2}\) per cent that is distributed by the N.R.C. is \(71 / 2\) per cent of the total direct money which has been distributed, so it is relatively small. But, even here we are suggesting that the control should be greater. Furthermore, we have proposed a number of ways in which we think the adjudication process itself in respect of the bulk of the funds that go to the universities can be improved, and should be improved.

You are questioning whether there should be a central agency, and suggesting that we have perhaps dismissed this idea too casually. We certainly did not intend to be casual about it. We did consider the possibility of a central agency. We found little support for this across the country, in either Ottawa or the universities, although the proposal was made once or twice.

I think it is important here to remember that we are not dealing simply with science in our report. We are dealing with research. We were concerned, and gave weight to the fact, that there are very great differences in the problems in respect of support of scientific research and research in the humanities. We found that these differences are sufficiently great that separate agencies to manage the funds for the very different purposes would be a more efficient way of handling this.

We had no special brief for the three councils except that they represent Canadian historical development, and we felt that three councils, in fact, can cover the whole spectrum of needs of university research if their terms of reference are changed.

Let me come to your question about the balance of funds for university research versus funds for public goals. We deliberately did not make that judgment because it is a judgment which we feel is a political judgment. It is the responsibility of the politicians of this country to decide what this balance should be.

We made it clear that we feel there is an important role for the Government in supporting universities for their own sake. However, we do feel that there is an important role for the universities in supporting research which does relate to public goals, that that role has not been exercised, and that it should be exercised in the future to a considerably greater degree than it has been exercised in the past. I should say that this is not a view that was universally accepted within the universities. When we discussed with some of the university personnel, including the presidents of universities, the idea that universities should engage more heavily in contract types of research, and in undertaking major tasks for the Government of Canada, there was resistance to it. Traditionally the fear was that the universities would become a vassal of government is this were to happen. This is a fear we do
not share and one which is certainly not the consensus of the academics. There are many academics across the country and many university administrators who feel that there is an opportunity and a need, and that the universities should be used more effectively

In order to come more specifically to the question of what the balance should be, the only evidence that I can put before you is the evidence of the United States in the publication on basic research and national goals, in which Harvey Brooks referred to the fact that, historically, the amount of support for basic research in that country has been about 9 per cent of what is provided for R \& D. I think it would be fair to say that he and his colleagues felt that that was perhaps a reasonable percentage. The percentage in Canada at the present time I would say is probably about 10 per cent. If one looks at the fact that we are now at a level of around \(\$ 100\) million in support of research in universities and one makes the arbitrary judgment that this is essentially basic research in universities, that is a little unfair, because there is a significant amount of applied research. If one compares that to the total R \& D expenditures in the country of roughly \(\$ 1\) billion, we are talking about 10 per cent. My own personal judgment is that that balance is probably reasonable, but I do feel that the universities could be much more heavily engaged in research related to public goals.

Senator Grosart: You seem to place . . .
The Chairman: Before you go on, senator, could I know at this time how many senators would like to ask questions in regard to chapter 5 ?

Dr. Macdonald: Mr. Chairman, Dr. Dupré may wish to add to my answer.

Senator Grosart: I have about two or three questions.

Dr. Stefan Dupré, Director, Centre for Urban and Community Studies, University of Toronto: Senator, I have very little to add to Dr. Macdonald's reply to your question. I might just perhaps try to underline the extent to which we were conscious of that delicate question between political money, on the one hand, and political control, on the other. It is our concern with this equation, among other things, that led us to reexamine the particular organizational status of the Canada Council as it stands at the moment. As honourable senators know, I am sure, the Canada Council is not any kind of a governmental agency.

The Chairman: It is becoming more and more so.
Dr. Dupré: Precisely. It is not any kind of a Crown corporation, and looked at in its historical context I suppose this probably makes a good deal of sense
when you bear in mind that the Canada Council was originally equipped with an endowment fund, the annual proceeds of which would be spent for research support.

Since 1965, as we know, the Canada Council has had to rely more and more on annual appropriations from Parliament. This, among other things, suggested to us that perhaps the organizational status of the Canada Council merited re-examination in this light, and warranted a suggestion such as the one we have made, namely that regularized status as some kind of a Crown agency deserved consideration, precisely because of the importance of the balance in this equation between money and control.

May I pick out a second part of chapter 5 in order to illustrate our concern over the money-control equation? I would say again that this played a certain role in our dismissal of the single council of the form of research support in this sense. One valid criticism, in my view, of the single council mechanism, is that it may create a situation where too many important decisions as to goals, priorities and so on may come to be taken at the infra-political rather than at the political level, where again a concern for the balance between money and control might suggest such decisions should be made. I simply want to say that these two particular examples out of chapter 5 indicate our own personal concern as a group over the necessity to take into account the control factor when you are looking at the expenditure of public funds.

Senator Grosart: I think it is understandable that almost everybody wants to get away, as far as possible, from political control in the sense of having to live with annual appropriations under the Estimates. Our whole trend of political mechanism, as it develops, is in that direction. I am not sure it is a good trend. It runs counter to some of the basic concepts of the control of public funds by Parliament. Perhaps I say this because some of us spent a day at MIT recently and some days in Washington.

The Chairman: You spent some time at Harvard too.

Senator Grosart: Oh, yes. We spent a day at Harvard, but personally I was very much impressed with the MIT approach, which as you know, leans over on the side of technology and innovation, as the famous story of route 128 suggests.

I see a concern here again in this business of political control. To take a sentence out of your chapter 5 , on page 98 , you point out quite properly, "There exist widely different attitudes and viewpoints among the major divisions of the scholarly and scientific community." You seem to suggest that this is a reason against the single agency. My view is that it is one of the best reasons in the world why
there should be a single agency, from the political point of view, because the decision-maker, as you point out again on the same page, is the Cabinet operating to some extent through the Treasury Board. Without a single agency feeding into them a consensus or an over-view of the claims of universities and the claims of various disciplines, how is the political decision-maker going to make his decisions if he has to sit down and set the viewpoint of this discipline against the viewpoint of that discipline? In other words, how can he equip himself to spin off the probably quite legitimate requirements of this council or that council-and you are suggesting a good many research councils. Why do you reject the idea of a central co-ordinating body? You, yourselves, point out, for example, that you have traced 41 different departments and agencies of Government that are funding research in universities in one way or another. Surely these have to be brought together. It seems to me that a case can be made for two levels of centralization of the decision-making input of information. One can be scientific, the other political.

All our evidence, all my reading, seems to indicate to me one thing: scientists want scientific control of the decision-making, but politicians are almost forced by the existing system and their responsibility to the public to insist on maintaining control. This means pre-audit, post-audit, technical assessment, and so on.

If you leave that out completely, how would your system work in terms of the input of the necessary decision-making information to the political level which as you say makes the final decision? How would it feed in?
I appreciate the fact that this was not your main concern...

Dr. Macdonaid: It was one of our concerns.
Senator Grosart: . . . but you have done a lot of work on this and I am particularly interested in the opinion you have on this, that is, on the feed-in.

Dr. Dupré: As Dr. Macdonald has pointed out, this was one concern that we addressed ourselves to and devoted quite a bit of our resources to.

In terms of input that we see going into the decision-making system, we of course look to each of the three councils to make its case when it presents its estimates before Treasury Board. Here to us is a vitally important input of information, because presumably the councils, like any other Government agency, would prepare their estimates, substantiate them and defend them to their best ability.

At this point, note that the inputs that we are providing are the views of three Government agen-
cies, one dealing with natural sciences, one with the health sciences and one with the social sciences and humanities.

The inputs of course do not represent a consensus among the three agencies, and at this stage of the game I suppose that the view that we may be said to take of the political system, of our political decision makers, is that we look to them to go beyond the registration of consensus into the mediation of competing group claims, which of course one can say is as legitimate a function of a political system as the registration of a consensus.

We look to the political system, to our political decision makers, to adjudicate, with the support of their administrative assistants, the question of balance among the various major segments of the research in the natural sciences and engineering, in the health sciences, in the humanities and social sciences.

We have attempted to provide our political decision makers, in their mediation of these competing claims, with assistance in the form of a committee that we have called the Canadian Universities Research Advisory Committee.

The Chairman: I said that you were knocking at the door, but you had another group being in, indoor, in the Treasury Board. You do not take too many chances.

Dr. Dupré: That is right. We are looking here to a committee that will provide advice to those who are mediating these particular claims, rather than look to a single council that will present them with some kind of consensus-heaven knows what-that has been reached in house.

Might I say, incidentally, since your visit to the United States was mentioned, that one thing which has impressed me about the American system, as a student of American science and Government, is the extent to which one of the divisions in the scientific community, in terms of interest levels of funding and so on, has been brought home very clearly to us by the American system, and I refer to the division between the health sciences on the one hand and the non-health sciences on the other hand.

Senator Grosart: We always have to remember that under our system we do not have the congressional power over appropriation, which goes hand in hand with detailed examination and assessment of scientific and technological programs and projects. We have to live with that limitation for the time being. Some of us hope that, in time, our committee system will be strengthened to the point where we would get this particular kind of assessment which
would fill the great gap which some of us have discovered in the evidence we have heard.

My final question, Mr. Chairman, so that you can pass on to somebody else, is this. The report would reduce the consensus centres in this area to three. You started with 41. What about the other 38 departments and instrumentalities of Government? Do they have to go through the three agencies? Are you really recommending such a complete flip over in our whole system of government organization?

Dr. Macdonald: Mr. Chairman, quite the contrary. To begin with, we suggest a division of these two goals of the federal Government, that is, the goal of supporting research in universities per se, for its own value, and the goal of conducting research which relates to other purposes of the federal Government.

We believe that the organizational arrangement should be similarly divided. We are suggesting, in respect to the goal of supporting research in universities, we need councils that are devoting their energies and resources to that purpose, and those are the three councils.

When it comes to the 39 or 40 other agencies of Government which do support universities research, according to our investigations, our view would be that this is an area where centralization would be damaging. It is not useful to try to establish an overall policy for science that applies to all of these entirely disparate objectives of Government.

\section*{The Chairman: Disparate, entirely different.}

Dr. Macdonald: Yes. For example, the problems that are involved in pollution, which are involving political scientists . . .

The Chairman: But take biology, in the field of forestry, fisheries, agriculture, for example.

Dr. Macdonald: If one is seeking to achieve specific applied goals, then there is a difference in the kind of research and effort which is made.

There are two levels of decision here; one is the political decision. What goal is one after? What does one want to do in agriculture? Is the object to improve the production per acre in a particular crop? If that is the objective, there are various ways of looking at that goal; they are not all scientific, although some are scientific.

Once the political goal has been determined-and we believe that should be determined by the department and agencies under the aegis of the politicians, that is, those who are responsible for the overall goals of the country-then there is in the agency a decision as to
the role of science and social science. That is an expert decision. How much can we put into the accomplishment of this goal through science out of our total resources? How much of it should go into the development of services, as opposed to scientific investigation? How ripe is a particular field for scientific exploitation? Are we still at a stage where we do not have enough basic information that we are able to conceive a scientific program to accomplish the goal, in which case one would reasonably conclude that there may still be a need for a greater input of basic research?

What we are suggesting is that the scientific goal should be tied to the political goal in each case and that there should not be a single, uniform science policy.

The Chairman: What about departments which have only a scientific mission, such as forestry? There is no political responsibility; it is only research. We have been told that in the Department of Energy, Mines and Resources about 95 per cent of the staff is directly or indirectly engaged in research, that there is no political mission there.

Dr. Macdonald: There is a political mission; there is the strengthening of the forestry industry in Canada. That surely is a mission. In the case of energy there is the development of energy resources in the country. Similarly, that is true in the case of mines.

These are political missions and to some extent these are accomplished by science. Of course it varies in different departments. In some departments the scientific input would be minimal; in other departments it might be the major activity of the department. We see nothing about this that is incompatible with first deciding what the political goal is and then harnessing science to that particular political goal.

Senator Grosart: Mr. Chairman, in conclusion may I just clarify my viewpoint. It is very easy to say that all that has to be done at the political level is to set goals in science or anything else, but the fact of political life is that politicians are judged and are required to account not merely on the basis of how good their philosophy was or how good their goals Were, but how they spend the public money, item by item. That is to say that accountability is the essence of the political system as we know it. That is why I am somewhat concerned about this tendency to say, "Let us get away from accountability; let us get away from annual estimates." Sure, they are a nuisance and nobody likes them. They have their limitations, but this is the method that we have developed and that seems to be the best method of assuring that there is technical assessment and technical audit of the spending of public money.

We hear over and over again that the politician just has to set goals, science goals and priorities. He is not judged on this at all; he is judged on how he spends that money. In other words, it comes down to a strict cost-benefit ratio of accomplishment.

Dr. Macdonald: Senator, we would fully agree with that; we do suggest that it is important for the politicians to be getting advice and information on which they can make their assessments, not only about accomplishment but before that issue has been reached, the question of feasibility. These things do have to be assessed by the politician. We are suggesting a more rigorous examination of the research programs of departments by Treasury Board each year to see in what ways the scientific effort of the department has related to the goals and in what ways it should strengthen the goals.

We apply that in particular to the support of any university research by these departments; we feel that the departments should be making their judgments basically on the basis of the relevance of the research which is being supported in the university to the department goal, not to the university.

Senator Grosart: In another part of your report you indicate that you do not want the politician to be able to go beyond the inside accounting of the university, that to me is an extraordinary recommendation. It seems to mean that the Auditor General, Parliament, a parliamentary inquiry or a regular, normal audit should not be able to go into the last detail of the expenditure in a university.

Your theory was tried in the Winter Works Program and it did not work. That was in respect to a provincial audit, not a university audit, I say that not to cast any aspersion on the validity of a university audit, but to say that the person who is spending the money is not the best reporter of the validity of the spending.

Dr. Dupré: Senator, I am sorry if we left the impression that we would in any way exempt the universities from standard federal audit practices. We addressed ourselves to this problem on page 171, which is where our recommendations concerning audit appear. We point out at the bottom of the page that:

With very few exceptions, federal agencies currently accept, without supporting vouchers, a university's accounting of grant or contract expenditures, subject only to the university's own annual audit. The agencies retain an over-riding right to audit university accounts but it is understood this right will be exercised only in exceptional circumstances.

Our recommendation concerning audit, from the way I read it, is that basically we would like all federal agencies to adhere to the present guidelines that are used by a majority of such agencies.

Our recommendation states at the outset quite clearly that we would have the federal Government retain the over-riding right to audit the appropriate university accounts when circumstances clearly warrant, but we simply go on to say that as a matter of normal practice.

Senator Grosart: Would you read the rest of the quotation?

\section*{Dr. Dupré:}

While retaining the over-riding right to audit the appropriate university accounts when circumstances clearly warrant, all federal agencies accept, without supporting vouchers and subject only to the university's own internal audit, university accounts of research project expenditures.
Senator Grosart: I can only read those words as saying one thing; however, it is not a major point.

Senator Cameron: I think in practice, Mr. Chairman, the auditing procedures within a university would be quite acceptable, even to Max Henderson, the Auditor General. That has been my experience with university grants of this kind.

Senator Grosart: I am not questioning that; I am merely saying that the general recommendation that you close the doors on outside audits is at odds with the overall political responsibility for expenditure of funds.

Dr. Macdonald: Perhaps before we leave this point, Mr. Chairman, I should come back to what may be central to the comments of the senator, and that is the question of whether there should be some single central overall agency determining policy. It seems to me that that separates further the political judgment and the political decision from the scientific decision. You are interposing then between the politician and the scientists in the individual departments of government a new agency which would be a powerful agency and which would determine policy for science, and it would not be a political agency.

Senator Grosart: You have put the word "determining" into a context in which I would not have put it. I would have said "co-ordinating" or "recommending", but not "determining", because after all the determination can be made only at the political level.

The Chairman: It would be a clearing house.

Senator Grosart: I am not suggesting that there be a science agency that determines policy-far from it.

The Chairman: That central agency would not make grants?

\section*{Senator Grosart: No.}

Dr. Macdonald: That is a useful clarification. Then, are you not really talking about the function of the Science Council?

Senator Grosart: No, because I do not know what the function of the Science Council is. I have not been able to find out.

Dr. Macdonald: Are you not really talking about the intended function of the Science Council?

The Chairman: The Science Council is advising on science policy in general, but it has nothing to do, in my mind, at least, with the allocation of funds or with finding out what is to be spent on the physical sciences each year.

Dr. Macdonald: Mr. Chairman, you are using the word "allocating" where I use the word "determining". It seems to me that the question is: Are you going to get from such an organization advice, or are you going to get a determination of what actually is done?

Senator Grosart: This will depend on how good that agency is.

Dr. Macdonald: Our view is that it would not be good for the country to have a central agency determining what is done in terms of science in the very large number of departments.

The Chairman: It would never have the power to decide this because no such agency would have that power.

Senator Bourget: Would not that be the role of the intercouncil co-ordinating committee, the establishment of which is the subject of recommendation number 6.

Dr. Macdonald: The purpose of this committee, Mr. Chairman, is primarily to deal with issues of jurisdiction between the councils, and particularly to deal with proposals emanating from the universities that do not fall into the terms of reference of the council as it is at any particular time structured. We have an example at the present time in the fields of archaeology and psychology. Do they belong in the social science area or the natural science area? We believe there will always be problems of this kind. One could make a division today of all the areas within the university and be content that he was covering every area, and I am sure that six months would not pass by before some enterprising person would come forward
with a proposal that did not fit any of the terms of reference. We are suggesting that an intercouncil coordinating committee would act as a clearing house, and would route proposals to new areas where the support of a particular council is required.

Dr. Erich Vogt, Professor, Physics Department, University of British Columbia: May I add to that by pointing out that Recommendation No. 10 concerns a Canadian universities research advisory committee, which Dr. Macdonald mentioned earlier, and the chairman referred to this as providing an opportunity for the universities not only to knock on the door of the Treasury Board but to push the Treasury Board from inside. I think that this committee, as envisaged in our report, would be entirely an instrument of the Treasury Board, which would give confidential inside advice to the Treasury Board. It would not be an instrument of the universities within the Treasury Board.

The Chairman: I would not serve as a member of this council when I knew that other university people are near the Treasury Board, and advising it in secret.

Senator Cameron: Mr. Chairman, we are all aware that the purpose of this Senate committee is to try and devise a science policy for Canada. We have heard a lot of submissions as to what should be done, and what is wrong now. From our discussions and hearings we have learned that there is a great deal of duplication, and there is no clear-cut inventory of what is going on in Canada.
Dr. Macdonald, you have been charged with the study of the role of the federal Governement in support of research in Canadian universities, but I am wondering if we must not see this in terms of the total program of research in Canada, and of our total in-put as a nation into research. So far we have not been able to get a complete picture of what is going on. You have dealt with what is going on in the universities, and you have made recommendations as to how this might be done, but we still have not an answer after 15 months as to an overview of what is going on in Canada. Perhaps we cannot get it.

We asked this question in Washington the other day, and found that although they do not have the total picture they do have a pretty good idea. Because of their congressional system, which is so different from our system, they do have a more accurate check and a more accurate picture of the total in-put into research as a nation than we have.

Now, you have been concerned with the role of the universities and the role of the federal Government in supporting research, but that is only part of the total package. Suppose we accept the recom-
mendations that you have made that there be three councils. How do you envisage the implementation of the recommendations that would come from the three councils, even when they have been vetted by this supercouncil or this advisory committee? How do you get this ready for the cabinet? Have you given some thought as to how this will be carried right into the cabinet committee for execution?

Dr. Macdonald: Senator Cameron, I think, if I understand your question correctly, that you are trying to get at the problem faced by the cabinet, namely: How much of this funding should go to the support of research in universities through the councils...

Senator Cameron: That is one thing.
Dr. Macdonald: . . . versus how much should go into the support of health activities or forestry activities, or agricultural activities, or whatever it may be, depending upon what the goals happen to be at a particular time. Housing, for instance, could be included in this. These choices for a government are what we refer to in our report as incommensurate choices. They are not alternate ways of doing the same thing. They involve subtleties and priorities, and that is why they are political decisions. In order to make those decisions the Government requires the best advice it can get about the potential contribution of research to those decisions.

We have to again come back to what I must emphasize, that there are two different kinds of goals in respect to the universities. One is the support of universities, themselves, because it is important that Canada have strong universities. Here I think that governments can decide what percentage of its total resources for research that it wants to put into university research of that kind. We talked about the fact that it is probably of the order of 9 or 10 per cent at the present time. That is a political decision. It relates to the number of good people that are available and it also relates to the experience of other countries, how much one can use in this way. It relates to the quality of the adjudication process and how rigorous it is? Are we supporting really meritorious research or supporting a large amount of research with inadequate funds which is not research that is very useful or moving us forward at a basic level or any other level.

The second area, of course, is the area of research, which is related to specific political goals, and here I think the kind of advice that Cabinet gets should relate to the political goal and possible input of research in this area. I do not think that Cabinet needs to concern itself with the decision within a department, how it wants to accomplish the research objective, whether it wants to do it through its own
intramural resources or wants to do it by contracting it to universities or some other private agency. This is a decision which is a practical one and one which has to be made by the department on the basis of where they can get the best buy.

I think that the Cabinet should be concerned about using good practices and that they are attempting to get the best buy in the research which they obtain. What Cabinet really wants to know at this level is whether the research that is being proposed by the department is forwarding the goal of that department as set forth politically by Cabinet.

I think it is fair to say that the kind of advice which government in Canada and perhaps government in most countries has had, has not been of such high quality as one would wish in these areas. The Science Council, I think, is an attempt in Canada to move in the direction of improving that quality, but I would again question whether we will have better decision making by trying to centralize the area of advice to government on the overall capacity of science when we have such a very large number of different goals.

I could take an example from another country. Our input into research in the field of defence in Canada is entirely different, in proportion to the total from that in the United States, but our goals are entirely different. Now, one could argue that because the United States puts a very large percentage of its research into defence and that has been highly productive in terms of technology and innovation related to defence, therefore, we could do it. But does that relate to what we want to do in this country? I come back to the view that the decision about what one is going to do scientifically must be related to what one is trying to accomplish politically.

The Chairman: That is one aspect of it. I am beginning now to understand what your purpose was here. In other words, if I understand you, you are not proposing any kind of change in the mechanism of allocating funds to universities. You are proposing that these three councils merely, with the intention that they will make money available, as you say in your first recommendation, "will encompass all disciplines recognized by Canadian universities." You do not propose any kind of change in the present mechanism for allocating money to universities.

\section*{Dr. Macdonald: Better advice.}

The Chairman: Except your small group and the Treasury Board.

Dr. Macdonald: Better advice to politicians and much better management and practice within the agencies.

The Chairman: That is not a change in the mechanism, that is only a recommendation for these agencies. I understood that some years ago, and I think it was last year, there was great complaint from Canadian university teachers that there were too many federal agencies involved in giving grants to universities and there was great confusion, because they did not know where to apply. Do you remember? I remember this kind of recommendation that was presented at some stage to the Government.

Dr. Macdonald: Well, our feeling is . . .
The Chairman: You have decided to ignore that request from Canadian university teachers.

Dr. Macdonald: I am quite sure that does not represent a consensus of Canadian university teachers. Our feeling is that pluralistic approach related to the specific goals, which one is trying to accomplish, is a healthier and better system.

The Chairman: You, of course, argue, and quite rightly so, that there should be a micro-approach to these problems of allocating grants. I maintain there should be also a macro-approach, because otherwise we are bound to arrive at all kinds of imbalances, as we have them at present. For instance, we are told that in the field of scientific manpower training programs, through the generous support which has been forthcoming from the National Research Council, we are about to produce a surplus of PhDs in Canada in the field of science and engineering. At the same time, we were told by the President of the Public Service Commission that the federal Government was now trying to find at least 400 economists and they could not find them. This kind of micro-approach, allocating responsibilities to specific missions does not always work for the public good.

Dr. Macdonald: It is bound to produce imbalances if there is no macroscopic view to complement that micro-approach.

Dr. Dupré: I might say, Mr. Chairman, in terms of implementing the macroscopic view, as you so felicitously phrase it, what the councils-if it is clearly recognized that the councils, themselves, represent an important goal, namely a goal of a balance of research efforts and research for its own sake in uni-versities-become one of the important tools to which the federal Government can turn in implementing a macroscopic approach.

The Chairman: These councils exist now and through their separate existence we have produced imbalances, but you do not propose anything which could correct or review that situation. That is my point.

Senator Bourget: Except the intercouncil committee they may set up.

The Chairman: The Treasury Board. We have been told by the Treasury Board people that they look only at the increment and at new programs. This was repeated to us when we heard some people from the United States Bureau of Budgets. They described their approach to their science budget as the increment approach.

Dr. Macdonald: My understanding, Mr. Chairman, is that the Treasury Board in Canada is moving toward the program budgeting approach, which is not the incremental approach and this will affect sciences, as well as all other areas.

The Chairman: I could argue with this.
Dr. Ernest Sirluck, Vice-President and Graduate Dean, University of Toronto: I wonder whether it is true that the report contains nothing that answers to your problem. I do not think there is a complete answer but there are two strains of influence that I think are worth mentioning. At the federal level of things, we put a great deal of emphasis on development grants which ought to answer a felt need, so we do not think that the right place to make a decision about relative investment is at the micro level of decision, at the level of the individual members of university staffs, but rather at the federal level, and that it should be made with universities as a whole.

The second strain of influence belongs, in our view, properly to the provinces, that is to say, the way in which universities will develop is very closely related to provincial responsibilities and above all, the most sensitive, education.

I would not expect much success from federal dicta saying that the universities will now turn away from the production.

The Chairman: I was not speaking about that at all: I was speaking about the control and supervision of federal spending.

Dr. Sirluck: Yet what really is the distinction between those two things? - It is perhaps less complete than may appear, because what a university does is to enlarge its commitment, expand its effort, in areas for which it can get support. And if the federal sources of support are heavily in the direction of engineering, the university will develop a very rapid interest in engineering. The imbalance that you speak about, Mr. Chairman, in the present Canadian scene remains to be demonstrated and, even if it is demonstrated, it may be very temporary.

For some years, universities have been asked to run flat out to produce every kind of high level manpower effort; and if it is shown, as the report of the NRC suggested, that it has achieved an adequate supply in some science fields-which I very much doubt . . .

The Chairman: You are not alone.
Dr. Sirluck: ... there is a self-correcting mechanism. Departments in those fields will begin to find difficulty in placing their products and will begin to slow down in their expansion.

The Chairman: Five or ten years later, perhaps.
Dr. Sirluck: Not really. I think, much sooner. At the provincial level we have evidence now in, say, the Departments of Chemistry in the Province of Ontario attempting to control further growth in relation to opportunity already-although the first signs of overproduction, if that is true, only came to attention about a year ago.

Furthermore, I am extremely skeptical about these data. They take no cognizance, for example, of such factors-or take only a limited cognizance of such factors-as the export of people who only came here temporarily, the export, continued and growing export of Canadians, the capacity, that Dr. Macdonald mentioned earlier, of the Canadian economy to import, to absorb here more people, if they are available, to its benefit.

The Chairman: I will win this argument, anyway ...

\section*{Dr. Sirluck: Undoubtedly.}

The Chairman: Because if we do not even know that there is a balance in our programs, that is as bad as if we knew there were imbalances.

Dr. Sirluck: We should know, but I do not think it would be advantageous to substitute draconian controls from the centre for the several measures that are anticipated in the report. I think they are interacting and complementary measures.

Dr. Macdonald: Mr. Chairman, I think that the question which you are raising is of profound importance from the philosophic standpoint, the kind of freedom which we want to have as Canadians to make choices as individuals. We have not had a planned economy in the sense that we are deciding how many chemists we need, or how many economists we need.

The Chairman: I am against that, too.
Dr. Vogt: Or how many politicians.

The Chairman: But when there is federal money being spent in one field where we are producing a surplus and at the same time when we have great scarcities in other fields, I think I do not call that planning to spend less in the first field and more in the second, it is just plain being rational. If you identify reason with planning, okay, but ...

Dr. Macdonald: I think the responses which will be made by our whole society to a surfeit of manpower will be the same kind of responses which we have now made in the last few years to shortages in manpower. We have made the effort and we are producing people. We strongly urge on all governments the production of better information on our manpower requirements than we yet have. If we have such information, and if Government can produce such information, the responses-the responses of the universities, the responses of the individuals, the responses of individual faculty members, the responses of the students-will be better. We believe that students, if they recognize the areas of shortage, or areas of surfeit, would make judgments accordingly. That is the way we should be trying to make our judgments. What we really lack is information about our manpower requirements.

The Chairman: Yet we have just been told that when there is money available, the university will do it.

Dr. Sirluck: That is exactly the point. If the negotiated and strategic development grants that we propose in this report are successful, they will be exactly answerable to needs in the society, of the kind that you have identified. If we create a shortage of economists, then the universities would be encouraged by the Humanities and Social Sciences Council to aim much higher in that field. But if they accepted this, it would be with the participation of their provincial paymasters. And I think that the conflict has to be avoided between federal goals and provincial goals, and I think the right way to avoid it, as far as the universities are concerned, is through negotiated grants.

The Chairman: I do not want to monopolize this, but I might come back to it at the end of the day. I do not want to frustrate my colleagues too much.

Senator Cameron: Dr. Macdonald and associates, you have had specific terms of reference in preparing this report and have come up with certain interesting ideas. We, too, as a Senate committee have terms of reference, and this involves coming up with a science policy for Canada that does not mean only what we should do but how it should be done, that is, the machinery whereby it should be done. I maintain that before we can answer the question of what
should be a science policy for Canada and how it should be executed, we must have a picture of the total resources going into science in Canada. That is, what is being spent in Canadian universities, what is being spent in the private sector-because this involves manpower, equipment, and what goes with it. We have not got it so far.

It may not be possible to get it entirely accurately but I would think that somewhere in this picture we must have this national inventory of the input in science and development. It is important, for another reason. All the informatin we have, as educators, is that the budgetary requirements are going to escalate at a fantastic rate if we are to maintain our position in this technological age. This again involves the necessity of understanding not only what the Government is spending but what the private sector spends. We have not got this. I insist we must have it in order to evolve in our best judgment what should be a science policy for Canada and also the machinery for its execution.

Dr. Macdonald: We would agree, Senator Cameron; this information is not available. It is needed; I think we have provided it in the university sector.

Senator Cameron: Yes, indeed.
Dr. Macdonald: I think a similar study is perhaps needed in the area of industry, the private sector. Perhaps there needs to be a more careful look at the performance of government, not just the federal government but all governments in Canada, in the area of research.

There could be two additional studies done. Beyond that we would strongly support the view that there needs to be a continuing collection of data of this kind on an annual basis.

We had grave difficulties in obtaining much of the information which is in this report, simply because there has been no systematic gathering of it over the past years. We think the kind of information which is in this report should be gathered regularly, much of it annually. The same thing applies in industry.

Senator Cameron: Have you given any thought to the kind of machinery we need to give this national inventory of research input?

Dr. Macdonald: I think the answer is that we have not thought about it, but we could perhaps try to think about it right now.
We do have the beginnings in the Science Council and the Science Secretariat, which has conducted a number of studies, but these are static studies of what a situation is at a particular point in time.

It would be quite conceivable to develop machinery and an organization charged with the regular annual collection and analysis of data of this kind.

There has been a tendency I think in this country to suggest loading tasks of this kind and many other tasks as well on DBS; it may be wise to establish agencies that are charged specifically with doing this on a regular basis.

Senator Cameron: I would think it requires a specific agency but I am wondering why has the Science Council or the National Research Council or any of these other agencies not done it? I think this is essential to the whole question of where we are going in Canada.

You suggest this inter-council committee. How do you see the role of that committee in carrying the recommendations to the Treasury Board, or whatever the agency is going to be that is going to implement it?

Dr. MacDonald: Are you talking, Mr. Senator, about the inter-council committee, or are you talking about the Canadian universities research advisory committee, which gives advice to treasury?

Senator Cameron: No. You suggested that you have three councils and I have no quarrel with that; then there is an inter-council advisory committee.

Dr. MacDonald: The inter-council advisory committee is to coordinate the work of the three councils. Its advice is direct to the councils. On its membership is the president of each of the councils and whatever colleagues the councils themselves should choose.
One of their tasks, and I would expect the councils would assign this to them as well, would be to determine the distribution of applications in new areas, who is going to handle them or if it is a multidisciplinary proposal, what councils jointly should handle them.
If it is a major proposal it may be that this committee would be involved in the establishment of an appropriate ad hoc review committee which would represent the three councils and perhaps, other agencies and organizations as well, to give their views, but the advice is to the councils themselves.

Senator Bourget: But they would not advise Treasury Board at all?

The Chairman: No. This is recommendation No. 6, as opposed to recommendation No. 10.

Senator Bourget: I understand that, Mr. Chairman, but I thought also being a coordinating committee of
the three councils they might have their say also and give their advice to treasury Board, because with your recommendations, as I see it, it is only the university advisory committee who will be inside.

Dr. Macdonald: I think it is quite possible and perhaps even likely if the councils establish such an inter-council coordinating committee that they might choose to give advice to Treasury Board about what should be done by way of funding the councils themselves. This would depend on the question of whether or not they could reach some agreement.

Senator Bourget: It seems to me that it would be a logical role for the inter-council committee.

Dr. Macdonald: If they reached agreement they would be in a stronger position in putting forward recommendations of that kind. On the other hand, if they cannot reach agreement that is what the confidential committee is for, to give Treasury Board some help in reaching logical decisions.

Senator Grosart: Do you see these three councils dealing only with the funding and channeling of basic research?

Dr. Macdonald: No sir. All research which is done in the universities under the auspices of the councils -which could be basic, applied or, as we pointed out, major proposals dealing with areas such as urban crowding, pollution etc.

The Chairman: What about research in agriculture in the universities; where would that go in your councils?

Senator Grosart: How do you separate the two? How do you decide which goes into these councils and which stays with the departments?

Dr. Macdonald: Work in agriculture could be scientific and it could be under the National Research Council. There could be economic work in agriculture and, of course, there are people working in the field of economics in agriculture. That would be under the Humanities and Social Sciences Council.

These councils would be responding to initiatives coming from the universities about research which they wanted to do. They would be making their decisions on the basis of whether this was meritorious research which should be done in its own right in the universities. Also on the basis of knowledge of what kind of work is being supported by the Canada Department of Agriculture. The councils would serve here a balance wheel function. In the event that there is a heavy engagement of universities in agricultural research through the Canada Depart-
ment of Agriculture, the councils would respond by diverting a larger part of their resources to areas other than agriculture.

Senator Grosart: But you say at page 97 that your definition of a legitimate discipline is one which is recognized at the university level.

Now we are back to the micro-macro business: does this mean that if no university happens to recognize a particular discipline it cannot be considered by these councils?

Dr. Macdonald: There would be no application if the universities did not recognize it, would there?

Senator Grosart: So this is just another group that does nothing but respond-the three councils do nothing but respond to requests?

Dr. Macdonald: Yes.
The Chairman: But what about the individual departments? A lot of these departments now have grants programs where they only give the money if an application has been received. This is exactly the same procedure as these three councils would follow.

Dr. Macdonald: Except that the judgment here should be on the basis of whether this proposal is something which is of genuine interest to the goals of that department, not whether it is of interest to the university. That is not the point for the department.

The Chairman: So that university people would be able, for instance, if they are interested in doing research on labour problems, to come to the Department of Labour, where they have a small grant program to do that, or they could go to the proposed council?

Dr. Macdonald: Yes.
The Chairman: So again there is no change in procedure in this field.

Dr. Macdonald: Except that here we are suggesting that the Department of Labour should make its judgment on the basis of its goal, not on the basis of wanting to be a sponsor of university research. We think that this role of departments of government as sponsors of university research per se as a goal for these departments is not appropriate, and this is an important change in outlook, we believe.

The Chairman: How could you enforce that advice or that recommendation on departments?

Dr. Macdonald: We have suggested that the departments must account annually to the Treasury Board for the ways in which they have funded universities, and show in what way this has forwarded the goals of the department.

\section*{Senator Grosart: They do that now.}

Dr. Macdonald: Except that it is not a requirement that that be work that is important to the department.

Senator Grosart: If it is not a requirement that the department must justify any expenditure on research and development, then I do not understand our system of government.

Dr. Macdonald: They justify it on the basis that it is important to the university in the training of manpower, but that, we feel, should not be their function.

Senator Cameron: I am wondering if there must not be a limit to the degree of freedom the university departments have in setting their goals. You say that the department will set the goals and carry them out, but I would think there must be some place in our national structure where these individual departmental goals or university goals are related to the national picture.

Dr. Macdonald: Excuse me, Senator Cameron, but I am not talking about university departments; I am talking about government departments.

Senator Cameron: But, again, I keep coming back to this national inventory which is necessary in order to make decisions. We know that the research carried out in universities is not by any means funded entirely by provincial or federal government grants. There are many private grants of one kind and another, and these occupy resources of manpower and resources of space. I think we must have this picture in mind before we can establish a proper national science policy and determine how it should be implemented, and we have not got it.

Senator Bourget: In recommendation No. 3 you say:

The National Research Council be reconstituted so as to have as its sole responsibility the support of scientific and engineering research in universities and related institutions.

How do you envisage the role of the N.R.C. in the future, and what is going to become of its laboratories, and who will operate them?

Dr. Macdonald: First of all, we do see an important, and perhaps more important, role for the laboratories in the future than they have had in recent
years. We did feel that it was beyond our terms to propose specifically what the laboratories should be doing, but we did urge that this receive examination and that the laboratories be related to goals of the country. We suggested the possibility that the laboratories be organized as a series of task forces for specific objectives which might be set by the laboratories, or by the laboratories on direction from the cabinet, or to specific objectives of departments of government. But, we stipulate that these be clearly defined tasks that the laboratories are undertaking, and that they be organized in such a way as to be able to accomplish those tasks making maximum use of the flexibility which would be available to them to group and re-group from time to time, to change the nature of the task, and apply their resources to these tasks.

I think it would be fair to indicate that this view of the role of the laboratories is consistent with Dr. Schneider's view, as President of the National Research Council-at least, that is our interpretation of the comments he made to us, and we support them and subscribe to them.

Senator Bourget: Does it mean that you may have task forces from other universities come down to Ottawa and use those facilities?

Dr. Macdonald: Well, that would be a decision for the laboratories. If they did not have the manpower resources in their own laboratories on a full-time basis they certainly should be able to second persons from industry or the universities to assist in the accomplishment of the tasks. They cannot be undermanned if they are to accomplish whatever task they undertake. We do feel that the division will enhance the opportunity for the laboratories to identify clear objectives for themselves which do relate to Canadian interests.

Senator Grosart: If the National Research Council becomes, in effect, the University Research Council, would we not still need a National Research Council?

Dr. Macdonald: This is the senator's terminology, and we do not hold any particular brief for the terminology that is used here. We suggest that the National Research Council be the agency to fund the universities' scientific and engineering research. We did not name the other group. It could be the National Research Laboratories, or it could be the National Research Council, and you could have some such new name as you suggest for the body to conduct university research.

Senator Grosart: It would hardly be entitled to be called the National Research Council if its respon-
sibilities were limited as you suggest in Recommendation Number 3.

Dr. Macdonald: That raises the question of whether the responsibilities are limited. We would expect that within three, four or five years its responsibilities in respect of support of university research in terms of dollars would have grown to a multiple of the level of the support of the laboratories. In the last year it has passed the level of support of the laboratories. We do not look upon this as small. This is one of the reasons why we view a separation of these two functions as being inevitable, because of the very great growth one can anticipate in the coming years in the university support function.

Senator Grosart: That is a quantitative rather than a qualitative approach to the problem.

Dr. Macdonald: Yes, it is.
Senator Grosart: And to some of us the qualitative approach is every bit as important.

Senator McGrand: I understood someone to say that about 10 per cent of the research money went to basic research. What proportion of this basic research is done by the universities and by the Na tional Research Council? There must be some proportion. Now, is it possible to get the number of these basic research projects that have been undertaken, and a copy of a written document. which a person could read for his own satisfaction.

Dr. Macdonald: I will answer your second question first. The projects that are supported by the Council generally do result in publications, and I think you could get from the National Research Council some indication of the publications. My recollection is that the Council does require the grantees to submit publications, although I may be wrong in that.

Dr. Vogt: There is a very complete annual report issued by the National Research Council which lists all the projects of individuals that it supports.

Senator McGrand: That would be sponsored by the National Research Council. Where would you get that sponsored, by the universities?

Dr. Sirluck: Mr. Chairman, there is no comprehensive list for all of Canada. An increasing number of universities are now producing this kind of information in annual form for their own members. I do not know what that number is, but you could get it. For example, I could give it to you for the University of Toronto. This would be of all sectors and it would be short titles.

The Chairman: Would it be a short list?
Dr. Sirluck: No, it would not be a short list, but a short-title list.

Senator McGrand: Where is the most basic research done, by the National Research Council sponsored by them and their grants, or by the universities?

Dr. Macdonald: Since I used the figure 10 per cent I will answer that. First of all, senator, I do not think you should take the 10 per cent as being a precise figure. I arrived at this by estimating \(\$ 100\) million in university research and assuming that all of it is basic research, but which assumption is not correct, as some of it is not. I did not take into consideration the basic research which is done by the National Research Council and the departments of Government, which would offset the applied research which is done by the university. That is the way I arrived at the 10 per cent. It is a very rough figure. In general, I would think it would be fair to say that the great majority of basic research is done within the universities.

The Chairman: I would like to ask you another question at this stage concerning these three councils. In the United States they have within the government only one foundation. As a result of our visit there we have not detected any great movement to alter that situation. How is it that in Canada, with a much smaller budget, we would need three councils, whereas in the United States they have only one foundation to do the same job?

Dr. Dupré: I think, simply looking at the American situation, Mr. Chairman, that a second organization may have, understandably at this stage, escaped your purview, and that is the National Endowment for the Humanities and the Arts.

The Chairman: I think the tendency now is to put that in the foundation itself.

Dr. Dupré: As I understand it, the National Science Foundation of course has evolved a quite considerable role in sponsoring research in social sciences. The National Endowment will be more geared towards research in the humanities. In that sense I am pointing out that there is a second body that deals only with the humanities.

A second point that I would bring to your attention is that, of course, organizational peculiarities differ very much between the American system and our own. I would find it difficult if I tried to give a panoramic view of research sponsorship in universities in the United States to exclude from the scene the National Institutes of Health. It happens that the

National Institutes of Health is an integral part of an operating department; the Department of Health, Education and Welfare. This suggests, of course, that one could conceive of the health sciences in this country as perhaps being funded, not by council, but by an operating department of Government. We considered this particular anomaly in the course of our research on this report.

We came to the conclusion that the evolution of sponsorship of health sciences and research in this country, which has been under MRC, a semiautonomous branch of NRC, warranted the continuation of a council form of organization, taking into account all the circumstances. If you look at the American scene and put down NIH, the National Science Foundation and the Humanities and Arts agency, you have there really three agencies that would correspond, in a sense, to our three councils. Of course, the organizational status of councils is quite different. The other difference, of course, in our scheme is that we would place social sciences along with the humanities rather than putting the social sciences under the umbrella of a natural science agency, and at this stage you get into the intangible sort of judgments that inevitably accompany any kind of recommendation dealing with the Government organization. This was the feeling of the study group and this was, I think, very much shared across the board. For methodological reasons, there are some very valid points to be made for continuing the link between the social sciences and the humanities. Neither can we ignore the long humanistic tradition in the social sciences, which is so much a part of the general Canadian tradition in the social sciences. This seems to speak in terms of what we were thinking of in favour of a grouping of social sciences and humanities under an individual council.

The Chairman: But how would the areas assigned to these three councils, as you say, encompass all disciplines recognized by Canadian universities? You will have the humanities in Social Research Council. This is fairly well defined and then the Health Council, which is again well defined. Do you mean that all the rest of these things or disciplines, which are taught in universities, would come under the \(\mathrm{Na}-\) tional Research Council?

Dr. Dupré: No, I would say, Mr. Chairman, that we have felt that the various disciplines would group themselves under each of the three councils in accordance with some of the recognized affinities that exist, for instance, between law, on the one hand or business administration and the social sciences on the other hand. Of course, it goes without saying that in describing our scheme at this juncture, the importance of the intercouncil co-ordinating committee becomes one of quite critical importance. What do
you do, for instance, with medical sociology or medical economics?

The Chairman: These are disciplinary. Why did you not think of having three main councils divided according to the main disciplines: the physical sciences, life sciences, social sciences, and humanities?

Dr. Dupré: I am not quite sure that I understand, that it is not, in essence, what we have.

The Chairman: Health, of course, is quite an important part of what is usually called the life sciences, but it does not cover, for instance, the research which is done in universities in the field of agriculture, forestry, school officiaries and biology. It seems to me to be quite restrictive. If this area or this council is restricted to the field of research on human health then by implication all the rest has to go to the National Research Council. Then you have a whole lot of things which can be very remote one from the other.

Senator Cameron: And the duplication goes on.
Dr. Dupré: Then this is a function where we would look to the intercouncil committee ...

The Chairman: But if you do not start with some kind of definite classification, I do not see how your co-ordinating committee will get out of confusion, because once the major responsibilities of the three councils has been defined, that will be it. Of course, the co-ordinating committee will have to divide the responsibilities between the three councils when they deal with the inderdisciplinary questions and problems.

Dr. Macdonald: I think the answer to this question is that we really do not see any ideal classification which is neat and into which everything can fall in a pocket or compartment where it automatically belongs.

The Chairman: That is impossible, but at least there are certain degrees of perfection.

Dr. Macdonald: Then we asked ourselves the question, can the present arrangement serve the purpose satisfactorily, and we concluded that it probably could serve the purpose as satisfactorily as any other kind of arrangement. We would not say, for example, that one would get away from the kind of difficulties you describe by simply dividing along the lines, physical sciences, and life sciences. What does one do with biophysics? You are into a problem there, whatever kind of division you make.

The Chairman: There always will be interdisciplinary problems.

Dr. Macdonald: That is true. This is the reason why you need the intercouncil co-ordinating committee. It seemed to us that we can on an arbitrary basis make decisions as to where a particular area is going to be located. To take the example of social work, it can be decided, and would I think have to be decided, if these proposals are acted upon, where research in social work is to lie-is it in the human-ities-social sciences council, or is it in the health sciences council? I think one would want to discuss it with the people involved in this field, to find out from them where they think their research and their future effort will more closely relate, where their affinities will be. But these are, in the last analysis, arbitrary decisions, and we are just finding that the present arrangement is sufficiently satisfactory.

The Chairman: It leaves it that the NRC has all kinds of residual things but they still carry on basic research in for instance, agriculture, or medicine.

\section*{Dr. Macdonald: Yes.}

The Chairman: It seems to me it might be more desirable if you had at least a division according to the three basic groups of disciplines and then of course you would still have the gray zones. But it seems to me that with that kind of allocation that you have here, you maximize the gray zones rather than try to minimize them.

Dr. Macdonald: You create some additional problems if you try to change the structures which have grown up over a long period of years and if one is going to do that, for example, dissolve the Medical Research Council and establish a life sciences council, with entirely different terms of reference.

The Chairman: Not entirely, it would be just an extension. You may have to expand, because this is the very purpose of your recommendation. We have now to create three councils which will cover all the research activities in the university. This does not exist at the moment.

\section*{Dr. Macdonald: That is right.}

The Chairman: So some of these three councils will have to extend their scope and activities.

Dr. Vogt: Mr. Chairman, the difference between what exists now and what is proposed is not very great. There are areas like law and education not encompassed at present by the councils, which would be fitted in.

The Chairman: Not because they are not covered by the responsibilities of the councils: it is just because of the fact that the Canada Council has decided that it would not give assistance to those
fields, but it could at present, if they wanted to, as it is entirely within their responsibility to do so.

Dr. Vogt: Mr. Chairman, you are really supporting my argument that at present the arrangement we are proposing is not really very different from what exists at present, that the councils are in a responsive role, but that does not mean that they have to give a certain amount of money to each field, depending upon how many requests there are from the universities. They can still decide to support law, in that field of research, or not to support law, or they can entertain applications.

The Chairman: If the only relation to life sciences and biology and related sciences at the moment is only human health, in the council, then those doing research in biology of fish will have to go to the National Research Council. It seems to me that in research related with human health and related with the biology of fish, trees and animals and all these things-at least if those councils have to devote their attention only to basic research and applied research -there are a lot of common problems in those fields. I do not think it would be desirable to take all these other research problems related to life sciences and put them with the physical sciences.

Dr. Macdonald: These problems of course exist now between the National Research Council and the Medical Research Council. They do have difficulties in deciding where a particular proposal or area should lie. We would not expect those to disappear, whatever kind of division one makes.

I think the only summary answer that I can give to your question is that it seems to us that we can accomplish the objectives in covering the spectrum of research within the three councils with no more difficulty . .

The Chairman: No more confusion, than now.
Dr. Macdonald: No more confusion, than would be the result of the changing of the structure in the way you suggest, or in any other way.

The Chairman: I would like to ask a few questions before we adjourn. Have you considered whether or not it was desirable to have government institutions which would carry on research, carry on non-mission oriented research more or less parallel to the work which is being done in universities?

Dr. Macdonald: For example, an institute of economic research?

The Chairman: Or in the social sciences or in some of the activities which are carried on now by the National Research Council doing a lot of work in basic and applied research.

Dr. Macdonald: We did not deal with it in a direct way. I think our response to that would grow out of the philosophy which is evident in the report, that is, that the basic research being undertaken for its own sake, should be supported in the universities.

\section*{The Chairman: But?}

Dr. Macdonald: But there is what we have called oriented basic research; that does need to be done in relation to the missions of government and should be carried on by government. It would be our feeling that it would be unwise to establish institutes for research of a basic nature which were not related to any particular goal within the framework of government itself; that this kind of work should be within the universities.

The Chairman: But you have not considered the problem in any systematic way?

Dr. Macdonald: No, we have not.
The Chairman: Thank you very much: We will adjourn until 2.30.

Upon resuming at 2.30 p.m.
The Chairman: There may be a vote in one of the Senate committees in about half an hour's time which will compel Senator Carter to leave us, so I will ask him if he has any questions.

Senator Carter: Thank you, Mr. Chairman. I am very sorry for being absent this morning, but I could not be in two places at once. Because I do not know what went on this morning the questions I ask may have already been answered, and if that is the case I hope you will stop me.

If I read this report correctly, it recommends that councils will take over the responsibility for science for its own sake, and agencies will be primarily responsible for what we call mission-oriented research. The report recommends also that we keep the three councils we have now, and add two or three more.

The Chairman: You did not read the report that I read.

Senator Carter: Perhaps I misread it. I did not make notes as I went along. What do you understand it to recommend, Mr. Chairman?

The Chairman: There is a proposal to set up three councils . . .

Senator Carter: Yes, to retain the three we have, and to add some more. Is not that it?

The Chairman: No. Perhaps you want to comment on this, Dr. Macdonald?

Dr. Macdonald: Briefly, senator, we recommend the modification of the jurisdiction of the three existing councils. We recommend that the Medical Research Council be reconstituted, and separation of the granting function to universities from the inhouse laboratory function of the National Research Council-that is, a separation of those into two different agencies. We use the term "National Research Council" to apply to the agency which would be responsible for the support of universities. In the case of the Canada Council we would separate off the granting function-that is, support for the humanities and social sciences-into a council for that purpose. We would separate that from the patronage of the arts. But, there are no new councils recommended.

Senator Carter: Then, I was a little mixed up. Did you not recommend that there be environmental research?

\section*{Dr. Macdonald: No, sir.}

Senator Carter: Who would do environmental research under your recommendations? How would that be done?

Dr. Macdonald: There is a very large number of departments of government that are involved in various aspects of environmental research, but we would look upon that as being mission-oriented research which sould be organized in terms of a government function which is to be performed, with research being one of the supporting elements of that function, whatever it is. And the Government, of course, from time to time changes its organizational structures and the boundaries of the various departments that it has.

Senator Carter: You have various agencies for research in water pollution, air pollution, and all the rest of it. Who is going to co-ordinate this type of research?

Dr. Macdonald: We made no recommendation about that. Our terms of reference limited us to the role of the federal Government in support of research in the universities, so we did not make any recommendation about how that should be done.

Senator Carter: The idea I have been getting as I have been listening to the evidence before this committee is that in the overall picture we should be concentrating upon what we can do best, and what
is most natural for us to do, such as Arctic research, marine research, communications research, and medical research. I know that you are dealing specifically with universities, and it seems to me that we should, first of all, establish centres of excellence so that we have certain universities specializing in certain types of research. Is that one of the things you have in mind?

Dr. Macdonald: That arrangement becomes possible if one accepts the proposals in our report for an extension of the numbers and kinds of grants, and support available, particularly in respect to the recommendation for a negotiated development grant along the lines that the National Research Council has pioneered, but extending it to the other councils, and with the Government having the option of investing larger amounts of money in grants of this kind if it so chose to develop centres of excellence.

Senator Carter: You touch on that in your report, but I got the impression-I must say that I did not have the time to study this as thoroughly as I would like-that you would concentrate on universities that were the best equipped physically, but these would not necessarily have the best men to make use of the equipment.

Dr. Macdonald: No, senator, our proposal in respect to negotiated development grants calls for the support, through this form of grant, of programs which have already demonstrated a degree of excellence, but which perhaps need additional support to establish what is commonly now called "critical mass" in order to become important nationally and internationally. The basic criterion which we call for is excellence already in existence.

Dr. Dupré: In addition to negotiated development grants we have proposed that the councils be in a position, as Government funds permit, to offer something that we have called the strategic development grant. Here, the idea is to fund research in universities where there is perhaps not very much activity in a certain field of research already, or where there is need to catch up, so to speak, to existing standards of excellence elsewhere. In brief, then, what we have is a range of tools which we propose the federal Government could use-negotiated development grants to build on strength and excellence where it already exists, and strategic development grants to make possible the emergence of a degree of excellence where none exists at present.

Senator Carter: When you come to select the centres of excellence do you find that there is already a consensus on what they are and where they are located?

Dr. Macdonald: I think in the case of centres of excellence there is generally a consensus. These places do stand out, but this is not to say that we are not calling for rigorous adjudication in a judgment by the councils or other agencies as to whether or not they want to provide negotiated development grants.

We feel that wherever the Government is providing funding it should be on a basis of adjudication, which looks at the merit of the proposal, the quality that exists at the present time in the organization, the need to establish a regional balance in Canada, and also the need to respect differences between English-speaking and French-speaking universities, to acknowledge such differences, and to correct inequities if they exist. All of these things should be taken into consideration in making the judgments, particularly in respect to strategic development grants, but certainly they are important also in developing centres of excellence in the country.

Senator Carter: Are there gaps now in the fields in which Canada should be developing excellence?

Dr. Macdonald: This is not something on which we pass judgment in our report, but I would think it would be the view of all members of the study group that there are important gaps. For example, there is the problem of Arctic research, and the funding in this area. Your chairman, during the lunch break, drew attention to the fact that we spend very much more in some areas than others.

The Chairman: This was off the record, but you can quote me just the same.

Dr. Macdonald: This, I think, would raise questions about whether or not there is a sufficient emphasis on excellence in some areas. There are many examples, of course, of which Arctic research is one. We have done very little in the area of pollution, although we are starting to do some now. There has been a great deal of criticism of the lack of organized effort in the area of transportation research.

Senator Carter: I think you mentioned in your report that you received complaints that fields such as architecture were neglected altogether.

Dr. Macdonald: We think this is a serious problem. There have been judgments, which appear to be almost arbitrary, that certain areas would not be supported by the existing councils. Architecture is one field that complained it had difficulty, as did schools of business administration, and faculties of education in universities. Until recently the engineers had been claiming that they were getting inadequate support from the National Research Council, but our feeling is that that criticism has been corrected, and that
they recognize it has been corrected. There are many examples of areas which are, even now, receiving little support from the-councils. Law is another one.

Of course, the result of all of these lacunae where support is not available is that those who are involved in these areas in the universities, see as a solution to the lack of support the establishment of new councils. We have had calls for a business administration council, an education council, a renewable resource council, and so on. A law council was one of them. As a matter of fact, I believe the deans of law have set up a committee of their own now to investigate the possibility of having a council on law research established at the federal level. If the existing councils had their terms broadened, and their mandates required them to cover all the disciplines in which research has been conducted in the universities, and to review applications from any discipline, the call for a multiplicity of new councils would disappear.

\section*{Senator Carter: Thank you.}

Senator Bourget: I thought that my friend, Senator Carter, was touching on a point that appears in the minority report. I wonder if we could discuss it now, Mr. Chairman.

\section*{The Chairman: You may.}

Senator Bourget: This concerns the basic philosophy which underlies your report, Dr. Macdonald. I suppose you have read the minority report. Dr. Dugal, unfortunately, cannot be here today. Are there some comments about what he said in his report?

Dr. Macdonald: I do not know whether there are any particular points.

Senator Bourget: I am thinking particularly about the opportunities that some university may not have when judged on merit or excellence. As you know, there are big and small universities, and I wonder if, in your recommendations, you have taken that fact into account so that the different universities will have approximately an equal chance of getting some help.

Dr. Macdonald: First of all, this bears on the question of adjudicating on the basis of merit, which is a view with which Dr. Dugal disagrees. Our position as a study group on this was that we do not see that it is an assistance to a university, or to the strengthening of research in Canadian universities, to give funds to support proposals which are not meritorious, either in terms of the implicit character of the proposal itself or the qualifications of the individual to carry the research out.

We feel that this does not mean you have to seek persons who already have a lot of experience, but the proposal which they want to put forward should be tied to the training which they have, and it also should be a proposal which on scientific grounds-if it is in the scientific area-has intrinsic merits of its own. The idea of distributing federal funds as general support of research, without reference to merit, seems to us to be an inefficient way of improving the quality of research in Canadian universities.

At the same time, and to balance this view, we proposed in particular the strategic development grant, which is a method for the Government to assist in the development of high quality research where it does not exist, and to look at regional disparities and disparities between English speaking and French speaking universities.

The Chairman: Why do you not call them "opportunity research grants"? The word "strategic" has a defence connotation that may not be understood in the Maritimes or in Quebec.

Dr. Macdonald: There is no objection. This kind of grant could be used at the Government's discretion as widely as it chose and, if Dr. Dugal is right that this does not provide the kind of thing that is needed to help the French speaking university to catch up...

Senator Bourget: I am sorry to interrupt. I am not speaking only for the French speaking university. As you can see, I am from Quebec. I am also looking to the other universities like Sherbrooke or Carleton.

Dr. Macdonald: This is the point I was making, that if we have not done it for the French speaking university, for the problem Dr. Dugal was speaking about, then we have not done it for the regional disparities that exist in Canada. We gave in our own minds and in our writing a good deal of attention to this issue. We think the mechanism which we have provided gives the Canadian Government a better way than they have ever had to resolve these disparities that are regional, or that are in some instances English speaking-French speaking. In some instances there are large complex universities with graduate schools, and there are small universities that are undergraduate and which have, therefore, particular problems in developing research programs. All these things we believe can be dealt with by the strategic development grant or the opportunity research grant.

Senator Bourget: Do you feel that these Recom-
mendations 49 and 52 would help them-that is, the
research grant, and the strategic development grant?
Dr. Dugal seems to infer, if I understood him well,
that some universities in the past had the financial
capacity to attain that degree of merit or excellence which seems to be your philosophy, and which I do not deny, while others were handicapped to that extent that they did not have the same opportunities. Probably that is the reason why he mentioned that in this report. I do not know as I did not see Dr. Dugal, but you may know.

Dr. Macdonald: We certainly agree that there are disparities and that these need to be corrected, but I think we would be unanimous-that is, unanimous with the exception of our dissenting member, Dr. Dugal-that this machinery can provide the basis for correcting those disparities.

The Chairman: It would be largely a political decision, after the Government has considered the proposal, I would imagine.

\section*{Dr. Macdonald: Yes.}

Dr. Vogt: Yes, Mr. Chairman, this committee has heard before, in testimony, that there are two kinds of research-good and bad. I think there is evidence that from Quebec, in particular, in the sciences there has been very good research emerging, and I think it needs to be encouraged. I do not think that one needs to encourage bad research, even in an emerging province.

\section*{Senator Bourget: I agree.}

Dr. Vogt: I want to point out that the committee is represented by eight people from Ontario and Quebec and one who is an outsider. In my own region in the west there are many ways in which we disagree with the University of Toronto. We disagree about the siting of telescopes-and as to where in the body of Canada the navel is located-but we do not disagree, I think, on questions that are raised in the report. I think our problems are very different in the west from what they are in Ontario. The recommendations that are made in the report for allowing universities to differ will do very well for a smaller province, or a different province like one in the west.

Senator Bourget: You are satisfied with that?

\section*{Dr. Vogt: Yes.}

Dr. Sirluck: Simply as a matter of location, Mr. Chairman, I think it is Recommendation No. 17 on which we are pinning our faith in this, rather than the derivative recommendations that are cited. On page 127 we explicity assigned to this device, the strategic development grant-and it may be that that is why the "navel" analogy has come forward-

The Chairman: Are you the author of it?

Dr. Sirluck: The object is to recognize the need, the desire, and the willingness to initiate a significant program where it does not exist. We think that there are some evidences in the past year of at least one, and perhaps two, of the councils having taken some initiative with parts of the country, including Quebec, where such a need and desire exist, and having made a more rapid development possible. We think it is at that level rather than at the level of the judgment of the individual researcher's project that the significant stimulus should come.

I think it is really very ineffective to judge the project of an individual who is already there on the grounds that his district needs special support. We should get the special support into that district by a massive program which commits the whole university and, with it, its provincial paymaster.

The Chairman: To go on with this, I would like to ask a question about this criterion of establishing merit or excellence. Although I agree, of course, that this should be the general criterion that should be used in so far as assistance to research in universities is concerned, I would like to hear the members of this panel comment on the way this criterion up to now has been applied in Canada.

Are you satisfied that this has been really the criterion which has been used? To what extent has it been used effectively to see to it that at the beginning, at the pre-audit stage, real excellence is encouraged?

Dr. Vogt: I have just one comment about that, Mr. Chairman. I think that the committee had some reservations about the recommendation in the past, at least in some of the councils, because we recommend that the review committees of the councils which look at the proposals have members appointed to them in such a way as not to perpetuate the membership of the committee-that is, that the committee does not choose its own members. We felt that in the past there has been perhaps some kind of an establishment in the various disciplines in Canada, and that this has tended to be reflected on some of the review committees. We would like to see that problem reduced.
I think that other than that we did not have many reservations in the study group about the operation of, say, the National Research Council review committees, which I think have operated very well in the past to locate proposals of merit wherever they originate.

The Chairman: But we have been told occasionally that at the beginning some of these committees give a chance to new people coming into the field of research. When they succed in getting a grant in their
own first years of research, irrespective of their performance afterwards they are more or less assured that they will receive assistance. If this is the kind of application of the criterion of science merit or excellence I do not think it is very worthwhile.

Dr. Macdonald: I would have to agree with that. We have had argument with members of the National Research Council about this. It is only fair to say that they feel that we are misinterpreting their history and what they have been doing to some extent. But, for example, we quote on page 120 the fact that in 1968-69, of 3,816 applications in all fields, 3,570 were supported, and only \(6.4 \%\) were rejected. That is a very low rejection rate.
There are certain justifications which N.R.C. points out. They do want to get the new workers started, but we feel that once the worker has started the kind of review process that looks at the grant on a year to year basis has left something to be desired.
We noted that the rejection rate in the Medical Research Council also was not very high. As a matter of fact, the Canada Council's rejection rate was the highest of the three councils, being \(34 \%\) in 1968-69.
I think I am speaking for the study group when I say that we feel that a more careful review of the proposal regularly each time it comes up, whether it comes up once a year or every third or fourth year as we propose in the management practice, is necessary, and it should be a rigorous review. The rejection rates are indeed very low.

The Chairman: So you would suggest that they be rather generous when they apply this criterion to newcomers at the so-called pre-audit stage?

\section*{Dr. Macdonald: Yes.}

The Chairman: But then these committees should be much more strict at the post-audit stage-

\section*{Dr. Macdonald: Yes.}

The Chairman: -when they are in a position to appraise the quality of the work which has been done?

Dr. Macdonald: Yes, and there are new applications coming forward.

The more experience they have had with an investigator, the easier it is to make judgment. This is not to say that at the beginning stages we think they should give money without a review process, but they should tend to be more lenient and lean over more in favour of the young worker at the stage where he has no experience, and no record on which to base the judgment.

I might also add-and it is relevant-a criticism which we heard from members of the council: The review committees do have some difficulty because they know that in many instances graduate students are supported by these grants, and in many instances the level of support is virtually the amount which is required to support the graduate student. They do not like to reject these proposals, because that rejects the support for the graduate student. That criticism is not one which is made only by us, but by members of the council to us. There is the feeling that this does make it difficult for the council to be as rigorous in its judgment of what proposals it should support as it perhaps would wish to be.

We propose machinery in respect to support of graduate students which we think would overcome that.

Senator Bourget: I have had some questions I would ask of Dr. Dugal, but I do not think it would be fair to ask them of Dr. Macdonald.

The Chairman: In the event they do not feel like commenting, it is their right to refuse comment.

Dr. Macdonald: I am very happy, Mr. Chairman, to try to speak for Dr. Dugal as well as I can.

Senator Bourget: In his final review report on page 358 he says:

Only three organizations-the National Research Council, the Canada Council and the Medical Research Council-have granted a higher proportion of our research money to the Frenchspeaking universities of Quebec (up to 13 per cent of the total), but this proportion is still much lower than it should be.
I wonder if during your studies you noticed that through the government agencies there was too little money granted to, let us say, Quebec universities and if, at the same time, your two recommendations concerning the negotiated development grant and the strategic development grant will take care of that?

Dr. Macdonald: I think it is certainly true that there is a disparity of this kind. I know that the National Research Council, through its president, has been concerned about this.

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As a matter of fact our idea for strategic development grants really originated with correspondence which we had with Dr. Schneider of the National Research Council. He was trying to find some ways of strengthening and assisting the French-speaking universities in Quebec to catch up. So this I believe is consistent with his own view of a way in which assistance towards catching up can be provided.
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Certainly the view of the study group is that this machinery, if it is used wisely and vigorously by the federal government, can provide the answer. If it is used in such a way that very little money is devoted to this purpose, it is not going to do anything. It really is a matter of government decision as to how vigorously it wants to pursue this goal.

Senator Grosart: Mr. Chairman, we are still on chapter 5 and we have not got down to the sixtyfour thousand dollar question.

The Chairman: I am watching you.
Senator Grosart: There is the recommendation that Canada Council support of research in the humanities and social sciences be terminated. I am very interested in that recommendation and I...

The Chairman: This is only the thirty-two dollar question.

Senator Grosart: I expected to find several pages of argument in support of that recommendation, instead of which I came across something that seemed to my simpled mind to be almost a non sequitur. There is only one paragraph leading up to that recommendation, and I would appreciate an explanation of the causal relationship between this argument and the recommendation:

For one thing, it is extremely difficult to place a number of important disciplines, linguistics and history, for example, in the category of humanities or in the category of social sciences. Then, too, as in the use of quantitative attribution techniques in literary criticism, there is a growing tendency in the humanities to borrow social science methodology. Conversely, much important work in social science, such as in the history of political thought, continues to be humanistically-oriented. Accordingly, we recommend that...
Perhaps somebody can explain the causal effect of this reasoning, and this very far-ranging recommendation.

Dr. Dupré: To take the first crack at that, senator, I believe that the particular reasoning which you quoted there is what leads us to recommend that there be a single council to cover both the humanities and the social sciences. Of course, we did look at the alternative, which was one of a number available, of having distinct councils-for example, one for the humanities, and another one for the social sciences. It was precisely the sort of phenomena to which you alluded in the quotation you read from the report which led us to the conclusion that there should be a single council to cover the humanities and the social sciences. Our point, therefore, is that
terminating the mandate of the Canada Council to support work in the humanities and the social sciences, should not lead to two distinct councils, one for the humanities and one for the social sciences. Our recommendation was rather that the humanities and the social sciences be covered by a single council.

The Chairman: But what was the reason why you wanted to separate the social sciences and the humanities from the arts? What is your criticism of the method of allocation of money of the Canada Council up to now which led you to that conclusion or recommendation?

Dr. Dupré: Again, I am willing to try to give some of the reasoning behind our recommendation. For one point I will go back to something that was raised this morning by Senator Grosart concerning the whole question of political control. It is true that what has been happening in the Canada Council in recent years is that it has become the subject of increasingly large annual appropriations as opposed to financing itself exclusively from endowment, as was originally the case. Once you have a situation where you are on annual appropriations you have to start, I suppose, to question whether you should have large annual appropriations going to a body that is not a government agency. This, of course ...

Senator Grosart: Excuse me; why do we keep hearing the statement that the Canada Council is not a Government agency?

The Chairman: It is not. That is specifically stated in the act.

Senator Grosart: It may not be an agency under the definition in the Financial Administration Act, but ...

The Chairman: It is a unique organization. I remember that very well because I drafted the bill.

Senator Grosart: It is all very well to say that it is in the act, but so long as it is getting annual appropriations it is an agency, because it has to report through the minister, and it has to justify its expenditures.

\section*{The Chairman: But it did not have to.}

Senator Grosart: It has developed along that line. If the Rockefellers or the Fords had come along to add to its capital fund that would have put it in the very unhappy position of operating as a granting agency completely divorced from control of public judgment, and so on. I am glad that this did not happen. I am glad it had to come back. I am glad that the National Arts Centre is in the same position and has to come
back and justify what it is doing. I like to see this happen. I like to see a relationship between the public will and public action. I like to see that relationship as close as it possibly can be. I am not saying that there should be no funding unless you are sure you have got a one hundred per cent agreement from the public, but I like to see a relationship, and I like to see that interplay.

The Chairman: In any case, we were just discussing the legal position, and the legal position is that the Canada Council at the moment is not an agency of the Crown, and that is stated in the act.

Senator Grosart: We are being semantic because the Financial Administration Act labels them without any great. .

The Chairman: It has other kinds of implications. For instance, the Canada Council can refuse to come before any parliamentary committee except the Public Accounts Committee. Again, that is stated in the act.

Senator Bourget: It is like the science adviser to the President of the United States, then.

Senator Grosart: I will not argue the point. But, in respect of the public funds it gets through the Estimates it has to report, and whether you call it an agency in the layman's sense, or in the sense of the Financial Administration Act...

The Chairman: This is beside the point we are discussing.

Senator Grosart: I do not think so, because we are discussing the Canada Council as it is, not as it is supposed to be. The report refers to the Canada Council as it has evolved, and I can understand why in the academic community there is some confusion. This is something that has evolved and ...

The Chairman: I think the recommendation here is that the Canada Council should lose this kind of privileged position.

Senator Grosart: That it should lose its mandate.
The Chairman: It should lose this privilege of not being an agency of the Crown. That is the recommendation.

Senator Grosart: All the others, according to the recommendation, are to be special kinds of agencies of the Crown. It is these kinds of inconsistency in this report that bother me.

Senator Cameron: Is it not true that circumstances have changed very much. The Canada Council Act was passed with the idea that the Canada Council was to
be funded through specific grants, and that it was not answerable to the Treasury Board. The demands upon it have grown so much that the Canada Council either had to get federal grants or fold up. The result has been that the federal Government for the last five years has been making very substantial grants, and the Canada Council is now in the anomalous position of operating on a basis entirely different from that which was contemplated. There is another implication here, I think, and that is if we recognize the fact that the challenge to Canada and to science policy is going to be the funding, on literally a colossal scale, of research in the social sciences, then there is probably good justification for separating this aspect of it from the Canada Council. This is what I am trying to get at. This is the rationale of the committee.

The Chairman: That was the purport of my original question.

Senator Grosart: I am sorry; I did interrupt while you were giving the explanation.

Dr. Dupré: Basically, it was simply that one of the thoughts we had in mind was that there might be a need to regularize the legal status of support for the humanities and social sciences in keeping with a system that rests very heavily on annual appropriations. Thus, we could see merit in the idea of a humanities and social science research council, which would have the legal status of an agency corporation of the Government of Canada.

The Chairman: If the Canada Council lost its present special status and became an agency of the Crown, like the other councils, would you still recommend a separation between the two functions?

Dr. Dupré: There is quite a bit to be said for this. Of course, our mandate did not direct us specifically to look into the support of the arts. Actually, from the way our recommendation has been framed it is entirely possible to create a humanities and social sciences research council, which is then and there an agency corporation of the Government of Canada, and to have the Canada Council, as it now exists, continue as a patron of the arts. There is an interesting question in my mind here in that it is entirely possible that the endowment that the Canada Council has might well be sufficient to come very close to covering a sort of a support that it is now given, and can be given, to the support of the arts.

The Chairman: Do you feel that over the years the Canada Council has not done a good job in so far as the social sciences and humanities are concerned? Is this why you want to separate the two?

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Dr. Dupré: Well, our work on the development of Canada Council policy certainly indicated that here is
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an agency that has had a very sympathetic concern for the humanities and social sciences, as is indicated by the growth in the support that the Canada Council has generated. We were also conscious, as we did our work, that as the humanities and the social sciences became an ever increasingly larger part of the total operation certain kinds of anomalies seem to be developing which, in our judgment, certainly warranted a good, hard look at a far-reaching organizational change. To be specific on this, there has been, for some time, the whole question of the extent to which the humanities and the social sciences, and the universities themselves, are represented on the council body. Of course, this is the kind of concern that one finds registered in studies such as that done by Professor Mabel Timlin for the Social Science Research Council of Canada. She points out, at the time at which she was writing, that the Canada Council had very little representation from the humanities. She noted there was none whatsoever from the social sciences.

The Chairman: If you exclude law.
Dr. Dupré: Yes, if you exclude law. I think it is worth bearing in mind here, of course, the fact that the Canada Council did evolve originally from the idea of very general patronage, including, of course, a substantial amount of patronage in the arts. In that light, it is undoubtedly extremely reasonable to have a council that is very heavily made up of persons who represent local community interests, and who are bound up in the arts. Once the support of humanities and social sciences becomes a very large part of the operation then the whole composition of the council has to be looked at in a different light. To be sure, this is something you could remedy without necessarily splitting the organization up, but, of course, you come back to this whole question of annual appropriations.

I would point out also that there are some other questions that arose in our minds in the course of our research. We go to some length in chapter 8 of this report to describe the kinds of management practices that are followed by the Canada Council in administering its research funds. Certainly, speaking for myself, I would say that I detected here traces of management practices that I would say are quite probably rather more appropriate to the patronage of individual artists than they are to the support of researchers.

Senator Grosart: Excuse me. You use the word "patronage" when you are speaking of federal support of the arts, but other terminology when you are speaking of the universities. Is there any great difference?

The Chairman: It is not political patronage.

Senator Grosart: Is there any great difference between patronage of the arts and patronage of the universities? Is there a necessity for a different word?

Dr. Dupré: I think that is probably more a peculiarity in the way I am expressing myself.

Senator Grosart: It is fundamental to your thinking, I am afraid.

Dr. Sirluck: Perhaps we are only to answer questions. Is it permissible to ask one?

The Chairman: I do not promise an answer.
Dr. Sirluck: I will put my intervention as a statement, rather than as a question. The report states that the fundamental ground it has for suggesting the termination of the mandate of the Canada Council in the support of research is that there is no real similarity of function between the patronage of the arts and the support of research in these fields, nor is there even any very close substantive relation between the sectors. I, for one, can see no real relation between econometrics and a symphony, and I daresay there are many physicists who are better critics of music than an economist is likely to be. It seems to me there is a real difference between the notion of patronage, and the notion of the sponsorship of research for specific goals. I think it is easy to understand how originally in Canada these two tiny efforts could be put together, because there were some commonalities between them. Perhaps both had to do with the humanities, and the Government formed some sort of link because they were too small to be handled separately. Now that research in the social sciences is growing even more rapidly than with the growth of research in the natural sciences, and in the humanities is also achieving maturity in Canada-and the cost for support for research in humanities is going to grow very rapidly as well-we have to ask whether this linkage between the two functions has anything except a historical reality. The feeling of this committee is that there is no important linkage in what is needed to constitute an expert body ...

Senator Cameron: When you say "this committee" you mean...

Dr. Sirluck: I beg your pardon; "study group". I meant the committee that is being questioned; not the one that is questioning.

The Chairman: You are a group.
Dr. Sirluck: That is right. The group view was that it requires, for the support of research in the humanities and social science, a council which is pre-
dominantly expert in that function (it should also have some public interest representatives); and it assumed that what is required in the sector of the support of the arts also requires some expertise.

If it were necessary to buttress that kind of judgment by looking into the details of administration or the details of policy, I daresay it would be possible to bring forward evidences that the Canada Council, in attempting to dispose of both its now very large functions, is using interchangeable methods more appropriate for the one field than for the other. We could, I think, if we had to draw up a list of faults, find material; but I do not really feel that the report would have been a more beneficial one if it had attempted to find fault in that sense.

If the criticism is that we do not put down a bill of particulars out of which an indictment flows, I think we would have to plead guilty to that criticism, because it was not our function to list things that could have been better done but to point to ways of doing things better in the future. We thought the real nature of the Canada Council is best understood historically and that a phase has really come towards its completion.

The Chairman: That makes me a Father of Confederation.

Senator Grosart: At the same time, a bit of a stepchild. Might I comment that this seems to be an exercise in academic pigeonholing. I would like to see the same criteria of adjudication apply to the grant to a ballet dancer in respect to public funds. I use the term "public funds" in the largest sense; in fact all the funds of the Canada Council are public funds in one way or another. Should not the same kind of criteria of adjudication be applied here as would be applied under your system to the funding of someone to write about or do some research on conflict of laws? What is the difference? Why is conflict of laws in the humanities, and the development of ballet in the field of drama?

\section*{Dr. Sirluck: Why not microcellular biology?}

Senator Grosart: Why are these in different categories? Tell me why you say the Canada Council must now or in the future concern itself only with grants in the field of culture in the narrow sense?

Dr. Sirluck: Sir, it is because, in the field of university research and in these two great sectors of academic work, we want a council which is oriented to that end. We certainly did not want to impose a handicap on the performing arts. Let me take one or two examples. In the other councils that are attempting to assess and support research in universities, the normal method of refereeing applications
is to draw upon the judgment of standing committees of the discipline, which get all the applications of the whole country and, therefore, the same group of people is able to establish a continuum within which they can rate the applicant.

Senator Grosart: Would you mind my interrupting there, to say that my impression is-knowing something of the Canada Council adjudication-that this is precisely what they do. They have groups from the arts-a music referee group, a graphic arts referee group-and I understand they do exactly the same as you are suggesting should be done elsewhere. I do not think it is fair to the Canada Council to say that they do not operate in a continuum of standard criteria of adjudication. I do not think it is fair to them to say they do not do that.

The Chairman: I think Senator Grosart is quite right, according to the evidence we have had before us.

Dr. Sirluck: The impression I had was that there were individual referees for each project and that subsequently the report of those referees came before the academic panel, which is a single panel covering the entire field of operation.

Senator Grosart: Excuse me, but I know for a fact that in the music field there is a panel, the chairman of which happens to be Louis Appelbaum. They are down here three or four times a year. They are called the grants committee. They referee them in exactly the same way, as is being suggested here.

Senator Cameron: May I interrupt? As one of the referees for the Canada Council on a number of occasions, I know this procedure is followed. But I do not want to get into that.

Looking at this recommendation, which has farreaching implications, and looking at it from a management approach, my feeling is that this is a good recommendation, having in mind particularly the size of the appropriations that will have to be made if we are to have any impact in the social sciences.

What I am concerned about is that no mention is made here of the role you see for the Canada Council in the future. Does it go back to what it was originally, to subsist on the revenues from the capital grant-which was \(\$ 50\) million, and a pretty good investment which was paying about \(\$ 5\) or \(\$ 6\) million; probably more than that today-or are you seeing it as a combination of living on the proceeds of the capital grant each year plus governmental appropriations every year?

The Chairman: They have not studied this and I think it was outside of their scope. They did not look at the arts.

Senator Cameron: The principle is important here. Here is a very important agency which has done a good job within limitations but it is facing a new era of development. We must keep the Canada Council going but in making this recommendation there should be some suggestion as to what the role of the continuing Canada Council would be. Is it going to be a fourth council? You have got three. Was it your thinking that it be somehow tagged along as a fourth agency? No one has said that.

Senator Grosart: You have now got five or six. This would mean seven or eight.

Senator Cameron: But this is not here. Historically, as the chairman says, this is very important.

Senator Grosart: I think it might be mentioned here that Senator Cameron heads the Banff School of Fine Arts, which is a university,-a very good one, and one that is very necessary one in Canada. Why do you take the fine arts out of this whole research grant to universities picture ? I do not understand it. There is a lot of research in the arts going on in universities, research in painting and in music, research in the whole spectrum of the graphic arts.

The Chairman: I think we should let our guests answer a little bit more than they have been doing in the last 15 or 20 minutes.

Dr. Sirluck: On page 107 the report says:
Always consistent with our view that the three federal councils should encompass all legitimate areas of research, we would envisage the new Council as supporting research in the history of art, the history of music and related fields. The Canada Council, for its part, would be solely responsible for the fine and performing arts as such, and would not form a part of the research council structure.
What I think the study group would answer to the question that has just been put is that so far as the arts are a field for research in the universities they should be supported, as any other humanistic discipline, by the Humanities and Social Sciences Council that we propose according to the methods of supporting research.

So far as the arts are an activity they should be supported by the Canada Council, continuing with the function it now has for the support of the arts. We are attempting to separate the research function from the patronage of the arts themselves.

I think that our silence on the nature of the structure that is the patron of the arts is mere humility; we did not want to make gratuitous recommendations that we had not been charged to make. This is not because we think it is unimportant. I for one think that it is of immense importance, but I think that the capacity of the Canada Council to respond to the performing arts in the future, when research is so much bigger than it is now, will be diminished if it retains responsibility for both functions.

The Chairman: I think that we will have to leave this, because I am sure we have other questions to discuss. I would like to ask, as far as I am concerned at least, a last question:

To what extent do you think that this recommendation for separation of these two main activities of the Canada Council is being supported by the university community in this field?

Dr. Macdonald: I do not think, Mr. Chairman, I could answer that yet. Certainly we did hear proposals as we crossed the country during our sessions when we were conducting the studies that there should be a separation.

We heard proposals for a greater separation. As a matter of fact, in some circles there were suggestions that there should be a separate council for the humanities and one for the social sciences. There certainly is support for the proposals that we put forward, but whether it represents a consensus I simply could not say yet.

Dr. Dupré: I have, of course noticed-I may say with some concern-the extent to which perhaps at least in the press the organizational changes that we have recommended have tended to eclipse other recommendations that have been made in the report.

Speaking personally on this point, Mr. Chairman, I am reminded here a little bit of that great Pope couplet:

For forms of government let fools contest;
Whate'er is best administer'd is best:
Translating that at the administrative level I suppose one may say for forms of administrative organization let fools contest; whatever policies are implemented are best.
My point I think really in the last analysis is the following: Government organization is almost inevitably I think, as Senator Grosart perhaps very rightly pointed out, an exercise in academic pigeon-holing, no matter what you are dealing with.
I think, for example, of immigration, which has been successively in the Department of Mines and Technical Surveys, the Department of Citizenship,
the Department of Manpower and heaven knows what will be the last optimal judgment as to where this particular function should be pigeon-holed in government.
I think it is very much like this in terms of any government function that you are going to look at. Just how are you going to structure it? Where are you going to lodge it ?

Speaking personally I would say this, that we have made a number of substantive recommendations in this report dealing with financing of research, the kind of tools that the federal government should use to support research, project grants, strategic development grants and so on, with the financing of research including indirect costs, and with a host of different kinds of administrative practices.

As far as my personal judgment is concerned I think that if these substantive policies could be brought about, regardless of the form of organization, we would have what I would think as a member of this group would be a very substantially improved system of supporting research in the universities. Certainly the actual organization form of pigeon-holing that takes place does not necessarily guarantee that these are the kinds of substantive policies that are going to come about at all.
I would say this, that in the opinion of the group it is probably fair to say that the kind of substantive policies that would make for the optimum support of research in Canadian universities would be more likely to come about under the organizational form that we recommended than perhaps under the existing form. In terms of personal priorities I would put the substantive policies that we have been talking about well ahead of a particular kind of organizational form.

The Chairman: I want to tell you that today in our questioning as a committee here we have not been impressed by the press coverage of your report-and I do not say this in terms of any kind of criticism of the press coverage. I want to tell you that we are primarily interested in at least one main subject of interest, the re-organization of the mechanisms for formulating and implementing our science policy. That is why we have been insisting on these recommendations today, as far as the federal government are paying for indirect costs of research in universities, and all this.
I think that there you have interesting suggestions which are after all not too new, because they were in the Bladen report which appeared some years ago, and have not yet been implemented.
Today, at least, I am not intending to question you indefinitely or in detail about these other aspects, or what you call the more substantive aspects
of your report. I think that for us a committee at the moment the recommendations you make as to re-organizing the mechanism for formulating and implementing policies are for us of great importance. That is why we have questioned you on this kind of separation of the Canada Council that you are suggesting, because if this recommendation is acted upon it will have all kinds of implications after that. Whether you like it or not it will be substantive.

This it the reason why we are following that kind of questioning today as far as we are concerned.

Senator Cameron: How many faculties of fine arts in Canada have made a recommendation along the lines of your recommendation?

Dr. Macdonald: Faculties of fine arts?
Senator Cameron: Yes, there is a number of faculties of fine arts in the Canadian universities. I am not sure just how many there are. I can understand it when you say there has been criticism of the Canada Council, but in arriving at this recommendation did you get representations from faculties of fine arts which would lead you to this conclusion?

Dr. Macdonald: If my memory serves me correctly, Senator Cameron, I think we had only one brief which came specifically from fine arts groups, and this was from a group of three universities in British Colum-bia-from a group of fine arts people at U.B.C., Simon Fraser, and Victoria.

The Chairman: The Banff School was not represented?

Dr. Macdonald: No, we did not receive a brief from the Banff School.

Dr. Vogt: Mr. Chairman, I just want to add a comment to the suggestions that we heard on our visits across Canada. As outsiders listening to people in the humanities and social sciences across Canada I think it is fair to say that we found that they had been long short of funds, and also that they were not very articulate about what they wanted to do. Generally, we found they were enormously grateful for what the Canada Council had done in recent years, and because they had this new-found wealth they were not very interested in making suggestions for change. I think some of the reasons for change were to make the arrangement parallel what we have in the National Research Council, which we are also uncoupling from an agency which runs laboratories.

The Chairman: I hope we will come to that very shortly.

Senator Haig: Mr. Chairman, you have allowed Senator Bourget to jump around the place, so I will turn to page 166 .

The Chairman: I should learn never to make exceptions.

Senator Haig: That is your privilege, Mr. Chairman, but with leave I will ask my question.
The Chairman: Very well.
Senator Haig: You mention here that the funding is given by a grant or a contract. In the second paragraph on page 167 you say:

A point of enormous significance, in our view, is that neither the grant nor the contract is an instrument developed specifically to support research.
I ask the chairman of the study group what he would suggest in its place.

Dr. Macdonald: We suggest in its place a research agreement. Perhaps Dr. Dupré would like to speak to this.

Dr. Dupré: We have suggested in place of the grant and the contract a new legal instrument that would be drawn up specifically to support research in universities.

Senator Haig: With an open-ended clause in it to the effect that if the research project is for a period of two or three years and it is discovered after a year and a half that another grant is needed, or another year is needed-would it be in an open-ended agreement?

Dr. Dupré: No, it would not. The research agreement could be drawn in such a way that the project would have to be reviewed, say, from a fiscal point of view annually, and, if it was a long range thing, the grant would be subject to termination on a year's notice. A research agreement could accommodate any of these possibilities, and, in a sense, a research agreement is a form of contract, if you will. By designating such an instrument separately we felt, first of all, that the Government would have a better means than it has at present of gauging just what kinds of agreements are being entered into with universities as opposed to all other kinds of contractual arrangements that sometimes take place with universities such as, for instance, the purchase of personal consulting services, and things of that sort. The same research agreement would highlight the kinds of broad standards of management practice that we hope the Government would consider to be appropriate to use in fincancing university research.

Senator Haig: Well, you put the grant and the contract together, and get a research agreement?

Dr. Dupré: In a sense, and I might point out also that our idea of a research agreement is not new. We spent some time studying the kinds of work that has gone on in the administration of research in Great Britain and the United States, and quite specifically the idea of a research agreement was first broached in detailed terms by a report that was issued by the Bureau of the Budget in the United States. That is a report by Dr. Lee Westrate, who went through very much the same kind of exercise that we went through in respect of chapter 8 . It went into the different kinds of practices-and there is a multitude of them-that now obtain in the existing system where grants and contracts are use sometimes almost indiscriminately and interchangeably for the support of university research in that country. The particular recommendation of this report of the Bureau of the Budget was that thought be given to segregating under a separate kind of legal instrument with its own name those particular kinds of transactions that occur between the federal Government in that country and the universities for the support of research.

Senator Haig: The universities will make an application for a research project, either basic or applied?

Dr. Dupré: Yes, sir.
Senator Haig: And if it is accepted when an agreement will be entered into between the federal Government, or its agency, and the university outlining the term of the research, the estimated cost, the capital or income, and so on. That would be drawn up?

Dr. Dupré: That is correct, sir.
Senator Haig: So you have really a combination of a grant and a contract?

Dr. Dupré: That is correct, sir, and, indeed, in a sense I think it is worth noting the way in which research procurement practice has evolved in this country. You have a situation where grants and contracts in many instances have started to look very much alike. This is not least because of the peculiar needs that universities have in terms of the kind of government procurement practice that is applied to them, and the idea of a research agreement is simply to try to sort out what is now a rather indiscriminate use of two legal instruments, and to group all procurement practices under one single form of legal instrument for the support of university research.

Senator Haig: What if a department of the federal Government requested a research project on, say, the colouring of the fish in Placentia Bay? That would be a specific research project initiated by the federal Government, or a department thereof, and given to a university?

Dr. Dupré: Yes.
Senator Haig: Then, would there be an agreement between the federal department and the university in respect of that project?

Dr. Dupré: We felt that for this kind of project the research agreement would also be an apropriate legal instrucment. We saw very few exceptions to the use of a research agreement with the universities. We set these out, I believe, and they are limited to the purchase of personal consulting services, to classified research, and to the actual procurement of hardware.

We see no obstacle to the use of a research agreement where the government department has, in a sense, intitiated the research project. We found in the course of our own investigations many instances of grants or contracts between the government agency and a university where which actually originated the proposal, the Government or the university is very often "a chicken and egg proposition". This is not least, of course, because university researchers so of ten interact with their professional counterparts in government.

The Chairman: It is already 4 o'clock. I would like to have some time to discuss NRC as well, therefore, I think that we should limit, for the time being, at least, questions which are not related to NRC. If you wish to ask another question, Senator Carter, in the same vein, I will allow it.

Senator Carter: I was not following that. I suppose probably it is related to it.

The Chairman: Ask your question then.
Senator Carter: You have Government agencies carrying on work in their own labs. I get the impression, from your report, that you feel there should be more integration, better relationship between the Government labs and the university labs, and that even the Government should have their labs on the sites of universities. Am I correct in that?

Dr. Dupré: This is now the case in a number of instances.

\section*{Senator Carter: You recommend more of that?}

Dr. Dupré: Absolutely. We recommend that the federal Government undertake a far-reaching study of its intramural laboratories with a number of criteria in mind. Just one of these criteria, which was included in the list, was the extent to which the siting of intramural labs in relation to universities might be beneficial, both to the labs and to the universities.

Senator Kinnear: I think you said in your report it was not very successful, because they got acquainted for a day or two and then forgot each other.

Dr. Macdonald: That is variable, senator. In a number of instances it has worked very well. In many instances it left a great deal to be desired, and the mere placing of the Government laboratory next door to some laboratories on a university campus is no insurance that there will be a good interaction. It seems to depend, more than anything else, on the personalities of the directors on both sides.

Dr. Dupré: It can also depend upon a number of technical and mechanical factors as well, such as the extend to which the personnel policies of both the federal Government and of the universities make it possible for intramural laboratory scientists, to teach part time on campus or vice versa.

The Chairman: I think we should come now to NRC and, fortunately on this occasion, I was not the father of that great institution which was established in 1916. I understand that you suggest that either, directly or indirectly, NRC, as it exists at the moment, should be eliminated-directly because they would cease to give grants to universities, and indirectly because the Government should reconsider the status of all its research labs. That would include, I am sure, the NRC labs. I am sure that you have given a lot of thought to this and I would very much like to have what went through your minds when you came to that direct and implicit recommendation.

Dr. Macdonald: Mr. Chairman, I think I could start by saying that we do not view this recommendation as, in any sense, being an elimination of the National Research Council. For example, it was not considered to be an elimination of the National Research Council when the Defence Research Board and Atomic Energy were hived off, and when the Medical Research Council was established and took with it one of the functions of the National Research Council.

We are keenly aware of a long and distinguished history of the NRC and the very important way it has contributed to the growth of science in Canada, without which, over the past 40 years or so, this country would have been in a very bad way scientifically. We are impressed at the same time with the fact that it has been an evolutionary process in which the National Research Council has undertaken certain functions, which have grown and become viable on their own as well as becoming functions which have been separated from the main body of the National Research Council and have operated autonomously. I have noted the Defence Research Board, Medical Research Council and the Atomic Energy.

For this reason, it is our feeling that there is no reason to anticipate that this evolutionary process may not continue and as John Gardner has said, renewal in institutions is an important function. From time to time institutions have to examine their own function and their own operation in terms of its relevance to the kind of society and kind of issues with which it has to deal. We see an increasing divergence in the function of the National Research Council as it is now structured; a divergence between the function of supporting university research, much of it basic in nature, and the desire of the council to have its laboratories revitalized and identified with clear tasks.

This difference in function is an important one, because the attitude of scientists who are involved in applied research or task oriented research, or whatever one might wish to call it, is likely, in many instances, to be different from the attitude of scientists, who are engaged in basic research without any application whatever in view. Both are needed. The size of the function of the support of university research is already equal to-indeed, it is slightly greater than-the function of the support of laboratories. The growth of the support of university research has been very much greater in recent years than that of the growth of support of the laboratories, and that growth is surely going to continue.

We are at a point now where we have, I think, about 16,000 full-time faculty members in our Canadian universities, 9,000 of whom are in the social science humanities sector and about 7,000 in the science, engineering and medicine sectors. With the growth of our universities from an enrolment in 1967-1968 of 270,000 to an estimated 540,000 by 1975 it is clear that there is going to be a very striking growth in the number of faculty members that are in the universities for educational purposes and to conduct research. We can, therefore, anticipate that there will continue to be a very much more rapid growth of the support function for university research than the growth in support for the laboratories themselves. Moreover, the function of the support of research is becoming even more complex. Certainly, if the proposals which we have incorporated in our report, as to program grants, negotiated development grants, strategic development grants, and other major proposals, are implemented, this will add a great deal to the complexity of the operation of the support of research. All of these reasons are adding administrative loads to the National Research Council, and require an organization that is devoting itself to the administration of very large sums of public money-sums which are getting rapidly larger and will continue to do so over several years.

All of this seem to us to be reason for feeling that the time has now been reached to seperate both the functions of the National Research Council, and to have them each go their own way.

This is not to say that we would wish to see at all any loss of contact between NRC scientists and the academic community-quite the reserve. We would like to see that comradeship and association continue as it has in the past. We think it can continue on a basis which is even more healthy if these two organizations were each to go their own way.

Finally, in my own mind, at any rate, the most important point of all is this. We have tried to set forth in this report the view that the federal Government has two fundamental relationships with the university-one is to support university research per se for the purpose of having a strong university, and the other, of course, is to procure research of interest to the Government itself.

We have 41 agencies that are involved in the support of university research development and it is our feeling that those who are associating themselves with the problem of supporting university research per se should be developed to just that, and that should be their sole function. They must relate to each other; there must be a very close interlocking of the functions of the National Research Council, the humanities and social sciences research council and the health sciences council as they are proposed in this report.

We feel that if these agencies are, by mandate, devoted to the purpose of supporting university research per se, for the purpose of having strong universities in Canada, then that particular goal of the Government will be ensured.

We are not concerned that the other goals of Government, in terms of support of research of interest to Government, will in any way be depreciated by the fact that three agencies out of a total of 41 are devoting themselves to the universities.

These are at least some of the thoughts that we had in mind in coming forward with this proposal.

The Chairman: So, in your Recommendation No. 26 you were not really raising any kind of fundamental question as to the future of the laboratories which are at present administered by the NRC?

Dr. Macdonald: No. We certainly would expect to see those laboratories continued. We would expect also on the basis of messages we received in discussion with Dr. Schneider that the laboratories themselves are going to make vigorous efforts to try to develop a new focus for their own work. We have there a great strength for the country and a very important resource which can be used more effectively.

Dr. Vogt: I want to reinforce that, Mr. Chairman. I think Canada has done very few things as well in science as the National Research Council laboratory,
and it would be a tragedy for the country to destroy that, or to destroy anything that is doing the work so well. It is very far from our intention to damage the laboratory in any way.

Perhaps that aspect gave us the greatest deal of concern in the study we made and the recommendations we put forward regarding the splitting up and the providing of alternative councils.

In the long run, we felt it was not healthy for laboratories to have this very large university granting function associated with it. The laboratories' budget over the last few years has remained stationary while the university portion has gone up by a large amount. To some extent, laboratories have felt inhibited from approaching the Treasury Board for funds, while the universities have been asking for large new funds. I think they should not have those inhibitions. If the separation occurs at the top of the National Research Council, then we are more likely to have a strong maintenance of the National Research laboratories in Ottawa.

Senator Grosart: Mr. Chairman, it seems to me that the recommendations here are boiling down to this: that we should have one lump sum which is federal funding to be allocated for university support per se-I do not know what "per se" means in this case, whether it is for education or for basic research. I know there is a problem in making the distinction.

The Chairman: Basic research, and producing manpower.

Senator Grosart: The literature on the subject is full of this argument as to where one ends and the other begins. I am asking: Is it the suggestion that there be a lump sum that would be allocated for university research per se, which would be administered by these three main agencies; and then would there be another lump sum directed to the support of research in universities which would be, if you like, missionoriented by departments and other agencies? Is this the basic suggestion?

Dr. Macdonald: The first part of your interpretation is consistent with our view-a lump sum for the three councils-but certainly not a lump sum for any of the agencies.

Senator Grosart: I mean, in the net result, there would be a lump sum if you add up the missionoriented support from the departments and agencies?

\section*{Dr. Macdonald: Yes.}

Senator Grosart: So you would have two lump sums. The lump sums would have all sorts of components,
but in the end result, in the public accounts you could break it and say that here is the total amount that now is going to universities for support per se-to use your phrase-and here is another lump sum that is going for mission-oriented support in the universities.

If this is so, could not there be another view, that rather than concentrate the per se money in the hands of one group, thinking only of university supportthat the present arrangement continue under which the National Research Council says: "Here is money for national research. It is good and sensible for us to say that so much will go into funding universities by grants or contract, and so on, and so much will go into intra-mural in-house activity, and so much will go to industry"?

Dr. Macdonald: That is not what happens now. There are two separate votes of the National Research Council, one for the laboratories and one for the support program.

Senator Grosart: Yes, the estimate is prepared by the NRC. They break it down. This is the very point I am making. Is it not good sense to have some agency, as Senator Cameron pointed out, looking at the university problem, the agency problem, and the in-house problem? I do not see it in your terms of reference, but where do you fit in this highly compartmentalized type into the overall system? What happens to the rest? This seems to be the problem. Again I appreciate the fact that you are not required to say what happens to the laboratories, but in this committee we have to wonder about this. If I may quote from page 103:

We see them under independent leadership responding to government directives as a group of flexible task forces capable of adjusting their organization and re-grouping their manpower from time to time to tackle important scientific assignments.

Personally, I cannot think of anything worse that would happen than to have that independent leadership responding to government directives. What is the independent leadership? Where do the government directives come from? How are these flexible task forces a group? How are they capable of adjusting their organization and re-grouping their manpower, unless you have somebody at the top exercising the function of this direction?

This may not be a fair question-it has nothing to do with the universities-but I am asking you what happens. I cannot see anything worse than a bunch of flexible task forces re-grouping themselves at will; we have enough of this now. We have lack of coordination and overlapping, and it seems to me this will make this problem much worse than it is. To break down the National Research Council laboratories into a bunch of task forces frankly frightens me.

Dr. Macdonald: Is that not the way they have operated for a number of years?

Senator Grosart: "Task force" is a comparatively new term.

The Chairman: It may be that we are dealing with an old situation under a new term.

Senator Grosart: There is a difference between "task force" and a "mission-oriented project" or "program," and I much prefer the mission-oriented direction to the task force. I would be interested to know if you do not see some danger in compartmentalizing this whole university funding and taking it out of the broader picture of national science policy.

Dr. Macdonald: No, I frankly do not see any danger, senator, in doing it; as a matter of fact, quite the reverse. I think it will ensure the kind of support for basic research in the universities which is important and which we do need to ensure.

Senator Grosart: But will it ensure a good national balance of R\&D funding?

Dr. Macdonald: That will depend on the quality of the judgments made by the politicians as to how much they are going to put into this area. We talked about this briefly this morning and the possibility that, perhaps, from experience it may now be roughly 10 per cent of the total effort of the country for R\&D. Whether that is the right percentage, or the best balance, is something that we would not be prepared to make a judgment on now, but I think the Science Council should be looking at issues of that kind and advising the government. The Government has to make the decision as to what constitutes balance, as to what is good balance.

Senator Grosart: This really becomes something much more than a science and technology judgment on the part of the Government, and this is what bothers me. This then becomes a separate judgment as to the funding of the educational capabilities of universities.

Dr. Macdonald: In terms of the training of manpower, that is part of it, yes.

Senator Grosart: That is one part of it. The whole scientific capability, whether you are in basic research or development, may be a capability for innovation or a capability to seize the opportunity of innovation. I do not see how you are going to get a government to separate these unless it is approached in much the same way as it is being approached now.

I agree that we need much more coordination and much better management but I am concerned about this compartmentalizing of the whole university funding. I think you are going to lose out; that is my worry.

Dr. Dupré: If I could say this, senator, I agree that there is a danger in compartmentalization, in the sense that you would not want to compartmentalize the kind of advice that will be given to our political leaders on the long-run merits of allocating resources as among let us say, business, industry and universities. This is very much in the nature of a scientific advisory process. But as we also know from experience in a number of countries, it has been deemed wise to separate the function of tendering scientific advice from operating agencies of a government. For example, we have the President's science advisory committee in the United States tendering advice on scientific policy, as opposed to the National Science Foundation. We have had in this country, of course, a change in the role of NRC. It was once very much of an advisory body, but this function has now been taken over by the Science Council of Canada.

I agree that there is a need for unity in the kind of advisory mechanisms that you have, so that when politicians make allocation decisions as among business, industry and universities, they make their decisions on the basis of advice that takes all of these sectors into account.

At this stage of the game, I think this is an excellent plea for a science advisory body that takes into account all objectives. It does not necessarily mean that your operating agencies, which are probably not appropriate in terms of rendering broad-gauged advice to government, should also be unified.

Senator Grosart: It is perhaps because I like the evolutionary process that I am impressed with the very thing that has happened in the National Research Council, where they have now split their money in half. They have roughly a hundred million dollars and they have evolved a pattern of funding of university research to its present level of forty-five million. I like this process better than that which somebody called the draconian approach.

Our problem, here as I see it in this committee, is to recommend some kind of mechanism which will put science into science policy and bring science action out of science policy.

I am becoming more and more convinced that the mechanism has to be a total and a global mechanism in the R\&D picture. Other than that, I do not see how it is going to function. After all, the separation of funding into three main sectors-university, intra-
mural and industry-is an artificial one, a bookkeeping one, and I see a tendency here to perpetuate this purely bookish approach to it, forgetting the importance of the global look at our whole research and development effort. That is my concern here.

Dr. Dupré: I fundamentally agree with your concern, in so far as the advisory function is concerned. However, I am not quite sure why you see a need for the same sort of global approach at the operational as opposed to the advisory level.

The Chairman: You may be right in suggesting more division, but the more you divide, it seems to me, the more you have to coordinate too.

Senator Grosart: Then you get back into this internal competition business which might develop out of some of these recommendations.

The Chairman: In this respect, I wonder if we could spend a few minutes dealing with your proposal as to this secret operation in the Treasury Board? I am intrigued by this.

Senator Blois: Before we leave this, Mr. Chairman, may I ask one question?

\section*{The Chairman: Certainly.}

Senator Blois: If you do away with the powers and authority of the National Research Council what effect would that have on the provincial councils? I believe that most provinces have their own research foundations which work closely with the universities and also with the National Research Council. They are doing a splendid job so far as the provinces are concerned. My worry is as to what effect this might have on these local foundations.

Dr. Macdonald: That is, organizations like the Ontario Research Foundation?

Senator Blois: Yes. I happen to have been a governor of the Nova Scotia Research Foundation since it was formed in 1946. I know of what excellent work it is doing, and I know it works closely in Nova Scotia with the National Research Council.

Dr. Macdonald: Senator, I do not see how these proposals would influence that relationship.

Senator Blois: Do you think that those foundations will continue as they are now?

Dr. Macdonald: I do not see how these recommendations would influence their activities at all. Perhaps
some of the others have comments to make in this respect.

Dr. Vogt: I think that the change we are recommending here in the National Research Council is not very much more than that it be a different person who walks to the Treasury Board with a recommendation in respect of the university granting function and for the laboratories. The organization of the laboratories, I think, would need a very similar board to that which they have at present, consisting of people from outside the universities, and there might be some cross membership between the boards of the National Research Council and the university granting foundation. I think that the importance of the change has been exaggerated in the discussion.

Senator Grosart: I think if you had put it the other way around and said that the National Research Council would carry on with the laboratory responsibility, and that there will be a new council called the University Research Council, you would have less trouble.

The Chairman: Yes, and, of course, there is always the danger of misrepresenting your recommendation about government intramural laboratories, which seems to me to be putting a kind of uncertainty on the N.RC. labs, especially when you take their name from them.

Senator Grosart: That is what I mean. It is a sacred cow.

Dr. Macdonald: I am a little disturbed to think that that kind of interpretation had occurred to you. This is certainly not intended at all.

The Chairman: I think I was a little bit mixed up also with another forthcoming report which will suggest that these labs be given to the universities.

Senator Grosart: I have been mixed up ever since you said at the start that this report did not recommend any great changes in the method of allocating funds.

Dr. Sirluck: Mr. Chairman, I can see how the language, which was rather hastily selected towards the end, can be misii terpreted, but this passage . . .

\section*{Senator Grosart: On what page is it?}

Dr. Sirluck: Page 103, I am referring to the passage you read before. This was really an attempt to get down to the substance of what the president of the National Research Council gave us to understand was the direction in which the labs were being reorganized. We thought that that was an extremely good direction for the labs.

The Chairman: I do not remember his mentioning this here. The only thing he mentioned in relation to your recommendation, as I recall it, was that he would be very upset if the National Research Council were cut off from assistance to universities.

Dr. Sirluck: Yes, I am sure that is so, but he did speak to us, while we were attempting to clarify our own minds, about what he saw as the optimum development in the labs for the future, about large missions and a restructuring of the labs in order to maximize their capacity to deal with emergent problems. I think it is in that sense that we had something here about government directives, but we were not attempting to construct the machinery for what was not our responsibility.

I do concede, from listening to the questions today, that in terms of the names of the two councils we used opposite practices in the sense that we thought that the Canada Council and the patronage of the arts were so inseparably linked in the public mind that we would have to provide ourselves on the university side with a new name, but somehow the other impression came through and the National Research Council...

The Chairman: I am surprised at our lack of imagination when we come to naming these agencies. There are so many words in English that we should be able to get away from "council" occasionally.

Dr. Sirluck: Some other names have been used, but they would not bear formalizing.

The Chairman: Should we come back to this matter of the outgrowth of the Treasury Board?

Senator Cameron: I would like to hear about the secret part of it. Secrets are always intriguing.

The Chairman: There is nothing now parallel to this within the Treasury Board?

Dr. Macdonald: That is true, Mr. Chairman. We are aware of that. We are aware from our discussions that members of the Treasury Board feel it would be useful if some machinery could be available to them to provide them with advice which would assist them in making judgments about the allocation of these funds.

\section*{The Chairman: Within each council?}

Dr. Macdonald: No. As a matter of fact, I certainly do not want to leave the impression that the proposal here has been suggested by the Treasury Board. The members of the Treasury Board presented us with their problem, and this is our attempt at solving that problem. We considered carefully the possibility of having a public agency-and at one time we used the
term "umbrella agency"-and that was discussed quite widely.

The Chairman: That is something that could very well be a kind of extension of your co-ordinating committee.

Dr. Macdonald: Yes, but we rejected that in favour of the kind of organization which is proposed here, and which would give confidential advice to the Treasury Board, and which would be the Treasury Board's instrument and not the universities' instrument. In other words, it is not there for the purpose of promoting the interests of the universities specifically, but to assist the Treasury Board in deciding how it should allocate these funds, particularly in the event that the Treasury Board specifies that it is simply not going to be able to provide the total sum for all three councils that is requested. How then shall it be allocated?

The Chairman: You will really have two groups of university people, those who will be on the boards of these three federal councils, operating more or less in the public eye, and then you will have the grey eminencies going through the Treasury Board and upgrading in secret. They will also be coming from universities. I suppose they will be the directors of the departments, as opposed to deans, on the boards of the councils.

Dr. Macdonald: We do not suggest, Mr. Chairman, that they should come from the universities. We say that they should be people knowledgeable in university matters.

Senator Bourget: Who will appoint them?
Dr. Macdonald: The Treasury Board will appoint them.

Senator Grosart: Would you let the Canada Council join?

The Chairman: They would not be there.
Senator Grosart: I am asking if they would be allowed to join.

The Chairman: You have studied the possibility of having this kind of umbrella under which the three councils would come, and you have rejected it?

\section*{Dr. Macdonald: Yes.}

Senator Cameron: Supposing this Senate Science Policy Committee recommends that the responsibility for science be taken away from the Treasury Board and that we set up some other machinery, what would happen to your secret advisory committee then?

The Chairman: I suppose we would have to revert to the umbrella.

Dr. Macdonald: This occurred to us, of course. There may be changes in respect to the whole pattern of advice in the area of science. It may be that, under those circumstances, the need for this kind of structure might disappear, but there was one additional consideration which was in our minds, and which, I think, is worth noting. That is, we are dealing here, not with science, but with research in universities which is covering a number of areas and which will be receiving increasingly large sums of money, in the humanities and in the arts too. Since these are not part of the science picture, it may be that, in terms of looking at the balance of the universities, this instrumentation or something like it might still be required.

The Chairman: Again, the Treasury Board would really be the place of last resort to decide whether or not the humanities and the social sciences should get more money than the National Research Council, and so on.

\section*{Dr. Macdonald: Yes.}

The Chairman: It is rather late in the day. Of course, there are many other questions. Perhaps I could make a suggestion before we adjourn today. As I told you this morning, we are planning to have our own week next week, and to have next Thursday afternoon a kind of plenary session with representatives from all the universities present, at a special place which has not yet been found, but I am sure that we will be able to find it. We are told that there will be quite a number of people present. I suggest it would be appreciated if at least some of you could attend that meeting, perhaps in order to answer questions from either the committee or the academic community. It seems to me it would add great interest to our meeting with the universities, were you to be available next Thursday when we meet with them in plenary session. We will have had an opportunity to see what we have said today and to have a more serious look at your report.

Dr. Macdonald: Thank you.

The Chairman: I wish to thank you for your having spent this day with us and, at the same time, I am issuing an invitation to you to come back next week.

Senator Cameron: Before you leave, Mr. Chairman, this business of the supervisory committee raises all kinds of questions in my mind. It certainly does not fit into the existing machinery, and does not fit into any concept I have of the kind of machinery we are likely to recommend should be set up.

Dr. Macdonald: Senator Cameron, I wonder if, in fact, the Treasury Board is not completely free right now to appoint people to advise, or to announce it to anybody?

Senator Cameron: They could hire consultants.
Dr. Macdonald: Do they not, in fact, do that kind of thing?

The Chairman: The trouble is that I suppose you are making something public here in terms of recommendation which has remained secret up to now.

Dr. Sirluck: There was the hope, Mr. Chairman, that it might be more responsible. I am not sure the language is not ambiguous, but there was no thought that this committee is descending to individual awards; it was as between the three major sectors.

The Chairman: Our feeling, or, at least, my feeling is that the Treasury Board should not act alone in deciding whether there should be more money going to the social sciences or to the life sciences or to NRC.

That is why we always come back to this kind of dual approach, which seems to be what is needed in this country, the micro approach, which I referred to this morning and the other more or less general approach which takes into view the public interest and the overall situation.

Dr. Sirluck: 1, for one, would certainly prefer to see a system in which, not the Treasury Board, but the whole Cabinet in overt political sessions made such judgments. We were attempting to improve the present rather undercover arrangements.

The Chairman: Anything that could improve the operation of the Treasury Board is highly desirable.

Dr. Sirluck: We meant this as an interim step, before your committee's report.

The Chairman: Again, thank you very much, and I hope we will be able to see you again next Thursday afternoon.

The committee adjourned.

First Session-Twenty-eighth Parliament 1968-69

\section*{THE SENATE OF GANADA}

PROCEEDINGS
OF THE
SPECIAL COMMITTEE
ON

\section*{SCIENCE POLICY}

\section*{The Honourable MAURICE LAMONTAGNE, P.C., Chairman} The Honourable DONALD CAMERON, Vice-Chairman

No. 44

TUESDAY, MAY 27, 1969

\section*{WITNESSES:}

Association of Universities and Colleges of Canada: Reverend Father Roger Guindon, o.m.i., ex-President; G. C. Andrew, Executive Director, and W. Waines, Associate Executive Director.

University of Dalhousie: Dr. M. J. Keen, Chairman, Department of Geology, University of Dalhousie, Halifax, Nova Scotia.

\section*{APPENDIX:}
60.-Supporting document entitled "A brief submitted to the Study Group sponsored by the Science Council of Canada and the Canada Council on the support of research in the Universities" by the Association of Universities and Colleges of Canada.

\title{
MEMBERS OF THE SPECIAL COMMITTEE ON \\ SCIENCE POLICY \\ The Honourable Maurice Lamontagne, Chairman \\ The Honourable Donald Cameron, Vice-Chairman \\ The Honourable Senators: \\ Grosart Haig Hays Kinnear Lamontagne Lang Leonard McGrand \\ Nichol \\ O'Leary (Carleton) \\ Phillips (Prince) \\ Robichaud \\ Sullivan \\ Thompson \\ Yuzyk
}

Aird
Belisle
Blois
Bourget
Cameron
Carter
Desruisseaux
Giguère

Patrick J. Savoie, Clerk of the Committee.

\section*{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 wasResolved in the affirmative. Clerk of the Senate.
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\section*{MINUTES OF PROCEEDINGS}

\section*{Tuesday, May 27, 1969}

Pursuant to adjournment and notice the Special Committee on Science Policy met this day at 10.05 a.m.

Present: The Honourable Senators Lamontagne (Chairman), Belisle, Blois, Bourget, Carter, Grosart, Haig, Kinnear, Leonard, Phillips (Prince), Robichaud and Yuzyk-(12).

In attendance: Philip J. Pocock, Director of Research (Physical Science); Gilles Paquet, Director of Research (Human Science).

The following witnesses were heard:

\section*{ASSOCIATION OF UNIVERSITIES AND COLLEGES OF CANADA:}

Reverend Dr. Roger Guindon, O.M.I., Ex-President;
G. C. Andrew, Executive Lirector, and
W. Waines, Associate Executive Director.

\section*{UNIVERSITY OF DALHOUSIE:}

Dr. M. J. Keen, Chairman, Department of Geology, University of Dalhousie, Halifax, Nova Scotia.
(A curriculum vitae of each witness follows these Minutes)
The following is printed as an Appendix:
60. Supporting document entitled "A brief submitted to the study group sponsored by the Science Council of Canada and the Canada Council on the support of research in the Universities" by the Association of Universities and Colleges of Canada.

At 12.50 p.m. the Committee adjourned to the call of the Chairman.
ATTEST:
Patrick J. Savoie, Clerk of the Committee.

\section*{CURRICULUM VITAE}

Andrew, Geoffrey Clement: Born July 3, 1906; Bayfield, N.S. Education: King's College School, Windsor, N.S.; 1925-29, King's College, Dalhousie University, B.A.; 1933-35, Oxford University, B.A., M.A.; 1962, University of King's College, D.C.L.; 1968, Université Laval D.Lett. Academic and Professional Experience: 1929-30, Master, Rothesay Collegiate School; 1930-33, House Master, Upper Canada College; 1935-42, Senior Housemaster and Teacher of English, Upper Canada College; 1943-45, Secretary, Wartime Information Board, Ottawa; 1945-47, Director, Canadian Information Service, Ottawa; 1947, Chief, Information Division, Department of External Affairs, Ottawa; 1947-53, Professor, Department of English, and Executive Assistant to the President, University of British Columbia; 1953, Carnegie Corporation Grant to study methods of university administration in Canada, the United States, Great Britain and Europe; 1953-62, Professor, Department of English and Dean and Deputy to the President, U.B.C.; 1954, Delegate to Institute of Pacific Relations, Kyoto, Japan; 1959, Member of Committee to advise New Zealand Government on Higher Education; 1962, Invited to observe higher educational development in China; 1962, Executive Director, Canadian Universities Foundation, and National Conference of Canadian Universities and Colleges; 1965, Executive Director, Association of Universities and Colleges of Canada. Associations: Canadian Association for Adult Education; Canadian Institute of International Affairs; Canadian University Service Overseas; United Nations Association. Publications: Articles on Education, International Relations, Literature and the Arts, in a variety of publications.

Guindon, Reverend Dr. Roger, O.M.I. (Oblate of Mary Immaculate). Born: September 26th, 1920, in Ville-Marie, Québec. Studies: Juniorate of the Sacred Heart, 1933-39 and St. Joseph's Scholasticate, Ottawa, 1940-47. Ordained priest in 1946. Further studies at the "Institut d'Études Médiévales de Montréal" in 1949 and 1951; graduate studies in Rome 1951-52; doctorate studies at Fribourg University, Switzerland, 1952-54; Degrees: from the University of Ottawa: B.A., B.Ph., 1942; L.Ph., 1943; S.T.B., 1945; S.T L., 1947. From Fribourg University: S.T.D. (D.Th.) 1954. Postings and Functions: St. Joseph's Scholasticate: 1947-59; Professor of Moral Theology in the Faculty of Theology, 1947-64; Librarian, 1947-1951; Secretary of the Pastoral Institute in which he was also a professor, 1957-64; Secretary of the Faculty of Theology, 1958. Sedes Sapientiae Centre: 1959-64: Superior and Director of studies in the ecclesiastical faculties; Dean of the Faculty of Theology, 1961-64; Member of the Oblate Education Association, 1961; Member of the Catholic Theological Society of America, 1962; Member of the foundation committee of the Institute of Pastoral Medicine, 1964; President of the foundation committee of the Canadian Society of Theology, 1964. Rector of the University of Ottawa, July 1964; Member, Board of Directors, Ontario Cancer Treatment and Research Foundation, 1964; Member, Board of Directors, Association of Universities and Colleges of Canada, 1965-(President 1967-68) ; Member, Board of Directors, Ottawa Philharmonic Orchestra, 1965; Member, Board of Trustees, Ottawa Civic Hospital, 1966; Member, Vanier Institute of the Family, 1966; Vice-

Chairman, Committee of Presidents of Universities of Ontario, 1966; Member, Council of the Assoc. of Commonwealth Universities, 1966-68; Member, Ontario Council of Health, August 1967; Member, Tribunal on Bilingual Higher Education in Nova Scotia, 1969; Honorary Doctorate (LL.D.) Trent University (May 1968) ; Honorary Doctorate (LL.D.) Laurentian University (May 1969); Home Address: 305 Nelson Street, Ottawa 2, Ontario.

Keen, M. J. Educated at Oxford University (B.A., Geology, 1957) and Cambridge University (Ph.D., Geophysics, 1961) ; Assistant Professor, Institute of Oceanography, Dalhousie University, 1961-1964; Associate Professor, 19641969; Professor and Chairman, Department of Geology, Dalhousie University, 1969. Interested in marine geology and marine geophysics. Author of a number of scientific papers and one book, "Introduction to Marine Geology". Age 34.

Waines, W. J., B.A., M.A., LL.D. Born Moosomin, Saskatchewan, October 27, 1901; Educated in public schools, Moosomin, Saskatchewan; taught school one year in Saskatchewan, 1920-21; attended University of Manitoba, B.A. (1924), M.A. (1925); graduate studies at Northwestern University and the University of Chicago; LL.D. (Mar.), 1967. Scholarships, etc.: 1923, Isbister Scholarship, University of Manitoba; 1924, Gold Medal in Political Economy, University of Manitoba; Gold Medal in History, University of Manitoba; Sir Daniel MacMillan Fellowship in History and Political Economy; 1925, Awarded Travelling Fellowship, University of Manitoba. University Appointments: 19261927, Instructor, University of Manitoba; 1927-1928, Lecturer, Lake Forest College, Lake Forest, Illinois; 1928-1942, Lecturer, Assistant Professor and Associate Professor, University of Manitoba; 1936-1937, Visiting Lecturer, University of Toronto; 1942-1963, Professor of Economics and Head, Department of Economics and Sociology, University of Manitoba. (1963, resigned as Head of Department, continued as Professor of Economics) ; 1947-1961, Dean of the Faculty of Arts and Science, University of Manitoba; 1960-1966 (June 30), Vice-President (Academic), University of Manitoba; 1966 (July 1), Associate Director, Association of Universities and Colleges of Canada and Executive Secretary of Social Science Research Council and Humanities Research Council; 1966 (July 1), Dean Emeritus, Faculty of Arts \& Science, University of Manitoba. Other Appointments, etc.: 1938, Member of Research Staff, Royal Commission on Dominion-Provincial Relations; 1939, Secretary, Royal Commission on Municipal Finances and Administration of the City of Winnipeg; 1943-1945, Economic Adviser on Post-War Reconstruction to the Government of the Province of Manitoba; 1949-1950, Economic Adviser and Consultant to the Royal Commission on Transportation; 1952-1958, Member, Board of Directors, Central Mortgage and Housing Corporation; 1953, Chairman, Wage Survey Board, City of Winnipeg; 1954, Canadian Delegate to the I.P.R. Conference in Kyoto, Japan; 1946, Chairman of a substantial number of Labour Conciliation Boards, President, Civil Liberties Association of Manitoba; 1952-1954, Chairman, Winnipeg Branch, Canadian Institute of International Affairs; 1952-1953 and 1953-1954, Chairman, Canadian Social Science Research Council; 1957-1958, Economic Adviser to the Government of the Sudan, United Nations, Technical Assistance Administration; 1960 (Summer), Canadian Director, W.U.S.C. Seminar in Israel; 1962 (March), Canadian Delegate to UNESCO-ECLA Congference on Education Santiago, Chile; 1960-1963, Member of Board, Community Chest of Greater Winnipeg; 1961-1966, Member of Canadian Welfare Council Commission on Social Work Education and Personnel. Also, member of the Executive Commit-

\begin{abstract}
tee and Chairman of the Sub-Committee on Undergraduate Education; 19621965, Member, Board of Trustees, Manitoba Medical Service; 1965-1966, Member, Winnipeg Police Commission; 1962-1965, Member of Executive Committee, NCCUC; 1965-1966, Member of Board of Directors, AUCC; 1962-1966, Chairman, CUF-AUCC Finance Committee; 1959-1965, Member of Canadian Commonwealth Scholarship and Fellowship Committee. Memberships: The Canadian Political Science Association-President, 1962-1963; The Canadian Historical Association; Canadian Institute of International Affairs. Publications: Federal Public Finance: Canada, Canadian Journal of Economics and Political Science, Vol. 3, No. 2, May 1937; Problems of Public Finance in the Prairie Provinces, C.J.E.P.S., Vol. 3, No. 3, August, 1937; Dominion-Provincial Financial Arrangements: An Examination of Objectives. C.J.E.P.S., Vol. XIX, No. 3, August 1953; Problems of the Drought Area in Western Canada, in Essays in Political Economy, in honour of E. J. Urwick, University of Toronto Press, 1938; Post-War Immigration Policy, the Canadian Banker, Vol. 51, 1944; Provincial Post-War Reconstruction Problems and Policies, Culture, Vol. 5, 1944; Government Control of Raw Material Supplies, The Canadian Credit Institute, Bulletin No. 16, December, 1930; Prairie Population Possibilities. A study prepared for the Royal Commission on Dominion-Provincial Relations. Ottawa, King's Printer, 1939; Public Finance, Encyclopaedia Canadiana; The Role of Education in the Development of Underdeveloped Countries, The Canadian Journal of Economics and Political Science, Vol. XXIX, No. 1, Nov. 1963.
\end{abstract}

\section*{THE SENATE}

\title{
SPECIAL COMMITTEE ON SCIENCE POLICY \\ EVIDENCE
}

\section*{Ottawa, Tuesday, May 27, 1969}

The Special Committee on Science Policy met this day at 10.05 a.m.

Senator Maurice Lamontagne (Chairman) in the Chair.

The Chairman: Honourable senators, with our one-day discussion with the Macdonald Group as background, we are beginning this week what we have called our university week.
We are very pleased indeed to welcome this morning the representatives of the Association of Universities and Colleges of Canada. First of all, let me welcome its President, Reverend Father Guindon.

\section*{[Translation]}

At this point, I would also add that it is my pleasure to introduce to you this morning my boss, the President of the Association, who is also President of the University of Ottawa.
I am going to be a good pupil, or a good employee, sir, you may be sure.

\section*{[English]}

I understand that our guests this morning were not in a position to have a full brief approved by the association and that Father Guindon will read an opening statement. Afterwards, we will have the usual discussion. However, the delegation should feel free, if the questions are too indiscreet at this moment, to reconsider or to decline to answer. I am not forcing anybody here. It is a free public forum.

\section*{[Translation] \\ Father Guindon.}

Reverend Father Roger Guindon, O.M.I., Outgoing President of the Association of Universities and Colleges of Canada: Honourable Senators, Mr. Chairman, I am afraid I must make a small correction in what you have just said-I am now the ex-President, I was President last year.

Unfortunately, the other elected members of the governing body were unable to attend this morning.

\section*{[English]}

If I may introduce the other members: these are my good friends, Mr. Geoffrey Andrew, Executive Director of the AUCC. Mr. W. Waines, Associate Executive-Director, and Mgr. Garneau, Assistant Executive Director of the Association of Universities and Colleges of Canada.

The Association of Universities and Colleges of Canada is a voluntary association of 61 universities and colleges, whose needs it serves in the two languages of instruction, English and French. The association is represented here today by its Past President, as I have indicated, and by the senior officers of the secretariat. Dr. Colin Mackay, President, and Dr. Roger Gaudry, Vice-President, regret their inability to be here because of graduation ceremonies and other commitments. The position of the association with respect to relationships between the universities of Canada and the federal government has been most recently expressed officially in a brief dated April 30, 1968, which the association submitted to the Macdonald study group, sponsored by the Science Council of Canada and the Canada Council, on the support of research in the universities. Copies of this brief have been distributed and are available.

The association has been preparing its response to the Macdonald Report ever since its recent release. It has had its committees on the sciences and on the social sciences and humanities review the recommendations of the Macdonald Report preparatory to having them submitted to the executive heads of all its member institutions on June 25, and to its board of directors on June 26. We hope that at that time the board will make any modifications which it considers desirable, to the position set forth in the brief to the Macdonald working group.

Members of the Senate Committee will note that the recommendations contained in the brief are based on the assumption that the governmental position with respect to these matters is that which was stated in the document submitted by the then Prime Minister, the Honourable Lester B. Pearson, to the delegates to the Federal-Provincial conference of October 1966. That document stated that the federal government had a constitutional responsibility in the fields of research, cultural development, and certain forms of manpower training, and equality of educational opportunity.

Our recommendations also noted the diversity of federal authorities and ministers who currently share responsibilities in these fields; that is to say: the Canada Council reports to Parliament through the Secretary of State; the office of the Secretary of State has an education support division; the feder-al-provincial arrangement respecting one half of the operating costs of all post-secondary education, is the shared responsibility of the Department of Finance and the Secretary of State; the National Research Council is responsible to the chairman of the Cabinet Committee on Scientific and Industrial Research; the Medical Research Council reports through the Minister of National Health and Welfare; the Science Council reports to Parliament through a designated minister; the Science Secretariat reports to the Privy Council. This list does not, of course, include those departments of government which themselves conduct extensive research operations and make grants.

There would seem to be an urgent need for correlation-if not coordination- of responsibility in these areas.

This could be achieved in a number of ways:
1) By developing the education support division of the Secretary of State's Department.
2) By bringing all the various responsibilities under one cabinet committee with a parallel body representing the granting and advisory agencies.
3) By forming a department or making a minister responsible for the development of science policy, and by having the various existing agencies report to him, or through him, if they currently enjoy the right to report to Parliament.

The AUCC recognizes the nature of our federal society, and accepts the primary responsibility of the provinces for education, but it also recognizes that cultural development and research are aspects of education and involve, deeply, education institutions. We therefore would appreciate the opportunity of studying with appropriate federal and provincial authorities the role which the universities and colleges of Canada should play through research and teaching in the cultural development of Canada. Our member institutions are conscious of the fact that they serve local, provincial, regional and Canada-wide constituencies at the same time as they must also attempt to serve the community of the world of learning itself.

We are not at this time advocating any particular solution in this matter. We are, however, concerned to ensure that the institutions of higher learning in Canada are in a position to work effectively on behalf of all their constituencies, and we are deeply conscious of the fact that in a federal country like Canada national development must include provincial and regional development.

Thank you, Mr. Chairman.
The Chairman: Thank you, Mr. President, or rather, Mr. ex-President. In the Senate we move rather slowly and I am inclined to think all other institutions are similar to us in that respect.

I am not sure how we should approach this matter this morning. You are not in the position at the moment to express any views about the kind of possibilities that you suggest on page 2 of your brief.

Mr. G. C. Andrew, Executive Director, Association of Universities and Colleges of Canada: Well, Mr. Chairman, we have had views expressed in the brief we have now submitted to you as evidence of our previously held positions, and you will find that in the brief to the Macdonald working group. Whether those positions will be modified in the light of the Macdonald Report, we are not in a position to say, but we have no hesitation in discussing the possibilities, if anyone wants to ask questions.
The position we held then, really, was first of all that we felt that the federal Government must have people who are as knowledgeable as the people in the Departments of Education in, for example, the provinces of Quebec and Ontario and who are as con-
cerned about higher education, because the federal Government is committing a vast sum of money to all forms of education and research, and it is a pity if the people who are committing this money are not as well advised as the provincial people are. Actually, the provinces now have better teams of people who are expert in these fields than the federal Government has. We feel rather isolated, as the Association of Universities and Colleges of Canada, because we are the only presence, nationally, on higher education, and, as a matter of fact, the federal Government has to use us, having no other instrument, in a lot of its international relationships in higher education. We are also the only persons to whom a lot of correspondence can be referred. We feel, as we are an interested party, that obviously we cannot expect the Governement to accept our advice, though we think our advice is..

\section*{The Chairman: Sound and objective.}

Mr. Andrew: Yes, sound and objective. Therefore, they should have somebody else's advice in the Public Service that is as well informed as, let us say, the Department of University Affairs in Toronto or, let us say, Mr. Tremblay, Mr. Yves Martin or Mr. Gauthier in the department in Quebec.

These are very well posted people.
If the federal Government does really mean that it has a constitutional responsibility in the field of research and cultural development and an equal responsibility in the field of educational opportunity and manpower training, then it must occupy the territory or else abandon it to the provinces. But we are not sure what the federal Government's posture is.

I think, when you were Secretary of State, Mr . Chairman, the educational portion of that department was established. Since your departure from that portfolio, it has not flourished. I cannot put it clearer than that.

Senator Carter: May I take it, Mr. Chairman, that this is the brief referred to a moment ago in connection with the Macdonald Report?

The Chairman: Yes, I believe our guests this morning have very definite views about the Macdonald study, but, unfortunately, they have not been able to submit those views to their board so that it would be rather embarrassing for them now to tell us in advance-
in effect, to give us a preview-what they will submit to their colleagues.

Senator Carter: We had better not ask any questions about that, then.

The Chairman: I am sure that some of you will try. We will see what happens.

Senator Carter: Mr. Chairman, I was interested in the last speaker's statement that the federal Government should either occupy the territory which it claims or abandon it altogether. I want first of all to sound him out on what he thinks the federal Government should do. Should the federal Government occupy this territory, and, if so, how should it go about doing so? Merely by making money available? Or should it go beyond that?

Mr. Andrew: No. As a matter of fact, I should like to modify that position. When I was talking about having no comparable educational authorities, I should have said that the federal Government has some extremely competent authorities in the field of research and granting. For example, I myself feel that the Canada Council is extremely efficiently staffed by Mr. Boucher and Peter Dwyer. In their fields there are no people more knowledgeable than they. Similarly, I think the National Research Council is well staffed for its particular granting functions. I think the Science Council is moving into the position of being an effective body in terms of science policy, but it is new and has had to move slowly to be efficient in this field.

The federal Government has occupied the posilion with respect to cultural development in a sense through the Canada Council, but the terms on which it has occupied the position are not quite clear.

The Chairman: And in various other ways to the National Cultural Institution and use programs.

\section*{Mr. Andrew: That is right.}

Senator Carter: The Macdonald Report has suggested that other councils be set up to cover all the disciplines. Do you think that that is a better way of occupying this territory?

Mr. Andrew: That is the crunch question that our board is going to have to answerwhether it is going to come out in favour of supporting the Macdonald recommendations to divide the councils or whether it is going
to come out in support of its earlier position on undivided councils on page 13 of its brief.

Senator Carter: If you cannot speak for your association or your group, perhaps you could tell us your personal feeling about the recommendation. I will read it to you. It is number 22 and it says "that the present form of NRC grants to university computing centres be discontinued." They recommend that the National Research Council be reconstituted to deal solely with scientific and engineering research, and I think, if I am not mistaken, that they also recommend that the NRC should not provide grants.

Mr. Andrew: The question of whether the NRC should be divided up into an in-house research agency on the one hand, and a granting body on the other is in fact somewhat different from the recommendation that the Canada Council be divided into an art council, a council dealing with the humanities and social science council. The question of separating the in-house aspect is one thing. The question of whether it would serve the claims of industry better in that context is one on which there are differing scientific views. But that is a different question from the Canada Council question.

One of the real problems that our board is going to have to cope with is whether you serve the interfaces between disciplines better by having more councils, or whether you would serve them better by having a united council. I don't know whether you have seen the document the Canada Council released a few days ago in which they took the view very strongly that the Macdonald Committee did not examine fully enough the possibilities of an undivided council in order to make sure that there were fewer things left out such as geography, clinical psychology and things like that.

Senator Carter: They mentioned things like architecture and business administration that probably were not getting proper attention at all.

Mr. Andrew: Well, the argument is as to whether you do better by having one comprehensive body, in which case you will have too much under one roof, or whether it is better to divide them up and possibly miss out some things in the gaps between.

Now I have some views on this particular question, but I am not going to state them
today. I will state them to my board in the discussion. I think that there are arguments on both sides as to which are the more powerful. We will try to release to the chairman of this committee as soon as possible after that our views on the subject, but at this time I think I had better stop there.

Senator Carter: Well, I have read some of the briefs from other universities, and some are in favour of a single body while others do not seem to have any strong feeling one way or the other. But practically all of them say that the federal government should do more than it has been doing. They say that research is so important it cannot be carried out without a sound infrastructure. If you do not provide the structure you start up a vicious circle which perpetuates itself like poverty so that you do not get down to doing research that is worthwhile.

Mr. Andrew: There certainly needs to be a more correlated-I will not say co-ordinated because I am not too fond of that-but there seems to be a great need for a more correlated infrastructure than there is at the present time. Let me give you an illustration of the kind of thing we have had to cope with on an ad hoc basis on the past. When the Department of Energy, Mines and Resources announced that it was establishing a research centre on inland waters at Burlington, they did so after consultation with scientists in the field, but the universities of Ontario had not been consulted in their collective capacity, and they felt they had a very great interest in this. They got in touch with us as the Cana-da-wide agency and we made representations to the department and to Treasury Board, and the result of that was that the department consulted us about getting the Canadawide interest of the universities in this field. We canvassed the situation very thoroughly and got a committee representing the Canadawide interests. It was not only of interest to Ontario; Quebec universities were equally interested and some of the western universities were also. As a result of that, we now have an advisory group not only there, but we also have an advisory group to the government on major research installations that involve either the training of graduates or co-operation with university research; and the Treasury Board now has requested all departments planning major research developments to consult with us. Now this is a piece of infrastructure that has grown up out of a
specific need, and the same relationship now exists between ourselves and the Fisheries Research Board. Dr. Waines is responsible for our domestic arrangements and our relationship with our member institutions inside Canada, and Monsignor Garneau is responsible for our external relationships. Dr. Waines has been responsible for developing this piece of infrastructure, but it grows slowly because we have no one body in the federal government to deal with.

Senaior Carter: In your opening statement you outlined three possibilities, through the Secretary of State, through a cabinet committee, or through a new department of science policy. Which of these do you think you would prefer?

Mr. Andrew: We really do believe that this is, if I can put it that way, a political decision. This is something for the federal government advised both by its research people and its policy people. I wish also that it were advised by some people with a specific intimate knowledge of higher education. We feel that is something for them to work out with the provinces. Let me give you another illustration indicating that we ourselves over the past three years have invited annually to a meeting three groups of people: representatives of the departments of education, or higher education, who have responsibility for higher education in all the provinces of Canada; representatives of the provincial or regional associations of universities across the country; and representatives of provincial commissions on higher education or postsecondary education. Those three groups have come together to discuss their common interests in inter-provincial and Canada-wide development.

At the last meeting, which was over a year ago now, that composite group authorized us, the AUCC, to retain a man to explore, with the provinces, with the federal authorities, with the provincial and regional councils of universities, with the provincial commissions and with the council of ministers of education, what their continuing interest was in developing a mechanism to help plan interprovincial and Canada-wide developments in this field. That inquiry is currently going on. We hope to have a report on it by the fall, but it is left to the private, voluntary organization to take these initiatives, and I just do not think that is good enough.

Senator Carter: Eventually, the federal involvement boils down to dollars and cents, X dollars or X million dollars. Somebody has to make a decision as to: How are we going to share this out? What proportion of this should go into basic research, pure research; how much should go into research and development?

\section*{Mr. Andrew: Yes.}

Senator Carter: And how much of the pure research should be devoted to the humanities, how much to the social sciences, and so on. How do you think these decisions should be made? Essentially, they are political decisions; they have to be made by one of these groups, or some minister or somebody.

Mr. Andrew: You refer to a rather complex infrastructure. In the first place, within this infrastructure, I think, the independance of the granting agency has to be guaranteed. As you will be aware, there was some public controversy about the Canada Council with regard to a couple of grants recently, and I would like to say that we in the universities feel that unless the Canada Council gives these grants totally free from any inquiry about the political orientation of the people who receive them for study or research, it is on a slippery slope.

So, first of all, the granting agencies have to be protected, and their function, I think, is that of being directed by a lay body of responsible citizens, as they are now. They may have quite good and sufficient reasons to have different granting policies for the humanities and the social sciences than for the sciences.

So, as is recommended by the Macdonald Report and as is recommended by us, a correlating committee of the executive officers of the granting agencies is one first step in the development of the infrastructure, so that they can explain to government that their policies, by agreement between them, vary in this and this respect.

Then, in the complex of the infrastructure, there needs to be also a relationship between the advisory policy bodies. For example, one of the things that has been considered by the Macdonald Committee is whether the Science Council should have its terms of reference expanded and have its membership broadened to embrace both the human sciences, les sciences humaines, and the social sciences; or whether it is better to confine them to the
sciences, and either to give that responsibility to the Canada Council or create another body. This is the second part of it. The granting agencies is one, and they really should be as free as independent citizens controlling them on behalf of Parliament can make them.

The second thing is that the Government needs advice on long-term policies in all these sciences. Whether they achieve that best by one or two councils is a matter of opinion. There are advantages and disadvantages in both.

Then, as a matter of fact, the question of whether at the Cabinet level you get better attention by a cabinet committee than you do by having a minister make or break his reputation on it, is, as you know, one of the age-long political questions. On that one, again I must say that I have always tended to think, in a personal way, that it is a good thing if you can put a minister on the spot; but there are other ways of doing it. The Cabinet already has a committee on scientific and industrial research. Whether you could have an effective Cabinet committee, all the way from the humanities through to engineering, I am not at all sure. But, again, this will be one of the questions the board of the AUCC will be considering.

I am sorry to take so long, but, as I see it, there are three levels to the infrastructure: the granting agencies; the correlating highlevel civil servants; and the Cabinet committee or minister.

Senator Carter: My final question is a dou-ble-barrelled one. I come back to your original statement, when you said that the federal Government should occupy its territory or get out of it altogether. I gather from that that you do not feel the federal Government is fully discharging its claims to the territory it wants to or says it should occupy. Supposing the federal Government took you at your word and said: "Fine. We will get out." How do you see that gap being filled?

Mr. Andrew: I am delighted to answer that question, and I am sorry to be hogging it, but I invite my colleagues to join in.
Your question No. 1 gives me the opportunity to repeat something that we have wanted to ever since the Bladen Report, which recommended that the federal Government should not only pay grants lent up to 30 per
cent for overhead costs on research. It based its argument on the fact that if the federal Government, in making grants for research, does not pay the indirect costs of research as well, then, in effect, it is handing on to the provinces the indirect costs of research in a way over which the provinces have no financial control; and if the Government does not come up with this kind of thing one of the provinces will in fact say: "Let us have research money by way of fiscal transfer too"-in which case the federal Government is not in a position to exercise its responsibility with respect to research for scientific, including cultural, development.

The second question is: If the federal Government does not occupy, what is the alternative? The alternative is to abandon the whole field of cultural relations, research, equality of educational opportunity, and high level manpower training totally to the provinces, and that raises the question of whether we can continue to think of ourselves as a country.

\section*{Senator Carter: Thank you.}

Senaior Grosart: Mr. Chairman, I have some understanding and considerable sympathy with the insistence we get from the science community on their independence in respect of various aspects of science policy, particularly in the granting function. To that I can only say that everybody else has the same desire, including the military. We have very good reasons for saying that we cannot just give the military the money and let them set up a granting committee, and develop what weapons they like, and what weapons anybody else they call in likes. I think the same applies in this field, and I say that for two reasons.

One reason, of course, has been stated very often, and that is that the ultimate responsibility is political. Given the problems of any kind of democratic government we have to remember that in the long run the responsibility for all decisions is placed on a group of laymen, the members of Parliament.

The second reason why I have some concern about the validity of insistence on total independence in this area is that these are public funds, and, rightly or wrongly-and we seem to believe in it-there must be an accounting right down to the last cent. I objected to the suggestion in one brief that there should be a cut-off point on the internal
audit of the universities beyond which the auditor general or a parliamentary committee should not be allowed to go. I disagree with that. This, of course, I think comes back to the essential problem that we are concerned with, and that is the in-put of scientific advice into the political decision.

You mentioned, sir, three main levels-the granting, the correlation, and the political decision-making. You did not include there, as most people do, the advisory function. Would you care to comment on where you see the advisory function from the science community fitting in to the political decision-making?

Mr. Andrew: I am sorry if I did not make that clear. I meant that in terms of the correlating group being an advisory group to the political group. It seems to me that in the correlating group there may be a need for two bodies of correlators-the correlators who are the executive officers of the granting agencies, and the correlators who are represented at the present time by the Science Council for the pure and applied sciences, possibly embracing the humanities and the social sciences, and possibly another which is at the level of advice to the political authority.

The Chairman: These are two different kinds of advice. One is as to policy, and the other is as to allocation of funds.

\section*{Mr. Andrew: That is right.}

Senator Grosart: Then you have a third with respect to administration. You have to have some kind of overview of the administration.

\section*{Mr. Andrew: That is right.}

Senator Grosart: That is why I raise this question of independence in the particular context of your own recommendation, and you might answer my question by filling out a little more the recommendation you made on page 10 of your submission to the Macdonald group. In the middle paragraph on that page you refer to a form of a liaison committee which would be advisory to a minister of the Crown. You then rough out the functions, and I might say that I think they are excellent. They are ones that somebody must undertake, and are, for instance:

To consider and from time to time advise the minister with respect to the annual rate of increase for research grants and whether or not this should be the same for all granting agencies.

This is the overall picture.
To recommend to government, policies with respect to overhead on research grants and how such overhead should be determined for the various fields of research.

I am sure we all agree with the basic concept that you have brought up, except that we must remember that in those indirect costs you speak of the federal Government is already the largest contributor. That would be on the side of the federal Government.

Mr. Andrew: No, I do not think so. One could argue at the moment that in the present fiscal arrangement with the provinces the federal Government is liable to pay one-half the indirect costs of research over and above what it pays in direct grants, but the direct grants do not cover the indirect costs of research. The Macdonald Report, as a matter of fact, recommends even more than our recommendation here.

Senator Grosart: I do not want to go into that in depth because I agree basically with your recommendation, except that you say that the Macdonald Report recommends more. Your recommendation is 30 per cent, is it not?

Mr. Andrew: It recommends a percentage in addition to the full costs of research, and the full costs are frequently more than the grants. Both the National Research Council and the Canada Council have tended to regard their grants as enabling grants, and not full grants. I realize that I am taking on a constitutional lawyer here, but on a constitutional point I have always thought that the functions of boards of governors of universities and, for example, the boards of the Canada Council and the National Research Council, and the reason for scrutiny by them rather than by Parliament, was what in selecting, as the Government usually does, eminent persons to sit on them, they are saying: "We are deliberately going to remove the possibility of political influence that might be brought to bear on the kinds of grants, or on the boards of governors of universities in respect to the kinds of subjects that are studied." I do
not want to be invidious, but I could point out occasions on which the political authorities have specifically withheld grants from university faculties. I thought that the whole constitutional theory was that the accountability, which no university disputes at all, in detailed scrutiny had to be handled by a board that represented the public but which was not political in its orientation. This then enabled public accountability to be called for line upon line; whereas the relationship between, let us say, in Ontario, the Association of Universities-the whole group of uni-versities-and government is then governed by an advisory committee which has devised a formula by which there shall not be line upon line accounting to political authorities which might open the door to the political authorities' saying: "We do not like Professor X. Therefore, there will be no money for that department." I thought that that was the constitutional theory. Is there any difference between us in respect to that?

Senator Grosart: No. If I may say so, I am not greatly concerned with constitutional theory here because I have always believed that if we can come up with the solution we can handle the constitution later. I do not want to get involved in that too much. The principle of accountability and how it is done is important, but less important, in my view, than adherence to the principle that the accounts must be open to parliamentary scrutiny. It is all right to say that boards of governors and university accountants are very capable and very honest, but a board of governors does not present its estimates and does not appear before Parliament; they are pretty well shielded from the kind of scrutiny some of us thing called a university commission or comof our system in the matter of expenditure of public funds. However, I do not want to go into that.

Mr. Andrew: I should like to make this point. Saskatchewan has chosen to do it one way, but Alberta, Manitoba, Ontario, New Brunswick and Nova Scotia all have something called a university commissionor committee, all appointed by the government, and their purpose is to undertake this line upon line scrutiny of the budgets on behalf of the government in order to make sure the government itself does not get involved with what in the university curriculum it will support and what it will not support. It seems to me that the collective political wisdom of most of the provinces of Canada, as well as
what most of them inherited from the practice in the United Kingdom, has been to set up a buffer body to scrutinize in detail and thereby obtain public accountability without that public accountability being directly exercised in a way that might become political.

Senator Grosart: If we are apart at all I think it is only on details.

\section*{Mr. Andrew: I see.}

Senator Grosart: I am more concerned with the method by which the decision is made and the amount of detail that goes into the basic political decision. That is why I am interested in this committee you suggest and the second of the responsibilities you would give to it. The third is:

To recommend to government which agencies should receive appropriations for research support to each academic discipline...
(4) To recommend to government the appropriate levels for support of research in those areas which encompass a wide range of scientific fields...
(5) To discuss the grant-giving mechanisms used by the grant-giving agencies.

This liaison advisory committee, as I think you call it, is to report to a minister. What happens then? This board advises the minister on these broad areas?

Mr. Andrew: That is right.
Senator Grosart: Then what happens?
Mr. Andrew: If it is a matter of policy the minister takes it to the Cabinet; if it is a matter of amount he takes it to the Treasury Board, I suppose.

Senator Grosart: Assuming that the input of science is there and a political decision can be made, then what happens? How does the science come out of the science policy decision? Let me give you an example. The Macdonald Report suggested first of all three main agencies and then found in necessary to fill in the gaps with a lot of others, so we wind up just about where we start. How do you see this filtering down? This decision is made. Do you see the departments and agencies still operating as they are operating? Do you see the NRC operating as it is operating? Do you see the Science Council operating as it operates now? Similarly the Science

Secretariat? Let us say the political decisions are made; they meet the five items on page 11 of your brief. I want to know what happens then.

Mr. Andrew: Let us take the National Research Council as an example of a grantgiving agency. Without at this time prejudicing the AUCC board decision whether to support one or two agencies-the ideal is two agencies-the National Research Council staried off with a policy of merely being permissive and responding to individual scholars' requests. In recent years it has started making a series of grants to institutions, strategic and special development grants and so on. It seemed to us at the time of writing this brief that this kind of development was highly desirable. I come back to the last remark in our preliminary statement. We believe that in a federal country like Canada national development must embrace the concept of regional development for the health of the scholarly community.

As a matter of fact, I disagree with one of the emphases in the Canada Council presentation. I think the scholarly community consists of both scholars and institutions, and the granting agencies, both the Canada Council and the National Research Council, should divide their moneys up in such a way that they separate applications made to them, and also give consideration to strategic grants to stimulate research in areas in which the cultural development of Canada requires it. Just as we now have a department of government concerned with regional inequalities, so we should have in the concepts of the granting agencies; I think they should be adjusted in terms of what I might call contemporary political wisdom. I am myself very keenly in favour of not dividing the scholarly community, not saying that the scholarly community is only scholars and not institutions, but rather saying that the scholarly community is a combination of scholars and institutions. We do not really get any high level development by grants to individual scholars alone unless the university commits itself over a long period of time to this kind of development.

My answer to your question is this. Once the device is made, I think the result should be some changes in granting policies to embrace what I might call the national interest in such fields as northern studies, communications and transportation. Let us take northern studies as an illustration. There are about

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seven or eight institutes of northern studiesin British Columbia, Alberta, Saskatchewan, Manitoba, McGill and Laval-and none of them is really of international repute.

I think it is shocking, the little that has been done to stimulate northern studies in Canada, particularly when the north is becoming really very much more important than it was ever before, politically and other-wise-it is shocking that the national interest in the north should not have received greater attention in the field of research. There is room, if I can put it this way, for the political authority to indicate its interest in research to the granting agencies instead of the granting agencies being merely responsive to individual requests.

Senator Grosart: I would like to find out how far you see this advisory committee going. Do you see it, for example, advising the minister as to the total federal Government requirement for the funding of research, R and D in its widest sense?

The Chairman: Or only for universities?
Senator Grosart: In total. It has to be. This is the whole point. It has to be in total or you cannot determine what the universities' share is to be. That would, of course, be my second question.

Mr. Andrew: My answer to that question is this: the committee that is envisaged here is specifically concerned with university support and research in the universities. The whole business of attempting to co-ordinate in that way, let us say, the in-house of the Department of Agriculture, Department of Forestry and Department of Fisheries, except that part of it in the universities, is beyond Government and the whole assortment of ministers would never allow one group to detail what should be done in applied research in the Department of Agriculture.

This committee should recommend to the Government the funds they consider desirable in the fields of research in ties in order to fulfill the Government's obligations for cultural development and research in its broadest sense in the national interest. Now, how you manage to handle the balance between industrial research, university research, and in-house research within Government, seems to me to be really the function of the Science Council as conceived in that field. It should take an overview of what moneys are
expended in all the departments in university research, and so on, and say that there seems to be a disproportion there. We are not supporting industrial research enough.

Senator Grosart: Can you tell me who is going to do this? It would seem to me meaningless to say that we need X dollars this year in research in universities, unless that is related to the total national science policy, which is what this committee is particularly concerned with. Do you see then a similar council for industrial grants, funding research in industry and another council to supervise departmental agencies-

\section*{Mr. Andrew: Advise?}

Senator Grosart: Advise or let us say super-advise.

Mr. Andrew: I see two functions to be performed. One is the advisory function on the relative emphasis between in-house research, university research, and industrial research.

Senator Grosart: Why does that?
Mr. Andrew: The Science Council.
Senator Grosart: The Science Council told us in very clear terms that they are not interested in making short-term political recommendations.

Mr. Andrew: It seems to us that the trend has gone too much in one way and should be corrected and go somewhat in another way. They should not be concerned with specific budgets, because as a matter of fact if they try to do that we would have every department of Government down their throats.

Senator Grosart: All right, every department of Government is going to be down somebody's throat if this job is done properly.

Mr. Andrew: The Treasury Board is the legitimate body.

Senator Grosart: Almost every witness that we have had said the big problem is that the Treasury Board is making science policy. Surely you are not suggesting that the breakdown between federal funding of research in these various segments should be done by Treasury?

Mr. Andrew: No. It has to be. In the last months it has been done by the Treasury Board. They are the people who talk amounts. The Science Council and the Canada Council
or equivalent body, representing the humanities and social sciences, are the people who say that we are not supporting regional development enough and are not supporting industrial research enough or supporting this too much. In the last analysis it really is the Treasury Board that has to say, in terms of this year's budget-until we get onto a three or five-year budget-this is how we interpret the advice we have received on general policies.

The Chairman: It seems to me that you are really advocating the establishment of a federal foundation in relation to research in universities.

Mr. Andrew: No, I am not, because I come back to it. If it seems to sound that way I want to correct that impression by drawing attention to the fact that we are keeping the three options open and those options were the ones we stated in our opening paper. I am not recommending that at all. The function of this body, which has been referred to, is a correlating function, not a co-ordinating function. I keep on distinguishing between these two because it seems to me it is necessary to correlate policies without having identical coordinated policies.

Senator Grosart: I would like to get back to this committee in its limited role in advising the Government on the funding of research in universities. Would you see it as saying to the Government " X dollars is the required amount this year." Would you see it going one step further and say that this should be roughly divided from the point of view of the university and so many dollars should be allocated for the teaching and institutional functions and so much for project research?

Mr. Andrew: No, I would not. I would say that this committee should, as a committee, go to the Government and say that we are representing the granting agencies and that the Canada Council hopes for an escalation this year of 30 per cent or so much money. We feel that is a perfectly appropriate amount in relation to the amount we feel the National Research Council and the Health Science or Medical Research Council require. We also feel that there is ample justification for differential rates of escalation on the basis of their past performance and the kinds of applications in front of them and for the needs for the stimulation of research through regional development, and so on. In short, the
correlation is merely to assure the Government that not only have each of the granting agencies thought through their position carefully, but that they have explained their position to each other so that the Government knows they are no not being competitive. Each knows what the other is doing. That is why I say correlation rather than co-ordination.

Senator Grosart: I do not quite follow you on the difference between correlation and coordination, because if you are suggesting that correlation is of the lesser magnitude of control then I say I am all for co-ordination if it is the higher magnitude of control.

Mr. Andrew: The reason I believe in correlation rather than co-ordination is that I feel that people who are asked by the Government to serve on the Canada Council, and National Research and Medical Research Council, as soon as you superimpose a body, negatives their advice and substitutes another level of advice. You have thus wiped out the utility of the Government using responsible citizens in this context.

Senator Grosart: That means that every royal commission should have resigned in protest long ago. The Government does not. .

Mr. Andrew: The Government does not have to take the advice of the correlation committee. It can sharpen its pencils or its knives. But the correlating committee is at least expressing the needs of the people the Government invited to serve them. The Government can at that point cut down the requests as it in fact does, after discussion; but the correlation is merely to show that the needs of all have been discussed together.

Senator Grosart: Are you not really then going back to a national science policy "in response", which is the next step to what we have been told it is, "by accident"? Why should a government be put in the position of saying "we merely respond"? Let me make it more specific. If Mr. Tremblay happened, on a CBC panel show, to ask a federal minister how much of the funding of universities is for education, (that is institutional), and how much is for project research, and why, where would the minister get the information that he would need to answer that question? It seems to me that it is quite a proper question: "How are you using the money? Are you
using the public funds to build up the educational level of the universities generally, particularly in science and in the cultural field, or are you using the universities to carry out specific political goals?"

I am not asking you to discuss the theory, but where does the advice come from, where does the minister get the information so that he may answer that question, and many others relating to it?

Mr. Andrew: I think the minister has to answer the question in relation to the expressed policies and granting policies of the granting agencies.

To carry that a little further, Mr. Tremblay's purpose in asking that question is that he himself believes, and has said so many times, that one cannot distinguish between cultural development and education. His conclusion from that is that, both are exclusively in the provincial domain.

\section*{Senator Grosart: Yes?}

Mr. Andrew: The federal government must have some counter to that, and the counter has to be, if it is going to be a counter at all, that although cultural development and education overlap, the federal Government has within its jurisdiction, and in fields like external affairs, northern affairs, and so on, its specific goals, as well as general goals. It has got specific goals that are represented by departments of Government and these general goals are represented by the support of research and cultural development.

Therefore, in the exact pursuit of these goals, it is not necessary for us to distinguish how much is what one might call contract or project research and how much is for cultural development. That is the answer.

It seems to me it is the only answer that the federal Government, in pursuit of its expressed constitutional responsibility, can give.

Senator Grosart: Leaving aside the constitutional aspect-that was not the purpose of my question.

Mr. Andrew: I think it was the purpose of Mr . Tremblay's question.

Senator Grosart: Mr. Tremblay might want the information as a citizen. I might want it. I might want to know what our national
science policy is in respect to the funding of research in universities, how it is broken down between institutional grants and specific mission-oriented, project oriented research. I might want to know; it is my money.

Mr. Andrew: Actually, the Science Secretariat probably could say. I see the former head of the Science Secretariat here. Perhaps he can answer the question for me. I think it is a function of the Science Secretariat to look at the research budgets of the departments and say to the Government, so much money has been expended in the last year for project research, so much money was expanded by the granting agencies for development research, so much was spent on responding to individual requests.

I think there is no trick to that. I think the Government should have that information readily at its fingertips, through the Science Secretariat.

Senator Grosart: The fact is that we do not have it. Over and over again in these proceedings, one of our great problems is that we do not have the information.

Mr. Andrew: Has the Science Secretariat been here?

Senator Grosart: Yes, the Science Secretariat has been here. As a matter of fact, when they first came before us they were the Secretariat of the Science Council. That is how long or how short a time ago it was, depending on your view of the chronology of the development of national science policy. May I ask you another question, leaving that one?

The Chairman: It is only part of the story, though.

Senator Grosart: The answer seems to be that the Science Secretariat may come up with the answer. Earlier, in referring to a question, you suggested we might ask the National Research Council. On another one, on science policy, the suggestion was to ask the National Research Council. I would not want to be the minister if he has to take this of way to get in the information on the total policy aspects of the breakdown of the millions of dollars of public funds that he is responsible for.

In regard to this committee which would be advising the Government merely on funding
in the universities, would it perhaps go so far as to say that all pure research should be done in the university, or most of it, and university research should be completely free of applied science goals? This is a recommendation, for example, which will come before us in the brief of the association of Graduate Schools. Would it go so far as to say that such and such a percentage of the total funding in universities should go into basic or fundamental research, none should go into applied, or so much should go into applied? Would this be one of the functions, to give this kind of advice to the minister?

Mr. Andrew: I would think it would give advice to the minister in this field, based upon the granting policies that have been carefully thought out and adopted by the granting agencies. And if this were one of the policies adopted by the granting agencies, or by one of the granting agencies, it may say, we feel that in such and such a field this might be the policy-let us say, in science it might be the policy but in the humanities and social science it might not be the policy, that we have not good and sufficient reasons for a variation in the policies as between these two.

Senator Grosart: I am not objecting to that, but what I am suggesting to you, is that there must be responsibility "somewhere" for advice to the political decision maker, as to these broad breakdowns?

\section*{Mr. Andrew: That is right.}

Senator Grosart: He must be able to answer the question, if someone says, you are putting all your money into basic research in universities and I do not think this makes sense.

Again, will this committee give him this kind of advice? If not, who will? These are policy elements. Everyone in science is asking for a statement of priorities.

Everybody also says they want to be left alone and be independent. All they want is the money. This is the dilemma.
Now, I understand it from the point of view of the universities; I understand it from the point of view of the military. The military are frustrated. They say that everywhere they go because there is always somebody saying that they must not do this or that. They must not escalate this war. They must have a conventional war. But the military say, "We don't want it to be conventional. We would
like you to give us the money and let us finish the job." But the politicians say no, because they have to consider the public will and they have to consider the climate.

Mr. Andrew: That is right.
Senator Grosart: And surely this applies in science.

Mr. Andrew: I totally agree with you, and our brief is to the effect that there should be exact kinds of policy control. We have suggested three different kinds of alternative ways in which policy control can be established.
Now, I have been trying to fit the existing agencies into the policy control picture, as you have been. I understood, really, that in the fields of science and applied science the Science Council was supposed to be the agency that gave advice about long-term trends. In short-term amounts to fit into the longterm trends, this is the function envisaged for this correlating committee of mine. But its recommendations should be considered by the political authority in terms of the advice it gets out of long-term trends.

Senator Grosart: The problem is, of course, that the minister needs desperately some advice tomorrow morning. He has got to decide about ING tomorrow morning.

Mr. Andrew: No, as a matter of fact, he does not. Because, you know, they fiddled about with ING for months and months and with the Queen Elizabeth Observatory, too. Actually, if they had consulted us about these things we would have engaged the whole academic community in advising, but this was before the inland waters research matter. We now have a mechanism for trying to advise the Government about these matters from the point of view of the total academic community.

Senator Grosart: My point is, you see, that the minister has to have advice at least once a year.

\section*{Mr. Andrew: That is right.}

Senator Grosart: If the minister is what I think you envisage here, he must be able to go to cabinet and say, "Here is the total amount we have to break out to fund research generally. Here is the total amount
that should go into universities and here is why."

I am not satisfied that it is enough for him to say, "Well, I have looked at what the Canada Council recommended, what the NRC and everybody else recommended, and my advisory committee thinks it is all right." Then, if somebody said to him, "Well, did your advisory committee initiate anything? Was your advisory committee concerned because the Macdonald Report said that if a university does not recognize a discipline it does not exist as a discipline; it does not exist so far as the Government is concerned?" This is what the report tells us. This to me is the problem.

The minister, if he is going to be the kind of minister who will make national science policy a vibrant mechanism in the public interest, has got to initiate policy. My suggestion is that somewhere you have to have somebody who can say what the policy is for all granters, what the broad policy is, and though you may want to make exceptions and so on, by and large this is what the Government policy is and this is where the money is to go.

\section*{Mr. Andrew: Okay.}

Senator Grosart: Do you see your committee doing that?

Mr. Andrew: No, not this committee.

\section*{Senator Grosart: Then who?}

Mr. Andrew: All right. If you take our option three, and I am not personally advocating this, that there be a minister responsible, the minister would have all these bodies-the Science Council, the granting agencies, the correlating committee-all reporting to him and then, as a matter of fact, he could create any other advisory agencies that he wished to to ensure that he had the advice that would enable him to introduce initiatives, but even so he would not have as tough a job, even with all these agencies reporting to him, as, let us say, the Minister of Energy, Mines and Resources has at the present time with all the agencies that report to him. He has to balance their claims out.

My point here is that with all the mechanisms that even Macdonald recommends, and certainly all the mechanisms that we recommend, the minister, if he felt there
was a hiatus, or something missing in the purview that he wanted to have over the operations, could create or might have to create, assuming the science policy was not changed, an advisory committee to himself on the humanities and social sciences, or he might have to embrace that body of advice within the Science Council in order to get the information he needs in order to initiate the policy he wants.
Senator Bourget: Who would then be the final adviser to the minister? If I understand your definition here, different agencies will submit their estimates to the minister, for example, and then the minister will have all that information in front of him.

\section*{Mr. Andrew: Yes.}

Senator Bourget: Who finally will advise him what to take, what to recommend to the Treasury Board or what should be dropped out?

Mr. Andrew: In that case I come back to my earlier statement which is that the federal Government, although it has expert advisors on certain kinds of research and cultural development, has not got at the present time people who are the equivalent, so to speak, of Mr. Tremblay, Yves Martin, Germaine Gauthier, Douglas Wright, Edward Stewart and so on. In short, he needs some top level higher educational advisers. That is all.

Senator Bourget: So that they would be a final advisory committee to the minister.

Mr. Andrew: Is this not what happens in any government department?

Senator Phillips (Prince): Mr. Chairman, I was rather intrigued by the first purpose of the committee, as mentioned on page 11 of the brief. It mentions considering from time to time and advising the minister with respect to the annual rate of increase for research grants. I wonder why they feel that the research grants must be increased each year.

Mr. Andrew: Simply because the country is growing and it is annually becoming more complex. Moreover, the constituency they are serving, the scholars of Canada, is increasing each year, and this was written at a time when the Government for a few years had a policy of increasing 33 per cent. I think that was the percentage increase initiated by the chairman of this committee. But whether it is
amounts or annual rates of escalation does not matter; government policies change from time to time.

Senator Phillips (Prince): Basically, I was interested in whether you would tie this to the increase in gross national product or the increase in the budget.

Mr. Andrew: No, I would tie it to the increase in the areas of federal concern. For example, assuming the federal government got really excited about the north, I would expect a substantial increase in the first year to do even a tithe of what the Russians have done by establishing research institutes in their north and tying them in with university research. So that actually the rate of increase should be related to the areas of prime federal concern plus the escalation in worthy applications from engaged scholars.

Senator Carter: I have a question which is supplementary to something long gone past. Coming back to this committee that you would set up to do the correlating, how do you envisage this committee going about its business? Would you have it authorized to receive or to compile national inventories from every university setting forth its budget and its projections for a period and then comparing these to see what overlapping or duplication exists? How would your committee function?

Mr. Andrew: Well, really a correlating committee of granting agencies would, I suggest, come back to a granting agency. For example the National Research Council knows now on the basis of the applications it has received over the last three to five years what the rate of escalations in those applications is, so that it knows pretty well how much money it will need to respond to some percentage of worthy applications. It also knows, but not accurately, the amount of money it could usefully spend to make development grants to universities for areas of national concern. The same applies to the Canada Council. As a matter of fact part of its brief was saying how the applications had escalated and what areas it was attempting cover and so on, and it has not yet adopted as a policy the making of grants, except to libraries, for major developments of regional concern. Therefore the committee would in effect be relating to government that those were the differing rates of escalation between the various constituencies of the granting agencies in areas
of common concern and would set out the gaps between them, let us say geography, education, psychology and so on. It would point out that it has to make an effort to fill these gaps and that it has considered the individual requests and that it considers that the individual requests should go to such and such an extent to meet the gaps between the agencies as well as to fulfill the expectations of the community. It is merely an explanatory function.

Senator Carter: But what would happen if there were three or four universities covering the same ground in research?

Mr. Andrew: This is where what I call the process of self-selection comes in and this is why I think that no university will ever make a major development of international repute on grants from outside alone. It has to commit itself. Let us take northern studies for example; I think the granting agencies over a few years would be able to estimate which of the universities now having institutes of northern studies seems to be most committed from provincial sources as well as federal sources to achieve something of international stature, and over a few years the grants would tend to concentrate on that. If I may give another example, the Canada Council has a policy in the arts of supporting a few centres of excellence rather than dispersing its funds over a wide area. They support the Toronto Symphony, the Montreal Symphony and the Vancouver Symphony rather than the Chilliwack Boys Band. I hope I am not quoted in the Press as saying this. I am not against Chilliwack in the least; it is one of my favourite towns. But it is not a centre of artistic excellence. The same thing would apply here; the government should not select the universities, but it should look to the universities to self-select themselves, and they must keep in mind that they cannot deploy their resources in every direction. But if one university shows that northern development is of particular interest, then it will obtain the federal money available.

Senator Carter: Would your committee concern itself with projects going on over a number of years without leading anywhere?

Mr. Andrew: It would try to keep under review the expenditure of money in relation to the developments that it is able to perceive.

Senator Carter: That would be a function of correlating, wouldn't it?

Mr. Andrew: Yes.
The Chairman: We have been told and I think we all agree there must be an area where the main criterion when we come to decide on grants should be scientific merit. We have also been told that that criterion at the moment is not always effectively applied and that young people get grants to start with-which is very desirable-but once they are on the list they can go back and ask for more each year without any kind of quality audit or any kind of effective appraisal of the output.

Mr. Andrew: I think you have to have periodic appraisals of output. Whether they have to be annual audits is another matter. One of the things you have to keep in mind if you are going to give a grant for a complex project, is that you are not going to see tremendous results for one, two or three years. Some grants should be given on that basis. But then you should have a severe audit in three years to ascertain the results at that time. It seems to me there are other things besides academic and scientific merit that have to be weighed. Let us take a specific example; oceanography certainly should be developed in British Columbia, Nova Scotia and Quebec.

Senator Carier: I think you should add Newfoundland.

Mr. Andrew: Yes, thank you.
Reverend Father Guindon: I think we have to be a little careful when we are using the word "scientific." Every century has a word which becomes a kind of mythological word, and we are now coming into research as being a kind of mythology that we all adore. The kind of sacred cow is changing over the years.
One of the reasons why the universities would like to have as much autonomy as is compatible with public accountability is that there is a number of fields which have not yet proved themselves as being rentable for the Gross National Product and which should be explored. We have, among the members of our staffs, people who are interested in projects which do not immediately capture the attention of the public or even of the politician. Maybe it is only with a stretch of the imagination that some people will think of,
say, the writing of poetry as scientific, but writing poetry is as scientific as analyzing oceanography or as going to the moon.

Senator Grosart: It depends on the poet.
Mr. Andrew: It also depends on the scientist.

Senator Grosart: That was my inference.
Reverend Father Guindon: We are developing a fine world, but everyone becomes alienated. There is a real problem for research which is as important as developing research in technology, and this is why we would like the different granting agencies to get together before the advice is brought to the minister, because they are intelligent people, and maybe one of them is so concerned with his own field that he does not realize what is going on or what are the requirements in other fields, and we want them to get together more.

Another point-and this has been said of the United States and it could be said eventually of Canada-with regard to this insistence on research and the research grants given to the universities, is that if they do not cover the whole cost of the research, then the money has to be found somewhere else, because the universities have only a certain amount of money, and then it is the teaching which suffers. If any element of the university is promoted without having regard to the other elements, there is the risk of breaking down the university, and right now in research grants that we are receiving, some areas are receiving more, other areas are receiving less, and yet others are receiving none. We have to be able to try to treat equitably all the members of our staff. Some of them can have supplementary revenue, with research contracts, and others cannot. It is as important for Canada that each and every one of them be given a fair chance to develop in his own field. Of course, they will not all get as much money as each other. People in the humanities are never going to get as much money as those in engineering or the medical field or the pure sciences, but they have to be recognized; and this is one of our concerns, that whatever be the mechanics, there be some funds available to provide them with an opportunity of proving themselves.

Senator Grosart: I would agree with that entirely, but again-to come back to somebody at the top saying, "All right, the arts are part of this whole picture. Therefore, a proportion of the total is to go to the arts"we have the Macdonald study saying, "Take it out of the Canada Council and take it out of this field entirely; it is a mistake to mix up the humanities and the arts." It seems to me a trend in the wrong direction. I would like to see some kind of description of the total picture and somebody in a position to decide what are the total finding requirements of R\&D. I do not see how you are going to get this with merely a response mechanism. I think there has to be an overview at some point, so that you can say, "This is it, and this requires so much money"-whether as a percentage of the GNP or something else.

The Chairman: When you speak about, to use the term of the Macdonald Report, the strategic grants, let us say, would you go as far as enabling the minister in charge to say to the Canada Council, for instance, "You will get that amount of money for those specific grants"?-of course, on the advice of the Canada Council, presumably or the advisory committee.

Mr. Andrew: That is right. I think the minister should be in a position to indicate the directions in which the Government of Canada feels the national interest needs to be served. I think that it should be based on the advice not only of the Canada Council but also of this small family of people who really know the potentialities of the universities in relation to the in-house research, and so on.

When you consider the expertise that is available to the Minister of Finance in this country, the high-level people, and the expertise that is available to the Secretary of State for External Affairs, and then consider the relative chaos that now exists in, as we have indicated in our opening statement, the number of bodies that report to the number of ministers, this needs to be pulled together, and there needs to be an overview, and the needs to be exactly what you are both saying. We, in our way, have been saying that we are concerned, simply because universities existing from coast to coast-and, for the most part, they are now organized into provincial systems of higher education-have to serve the provinces' needs, the local needs and the world of learning.

We also hope that, by agreement between the federal Government and the provinces, they can be effective instruments for serving the national needs on a regional and provincial basis, and we cannot do this effectively unless the political machinery makes it possible.

The Chairman: To come back to your three alternatives, it seems to me that they could be viewed as alternatives, but they could also be viewed as complementary.

Mr. Andrew: That is right.
The Chairman: Because you could certainly envisage the possibility of giving the main responsibility to the Secretary of State for the federal involvement in education as well as for cultural affairs, and that would seem to be quite an homogeneous assignment. Then individual things related to the sciences and to research, given your number 2 or 3 there, could be combined, because I could quite easily see the minister responsible for science policy being the chairman of a Cabinet committee. So, I think you have not developed all the possibilities there, and it might be a little misleading to present them as alternatives.

Mr. Andrew: This is exactly why we have made these kinds of recommendations to this committee. And, if I may say so, during your period of office as Secretary of State, the universities of Canada became very much aware of your deep concern and the flexibility of your mind with regard to possible political solutions to this, so this is why we ourselves do not favour any specific solution at this time. We feel that this is really the chamber of sober second thought and, as I have seen this morning, there is a lot of concerned expertise here.

Senator Carter: Is the other group here yet, Mr. Chairman?

The Chairman: No, they have not arrived yet.

Senator Carter: Mr. Andrew, you spoke earlier of centres of excellence. Do you think it should be a part of government policy to develop at least one centre of excellence in each province of Canada?

Mr. Andrew: No, that would not be either good or logical, but let me discuss some of the obvious things. I have already indicated
that in oceanography there are certain provinces that would obviously be concerned in the subject, but how many centres of oceanographic study there should be is, in the last analysis, a political decision. This is where the over-view comes in. International studies is another field which is within the federal jurisdiction because it at least has a responsibility, if not an exclusive responsibility, for international affairs.

It seems to me clear that the universities of British Columbia should be involved in Asian studies. I think we always have to bear in mind here that by and large where there is an adequate need there should be developments in the French language universities as well as the English language universities in major areas of federal concern. For example, at the moment Laval has the only developed institute of bilingualism. I feel it should really get major support to develop that so that we have teaching instruments in French and English that are devised in Canada; so that we have voix et images du Canada rather than voix et images de France. Actually, the French language in Canada is a North American variant of the French language, and it should be so recognized, and I think its association with North American technology makes it highly desirable. These are all problems central to the French Canadian society which need to be handsomely explored.

Without saying that there should be something in every province, I think that certainly across the country you can find opportunity for real centres of excellence. Not every university can have a centre of excellence in every subject, but in every province there should be a centre of excellence in some particular field.

Senator Carter: That is really what I had in mind, but I would like to pursue that a little further because if you limit your centres of excellence to the large universities in the large centres then what hope is there for the smaller ones?

Mr. Andrew: No, I totally disagree with you there. This is what we mean when we say that national development must include regional development. This applies to the smallish institutions as well as the great institutions. It does not seem necessary to deprive, as I say, the University of Toronto of some of its developed areas of research and study, but if we plan now for the future
we can plan for the support of self-selected, and not Government-selected, areas of excellence in the fields that are of concern to Canadian society.

Senator Carter: Would you say that there is such a thing as uniqueness about certain universities?

\section*{Mr. Andrew: Sure.}

Senator Carter: Some universities have a unique setting and a unique environment. Should not that uniqueness be developed?

Mr. Andrew: Sure. Let us take a clear example of Queen's. I remember a few years ago talking to Dr. Corry and saying that one would expect that what was originally a Presbyterian foundation would be strong in economics and commerce, and would have some pretensions in philosophy. I was trying to be insulting in a friendly way. He said, "You can repeat that because we had a special lecturer up from New York not long ago and he said that he did not know much about the university." I told him that it was founded as a Presbyterian foundation, to which he replied, "Then you will be good in economics, but no good in sociology." He added, "I had to confess at that time that we had no department of sociology." One of the unique things about Queen's is its strong interest in economics and political science. Actually, it is not surprising that there should have been developed there an institute intergovernmental relations. That institute has not had any real and substantial support yet, but Queen's is uniquely placed to favour that. Carleton has its Institute of Canadian Studies, and that will develop.

The Chairman: And Ottawa is concerned with international co-operation.

Mr. Andrew: Yes. You know, they all sooner or later declare their hand, so to speak, in respect of their uniqueness, and what government has to be able to do is to support that uniqueness. There must be institutional integrity and institutional differentiation in order that they shall not become replaceable parts serving purely provincial needs.

Senator Carter: And you would regard that as a legitimate aim of federal science policy?

Mr. Andrew: Sure.
The Chairman: Provided it is done on a fair basis.

Mr. Andrew: Yes.
The Chairman: Do you think that your association, assisted, of course, by the individual universities, would be in a position to cooperate actively in any kind of a government agency designated for this purpose, so that there would not be too many fights?

Mr. Andrew: As a matter of fact, for years we have been anxious to be propositioned by the federal government in order to find out the extent to which our member institutions would support this kind of viability.

Senator Carter: Could I ask one last question in respect to your correlating committee. I am thinking in terms of centres of excellence. Obviously when you have a province like Ontario, with a huge university like the university of Toronto and a number of smaller universities, there is a special role for a big university in developing and helping the smaller ones to develop. Would your committee embrace that in its role as a correlating committee?

The Chairman: I do not think the Government of Ontario would like that very much.

Mr. Andrew: Yes, we do not have to worry about that because the Committee of Presidents of Ontario Universities are attempting to cope with the rationalization of graduate studies in Ontario.

On the question of smaller universities being helped by the larger, it does not quite work out that way. The smaller universities are entitled to state their ambitions, and if those ambitions fit in with the general work of development in Ontario universities, the two bodies concerned with that are the Committee of Presidents of Ontario universities and the Council on Graduate Studies, and also the advisory committee to the government. At this moment we do not have to consider too much at the national level the internal relationships of universities in the larger provinces; they have mechanisms of their own to relate those things.

Senator Carter: Suppose a university or the government initiated a research project, a new field of research, which is to go on for ten years, which is then broken down into various sub-projects. Some of those could very well be done by some of the smaller universities. Obviously the government cannot give a sub-project of this major project to
each university, but surely there should be a place for the little fellows to fit in. Who would decide that?

Mr. Andrew: This is where what are called the strategic development grants of the granting agencies come in to assist smaller universities to develop a particular research capacity in the field in which they believe, with justification, they have potentialities.

Senator Grosart: With regard to the possible distortion of science effort in the universities through federal project grants, is there any evidence at the moment of major distortion brought about by the specific nature of project grants?

Mr. Andrew: Let us see if we are talking about the same thing. The project grants?

Senator Grosart: The point of my question is this. There is a feeling in the American universities that the military defence project grants in universities tend to distort the academic picture.

The Chairman: You mean when the granting agency takes the initiative and offers a grant for a specific purpose?

Senator Grosart: That is right. That is a project grant. Has it yet brought about a distortion in what might be regarded as the most viable academic mix.

Mr. Andrew: Let me give you an example from personal experience. Professor Forward and I were both at the University of British Columbia years ago when we first got into graduate studies. We got into them in fields like physics, chemistry, zoology, and in his department, metallurgy. We got into those fields because in the early post-war years they were the most competent and capable of developing graduate studies. My own department was English, and, although we had an immensely larger department, our library resources and other things were not at that time up to developing a graduate program. In one sense you could say that the university in that period, in terms of its excellence, was dis orted, so to speak, on the side of the sciences.

I would not use the word "distorted" there. I would say that the initiative of the sciences started elevating the standard of the university as a whole, but it became vitally important that the social sciences and humanities be given a chance to catch up. The ones in the
social sciences that did were economics and anthropology. But they had to receive a push, and we had to scramble for the money to find the push, which was not easily given up because the granting agency at that time, the Canada Council, had no money for development grants. The National Research Council was better funded. It all depends on how you look at it. I do not call it distorted in the same sort of way that they are talking about in the United States at the present moment where military research, as some of the major universities have noted, has distorted in growth beyond their control and made them make commitments to people they cannot see their way to finally possibly discharge.

Senator Grosart: A good definition of "distortion".

Senator Yuzyk: On page 10 of your brief I notice you say that the membership of this liaison committee should include, among others, the chairman or executive officers of the various granting agencies, and you list the National Research Council, the Defence Research Board, the Medical Research Council, the Canada Council, the Chairman of the Science Council of Canada, the Director of the Education Support Branch of the Department of the Secretary of State and the Director of the Science Secretariat. Certainly there is a tremendous imbalance here when one considers that the social sciences and humanities have, according to the statements madeand I agree with Father Guindon-been neglected over the years, and something should be done right across the line in the universities to improve the position of the social sciences, humanities and arts. The Canada Council can claim to speak, at least partially, on behalf of many of these disciplines, but if it came to a vote in this committee the natural sciences certainly seem to outweigh the others. How would the AUCC try to fill in this gap, shall we say, of those subjects not represented at all, which should be taken into consideration?

Mr. Andrew: We periodically make representations to the granting agencies about what we feel should be done from the educational point of view.

\section*{Senator Yuzyk: To the AUCC?}

Mr. Andrew: Yes. You have put your finger on why it should be a correlating committee and not a coordinating committee. A coordinating committee might vote, and I want
the Canada Council in this particular to be free to make its representations to all the other agencies about the adequacy of its grants.

The Chairman: In statistical theory there is quite a distinction between a low degree of correlation and a high degree of correlation.

Senator Yuzyk: And there could be non-correlation.

The Chairman: Would you prefer a high cœefficient or a low one?

Mr. Andrew: I am not sufficiently familiar with statistical theory.

Senator Yuzyk: We are interested in having a more effective voice for the social sciences and humanities, and I think a little more attention should be paid to the composition of this liaison committee.

Senator Grosart: Do you think there should be a split between the cultural and arts sciences and the harder sciences along the lines Senator Lamontagne suggested, that perhaps one group should be under the Secretary of State, and that the sciences proper, if I may use that term, should come under...

The Chairman: I did not say that.
Senator Grosart: You suggested that some might come under-

The Chairman: The arts and the cultural affairs.

Senator Grosart: That is what I said. I call them sciences.

The Chairman: I do not include economics in the arts.

Senator Grosart: Although, there is a good deal of fiction there too.

The Chairman: The same thing applies to law.

Reverend Father Guindon: You know what they say about people studying examinations in economics, they keep the same questions, but just change the answers.

Senafor Grosart: What about the impact of federal funding in the relationship between the research function and the teaching function? It is sometimes said that in the sciences the tendency is for people to fall in love with research and forget there is a teaching function there. Is there a distortion of this kind?

Mr. Andrew: There is a good deal actually. A lot of their protests, particularly in the undergraduate level is because universities have forgotten that they are concerned with values, as well as knowledge. They object to a curriculum loaded too exclusively on the side of knowledge, in the sense that most of the offerings, according to them, are prerequisites for either professional training or graduate training rather than a relevant curriculum concerned with man's relationship to his fellow man and nature.

The Chairman: Man and his world.
Mr. Andrew: Yes, man and his world. I remember years and years ago when Dr. Schoum, who was then head of the Department of Physics at the University of British Columbia, wanted to engage a very able young scientist who had been highly commended to him. He outlined to this young man his duties, which would be to teach, at that time, three courses, one at the freshman level, one at advanced level and one postgraduate. The young fellow said, "I don't intend to teach any damn freshman," and he was faced with the dilemma of yielding to this fellow or letting him go to another university, to lose some scholarly impetus in his department, or take him and accept his conditions.

I would say it is true that universities have, in fact, been offering courses that are more dictated, by the subject the fellow got his Ph.D. in, than by their exclusive relevance to an undergraduate program designed for undergraduate, general education, as well as their introduction to professional and advance studies. Therefore, the exact mix between knowledge and values has been distorted to some extent. I think it is fair to say, and this is a personal opinion and not the association's opinion, that there has been some distortion there and that we are going to have a correction, because students are now wanting a say, at least in the policies that determine how much you count teaching competence for promotion and tenure, and by and large, I think they should have a say in the policies in this matter, not in terms of individuals.

Senator Carter: There is another factor, too, where the pressure upon the professor in the university, in order to maintain and enhance his reputation, has got to publish a book every once in a while, otherwise he is
not known. He becomes so engrossed in this that he does not have time to bring his lectures up to date and the quality of his teaching suffers considerably.

Mr. Andrew: That is not quite the emphasis. The current emphasis in that there is a revaluation going on in almost every university about the relationship of teaching competence to research competence. This is going on because the students have made it necessary for it to go on. I personally have great respect for this aspect of the student protests.

Senator Grosart: It is not only teaching competence, but teaching willingness. I have sometimes heard my friends, who are teaching in universities, say, "You know, the universities have been very good to me this year; they have cut down my teaching hours by so many hours." It seems to be a status symbol as to how few hours you have to teach.

Mr. Andrew: That was done, of course, to make room for more research productivity. I do not want to seem to be saying that there is not an equal need now as there ever was for research emphasis in universities. I think, however, that there is a need to reappraise the willingness as well as the competence of teachers to teach.

The Chairman: But, do not you think there is a necessity, because of this danger and because there might be very good researchers who are not interested very much in teaching, to keep centres of excellence in research which are not directed or related to teaching?

Mr. Andrew: In this sense we raise another question. Should there be centres of research that are not in universities at all? Of course, there should be. There should be, however, centres of research in universities and the centres of excellence of research in universities should always have some professors who have no teaching load and a few granduate students. This is the point at which they are real centres of excellence and not on the lower levels of the slope. I think, myself, that there are not more than about 5 per cent of the scholarly world who have a big enough research talent to be totally occupied with research for their whole working life; most of us have a few ideas in our lifetime. If we are lucky, we hope to have time to develop these ideas and that time should be available. The majority of people really enjoy exposing their
ideas while they are in the process of clarification, to students. I feel this is the common characteristic of real scholars. They know very well that a sharp student is lilely to expose fallacies in their thinking. This is a part of the rough and tumble of academic life most good scholars really enjoy.

Reverend Father Guindon: Here again I will express a little word of caution. This professor, who is just groping for his own ideas in front of his student, is doing as much research as a man who is in a lab. This is one of the problems. We are using the word research in such a restricted sense. If we scratch a little bit we find research is mostly in scientific fields and not quite as much in the social sciences. In teaching, the member of the staff who is preparing a class, is doing as much, but this is not recognized as research, unfortunately. I think there might be a lot of semantics involved here. This is one of our difficulties, that we consider research as being the office of certain groups doing a certain type of work. While research in fact should be a personal involvement of every member of the university and in fact it is, much more than it is recognized.

In ancient times people used to talk about the educated man as a philosopher, which really means as an amateur of wisdom. "Wisdom" was the word at that time. Then it became the "artist," but not in the sense we are using that term now. Then it became, in some of the French countries, l'honnête homme, the honest man. It was completely different. Now we have come to the scientist who is becoming the big man. I have nothing against science. On the contrary, but I would want that we always keep in mind that the university has to bring together all these sources, and the university has to be given the means to support each and every one of its members in a fair and equitable way.

Since there are some groups which have not been recognized, we are putting a voice for them. Since the different groups more often than not develop individually, without getting together, this interdisciplinary method which is being introduced today is going to salvage the university. Otherwise it is going to break into islands and in fact they are part of an archipelago, they are not just individual islands.

Senator Yuzyk: Is this a general trend in the universities now across the land?

Reverend Father Guidon: One of the frustrations of most of the good teachers who do not happen to be recognized as good researchers is that they are the underdogs in the university. We as university administrators have a problem there. We cannot treat a group of our men, and especially those we feel are doing an excellent job, as teachers, without perhaps publishing a paper. We have to be able to recognize them and give them the support that they require to continue their work.

Senator Grosart: This is where you get your problem of the tendency of funding to emphasize the project-because you can justify the money more easily, whereas if you get into the less visible projects of the humanities it is less spectacular and appears to be less important.

\section*{Reverend Father Guindon: Yes.}

Senator Grosart: Shakesperean research after about 200 years and 2,000 or 3,000 books, results in this, that the best book written is called "What Happens in Hamlet".

Senator Carter: World wars give a tremendous impetus to the sustaining of research and development. After World War II we saw a slump down and we began to coast along resting on our oars, and during that period the humanities really got more emphasis, probably, than science. After that, about ten or twelve years ago, Sputnik I went up and suddenly we became conscious that we probably are behind in the scientific race in the western world. Then we get this emphasis which is back now on science. We get these cycles which probably level out now, and the trend seems to be more towards the humanities. Would you agree with that?

Reverend Father Guindon: I think I would agree, sir. The very fact that our present situation in the west in certain ways is in a kind of mess, and that there are no many alienated people, should put our minds a big question mark, as to whether we should not put some emphasis on other elements. Perhaps it should not be a deminishing emphasis where it has been laid recently. I think we need that. But I would say that we do this and we do the other one, and perhaps give a fairer proportion of support to the other elements which appear to be really pressing problems.

Senator Grosart: This is why the social scientists elected to call themselves scientists, to get into the club.

The Chairman: I think that is very unfair. I will not answer it now.

Senator Grosart: I am not saying it critically. Perhaps I should have said, "Insist that their status be recognized so that they could get into the club."

The Chairman: Is this because law is not recognized by the Canada Council?

Senator Phillips (Prince): I am intrigued by the statement that universities would participate in studies and changes in Canadian society and economic population migrations, different economic levels, and so on. Does this mean that the Canadian universities and colleges are more interested and more willing to participate in the problems of regional development than they have been in the past?

Mr. Andrew: From my point of view, yes. I would like here to put in a plug for the fact that the biggest amount of money that ever became available to the human and social scientists was distributed in the early days of the Royal Commission on Bilingualism and Biculturalism-which was the first time that research in these fields had ever been undertaken in Canada.

The Chairman: They certainly went at it with a vengeance.

Mr. Andrew: Yes, with a vengeance. It is frightening to think of what would have happened if the Canada Council had not got more money for research in the humanities and social sciences for those who had had their appetites whetted for a few years by this development.

It so happens that our organization this summer hopes to launch a study of Canadian studies in Canadian universities. It will take about a year to complete it. What we are interested in is how interested are the universities in Canada in Canadian literature in two languages.
For instance, when I went to a university, there was no study of Canadian literature: it was all a study of English literature. We are interested in Canadian history in two languages, and with regional development, but basically we are interested in studying how interested the Canadian universities are in the

Canadian content of such subjects as political science, economics, sociology, anthropology, and so on. We want to find out if we get enough well-trained people to respond to the universities' needs to study these subjects, if they feel they should study them-are the source materials available and are the textbooks available? -and to find out if there are some assumptions in contemporary social science, such as the assumption of value free social science-these assumptions having been developed in the great graduate schools of the United States-that have universal validity or whether some of them are products of particular circumstances of American society in the contemporary world?

These subjects need to be studied. Our organization feels that the question of how many Canadians with American degrees, or Americans with American degrees, or British with British degrees, are teaching in our Canadian universities, is a wrong emphasis. What is important is to know how important Canadian universities feel the study of Canadian institutions and Canadian problems is, as an academic discipline. Here again we feel this is an area which has not been adequately supported at the granting level in Canada, possibly because the federal Government has not a posture in this.

Senator Phillips (Prince): I am more interested in the regional development on the economic level. I am thinking of two years ago when the Atlantic Provinces, the four provinces, hired a consultant to deal with a graduate agency in development. They brought in a group or an individual from Scotland. This always struck me as being rather strange, that we could not find someone in Canada qualified to do this. The answer I got from several of the provincial premiers was that our Canadian universities did not train people along this line.

Mr. Andrew: I think, actually, we are coming back to this distortion, if you like to call it that. I think that graduate studies in the sciences in Canada are much more advanced than graduate studies in the social sciences and humanities. We feel that this is a shame, that this cannot and should not prevail, but that, as a consequence, they have not turned out enough people to staff our universities in these fields with people who have been trained in, so to speak, the Canadian aspects of their disciplines. Therefore, there is a shortage of people for this kind of call.

For example, I think Canadian economic history, really, is a fascinating field, but it is not a highly developed field yet. It is not highly enough developed to serve the Canadian society.

Mr. Waines is an economist. Perhaps he would like to comment on that.

Mr. W. Waines, Associate Executive Director, Association of Universities and Colleges of Canada: I think on the last point you have made, one of the important points in the trends in economics is towards mathematics, econometrics and that sort of thing. We find economic historians concerning themselves primarily with the quantitative economic history. This is, if you like, in my view, and I am trained in the traditional rather than the modern theory, the fad in economics these days.

Senator Yuzyk: This is a question of individual preference.

The Chairman: This committee has even discovered that the Bank of Canada has gone "go-go".

Mr. Waines: Of course, all the institutes that are in research in the economic field have gone modern.

Senator Grosart: You have to be a mathematician to be an economist these days.

Mr. Waines: This has sort of distorted the training and research development in economics to the disadvantage of our whole understanding of our economy.

Senator Yuzyk: But the universities are conscious of this and are trying to rectify it, are they not?

Mr. Andrew: Well, you run into problems there. Once the majority in a department gets committed to model building, the tendency is to recruit more of the same. Some day I think we will rediscover that there is a thing called political economy that was abandoned 20 years ago.

Senator Grosart: Then again you call it a "model" to get into the science club, but when you ask to see the model it is just some more pieces of paper.

Mr. Waines: Even the linguists are doing this.

Senator Grosart: In order to get into the club you say that you have to have an econometric model.

Mr. Andrew: This is why this Senate committee is performing an important function. It is airing a whole lot of things that have needed airing in the academic community. Its relationship to federal and provincial authorities and federal purposes in research is important. I hope you gentlemen are conscious of having as high a purpose as we think you have and as good an impact.

Senator Grosart: Father Guindon, when a research project is offered to an individual in the teaching staff of the university, is the management, if I may use that word, of the university consulted? Furthermore, does the management of the university have any veto on the undertaking by that individual of what may be an extramural activity.

Reverend Father Guindon: In many instances, sir, the grants are given to the individual and the institution as such is not consulted. However, the individual will talk to the head of his department and to his dean.

So far as the veto powers go, almost the only veto we can exercise is when it comes to a project which would require erecting another building or getting facilities that are not provided in the grant and which the university cannot provide.

Senator Grosart: You d'ont have any NHL contracts.

\section*{Reverend Father Guindon: Not yet.}

Mr. Andrew: Nor do we desire them.
Senator Grosart: It seems extraordinary that any department or agency of any government would deal directly with a member of a university staff without consulting the university first. Is this a problem, so far as you are concerned?

Reverend Father Guindon: It could develop into a problem, if it went much further than it has up to now. We have more or less managed. But I must say that we have managed until now because we have had tonot take away but not give to other areas of the university, having to live within a limited amount of money. If the project was going to go, we had to find the money.

Senator Grosart: This comes into the problem of total funding where, if you were
consulted, you might say, "Well, no, unless you are prepared to pay the whole shot."

Mr. Andrew: It also comes into the interrelationship between the scholar and the institution, because scholars are a mobile group. They can take their grants and move; they can take up their beds and walk. Universities sometimes find themselves left with equipment that is no longer useful to a particular person, but, on the other hand, it would be wrong, if the institutions were the arbiters of scholarly activity. So our association is terribly concerned to relate the institutional commitment to the scholarly involvement. So we do not want to be the final arbiters on anything, irrespective of scholars.

On the other hand, we feel that unless the scholar gets the support, the commitment of his university, he cannot really build a monument.

The Chairman: I don't know if we should establish a precedent here, but one of our visitors desires to ask a question. This has not been done before.

Dr. J. J. Keen, Chairman, Geology Department, Dalhousie University: Mr. Chairman, it is just a matter of correction. I believe the two witnesses are incorrect in stating that there is no veto power at the universities over grants to individuals. There is, in fact, a direct veto power in the matter of NRC grants. The form of appropriation has to have the signature of the dean and he can say no.

Mr. Andrew: I would like to correct the corrector. The Canada Council makes it very clear that when a signature goes on it, this is merely a signature that certifies that the university has been informed, and both the university, the Council and the individual deny categorically that this is any veto power.

Senator Yuzyk: If a group of university professors takes on a project from the Canada Council, for example, is this not administered by the university as such and at that time does the university not have some say in the development of that project or in its completion?

Reverend Father Guindon: The grants are given at times to the individual and at times to the university for administration depending on which appears to be the more suitable. In fact in the research requests the researcher has established this own budget and the only administration that the university does is to
see that the monies, when the grant is given to the university, are spent for the indicated items on the budget. Now some of the researchers can ask to have the funds switched from one item to another and when this is approved, the university administers this. It is not an auditive function that the university performs but an administrative one only.

Senator Yuzyk: But what if the university officials or somebody in the administration finds out that the money is not used properly, or that the project is not developing according to the plans laid down. Can you then stop this project?

Reverend Father Guindon: I think it is for the researcher to present his report to the granting body and it is for the granting body to make the decision.

Senator Yuzyk: Therefore the university plays no part in it.

Reverend Father Guindon: We have to be very clear about this. University administrators are not per se in the position to judge the academic purpose of a research grant as such, and therefore it would be presumptuous for them to comment on how a thing is proceeding. That is between the grantee and the grantor. But the researcher is supposed to submit reports and those reports have to be adequate.

The Chairman: We as a committee have gone to the United Sates recently, to Washington and Boston and we have also visited the M.I.T. and Harvard. We were very much impressed by the great mobility of the broad scientific community in the United States. Now I do not know if we saw a non-typical
example, but most of the people that we met had been, if they were not in a university, working for government or industry before. I do not think we have the same kind of mobility here in Canada and I think it would be highly desirable.

Mr. Andrew: There is a good deal of mobility within universities now, but actually youk have raised indirectly another important matter and that is the adequacy of research in the industrial sector. Of course many of our industries are branch plants of industries in the United States, and since most of their research is done in the United States this limits the amount of mobility as between industry and university. There are many reasons for this. I feel there could also be more between government and universities. I know some departments of government are concerned about the interchange but I myself think it is not a bad experience for people to have the opportunity to serve in both capacities from time to time.

The Chairman: I am sure that I am speaking on behalf of the members of the committee when I thank you most sincerely for spending all this time with us this morning. We are a little frustrated in that you have not been able to present your views to the board before appearing here today and giving us the benefit of the result. I realize this is probably our own fault because of the way we have worked out the schedule of our hearings. We certainly hope we will get a copy of the brief that will eventually be adopted by your board in relation to the Macdonald study.

Again, gentlemen, I want to thank you very much indeed, for being with us.

The committee adjourned.

\section*{APPENDIX 60}
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                                    A Brief
                                    Submitted to
                            the Study Group
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Sponsored by the Science Council of Canada and the Canada Council
                                    on
                            The Support of Research in
                            the Universities
                                    by the
Association of Universities and
                            Colleges of Canada

April 30, 1968.

Institutions of higher education have two primary functions: teaching and research. These functions are concerned with knowledge for its own sake, but they are also concerned with the scientific, technological, economic, social, and cultural development of all the communities which they serve, whether local, provincial, regional, national or international.

Canadian universities, conscious of these teaching and research responsibilities, are trying to find ways by which they can relate to all the authorities which have responsibilities for economic, social and cultural development and for international cooperation. They are concerned especially about the intimate relationship between expensive research and high-level manpower training. In addition, the universities are conscious of their responsibility for developing international studies, for maintaining contact with universities throughout the world, and also for assisting in programmes of aid to developing countries.

Canadian universities and colleges are fully aware that in order to achieve these goals they must hope for close cooperation between appropriate provincial and federal authorities.

Most of the universities' problems stem from the universal dimensions of education. They are tied in with the explosive growth of knowledge, and the extraordinary multiplication of fields of specialization. Adequate planning in this context requires, therefore, Canada-wide consultation between representatives of the provinces, the federal government and its agencies, and the university community, if the development plans of the various political jurisdictions are to be served, and if the universities' obligations to the world of learning are to be recognized, without unnecessary duplication, overlapping, and wastage of resources.

This Canada-wide consultation is also urgently needed to cope with a range of social and economic problems which the universities may help solve:
- changes in Canadian society and its economy, population migrations, differences of economic levels causing serious drainages of manpower and resources from one region to another;
- international responsibilities, e.g. the training of specialists in African, Asian, and other regional studies which need not be undertaken by all institutions;
- the special requirements of professional and quasiprofessional bodies and of various groups concerned with higher education, e.g. medical and health associations, continuing education organizations, etc.
- students' role in university affairs and the portability of student benefits across provincial boundaries;
- formula financing and other financial aspects of higher education.

Cooperation is equally needed to deal adequately with some or all of the following areas of specific concern.
1. Matters which fall within provincial jurisdiction but which have Canada-wide implications such as urban and rural development; health and welfare; forestry, including fire and disease control.
2. Problems of economic, social and cultural development, which may fall within provincial jurisdiction with Canada-wide implications or within concurrent or divided jurisdictions: productivity and economic growth; natural
> resources, fisheries, inland waters, oceanography, conservation and pollution problems, etc.; communication, climate control projects, nuclear energy facilities; northern studies; upper atmosphere and space studies; regional computer centres, etc.
3. Matters which fall within federal jurisdiction: defence, external affairs, inter-cultural relations in Canadian society, including bilingualism; transportation on an interprovincial and interregional basis.
4. Matters which require cooperation interprovincially between universities and provincial governments, such as the exchange of information, the use of new media of communication, the development of compatible equipment to permit exchanges; cooperative production and use of recorded material; library development and cooperation; central information retrieval systems. The urgent need for rapidly available statistical data regarding students, staff and finance and other aspects of higher education cannot be stressed too much.

It should first be noted how much of the machinery for effective university-provincial or university-regional cooperation has been developed in the past few years.

Provincial, or regional, "associations" of universities now exist in the Atlantic provinces, Quebec, Ontario, and the western provinces. In addition, in a number of provinces, the government departmental arrangements for considering higher educational needs and problems have been reviewed and revised. And finally in Nova Scotia, New Brunswick, Ontario, Manitoba, Alberta and British Columbia, agencies have been brought into being, intermediate between government and universities, to consider university and pro-
vincial needs for higher educational services and makr appropriate recommendations to government. Not all these agencies have the same responsibilities in detail but the patterns of responsibility are similár. In short, it can now be said that great strides have been made in developing provincial (and to a minor extent, regional) systems of higher education to meet some of the most pressing and particular needs of the complex Canadian federal structure.

The purposes of these basically provincial systems are to:
1) assist the universities in planning to meet provincial needs for higher learning, research, and high level manpower training;
2) to rationalize university offerings and areas of specialization, avoiding unnecessary duplication, and making the best use of available resources.

It would be premature to report enormous progress in achieving these objectives. It would seem to be apparent to all concerned that the objectives cannot be pursued successfully in a provincial context alone, but that in a country like Canada, they have to be pursued concurrently, in provincial, regional, federal and national contexts.

National objectives are not by any means the same as federal objectives, nor are they the same as provincial objectives because they embrace both the federal and provincial responsibilities as well as those which universities have to the world of learning.

The Centennial Conference of the AUCC recorded in the form of the following resolutions their concern for research development in Canadian universities.

\section*{RESEARCH PRIORITIES}

RESOLVED THAT the AUCC continue to encourage its members to pay primary attention to the development of research policies
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which relate to the universities' responsibilities for teaching and enlarging the body of knowledge, but at the same time to reme:ver that emphasis should also be placed on mission-oriented research projects which are in the national interest.

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\section*{GOVERNMENT RESEARCH LABORATORIES}
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RESOLVED THAT the AUCC urge governments to adopt the policy of establishing government research laboratories on university campuses, and in such circumstances, the university be given adequate means to strengthen the related departments.

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\section*{PRODUCTIVITY AND RESEARCH}
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RESOLVED THAT the AUCC encourage increased support for applied research in universities as a means of raising national productivity.

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\section*{RESEARCH IN THE BIOLOGICAL SCIENCES}

RESOLVED THAT the AUCC acquaint the government of Canada and the general public of the vast increase in the research requirements of the biological sciences that will take place during the next decade; the AUCC believes that it is in the national interest that the universities' facilities be increasingly employed and developed with public funds to carry on the greater part of this expanded research activity.

RESEARCH SUPPORT FOR SMALL UNIVERSITIES
RESOLVED THAT the AUCC recommend that granting agencies support research in small universities sufficiently to provide on a continuing basis technical assistants and services necessary for efficient research.

\section*{INSTITUTIONAL GRANTS}

RESOLVED THAT the AUCC while encouraging agencies granting
research funds to continue with their traditional grants to individuals, nevertheless urges that such agencies award grants to institutions of higher learning in order to enable them to initiate and maintain significant research projects, particularly those in the national interest.

\section*{ROLE OY UNIVERSITIES}

RESOLVED THAT the AUCC urge its members to identify and interpret their distinctive roles in education, research and community service and to cooperate with other institutions of higher education and governmental agencies thereby ensuring a coherent effort, serving the economic, social and cultural development of provincial and national communities, employing scarce resources most effectively.

\section*{SOCIAL SCIENCE RESEARCH AGENCY}

RESOLVED THAT the AUCC, in close cooperation with the Social Science Research Council of Canada and other appropriate learned societies, and with the assistance of the Canada Council, establish a Committee to study the feasibility of the creation of an inter-university agency which would have the following functions:
a) the organization of a social science data-bank,
b) the provision of appropriate services to facilitate survey research.

ASSISTANCE FOR INTERNATIONAL STUDIES
RESOLVED THAT the AUCC recommend to appropriate agencies that assistance be given to Canadian universities and colleges in their efforts to broaden and deepen the international studies content of undergraduate and graduate sivies teaching programs.

\section*{INTERNATIONAL STUDIES GRANT}

RESOLVED THAT the AUCC recommend to appropriate agencies the establishment of generous programs of awards for Canadian scholars in the field of international studies.

\section*{RESOLUTION ON CANADIAN UNITY}

RESOLVFD THAT in order to ensure that the intellectual resources of Canada, to the fullest extent possible, may be devoted to the needs of Canadian unity and individual human well-being, the AUCC shall seek to encourage research, teaching, publications and student-teacher exchanges, all with a view to achieving a deeper awareness and acceptance of Canada's two official languages and cultures and those fundamental values held in common by all Canadians.

The first essential element in developing a strong Canada-wide system of higher education is to ensure that adequate machinery for provincial consultation for provincial development exists and works satisfactorily.

It would appear that the machinery (as indicated above) is being developed in most provinces and in some it is already being tested with respect to rationalizing the requirements for professional and graduate studies.

Less attention has been given so far to the relationships between the universities within a province and the research needs of the province as a whole, though it is clear that the universities are expected to make a major contribution to the solution of the scientific, technological, economic and social problems of the province. That is to say, the universities are expected to make their appropriate contributions to applied as well as to basic research. Universities must be concerned with the applied problems of engineering, education, the social sciences and humanities, provided that these problems possess the quality which calls for theoretical understanding as well as technical knowledge. A good deal of care will have to go into defining what is appropriate in such fields.

However, it is recognized by most universities, provincial grants commissions, and provincial higher educational authorities that efficient rationalization and planning at the provincial level requires some knowledge and consideration of regional and federal government planning, particularly in the fields of research and high level manpower training.

The need for planning on a wider than provincial basis is reflected regionally in the existence of the Association of Atlantic Universities, the Interprovincial Committee for University Rationalization (for the prairie provinces), and the Commission inter-universitaire des cours télévisés et radiodiffusés, and on a Canada-wide basis by the establishment of the Council of Ministers of Education. The Association of Universities and Colleges of Canada and its associate members such as the Association of Canadion Medical Colleges, the Canadian Association of Graduate Schools, the Canadian Association of College and University Libraries, etc., are concerned with ways and means by which the universities and colleges of Canada can serve both provincial and federal interests;- and through l'Association des universités partiellement ou ertièrement de langue française, the Association of Commonwealth Universities and the International Association of Universities, the universities of Canada express their interest in matters of international concern.

The last formally stated federal position (presented by the Prime Minister in his address of October 1966) affirmed a federal responsibility for research, cultural development, equality of educational opportunity, and certain kinds of manpower training or retraining.

Recent discussions of federal and provincial responsibilities have made it evident that no clear line can be drawn between education and culture. Most educators would agree that all research (whether in the physical and binlogical sciences, the social sciences or the humanities) which contributes to the advancement of learning is an aspect of cultural development.

If the federal government is to continue to be involved in research in its own laboratories and to support research in the universities for national purposes it is essential that the federal government the provincial authorities and the universities should be able to keep under review the relationships between provincial needs and programs, federal needs and programs, and the resources available to the universities to carry out their part of national programs.

For the past two years, the AUCC has taken an initiative in convening a meeting to discuss the development of a consultative mechanism to relate provincial, federal and national concerns in research and the high level manpower training which normally accompanies it. Those attending have comprised representatives of provincial departments of education or university affairs, the executive officers of provincial or national associations of universities and the executive officers of provincial advisory committees or commissions on higher education. At the last meeting on April 17, 1968, Dr. W. Swift was requested, on behalf of the representatives present, to explore the holding of a similar meeting in 1969; to enquire into matters that might be profitably discussed at such a meeting; to enquire into the appropriate bodies or agencies to be represented at such a meeting; and to decide upon the appropriate time to hold such a meeting.

As has been noted, the universities of Canada, through their provincial, regional, and national organizations, have begun to appraise and review their research and graduate training structures with a view to the selection and development of areas of special strength. In Ontario, for example, the Ontario Council on Graduate Studies has begun to devise appropriate mechanisms for the selective development of graduate and research strength in that province.

More recently, an advisory committee was formed by the AUCC and the federal Department of Energy, Mines and Resources to assist and advise on the development of inland waters research throughout Canada.

A similar relationship has been developed between the AUCC and the Fisheries Research Board.

Most recently, the AUCC has contracted with the External Aid Office to undertake a study of Canadian university resources for cooperation in higher education with developing countries.

In addition to encouraging the development of the self-selective and cooperative mechanisms described in the preceding paragraphs, the AUCC feels that it is desirable to have an organism within the federal government which will allow the universities to have access to a single body representing the major federal research granting agencies and advisory bodies. Such a mechanism would facilitate the development of policies with respect to granting research funds to universities, with the understanding and support of all the federal agencies involved.

The AIJCC recommends that this mechanism should be developed in the form of a liaison committee which would be advisory to a Minister of the Crown. It suggests that the chairman of the committee might be elther the Secretary of the Cabinet or the Deputy of the Minister to whom the committee reports. It suggests further that the secretary of the committee might be the Director of the Education Support Branch of the Department of the Secretary of State. The committee membership should include, among others, the chairman or executive officers of the various granting agencies: the National Research Council, the Defence Research Board, the Medical Research Council, the Canada Council, the Chairman of the Science Council of Canada, the Director of the Education Support Branch of the Department of the Secretary of State, and the Director of the Science Secretariat.

The primary purpose of this committee should be to help the granting agencies and related advisory bodies to develop policies, whether integrated or diversified, relating to the support of research in the universities of Canada. In particular, we would suggest that the following, among other matters, should fall within the terms of reference of the committee:
1. To consider and from time to time advise the Minister with respect to the annual rate of increase for research grants and whether or not this should be the same for all granting agencies.
2. To recommend to government, policies with respect to overhead on research grants and how such overhead should be determined for the various fields of research.
3. To recommend to government which agencies should receive appropriations for research support to each academic discipline, sub-discipline, and to the new developing interfaces between disciplines.
4. To recommend to government the appropriate levels for support of research in those areas which encompass a wide range of scientific fields and cross the boundaries of the terms of reference of a number of granting agencies. Examples of such areas particularly relevant to Canadian interest might include: communications, transportation, northern studies, etc.
5. To discuss the grant-giving mechanisms used by the grant-giving agencies.

It should be noted here that the AUCC has been particularly concerned for a long time that the federal granting agencies should defray the overhead costs of research conducted in the universities with the support of federal grants.

In September 1965, in a memorandum to Government we endorsed the recommendations of the Bladen Commission that all federal research grants should carry with them a \(30 \%\) supplement as an unconditional grant to the university.

On May 30, 1966, in a letter to the Prime Minister of Canada (appendix " \(\Lambda\) ") we drew special attention to the Bladen recommendation that
research grants to universities should carry with them a \(30 \%\) supplement for overhead and urged "that this be accepted as an integral part of the federal responsibility for research activity".

On February 9, 1967, in a further letter to the Prime Minister of Canada (appendix "B"), we again urged the need for action in the following terms:
"It is apparent to us that if the Federal Government intends to continue to provide research grants through the National Research Council, the Medical Research Council, the Canada Council, and other federal agencies direct to the universities, it must also make provision for the indirect costs of that research if it wants to avoid claims by the provinces that the indirect costs of such research grants consitute a charge against university budgets and consequently against provincial revenues over which they have no control.

It has now become urgently necessary to reassure the provinces on this matter, and, with this in mind, the AUCC is particularly concerned to obtain a concerted government research policy. The National Research Council, the Medical Research Council, and the Canada Council have all been considerin , the matter as has also, we understand, the Science Council, but \(^{\text {a }}\) it is difficult to get a concerted policy as the Councils concerned report to three different ministers. It is not yet clear whose responsibility it is to concert government policy in research matters."

Further, in a letter to Dr. Solandt, dated May 25, 1967(copies to Dr. Roger Gaudry and Dr. J.B. Macdonald) the AUCC urged the need for an interim report by the Macdonald Study group on this important matter(appendix "C").

Finally, the following resolution was passed at the annual meeting of the AUCC in November 1967.

FULL SUPPORTING COSTS OF RESEARCH
RESOLVED THAT the AUCC urge agencies which provide research funds to universities to include in their grants the full supporting costs of the research.

The interest of the AUCC in this matter of overhead has been long sustained and remains unabated, although it recognizes the need to deal with the subject in somewhat altered terms in the light of the new fiscal arrangements.

The AUCC does not recommend any changes at this time in the existing granting agencies or in the advisory bodies. It has chosen to concentrate on recommending the establishment of the above-mentioned committee to advise the government regarding the relative advantages of integrated or variant policies with respect to the various fields of knowledge and the different granting agencies.

If some developed policies emerge from the recommendations of such a committee, the universities of Canada will be in a better position to order their relationships with the individual departments of government which also supply money for research or training purposes.

The existence of such a committee would enable the federal government to cooperate more effectively with the provinces, with the Council of Minister of Education, and with the universities. It would further aid the univer sities to self-select areas of particular research strength to meet provincial, federal, and national needs, without excessive duplication, and with due regard to the contribution which the universities and colleges of Canada ought to make to the world of learning.





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First Session-Twenty-eighth Parliament 1968-69

\section*{THE SENATE OF CANADA} PROCEEDINGS

OF THE
SPECIAL COMMITTEE ON

\section*{SCIENCE POLICY}

\title{
The Honourable MAURICE LAMONTAGNE, P.C., Chairman The Honourable DONALD CAMERON, Vice-Chairman
}

No. 45
TUESDAY, MAY 27th, 1969
WITNESSES :
Dr. J. M. R. Beveridge, President (Academic), Acadia University, Wolfville, N.S.; Dr. G. F. O. Langstroth, Acting Dean, Faculty of Graduate Studies, Dalhousie University, Halifax, N.S.; Dr. M. J. Keen, Chairman, Department of Geology, Dalhousie University, Halifax, N.S.; Sister Mary Evelyn Fitzgerald, Ph.D., Chairman, Department of Chemistry, Mount St. Vincent University, Halifax, N.S.; Dr. W. A. Bridgeo, Dean of Science, St. Mary's University, Halifax, N.S.; Rev. Dr. E. M. Clarke, Head, Department of Physics, St. Francis Xavier University, Antigonish, N.S.; Dr. G. W. Holbrook, President, Nova Scotia Technical College, Halifax, N.S.; Dr. D. B. Burt, Associate Professor, Department of Biology, University of New Brunswick, Fredericton, N.B.; Dr. Jean-Rene Longval, Director, Department of Engineering, University of Moncton, Moncton, N.B.; Dr. L. Loucks, Assistant Professor, Department of Chemistry, Prince of Wales College, Charlottetown, P.E.I.; Dr. M. Laird, Head, Department of Biology, Memorial University of Newfoundland, St. John's, Newfoundland; Dr. I. Unger, Assistant Professor, Department of Chemistry, University of New Brunswick, Fredericton, N.B.

APPENDICES:
61.-Brief submitted by Faculty of Science, St. Francis Xavier University, Antigonish, N.S.
62.-Brief submitted by Memorial University of Newfoundland, St. John's Newfoundland.
63.-Brief submitted by the Science Faculty, St. Mary's University, Halifax, N.S.
64.-Brief submitted by Dalhousie University, Halifax, N.S.
65.-Brief submitted by Acadia University, Wolfville, N.S.
66.-Brief submitted by Faculty of Science, University of New Brunswick, Fredericton, N.B.

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\section*{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
\begin{tabular}{ll} 
Grosart & Nichol \\
Haig & O'Leary (Carleton) \\
Hays & Phillips (Prince) \\
Kinnear & Robichaud \\
Lamontagne & Sullivan \\
Lang & Thompson \\
Leonard & Yuzyk \\
MeGrand &
\end{tabular}

Patrick J. Savoie, Clerk of the Committee.

\section*{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 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 Procedings 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 wasResolved in the affirmative.

ROBERT FORTIER, Clerk of the Senate.
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\section*{MINUTES OF PROCEEDINGS}

Tuesday, May 27, 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), Belisle, Blois, Bourget, Carter, Grosart, Haig, Kinnear, Lang, Phillips (Prince), Robichaud, Sullivan, and Yuzyk-13.

Present but not of the Committee: The Honourable Senator Smith (Queens-Shelburne)-1.

In attendance: Philip J. Pocock, Director of Research (Physical Science); Gilles Paquet, Director of Research (Human Science)

The following witnesses were heard:
Dr. J. M. R. Beveridge, President (Academic), Acadia University, Wolfville, N.S.; Dr. G. F. O. Langstroth, Acting Dean, Faculty of Graduate Studies, Dalhousie University, Halifax, N.S.; Dr. M. J. Keen, Chairman, Department of Geology, Dalhousie University, Halifax, N.S.; Sister Mary Evelyn Fitzgerald, Ph.D., Chairman, Department of Chemistry, Mount St. Vincent University, Halifax, N.S.; Dr. W. A. Bridgeo, Dean of Science, St. Mary's University, Halifax, N.S.; Rev. Dr. E. M. Clarke, Head, Department of Physics, St. Francis Xavier University, Antigonish, N.S.; Dr. G. W. Holbrook, President, Nova Scotia Technical College, Halifax, N.S.; Dr. D. B. Burt, Associate Professor, Department of Biology, University of New Brunswick, Fredericton, N.B.; Dr. Jean-Rene Longval, Director, Department of Engineering, University of Moncton, Moncton, N.B.; Dr. L. Loucks, Assistant Professor, Department of Chemistry, Prince of Wales College, Charlottetown, P.E.I.; Dr. M. Laird, Head, Department of Biology, Memorial University of Newfoundland, St. John's Newfoundland; Dr. I. Unger, Assistant Professor, Department of Chemistry, University of New Brunswick, Fredericton, N.B.
(A curriculum vitae of each witness follows these Minutes)
The following are printed as Appendices:
61-Brief submitted by Faculty of Science, St. Francis Xavier University, Antigonish, N.S.
62-Brief submitted by Memorial University of Newfoundland, St. John's, Newfoundland.
63-Brief submitted by the Science Faculty, St. Mary's University, Halifax, N.S.

64-Brief submitted by Dalhousie University, Halifax, N.S.
\(65-B r i e f ~ s u b m i t t e d ~ b y ~ A c a d i a ~ U n i v e r s i t y, ~ W o l f v i l l e, ~ N . S . ~\)

66-Brief submitted by Faculty of Science, The University of New Brunswick, Fredericton, N.B.

At 5.55 p.m. the Committee adjourned to the call of the Chairman. ATTEST:

\author{
Patrick J. Savoie, Clerk of the Committee
}

\section*{CURRICULUM VITAE}

Beveridge, James MacDonald Richardson. Born: 17 August, 1912, Dunfermline, Scotland. Married: Jean Frances Eaton, 1940; 2 daughters and 5 sons. Degrees: B.Sc. (1937) Acadia University; Ph.D. (1940) Toronto; M.D. (1950) Univ. of Western Ontario; D.Sc. (1962) (hon.) Acadia University; LL.D. (1966) (hon.) Mount Allison. Occupations: Research Assistant, Banting Institute, University of Toronto, 1940-44; lecturer, University of Western Ontario, 1946-50; Craine professor biochemistry, head department, Queen's University 1950-64; chairman, board of graduate studies, 1960-63; dean, graduate studies, 1963-64; 1964-present, President, Acadia University. Principal Fellowships and Memberships: Fellow, Royal Society of Canada; Fellow, Chemical Institute of Canada; Member, American Institute of Nutrition; Member, Canadian Biochemical Society; Member, Canadian Physiological Society (sec. 1953-56) ; Member, Nutrition Society of Canada (pres. 1965) ; Director, Canadian Broadcasting Corporation (1966-68); Member, Alpha Omega Alpha (Honor Medical Society); Member, Science Council of Canada (1968-). Publications: Has published almost 100 papers in the fields of protein analysis, lipotropic factors, and fat metabolism.

Bridgeo, Dr. W. A.-Dr. W. A. Bridgeo is a native of Saint John, New Brunswick where he received his early education. He graduated from Saint Francis Xavier University in 1948 with a Bachelor of Science degree and he joined the Nova Scotia Research Foundation as an Analytical Chemist. From 1949 to 1952, he pursued graduate studies in Organic Chemistry and received his Ph.D. from Ottawa University. After a further year of study at Notre Dame University, he returned to the Nova Scotia Research Foundation to develop its technical information service to industry and carry out a wide range of projects and duties. This activity grew into the formation of the Technical Services Division in 1958 which he headed until January, 1962 at which time he went on leave of absence for eighteen months to work on a fuel cell research project at New York State University College of Ceramics, Alfred, New York. On returning to Halifax in 1963, he resumed his duties with the Nova Scotia Research Foundation and also was appointed as an Associate Professor of Chemistry at Saint Mary's University. In 1965 he became Director of the Chemistry Division of the Nova Scotia Research Foundation and in 1967 was appointed Dean of Science at Saint Mary's University. Dr. Bridgeo is Chairman of the Atlantic Section of the Chemical Institute of Canada and holds memberships in the American Association for the Advancement of Science, the Nova Scotia Institute of Science, the Halifax Board of Trade, Saint Thomas Aquinas Men's Association and the Waegwoltic Club.

Burt, Michael David Brunskill; Date and Place of Birth: January 19, 1938; Colombo, Ceylon; Marital Status: Married, with four children; Position: Associate Professor; Department: Biology; Institution: University of New Brunswick; Degrees and Qualifications: B.Sc. (First Class Honours) in Zoology with Para-
sitology as special subject. University of St. Andrews, Scotland, 1961; Ph.D. for a thesis entitled "Parasitological Studies"; University of St. Andrews, Scotland, 1967; F.L.S. elected in 1966. Academic and Research Experience: 1956-1957 University of St. Andrews, Scotland; 1957-1958 Union College, Schenectady, N.Y., U.S.A., on a C. Vreeder Scholarship; 1958-1961 University of St. Andrews, Scotland; 1961-1962 Assistant Professor, Department of Biology, University of New Brunswick; 1962 (summer) Research Assistant to Dr. T. W. M. Cameron, Institute of Parasitology, Macdonald College, P.Q.; 1962-1964 Research student and senior demonstrator, University of St. Andrews, Scotland; 1963 (summer) British Council Research Scholarship for study at the Université de Neuchâtel, Switzerland, under the direction of Professor J. G. Baer; 1964-1968 Assistant Professor, Department of Biology, University of New Brunswick; 1968-present, Associate Professor, Department of Biology, University of New Brunswick. Number of Publications: Nine, on Parasitology.

Clark, Ernest M., Chairman Department of Physics, St. Francis Xavier University. He was born in Saint John, N B. on May 12, 1911. He received the B.Sc. with Engineering from St. Francis Xavier University in 1932, and the D.Sc. from Laval University in 1956. His doctoral thesis was on "The Measurement of Ionization Potentials with a Mass Spectrometer" and he has published ten papers in this field. He first taught at St. Patrick's College, Ottawa, and since 1936 has been attached to St. Francis Xavier University, being ordained to the Roman Catholic Priesthood in 1942. He has been a consultant to the Gulf General Atomic Laboratory in San Diego, California in the field of electron impact phenomena, and to the Nova Scotia Department of Mines and the Nova Scotia Research Foundation in the field of non-destructive testing.

Fitzgerald, Sister Mary Evelyn: Chairman, Department of Chemistry, Mount Saint Vincent University, Halifax, Nova Scotia. Born in Calgary, Alberta, August 20, 1911. Attended elementary and secondary schools in Swift Current, Sask., Medicine Hat, Alberta, and Edmonton, Alberta. Worked for two years in the Department of Education, Edmonton. Entered the congregation of the Sisters of Charity, Halifax, in 1930. B.A., Dalhousie University, 1935; M.A. (Chemistry), University of Toronto, 1937; Ph.D., Catholic University of America, Washington, D.C., 1951. Taught high school in Nova Scotia and New York. Currently teaching (1940- ) at Mount St. Vincent University.

Holbrook, George William: Date of birth: 16 December, 1917; Marital status: Married; Degrees Obtained: B.Sc. 1938, London University; M.Sc. 1949, Queen's University; Ph.D. 1956, London University; Teaching Experience: 1941-42, 151 OCTU as Radio Instructor, Aldershot, England; 1948-50, Chief Instructor, Royal Canadian School of Signals, Vimy Barracks, Kingston, Ontario; 195058, Head of Dept. of Electrical Engineering, RMC, Kingston, Ontario; 195861, Chairman, Division of Engineering, RMC, Kingston, Ontario; 1961, President, N.S. Technical College, Halifax, N.S.; Professional Experience: 1938-39, Standard Telephones and Cables, London, England; 1939-50, Royal Corps of Signals in ranks of Lieutenant to Lt.Col; 1950-61, RMC Department of Electrical Engineering, Kingston, Ontario; 1961, President, N.S. Technical College; Memberships in Professional Societies: Professional Engineers, Province of

Nova Scotia; Associate Member of Institution of Electrical Engineering; Member Engineering Institute of Canada; Member of I.E.E.E.; Honours and Awards: Ross Medal of Engineering Institute of Canada (awarded 1956).

Keen, M. J. Educated at Oxford University (B.A., Geology, 1957) and Cambridge University (Ph.D., Geophysics, 1961); Assistant Professor, Institute of Oceanography, Dalhousie University, 1961-1964; Associate Professor, 1964-1969; Professor and Chairman, Department of Geology, Dalhousie University, 1969- . Interested in marine geology and marine geophysics. Author of a number of scientific papers and one book, "Introduction to Marine Geology". Age 34.

Laird, Marshall. Born: Wellington, New Zealand, 1923. Married: 1949 (two daughters-one born in Singapore, 1955; one born in Montreal, 1958). Degrees: (All University of New Zealand); M.Sc. (Hons.), 1947; Ph.D., 1949; D.Sc., 1954. Distinctions: Hamilton Prize, Royal Society of New Zealand, 1951; Research Medal, New Zealand Association of Science, 1952; Fellow, American Association for the Advancement of Science; Honorary Member, Royal Society of New Zealand, 1966. Positions held: Entomologist, Royal New Zealand Air Force, World War II Service, and subsequent research assignments until 1954 (rank of Squadron Leader) ; Lecturer, Department of Parasitology, University of Malaya (now University of Singapore), 1954-57; Assistant Professor, Institute of Parasitology, McGill University, 1957-58, and Associate Professor, 1958-61; Chief, Environmental Biology Unit, World Health Organization, Geneva, 1961-67; Professor and Head of Biology, Memorial University of Newfoundland, 1967. Committee Memberships: Member, Expert Advisory Panel on Insecticides, World Health Organization, 1953-61, (Chairman, 1960); Currently, Member of Canadian International Biological Programme Subcommittee on Marine Productivity, etc. Interests: Protozoology, especially blood parasites of birds (the Department of Biology of Memorial University was recently designated as the World Health Organization's International Reference Centre on Avian Malaria Parasites); Ecological aspects of public health entomology, including mosquito larval habitat ecology, biological control, and insect control in relation to international transportation; Parasitology in marine and other aquatic environments.

Langstroth, George Forbes Otty. Date of Birth: July 13, 1936. Present Address: 2-304 Bedford Highway, Rockingham, Halifax, N.S. Marital status: Married, 2 children. 1953-57, B.Sc. (Alberta). Awards: University of Alberta Honour Prize; University of Alberta First Class Standing Prize; University of Alberta President's Scholarship; Seismic Service Supply Bursary; 1957-59, M.Sc. (Dalhousie); Awards: James Gordon MacGregor Teaching Fellowship N.R.C. Studentship; 1959-62, Ph.D. (London) ; Awards: 1851 Exhibition Overseas Scholarship; N.R.C. Special Scholarship; 1962-63, Research Associate, Department of Physics, Dalhousie University; 1963-67, Assistant Professor, Department of Physics, Dalhousie; 1967, Associate Professor, Department of Physics, Dalhousie; 1967-68, Assistant Dean, Faculty of Graduate Studies; 1968-69, Acting Dean, Faculty of Graduate Studies.

Longval, Jean Rene. Born in Trois-Rivières, 11th December, 1924; Studies: T.D., Institut de Technologie, Trois-Rivières, 1955; B.Sc.A. Université Laval, Québec, 1961; M.Sc.A. École National Sup. de l'Aéronautique, Paris, France 1962; Ph.D. University of Saskatchewan 1969. Occupations: Bell Canada, summer 1961; University of Moncton 1962-65; University of Saskatchewan 1965-68, University of Moncton 1968. Member of the Engineering Institute of Canada.

Loucks, Leon F. B.Sc University of Toronto 1961 (Honours Chemistry) ; PhD. University of Ottawa 1967 (Chemistry under Prof. K. J. Laidler); PostDoctoral Fellowship 1966-1968, National Research Council (Applied Chemistry under Dr. R. J. Cvetanovic) ; Assistant Professor (Chemistry) Prince of Wales College 1968-present.

Unger, Israel. Date and Place of Birth: March 30, 1938. Tarnow, Poland; Martial Status: Married with one child; Position: Assistant Professor; Department: Chemistry; Institution: University of New Brunswick; Degrees and Qualifications: B.Sc. Sir George Williams University, 1958; M.Sc. University of New Brunswick, 1960; Ph.D. University of New Brunswick, 1968; Academic and Research Experience: 1963-1965, Postdoctoral Fellow, Department of Chemistry, University of Texas; 1965, present Assistant Professor Department of Chemistry, University of New Brunswick; Member Chemical Institute of Canada; Chairman Chemical Subcommittee, APICS; Number of Publications: Fourteen.

\section*{THE SENATE}

\section*{SPECIAL COMMITTEE ON SCIENCE POLICY}

\section*{EVIDENCE}

\section*{Otıawa, Tuesday, May 27, 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 believe we have before us 10 delegations from the Universities of the Atlantic Provinces and, if agreed, we will have two successive groups at the head table. First, because it is the biggest group-I am not going to make any qualitative evaluation at this momentwe will hear the delegation from the Nova Scotia universities, and then the second group, from New Brunswick, Newfoundland and Prince Edward Island. I would ask each leader, represented from each university, to make an opening statement, but I would advise that these opening statements should not be too long for the obvious reason that if they are, we will not have any time to ask questions.

I would ask each delegation to try to limit itself to five or six minutes. This is assuming, of course, that we have read the briefs, and I think it is a pretty realistic assumption.

I would first invite Dr. Beveridge, Dr. Langstroth, Sister Fietzgerald, Rev. Dr. Clarke, Dr. Bridgeo and Dr. Holbrook.

Dr. J. M. R. Beveridge, President (Academ-
ic) Acadia University: Thank you, Mr. Chairman. Mr. Chairman, honourable senators and distinguished visitors, as we have been warned by our chairman that it would be best not to read the entire brief, I will simply refer to the fact that the main thrust of our brief is the fact that the federal Government ought to become involved or more involved in the support of university work, not only at the level of graduate and research
work-I realize that all of these are closely associated and may not be looked upon as completely identical-but also in respect of the support of certain sorts of relatively expensive undergraduate faculties. For example, up to only about 20 years ago half of the provinces in our country had no medical school and even today, three of the ten provinces are still without one. Thus the main responsibility for providing medical doctors for the entire nation, up until a little over a decade or so ago, had to be accepted by five provinces. This is a most anomalous situation, especially when one considers that the federal Government has not, and does not yet provide appropriate support to these schools. One might well speculate, or ask at this point, to what extent the lack of formal federal or constitutional involvement in higher education has impeded the development of the universities and consequently of Canada as a whole.

The Chairman: I remember, sir, contributing \(\$ 2.5\) million some few years ago for the construction of a medical school in Halifax.

Dr. Beveridge: Yes, I am sure you did. In terms of costs, of medical schools may I say this is a drop in the bucket.

The Chairman: I know.
Dr. Beveridge: Certainly, no one can deny that the universities have fallen behind in their efforts to provide adequate facilities for teaching and research for the numbers of students who are now seeking higher education. This is especially true of medical education. We have failed in our task to meet the demand for medical doctors.
What has been said with regard to medical education applies to a greater or lesser degree to a variety of other disciplines. For example, I am thinking of dental faculties, veterinary
medicine, faculties of agriculture and certain other highly specialized graduate programs. The fact that the federal Government in October, 1966, withdrew its direct support for the financing of university work and transferred this support entirely to the provinces, has made it necessary for the planning of higher education at least on a province-wide basis. It is obvious, too, that there is a great need for the same sort of planning, co-operation, and co-ordination in the provision of facilities for relatively expensive professional or other highly specialized faculties on a regional basis. This obviously ought to involve not one, but several contiguous provinces since no one province-the Maritime Union might be able to-certainly in the Atlantic region at least, is large enough to provide for a complete offering of degree programs in university education.

The point should also be made that when provincial governments have the responsibility of providing the major financial support to universities there will be a danger that conditions will be imposed creating a barrier for out-of-province students. Furthermore, this circumstance may prevent a student from being given an opportunity to take a specific degree program. The only acceptable solution is one enabling Canadian students to be considered for admission on an equal basis to any university in the country regardless of their official provincial origin or residence.

It is well recognized that universities have not only a provincial function but a national, and indeed an international one. If we continue to regard the support from governmental sources as being purely a provincial responsibility, inevitably the provincial interests served by these institutions will be promoted to the detriment of those of national and international significance.

The enrolments of our universities should be drawn not only from every province in Canada but also from a good many foreign countries. No one would argue the importance of this circumstance, yet by no stretch of the imagination can this be looked upon as serving a provincial interest. Even in the case of students attending institutions within a province of which they are resident, after graduation, being the most mobile component of our work force, many of them cross provincial boundaries not once, but several times during their career. Of course, it is well known that
this is an extremely important problem in so far as the Atlantic provinces are concerned.

The history of scientific discovery is replete with the important advances made by scientists working essentially alone. Although it is agreed that there are certain advantages in the group approach, our resources should not be so allocated that there is no place or support for the individual scientist working in a relatively isolated manner. We believe, therefore, that those working in this way should be given support within the reasonable limits imposed by the need to avoid the undesirable duplication of expensive facilities. If appropriate support is not forthcoming for those scientists who prefer to work in such an environment, science in the smaller universities will be crippled and the deleterious effects will not be confined to science faculties but will be felt throughout. Just to give an example of the sort of thing to which I refer, I have some data which has come to hand indicating the percentage of support from various fund granting agencies in the country to the universities in the Atlantic region. You may recall that the population of the Atlantic region, I think, is roughly 10 per cent of that of the total and I do not mean to imply by that, that funds should be distributed on a basis of population. The figures are as follows:

\section*{NRC 8.3 per cent}

Canada Council 3.8 per cent
Medical Research Council 3.9 per cent
DRB 3.8 per cent
Although most of the foregoing remarks are just as applicable to the natural and physical sciences as to the humanities and social sciences, it must surely be recognized that by any standard of comparison our record of support for the latter has been abysmally poor. If we are to reap and to enjoy the fruits of our research and development in the realm of science and technology, it is patently obvious that comparable advances must be made in the humanities and social sciences. Only in this way can we look forward with confidence to an improvement in the quality of our life.

To sum up, I look upon an increasing involvement of the federal Government in the financial support of higher education as not only justifiable, but essential if Canada is to keep or to advance her position in the hier-
archy of nations in the years ahead. Failure to make appropriate provisions in this regard can have but one inevitable result, the relegation of Canada and Canadians to increasingly subservient roles in the future of world affairs. Thank you, Mr. Chairman.

The Chairman: Thank you very much, Dr. Beveridge. I do not know if I have said this at the beginning, but Dr. Beveridge is accompanied today by Dr. Smith, who is the Vice President in charge of Academic Programs.

Dr. Beveridge: I am sorry, sir, I should have told you that he was unable to come.

The Chairman: I am sorry. Now, I suppose that Dr. Langstroth is going to speak on behalf of the Dalhousie University.

You are not speaking on behalf of the university, but I presume that your brief represents the views of the Science Faculty.

Dr. G. F. O. Langstroth, Acting Dean, Faculty of Graduate Studies, Dalhousie Universiiy: Yes. I believe, sir, that our brief represents the views of the majority of the scientists at Dalhousie.

Mr. Chairman, honourable senators, and distinguished guests, very briefly, we, at Dalhousie, feel that a national science policy for Canada should be a policy which will define goals and assign priorities, taking into account the resources which Canada has, both in manpower and in physical resources and of the development of science policy elsewhere. The objective we submit ought to be the identification and development of those things for which Canada can gain an international reputation. If these aims and objectives are defined and identified then the policy ought to provide a co-ordinating mechanism. I may use Dr. Andrew's term, for the programs that fall within the policy so that all of the elements of the scientific communities can work together toward the national goals.

It is reasonable to expect that some of the goals will sort themselves out into regional problems and these can be tackled on a regional basis by the various scientists within Government, industry and the universities. We think it is very important that the matter of technical thought and communications among scientists throughout the various sectors of the scientific community and between scientists and the rest of society should not be
overlooked as the policy evolves. We feel that there are matters which need attention in this regard, at the moment, and that if we are to keep our place in the growing technological age, if you like, then it is necessary that we do develop appropriate technical information media. We feel that, in the area of applied research and so-called mission oriented work there is no fundamental reason why the universities should not be encouraged to participate in this work. I feel very strongly, however, that any undertaking of such work can only really be done on the basis of strong basic science and perhaps basic social science, humanities and art departments as well. Also, the support of basic sciences and social sciences and humanities are not adequately maintained and any attempt to indulge in mission oriented work is not likely to be successful in the universities.
We have not had access to copies of the Macdonald report for a sufficient length of time in order to produce a reasonable comment in regard to it, but I would like to make one or two observations about a couple of recommendations. First of all, we would endorse quite heartily the proposal that there be established a system for the awarding of project grants in addition to the present practice of making grants to individuals. We feel that these project grants are important to the development of interdisciplinary work of the kind which is apt to be useful to the region and to the country. On the other hand, we feel very strongly, that the support from the federal Government and direct support for the computer centres ought to be maintained. This is contrary to the recommendation of the Macdonald Report. Our reason for this is that we feel that the computer centre is like the library, a central university service and to withdraw direct support for it in places, funding in the hands of individuals, is likely to have the effect of decentralizing the service. We fail to see that this would be beneficial in the long run, particularly when one looks at a computer centre from a variety of points of view. It is used for teaching research and administrating purposes and if we look ahead to a time of regional hookups of computer systems we feel that if there is not a central fund, a centrally supported computer centre, then the participation in regional activities is apt to be rather difficult.

One final point which I think ought to be drawn to the attention of the committee con-
cerns the existence of an organization called the Atlantic Provinces Interuniversity Committee on the Sciences or APEX, as we call it for short. This was formed in 1962 and the purpose of it was co-ordinating the development of teaching and research in science and engineering in the Atlantic provinces. In 1964 the committee was adopted by the Association of Atlantic Universities as its official science committee. The members are the deans of science and the deans of graduate studies from the participating universities, and in addition, the directors of the federal Government laboratories in the area. The committee operates a number of programs, although it does not have administrative authority. It operates a scholarship program and programs for exchange of staff among the universities on a temporary basis and maintains a number of discipline subcommittees which meet regularly in order to air their common problems and to try to see how the various institutions in the Maritime region can better co-operate with one another.

Finally, I might mention that we have had some experience in co-operation in our university with the various Government laboratories. They have taken a variety of forms with a variety of degrees of formality in the arrangements. In order to illustrate this, with your permission, Mr. Chairman, I would like Dr. Keen to make a few remarks about oceanography, as it represents, first of all, an interdisciplinary kind of activity and also one in which there has been a good deal of cooperation and participation, jointly, by the university with the Government.

Dr. M. J. Keen (Chairman, Geology Department, Dalhousie University): Mr. Chairman, honourable senators, ladies and gentlemen, Bedford Institute is a federal Government institution for oceanography which is in Dartmouth, Nova Scotia and Dalhousie is in Halifax, only two or three miles away. As a federal institute it is probably one of the largest oceanographic institutes in the world, and one of the best. We have been engaged since the foundation of the institute and before that-it was preceded by the formation of an institute of oceanography at Dalhousie University-in some co-operative programs which are by and large carried out through informal arrangements. By and large, the co-operative programs work only because of personal relationships. There is very little formal structure
set up at the present time so that if people started fighting together then I think there would be no co-operation. People do not fight together and there is co-operation. The sort of co-operation which goes on is a two-way process.

You may find a federal Government employee on educational leave who wishes to take an advanced degree in things marine, which may or may not be a degree in oceanography. It may be a degree in something else, geology, physics or whatever. He will often be given leave to come to Dalhousie University. He may well be working on a project for his thesis, which is of interest to Bedford Institute who are his normal employers. On the other hand, a staff member or student at Dalhousie who has nothing to do with the federal Government and is not employed by them may often need facilities which Bedford Institute has and these facilities may be made available. A recent example of a co-operative program is Hudson 70, the scientific investigation around the Americas. This is a federal Government expedition on Hudson and funded by the federal Government.

There is a large number of scientists from Dalhousie directly involved in leading projects which are being carried out on Hudson 70. Again, a number of scientists at each institution felt that one area was neglected and so we proposed that we should carry out a minor expedition in association with Hudson 70. This sort of joint approach proves profitable. But it must be a joint approach, not a one-way affair. It is my personal opinion that, at least superficially, the Government agencies have so very much more money and, consequently, more facilities than the universities have that the universities are, in a sense, the poor relations. Perhaps this is because one does not include in the accounts the cost of the teaching facilities or the ability to teach when you are attempting to evaluate two institutions. I was a little disappointed this morning when Mr. Andrew excluded from the responsibilities of his correlating committee overall research, including the effort of the federal agencies, and tended to concentrate only on the research efforts of the universities. It seems to me that if the country is putting effort into inland waters, for example, you should investigate the total effort, not just the university effort.

So I think in summary the reIationship between Bedford Institute and Dalhousie University is a rather healthy one. I am sure there are many ways it can be improved. By and large, however, it works largely because personal relationships allow it to work.

The Chairman: Thank you. Sister Fitzgerald.

Sister (Doctor) Mary Evelyn Fitzgerald, Mount St. Vincent University, Halifax, Nova Scotia: Mr. Chairman, I did not come prepared with a brief because I had not been told ahead of time, but since I represent the only women's University, and the smallest, I think probably that, as a member of the AUCC, I should come forward when my name was called.

We certainly feel that we should still have support for faculty research from the federal government, and the remarks of Dr. Andrews with regard to funds for research along educational lines as well as along project lines, we think, is something that needs to be implemented more strongly than it is at present.

I think I cannot say too much more about the university's policies with regard to this as we are currently talking with Dalhousie University on some form of cooperation, and I am not sure exactly what the status will be in the future. Thank you.

The Chairman: I am sure that these negotiations will be successful and that your university will be able to make a great contribution to Dalhousie because of your special approach.

Some hon. Senators: Hear. Hear.
The Chairman: Now, Dr. Bridgeo. Dr. Bridgeo is the Dean of Science at St. Mary's University, Halifax.

Dr. W. A. Bridgeo, Dean of Science, St. Mary's University, Halifax, Nova Scotia: Mr. Chairman, honourable senators, ladies and gentlemen, the authors of our brief are committee appointed by the chairman of the department of science faculty of the university. The authors agree that the question of a national science policy is very complex and yet very important to the health of the country, to economic health almost directly, intellectual, and even spiritual health a little more
indirectly. We do not pretend to know all the answers.

I must say that, after hearing Senator Lamontagne speak in Montreal, yesterday, I thought I would buy my ticket and go home because he impressed us with all of the people he has spoken to to date. I am sure you have much background. However, we pass on our ideas as objectively as we can on a few points which we feel should be considered by you.

No. 1, we ask that you seriously consider the role of the undergraduate science faculties as feeders of our graduate schools and the country's scientists of tomorrow. We suggest that this feeder role, if well-played, is an integral part of any program to strenghthen the country's position in science and technology. One example of this feeder role re astronomy is presented as an addendum to our brief.

No. 2, we ask that you consider research in psychology, including experimental social psychology, as worthy of a place in a national science policy. Man's prowess in the physical sciences has far outstripped his ablity to solve the "people" problems. I will suggest in a moment that the problem you face in constructing a national science policy is as much a people problem as it is an economic problem.

No. 3, we suggest that professors in undergraduate science faculties should be encouraged to do some research involving their students, where possible, and that a good portion of such research be aimed at or relevant to real problems in this country. This can be done and it can be done furthermore as a group effort between disciplines. An awareness of this research going on in universities, an awareness on the part of the students, and an involvement by some, will help to orient many people on what is involved in science research and development and how it can be used.

I would like to refer once again to the Senator's talk of yesterday where I understand that many of your committee visited influential people all over North America and had visits from people abroad to get some knowledge in depth of what is involved. We suggest in our brief a few phases in which this can be helped along.

No. 4, we point out that people, individuals or small groups of individuals, conceive ideas
and reduce these ideas to practice. It may be necessary to have bigger groups of supporting staff in the country. The supporting staff may have PhD's, they may be involved in university teaching or they may be involved in commercial service laboratories, but they are still supporting staff. It is the first group that deserves the heavy support, including streamlined fiscal control and purchasing policy, They should be permitted to buy it and fly it.

We suggest that it is very easy to stifle these valuable people in this country and that some way be found to release their energies, harness their ideas and skills. We suggest that industry be given another chance to do it. At the same time, however, make it easy for such people to form their own companies, if necessary, possibly in association with universities, and assist in financing. Levies possibly could be made on those big industries which refuse to do research in industry to help pay the costs of it. The funds could be channelled through such bodies as you are considering, such as the regional development agency.

Finally, we suggest that education and science form the foundation of economic growth for the remainder of this century. Insofar as our economic growth has a regional pattern, education and science policy should be considered on a regional basis. Thank you.

The Chairman: Thank you very much. Dr. Clarke, please. Dr. Clarke is from Nova Scotia, Antigonish.

Rev. Dr. E. M. Clarke, Head, Depariment of Physics, St. Francis Xavier University, Antigonish, Nova Scotia: We generally agree with the speakers from the Maritimes on these four regional developments. The first point is the necessity of development in Canada, that if we are going to compete in this present day world we have to look for very high technical competence, and this does involve spending money.

When it comes to spending public money we propose that the social implications of this spending should be considered very, very intensively and that areas which are now underdeveloped could be helped by fairly intensive research developments in those areas, but basically this development would be through the universities as far as fundamental research is concerned. However, we also
would like to see perhaps an extension of the National Research Council laboratories into other regions so that they could act as centres for information and, as Dr. Bridgeo has mentioned, a chance for some of their workers to spawn new ideas, as you have had in California, Cambridge, Mass., and so on.

To get the universities going on this, and I am speaking here really for the small universities, we need some base funds so that we can get enough staff and a small research group going so that we get the competence to apply for these larger grants. If we are cut off completely from this basic support it will then be very difficult for us to get above that stage.

I note with rather a bit of sadness in this MacDonald report table 3-3, that 15 of the universities in Canada do not get any research support at all. This is something that really should be pushed by the granting agencies.

The essence then is that more of the research funds should come from the federal government. At present they are coming through the province. Fifty percent of our funds come from the province.

There is pressure from the activist students, and there are others, that we are not spending enough money on the arts faculty, that the ratio of science students to faculty is much more favourable than that of the arts students to faculty. If we are forced to withdraw provincial funds from research in order to increase the arts faculty we will be in serious difficuity when it comes to doing significant research unless we have funds from the federal government that are tagged. And we need to have a bit more than the amount necessary just to get equipment; we need some additional support on buildings and possibly on research workers. Thank you.

The Chairman: Thank you, Dr. Clarke.
The last one on my list is Dr. Holbrook who is the president of the Nova Scotia Technical College, Halifax, Nova Scotia.

Dr. G. W. Holbrook, President Nova Scotia Technical College, Halifax, Nova Scotia: Thank you, Mr. Chairman. Ladies and gentlemen, I would like to speak from the engineering point of view because my institution is somewhat unique in that we only conduct the first degree and higher degree work in engi-
neering and architecture. In order to give you the setting of this, I should explain that we accept students into our university in the junior year level from eight or nine other Atlantic colleges or universities. In addition to Nova Scotia Technical College there is a complete engineering school at the University of New Brunswick, another one at Moncton, and a fourth one forming in Memorial, Newfoundland.

We, as Nova Soctia Technical College, did contribute to the brief which was sent in by the Canadian Deans of Engineering and also by the Committee of Deans of Graduate Studies. On the other hand, I think there are two specific points I would like to raise from the Atlantic provinces' point of view with respect to engineering. We, as an engineering school, I believe, are very much closer to industry perhaps than other disciplines. We are the almost intimate interface between the university and our local industries. Consequently, I think we have a particular role to play.

In the Atlantic region we have very few industries, if any at all, locally based ones, which have any research divisions of their own. There are one or two industries that do have research facilities in the Maritimes but they are, generally speaking, based on large organizations in central Canada. Consequently, we, as an engineering school, probably have the only kind of heavy engineering testing equipment which is available to some of these firms in the region. Consequently I think we have a commitment to local industry to provide some kind of service to them which they cannot possibly afford to buy themslves as individuals.

I think that applies as well to their desire to do research and development. None of them are big enough, or very few of them are big enough to get involved in research programs themselves. However, in combination with engineering schools, a very viable form of research or development can take place with a measure of cooperation between the industry and the college. To this point we have established, with the aid of the old federal Department of Industry, one of the industrial research institutes, which is based upon my college, the Atlantic Industrial Research Institute.

I would like to think that in your deliberations you would tend to emphasize the work which these industrial institutes can do in
bringing together the local industries and the engineering schools, with particular reference to the Atlantic region where industries do not have the capability of doing research themselves.
The second point I would like to make is that I believe research, which I think should be encouraged in engineering programs, should have some regional connotation. I believe that we should be interested in the ocean at Halifax and in some of our mineral deposits. I find it rather strange that universities in central Canada are developing programs in coastal engineering and in seaweed and things like that. Perhaps there should be more stress placed upon the encouragement of research, certainly from our point of view in the Atlantic region, on our Atlantic resources. Thank you.

The Chairman: Thank you very much.
Well now, if you would perhaps regain your seats and remain available for the question period, I would now invite the representatives from the University of New Brunswick, the Université de Moncton, Memorial University and Prince of Wales University to come forward. We will hear first from Dr. Burt who is Associate Professor Biology of the University of New Brunswick, speaking on behalf of his college.

Dr. M. D. B. Burt, Associate Professor of Biology, University of New Brunswick, Fredericton, New Brunswick: Mr. Chairman, honourable senators, distinguished visitors, the brief we are submitting is one that has been prepared on behalf of the science faculty at the University of New Brunswick, and it has been put together by four members of the science faculty. The other three members are present: Dr. Pajari, Associate Professor of Geology, Dr. Unger, Assistant Professor of Chemistry, and Dr. Young, Assistant Professor of Physics.

I would like to make it clear, Mr. Chairman, we are speaking here from a somewhat restricted point of view, being concerned primarily with the research itself, and we hope that the remarks we have to make will be of some use to your committee in their final deliberations concerning an overall science policy for Canada.

In Canada, as in many other countries, a large number of highly qualified scientists are
doing research in universities. In view of the increasing demands being made on federal funds to support research and development in several different spheres we welcome this opportunity to present a rather short brief outlining what we believe to be the most cogent arguments for not only continuing, sir, but even increasing financial support of scientific research in Canadian universities.

In summary, if I may just present the major points we cover in the brief, first we strongly recommend that federal funds to support scientific research in universities should be substantially increased for the following reasons, and there are four reasons here:

Firstly, the quality of university scientific research is high while the contribution of university scientists to scientific knowledge per se is substantial and has been made at fairly modest cost.

Secondly, only by increasing the number of graduate students can Canada continue to improve standards of education, government, and research at all levels. This improvement of standards, by upgrading scientific positions in most fields is essential if Canada is to remain a technologically advanced country.

Thirdly, as it is impossible to predict through foresight which basic research will have useful application at a later time, the continued investigation of basic problems in universities is utterly vital and invaluable to research in its broadest sense and to the eventual success of applied research.

Finally, it is vital to our national cause to possess and continually increase that body of research scientists not only for their productive capacity and output of new knowledge, but also for their expertise and technical know-how. This body, we believe, is the only one available to focus on any problem, fundamental or technical, of national concern.

The second point we would like to make in the summary here is that we would strongly recommend that federal funds supporting university research continue to be distributed by NRC for these two reasons:

Firstly, this uniquely Canadian method has proven itself to be an eminently suitable one which has, in large measure, been responsible for attracting many excellent scientists to Canadian universities from other countries as
well as for keeping our own scientists. We believe also that this particular method has kept a number of people in Canadian universities who might otherwise have been tempted to leave Canada.

Secondly, it allows for the best possible assessment of applicants by the finest researchers in Canada in every different field, thus ensuring that awards are granted on a sound merit basis.

The third recommendation that we would put to you is that the total amount spent by the federal government on research and development increase as a proportion of the Gross National Product. In this way additional financing of industrial and applied research would be possible without adversely affecting the vital role which universities play.

Finally, we would recommend that some of the additional funds referred to above be made available to allow cooperative research between government, industry and universities. In this way the available scientific expertise in Canada could be brought to bear on national problems and, in fact, could be used to maximum advantage. Thank you, Mr. Chairman.

The Chairman: Thank you.

\section*{[Translation]}

Now Dr. Longval, who is Director of the Engineering Department, and is representing the University of Moncton here today, I believe.

Dr. Jean-Rene Longval, Director, Department of Engineering, University of Moncton, New Brunswick: Mr. Chairman, Senators, honoured guests-the University of Moncton, which I represent before you today, is a young and as yet a small institution. Its establishment actually dates only from June, 1963, when the New Brunswick government decided to merge all French-language institutions of higher learning in the province into one. The university so formed now comprises Bathurst College, formerly Sacré-Cœur University, St-Louis College, formerly St-Louis d'Edmundston University, St-Joseph College, formerly St-Joseph de Memramcook University, and the women's colleges of Maillet, StBasile and Jésus-Marie de Shippagan; these institutions now form the Faculty of Arts of the University of Moncton. In 1968-69, the Faculty had a student enrollment of 1,306 and
a teaching staff of 130 . Apart from St-Joseph College, the Moncton campus accommodates the Faculties of Science, Commerce, Education, Psychology, Social Science, Nursing and Domestic Science. In 1968-69, these specialized faculties had a total of 1,010 students and 88 professors. In the same year, the Faculty of Science, which embraces the Departments of Physics and Mathematics, Chemistry, Biology and Engineering, had 260 students and 32 professors. I would ask the honourable Senators to excuse my quoting all these statistics, but they will facilitate better understanding of the rest of my remarks.

Such a new and small university certainly cannot have any great influence on decisions regarding scientific research policy in Canada. With your permission, I shall therefore deal rather with the influence such decisions can have on the smaller universities, such as the one I represent. Our university will have to conform to whatever shape our national science policy takes in the future; nevertheless, your recommendations can have a major influence on the development of small universities.

Recent trends in the allocation of funds to scientific research give one reason to believe that, in future, such investments will be determined by concern for the greatest possible effectiveness. The validity of this objective is doubtless indisputable, but we are uneasy about the ways in which it will be pursued. If the goal of efficiency were to require, as an absolute rule, that research in a given field be centralized through the collaboration of several researchers, then institutions such as my own would be deprived of subsidies for work in a number of areas. As you know, it is difficult to conceive a university science program that does not offer professors the opportunity to conduct research. It is possible to question the need for this, and to recommend that some institutions limit themselves to teaching and exclude research, but universities adopting such a course would find it extremely difficult to recruit a competent teaching staff. It seems essential to me, therefore, that whatever decisions are made regarding future science policy in Canada will have to allow the smaller universities to carry out scientific research; without such provision, some institutions regarded as essential components of our educational system will find themselves in a precarious position, and will eventually have to
close. I must confess, Gentlemen, that I am alarmed at the thought of such a future for the University of Moncton, which is regarded with good reason as one of the keys to Acadian survival, and of which the Faculty of Science is an important part.

If the work of isolated researchers is relatively unproductive-which may not be absolutely true in all fields-then the policy of subsidizing agencies should be to bring the researcher out of his isolation, rather than to discourage him by offering only minimal subsidies. Professors in a small institution are mostly isolated researchers. In most cases, team work would be much more productive, but present subsidy arrangements do not favour teams made up of researchers from groups of neighbouring universities. Furthermore, collaboration between professors from our universities and researchers from government agencies is often difficult because of the distances separating us from government research centres. Thus, two elements of a solution to the problem become clear: the setting up of a system of subsidies for frequent travel to neighbouring universities by professors wishing to join research teams, and the establishment of government research laboratories near the campuses of the smaller universities.

As far as research is concerned, the problems we face at the University of Moncton were expressed very well by Dr. Schneider, in his address to the last seminar of the Atlantic Provinces Inter-University Committee on Science meeting in Fredericton on May 27, 1968; I quote:

\section*{[English]}

These no doubt would work exceptionally well if each institution started from the same base as far as staff and resources, both as far as money and manpower are concernd, but here one finds a considerable disparity, and over a longer term the rich get richer and the poor have difficulty getting off the ground. The maritime provinces constitute a region in which the resources available to local universities are generally below those of the other provinces. In Francophone universities science tends to have a more recent origin and there is now a determined effort to catch up. In contrast, Anglophone universities have built up their science programs over a long period and tend to be more developed.

\section*{[Translation]}

The university I represent enjoys the threefold privilege of being young, French-speaking and located in the Maritime provinces. Should an institution in such an unfavourable position close its doors? Possibly; however, I dare to hope that this Committee will present the competent authorities with much more constructive recommendations, which will permit the most effective use possible of the human potential of the University of Moncton.

The Chairman: Thank you very much, Dr. Longval. I trust the University is going to continue its courses, with occasional co-operation from the students.

\section*{Dr. Longval: Yes. \\ [English]}

The Chairman: Now we will hear from Dr. Loucks from Prince of Wales University, P.E.I.

Dr. L. Loucks (Prince of Wales College, Charlotietown, Prince Edward Island): Mr. Chairman, I have not submitted a brief but I have a number of points that I would like to outline very briefly. I represent the science faculty at Prince of Wales College and very shortly Prince of Wales College will become part of the University of Prince Edward Island with the amalgamation of St. Dunstan's University and Prince of Wales College.

First of all, we support the efforts that are being made to develop a single science policy for Canada, and I wish the committee well in that. We feel that the social sciences should certainly be included and, if possible, the humanities should be supported. These areas need stimulation in Canada. The traditional sciences have had support for many years and the programs in Canada have been welldeveloped and we have been able to produce PhD's to staff our universities. However, in the social sciences and the humanities things have not been as easy for those students who wanted to take postgraduate work.

I think that the centres of excellence must not be the only locations for the research that is done in Canada. At the same time I would not say that we have to eliminate centres of excellence like NRC. I don't suggest that. However, I think that we must support the small universities and, in particular, there is
a special problem for those colleges which offer only an undergraduate program. At such an institution the conducting of research becomes more difficult because you have no postgraduate students that are working for you. In such a location the grants to the staff members are essential and must be continued to buy not only the specialized equipment that you may need over and above the equipment you have in the university for the undergraduate courses but also to supply the technical staff, both in the form of summer students and in the form of technicians.

We feel that it is obvious that selection of a university for an expensive project may well be necessary in the future in order to avoid duplication of expensive facilities. This will necessarily mean that some universities will not get their first choice projects and will have to do with something that is second choice. I think this is fair enough because any good scientist must have more than one good idea. And I think this is one region in which money can be saved.
One thing I think should be kept in mind by the committee and that is that scientists guard very jealously the projects they wish to work on. A science policy that would give money only for a project which has been selected and assigned by a government agency would not be a healthy policy, with which the researcher could work, and we suggest it would in fact be a dangerous policy.

The Chairman: Thank you very much. Our last speaker is Dr. Laird.

Dr. Laird, I must remind you that you are not alone in your province to speak last. Every time your Premier attends federal-provincial conferences he speaks last.

Dr. M. Laird (Head, Department of Biology, Memorial University of Newfoundland): Mr. Chairman, honourable senators, distinguished visitors, Memorial University's brief has been submitted but as, until the end of last week, our President, Lord Taylor, was to have been our representiative here, I arrived without any kind of written submission. However, I believe that much of Memorial's contribution to this special committee's deliberations can be summed up under four headings:
Firstly, we at Memorial are very much in favour of the promotion of more effective research coordination and I will try to make this clear by specific example in a few minutes.

Secondly, at the same time we live on an island, as recent postal and air transportation problems made painfully clear to us. Living as far as we do from Halifax poses special problems to us as regards close participation in future regional pools of sophisticated equipment, such as electron miscroscopes, for example. And, furthermore, we are a oneuniversity province. We therefore have a demand for research support that might at first sight seem overly ambitious in a province that is still sadly underdeveloped. The reference in this special committee's preamble to gaining experience from other industrialized countries does not really apply to us yet. For all that though we are already among the first ten Canadian universities in terms of student body, with more than 5,000 at the present time.

Thirdly, we are not experiencing trouble in getting good faculty, but space for these faculty and their equipment is another matter. In fact, we find ourselves, because of the underdeveloped level of the province, running into a special problem of being unable to apply for the kind of research support that our present faculty could qualify us for because we simply do not have the space to house the equipment and additional faculty and nonacademic staff who might be brought in under grants. So this makes us especially receptive to the item in the Macdonald report that refers to \(35 \%\) of the direct cost of research being made available for indirect costs. This would seem to be a very important item to us, as would the provisions of some form of capital cost assistance by the federal government in order to make additional buildings feasible.

Fourthly, uniqueness of site was mentioned this morning, and I would like to close on this item by giving a specific example. In the research field, Memorial is trying to exploit uniqueness of site to develop centres of excellence at the national and international levels, and the most advanced of the auxiliaries we have at the present time in our biology area, and at the same time the most ambitious of our total research undertakings, is the Marine Sciences Research Laboratory. Note that word "Sciences" and not "Biology". Every effort is being made to encourage interdisciplinary studies at the Marine Sciences Research Laboratory where chemists, biochemists, physiologists and representatives of our new
medical faculty are already working together with biologists.
International as well as national advice has already been sought in building up a longterm research program for the Marine Sciences Research Laboratory. Last year a scientific advisory group was convened, consisting of six scientists from the United States, from Iceland, from France and Italy as well as from Canada, supported by background documentation specially prepared for the meeting by more than fifty scientists in a dozen countries elsewhere. And all of these participants and authors of background papers had in common a deep interest in the colder waters of the North Atlantic, which colder waters wash, often with considerable force, right up to the doors of our Marine Sciences Research Laboratory.

The point of the meeting was the preparation of a report which will soon be published indicating long-term planning based upon a desire not only to make maximal use of our year-round supply of circulating sea water, and very pure sea water at that, on the east coast, but also our access to the open North Atlantic in undertaking research for which we have the personnel and equipment, and at the same time we wanted to implement this research in such a manner as not to duplicate but rather to augment and supplement work in progress under other auspices elsewhere.

Looking at the total picture of research in this particular subject area from where we sit at St. John's, we like to envisage a future pattern of close collaboration between our Marine Sciences Research Laboratory, the proposed new consortium at St. Andrew's, which will be the Ontario outlet to the sea which was spoken of earlier, the existing facilities of the Bedford Institute and the new Aquatron at Dalhousie, as well as McGill's Bellairs Institute in the Caribbean. We look forward to all of these institutes collaborating in a pattern, each of them as one part of a mosaic, if you like, collectively constituting an eastern Canada centre for marine studies that might, by careful planning at the very earliest stage, succeed in putting together a research program that w,ll really preclude unnecessary duplication and that will promote real collaboration between those stations best fitted to participate in this kind of scientific undertaking.

The Chairman: I would ask Dr. Beveridge to come back as well as the others who were before us previously, to get near this table.

Now, we will have our usual question period. I would like to tell our guests of today that within our committee we have a very powerful lobby for the maritimes. We have at least four senators from your area. I will ask first Senator Phillips from Prince Edward Island to begin the discussion.

Senator Phillips (Prince): Mr. Chairman, you have taken me rather by surprise. I thought I was going to be able to benefit from the questions asked by previous questioners.

I noticed Dr. Beveridge referred to support for the undergraduate schools. He emphasized the extensive nature of schools such as medical schools and dental schools.

I am not quite sure, Dr. Beveridge, whether you were advocating more schools of this nature within the Atlantic region or merely pointing out the...

Dr. Beveridge: No, I was not advocating more schools of that nature in the Atlantic region. I understand, for example, that Memorial's plans are well along for the establishment of a medical school. This will be an albatross around the administrator's neck, I am sure, for some time to come. I was simply emphasizing the fact that in the past history of university education in Canada, despite the constitution which indicates that education is primarily a provincial responsibility, it has not been that in any real sense of the word, and it still is not now.

Senator Phillips (Prince): I am not expressing opposition to the fact that Memorial is going ahead with a medical school. I have discussed this with Dr. Stewart, the dean of medicine at Dalhousie, and he has expressed support for another medical school within the Atlantic provinces but has two reservations, one that everyone has, finances. I am sure you had that in mind when you remarked it would be an albatross. But, secondly can your Atlantic province universities turn out students not only to go into medical schools but graduate students to support the medical staff? For instance; if you need an embryology teacher you don't necessarily have a man with a medical degree. He is probably a biologist specializing in embryology.

Dr. Beveridge: Well it could be either. Medicine, after all, is human biology applied.

Senator Phillips (Prince): It seems to me that would be an awful waste of medical talent, to restrict him to teaching embryology.

Dr. Beveridge: Well, not necessarily. I would have to put it in those terms. I think the answer is that if we have adequate financial support, certainly we can turn out the graduates to staff a medical school in Newfoundland or elsewhere in the Atlantic region. However, we must have support for graduate work in the medical field, and also in the basic medical sciences.

Senator Phillips (Prince): I was impressed by the figures you gave concerning the allotment of research money. I notice the Defence Research Board, according to your figures is \(3.8 \%\). Now, does the Defence Research Board have any association with the Atlantic university group? Or do they operate entirely independently? Do they ever go to you for assistance in a project such as the American universities have happen?

The Chairman: If I may interrupt, Dr. Beveridge, I would like also as we go along and invite all those who have appeared before us this afternoon to join in the discussion whenever they feel like it. They have only to ask me and I will recognize them too.

Dr. Beveridge: Well, I think for the most part the Defence Research Board, as do most other fund-granting agencies, simply announces its policy on the granting of funds and the conditions under which these funds will be granted. These are circulated to all people who would be potentially interested in obtaining funds in this way and, if it so happens that they have some interest in research that has a relationship to defence, and I must admit that in many cases, and I have been a member of one of the Defence Research Board panels, the relationship to defence is sometimes a bit far-fetched or at least tenuous, but nonetheless very often money has been granted. I don't know of any instance in which the Defence Research Board has approached universities in the Atlantic region but I am quite sure that they probably have in one respect or another.

Dr. Holbrook: May I speak to that, Mr. Chairman?
The Chairman: Yes.

Dr. Holbrook: We have had quite a good liaison with the Defence Research establishment Atlantic whereby we have undertaken research for them on a contract basis. We have, of course, also had grants-in-aid from the Defence Research Board itself. We also have had part-time graduate students, young engineers, who are working at the Defence Research Board Atlantic, and taking a postgraduate program with us on a part-time basis. And they have certainly come to us asking us to take on contract research on their behalf. So it does happen.

By the way, I think Dr. Beveridge's figures were on grants rather than on contracts probably.

Dr. Beveridge: I think that they were, yes, on grants. I am not sure that contracts were excluded.

The Chairman: Were these similar figures to those that were published in the Macdonald study? I remember there was some kind of regional distribution of money but I don't know if these figures covered it.

Dr. Beveridge: I have forgotten whether they were taken from that source. I must confess that I obtained them at the recent meeting of the Science Council.

Senator Robichaud: Were you refering to the grants given to universities?

Dr. Beveridge: Yes. Well, to researchers or investigators at universities.

Senator Robichaud: With regard to those grants, where about \(4 \frac{1}{2}\) per cent of the total grants.

Dr. Beveridge: No, more than that.
Senator Robichaud: . . . went to Atlantic universities; now, were those based on the population of the Atlantic provinces or on the total enrolment of the universities?

Dr. Beveridge: No, those are the percentages of the total amount of money disbursed by these fund-granting agencies.

Senator Robichaud: If you relate those figures to the total enrolment of the Atlantic universities compared to other universities, the percentage could be different.

The Chairman: It could be higher, I am sure.

Dr. Beveridge: Well, the total enrolment in the Atlantic universities compared to the entire Canadian university enrolment is a little over 10 per cent. So that by any measure other than that having to do with the enrolment of graduate students, but certainly on the basis of population or university student population, the proportion of funds granted is rather low. However, on the basis of graduate enrolment there is a closer correspondence.

Senator Phillips (Prince): May I say I was very interested in Dr. Keen's report of the cooperation between Dalhousie and the Institute of Oceanography at Bedford.

I have long felt, Dr. Keen, that probably a great many of our government research agencies could probably be working more closely with universities or indeed placed directly in the universities. Take, for instance, the Department of Fisheries; I often criticize their research people. They can pinpoint a specific fisheries disease but they cannot go beyond that, such as to associate it with the effect it has on the fishermen, which is really a very essential part of the problem.
Do you feel that, as a result of your cooperation with Bedford, that probably this type of research could be handled better in the universities than through a government agency?

Dr. Keen: I think there is always going to be a lot of difference of opinion as to the general question, should a research institution be on a campus under university control or should it be in the hands of a federal agency. I don't believe the Macdonald report examines this question in anything like the detail it should have done. In only one of their recommendations do they even touch upon it.

You can take the point of view that a university should not be concerned with routine work or with data collecting if you like, that it should look at other things, but nevertheless you can also take the point of view of looking at the foreign institutions, such as the one I always think of, which is Lamont Geological Observatory, which is the best marine institution in the world of things geological and geophysical, and our own Canadian policy would not allow the establishment of such an institution. You can then go on to Bedford, and do you want it on the campus or indeed would you in 1969 or 1970 , would you want to establish such an institution because it is an historical fact of its time? The answer may be no, you don't.

You must find a way of ensuring much greater cooperation. We must ensure that the calibre of work done by such an institution can be done in Canada. The way I see it happening, the most viable way, is either by putting research establishments on campus or with federal institutions such as Bedford Institute, making sure that cooperation is a two-way affair, not a one-way affair. Sometimes the situation arises, say with the geological survey of Canada with such an institute, that a student will, as it were, acquire a problem from that institution and he will deal with it at the university with the tacit encouragement of the university and will be supervised in the university. This, it seems to me, only allows marginal interest on the university's part, and the two-way process of the university's purpose and the federal purpose with students working as a triangle is going to be much more healthy, and this is certainly what we are trying to do at the present time. It has to be a triangle, it cannot be just a one-way affair.

Senator Phillips (Prince): If I recall your remarks, Dr. Keen, you said you cooperated mainly because you had no format or rules laid down.

Dr. Keen: No, there was no "because" in there. There were no formal rules.

Senator Phillips (Prince): Would you care to have a Minister of Science lay down a definite guideline or would you prefer to work as you do now?

Dr. Keen: I would have thought there would have been considerable value in having a formal association between two institutions such as Dalhousie and Bedford Institute. Yes, I think this would be valuable. At the present time you could say it is not necessary but in, say, joint graduate programs between Bedford and Dalhousie, yes, formal arrangements could be most valuable. That is my personal opinion. I do not speak for anyone else.

The Chairman: Two of our guests here have asked me to make some comments on this. First, Dr. Burt.

Dr. Burt: Mr. Chairman, there is something I would like to say here generally endorsing what Dr. Keen has said. We find in Fredericton, for instance, at the University of New Brunswick, that there is considerable cooper-
ation with the Fisheries Research Board in St. Andrew's, that it does not represent only the Ontario outlet to the sea, Dr. Laird, but also the New Brunswick outlet to the sea.

By way of example, we do have in Fredericton, for instance, an electron microscope complex which the people in St. Andrew's make fairly substantial use of. And, by the same token, we in Fredericton, particularly in the biology department, make substantial use both of the facilities that they have at the station there and also of their ocean-going vessels. This is a very close tie but I must say again it is built on the whole business of personal relationships.

I think all of this comes right back down to the ability of one researcher being able to go to another one and perhaps, knowing him personally, saying, "Well, what about it? Here is our problem. Can you help?"

The Chairman: Would you like to have these relationships more formalized?

Dr. Burt: Again I would agree, yes. I think that if there is some kind of formal association laid down it makes it a lot easier to establish the relationship. Otherwise, it takes a long time for a person settling into a university to get to know the staff at the other place and to get to know in what areas one can help.

The Chairman: Dr. Laird.
Dr. Laird: Mr. Chairman, the purpose of my intervention was actually to make good the admission that the previous speaker just referred to. In fact, we are very well aware of these other aspects of the proposed new consortium at St. Andrew's, and I should have also of course mentioned the Fisheries Research Board labs in the Atlantic provinces in general as part of a sentence that got out of control.

However, I would like also to say that I most heartily endorse Dr. Keen's remarks. At Memorial we have excellent working arrangements with the St. John's biological station of the Fisheries Research Board of Canada. The director of that station is an honorary professor in the department of biology. There are graduate students who are supervised at the Fisheries Research Board while maintaining regular contacts with the campus. And under our building program it is planned that a fine, new Fisheries Research Board station
will actually be constructed on our campus in close proximity to the new Life Sciences building. When this happy stage is reached we anticipate a very much more formal working arrangement with additional members of the staff of the FRB station participating quite actively in work at the biology department itself, and with sort of a reverse lend-lease aspect, with laboratories at the FRB establishment being made available to people working within the department of biology.

\section*{The Chairman: Dr. Beveridge.}

Dr. Beveridge: Mr. Chairman, I was simply going to speak along the same lines as the previous two speakers.

The Chairman: There is great unanimity here.

Dr. Beveridge: ...to indicate that this, as a matter of fact, is a policy that is now being actively followed by the Fisheries Research Board. I should explain I have just come off this board after a period of ten years as a member. A few years ago I chaired a committee having to do with making recommendations for the relations between the Fisheries Research Board and universities. This was one of the recommendations which was made from this committee, that in the future when new institutions were established we ought to attempt to establish them either on the campuses of certain institutions or as close to the campuses as we could.

I should point out that the Pacific Fisheries Experimental Station is, for example, on the campus of the University of British Columbia. The Fresh Water Fisheries Institute is established on the campus of the University of Manitoba, and there is a close relationship between the faculty, the relevant departmental members of the university, and the members of the staff of that station. And of course reference has already been made to the situation at Memorial. So I think that this is the sort of thing that we ought to look forward to increasingly as time goes on.

Senator Robichaud: If I may add on this matter of co-operation...

The Chairman: This is Senator Robichaud from New Brunswick, who is a former Minister of Fisheries.

Senaior Robichaud: The Department of Fisheries in Montreal at McGill in connection with the work done at MicGill University, and also Laval University, has been approached to have certain land available in order to build a special lab for the Province of Quebec. So there is definitely close co-operation between the Fisheries Research Board and the different universities.

\section*{The Chairman: Yes.}

Dr. Langstroth: Mr. Chairman, I just wanted to say that in addition to the close working arrangements which Dalhousie enjoys with Bedford Institute of Oceanography, which Dr. Keen has described, we do have two other arrangements, one with the Fisheries Research Board in Halifax, and the other in connection with the Atlantic Regional Laboratory of the National Research Council. It is to the latter I want to speak because this has two features about it that may be of interest.

The first is that the Atlantic Regional Laboratory is on the campus and it affords therefore a model or example of the kind of situation which Dr. Beveridge has suggested.

The second feature about this is that our relations with the Atlantic Regional Laboratory are quite formal. Money passes from the National Research Council to the university by terms of a contract. Staff at the Atlantic Regional Laboratory hold honorary appointments in the faculty of graduate studies at Dalhousie. They give classes. They supervise graduate students. The supervision of these students is normally done in the Atlantic Regional Laboratory using their facilities, and they pay the overhead.
We found that this works quite well. There have been occasional abrasions between the staffs of the two institutions but, by and large, both institutions feel that they benefit greatly from the association which we have.
The working arrangements, however, are maintained and nourished, if you like, through the man-to-man contact of the scientists at the working level. Without this I think the whole program would collapse. I would just say that I think it is important, if formal guidelines are to be laid down, formal agreements for such arrangements are to be set up, that the guidelines ought to be permissive ones rather than dictatorial ones which might lead one party or the other to think that something is being rammed down its throat.

Senator Phillips (Prince): Two more questions, if I may, Mr. Chairman. I would like to direct one to Dr. Loucks for two reasons. I happen to be a graduate of Prince of Wales and a member of the board of governors before we ere legislated out of existence and I wouldn't want him to feel neglected here.

The Chairman: I hope this was not a precedent which will be applied to our own institution here.

Senator Phillips (Prince): I have heard rumours to that effect, senator.

You mentioned, to avoid duplication, that is that there should not be duplication of expensive equipment and so on, that there should be some form of assignment by a government agency. I wonder what would happen in a case such as this, Dr. Loucks, where universities from Prince Edward Island may make a request to do certain research work, say in fisheries, and the Science Minister or whatever government department comes out of this study says, "No, you should be more interested in another factor of the economy", say the potato industry. Now, what would happen in that case if a scientist is already interested in a certain project and it has been handled entirely differently?

Dr. Loucks: The situation I was thinking of was more if Dalhousie and the University of New Brunswick both at the same time decided they wanted to take on a particular research project and a decision would have to be made by the government agency between the two locations, assessing the personnel that they had, the facilities they have at the present time, and then deciding it will be done at one of those locations and not at both locations. That is the sort of duplication I think should be avoided.

As far as a specific project on fisheries or on the potato industry, I think that the location in Prince Edward Island should be able to take on that project because it has such a direct application that I think it should be given that project.

Senator Phillips (Prince): Thank you. I would ask the chairman not to turn his usual green colour when I broach this subject, and that is regional development. I would like to direct a question to the Reverend Dr. Clarke, because I think St. Francis Xavier has been a leader in this field, and
inquire as to why Atlantic provincial universities in particular do not take more of an active part in studying our regional development problems. This was a problem a few years ago.

Rev. Dr. Clarke: We have done some work on regional development. Historically there has been a lot of work done trying to get the farmers and fishermen into cooperation in cooperatives. The extension staff is working in the Cape Breton area very actively. They have been carrying on adult education programs. This is probably the key part of the situation, that you have to change a lot of attitudes in the people. You have a miningsteel group, and to get a change there you have to change quite a bit of their attitude. A lot of work has been done on this.

We have proposed regional development in certain fields. For example, we did propose two years ago the possibility of a research lab specializing in metals with the hope it would pick up the steel industry. There was no action on this, but we did propose it.

Senator Phillips (Prince): I am thinking too of Father Hogan who gave very valuable assistance at the time Dosco announced the closing of the steel mill and the expertise from the university was made available to the provincial government. I know he said it was appreciated and the provincial government found it of great assistance.

I would like to see more of that type of thing being done in the Atlantic universities. I might make the suggestion-I know I don't have to make it to you, sir-that the universities have been outstanding in that regard.

\section*{The Chairman: Senator Robichaud.}

Senator Robichaud: Unfortunately or fortunately, the main questions I had in mind have been asked by my colleague, Senator Phillips, but may I mention in passing that I noted that, notwithstanding the fact that there does not seem to be a consensus of opinion or complete agreement in the Atlantic provinces regarding the amalgamation of the four provinces into one, this afternoon we have noticed that there is complete agreement, complete collaboration, and I might say almost complete coordination in fact, in this one particular aspect of the problem facing the Atlantic universities, that is that the federal government should become more
involved in support of universities, and this not only in the field of science but in other disciplines.

I hope, Mr. Chairman, that we will take this fact into consideration when we prepare our final report.

There is one question I had in mind which has been asked by Senator Phillips. It was the one mentioned by Dr. Beveridge when he stated that there was no medical schools in some provinces, and he referred to the assistance which the federal government was justified in giving in many circumstances regarding assistance to medical schools. I know the question has been asked regarding the specific support that the federal government should give in this regard, but also, before such support is given, and in order to justify the spending of federal money, is it not an important factor to be considered that, before making such grants, the government should consider the hospital facilities in the area, the availability of qualified personnel, qualified staff to teach in medicine, and also the population of the province?

If I were to express a personal opinion, I would rather see a high-class medical school, say, at Dalhousie, and then the University of New Brunswick to specialize in, say, engineering or forestry, and Memorial University to specialize in fisheries or other fields. I would like to have other opinions on this.

The Chairman: In other words, you want to have one big university for the Atlantic provinces with different schools or faculties in each province?

Senator Robichaud: Right. I think it is a mistake to have all the faculties in every university because I don't think that financially it is wise. I don't think it is practical. And I don't think we have the population or that we have the means to maintain that.

The Chairman: Let us see if we can have unanimity on this one?

Senator Robichaud: I doubt that we will, but I am just expressing a personal opinion.

Dr. Beveridge: Mr. Chairman, Senator Robichaud has certainly placed his finger on a number of relevant criteria that must be considered before going ahead with the establishment of a medical school. It is true that once one decides to go ahead, then there immedi-
ately come up a number of other faculties and schools that have to be considered as part and parcel of what might be called the health sciences approach to medicine. To buttress the work of the medical school one ought to have a school of pharmacy, let us say, a school of nursing, and so on. It is very often not just one facet of the school you are talking about, but a number of activities in education related to medicine. But it is quite true that certainly one has to consider the amount or the number of people in an area that are going to support or are needed to support a medical school before you go ahead with it.

I think probably Newfoundland is skating on rather thin ice with what, say, 600 or 700 thousand population in the whole of Newfoundland, something of that order, but I think, as far as staff is concerned, once you have the money and the facilities, and assuming...

\section*{Senator Robichaud: Money first.}

Dr. Beveridge: . . . assuming the geographical situation is not a factor, you can attract staff.

Dr. Burt: Mr. Chairman, there are just three points that come to mind in relation to Senator Robichaud's question. The first one is if we take the assumption that we should have this sort of macro university with different faculties in different places, then we are automatically denying the fact that we hope that the Atlantic provinces are going to grow. If we take the assumption that we are going to have growth in the Atlantic provinces, that we are going to have an increase in population, then you will eventually reach the stage where each of these different faculties is going to get so top-heavy, because they are not going to have the balance, and I think this is the second point I would like to make, that we must have the balance at the undergraduate level, and in order to attract good people to teach undergraduate courses, you have to have some facilities for these people in relation to research.

This brings up perhaps another problem altogether regarding the very place that universities have in modern society. We talk a lot about research but we must not forgetDr. Beveridge pointed this out very well-we must not forget the point of teaching, and this point was made this morning also by Dr. Andrews.

Thirdly, in relation to the medical building particularly, the medical faculties, I think it
is extremely important to take an evolutionary viewpoint here by building up the life sciences complex particularly. I think it is only if you can get substantial departments of chemistry perhaps, organic chemistry, biochemistry, biology, zoology, it is only once you have this as a backup to the medical school that it becomes feasible on a university campus. We have to take into account obviously the hospital situation also.

Dr. Loucks: The only point I wanted to make has already been taken care of. If you are going to specialize you still require chemistry teachers and physics teachers. You cannot have medical doctors teaching in that area, so you are going to necessarily have various disciplines in your organization.

Senator Carter: And research in those as well as teaching.

\section*{Dr. Loucks: Yes.}

The Chairman: Dr. Longval.

\section*{[Translation]}

Dr. Longval: In reply to Senator Robichaud: the policy of the University of Moncton is to serve the French-speaking community of the Maritime region, and with your program, you are taking away the reason for the University's existence.

Senator Robichaud: In other words, you think the University of Moncton would be justified in having a faculty of medicine to serve two hundred thousand or so Frenchspeaking residents of the province?

Dr. Longval: No. However, if you mean the Faculty of Medicine, I agree with you. But if you mean the problem in general-no.

Senator Robichaud: On the contrary. The problem in general, I agree completely.

Dr. Longval: Agreed. Thank you.

\section*{[English]}

Dr. Langstroth: Mr. Chairman, on the question of the macro university, as Dr. Burt has dubbed it, it seems to me if you consider the situation that pertains to a growing university, perhaps a very small institution that grows slowly as opposed to some of the new places that seem to appear very rapidly, these start out with perhaps a faculty of arts and sciences or something pertaining to a discipline that one associates with a faculty of arts and sciences. It teaches undergraduates. And
as it becomes bigger it begins to do perhaps graduate studies, and then it starts to think about professional schools, law and medicine. These things are added on later.

Now, if the university is allowed to follow this pattern of growth, it will eventually go through various stages of increasing size and complexity. The problem is where you have, as we do, in the maritime region, some fourteen universities, some of which have already gone through several of the stages of increasing size and complexity, how do you conduct the process of adjustment which would be required to make the existing situation fit into the kind of institution you have suggested?

Senator Robichaud: Well, maybe I should add this; perhaps, as has been referred to so often in our discussions, the assistance to science should be based on a certain percentage of our Gross National Product. However, if, on the other hand, all the universities in the maritimes want to get involved in all faculties, what percentage of the Gross National Product would you get? I mean, they would only get bits and pieces and none of them would be effective. On the other hand, if there is a tendency for a certain universiy to specialize in certain fields, in certain disciplines, then they may get a worthwhile share of this amount being made available for assistance in the form of grants.

Dr. Langstroth: I think I agree with that point of view.

Senator Robichaud: I have another point. This is perhaps a touchy one and I don't know whether I should bring it up or not. Reference has been made to certain occasions when special economic studies, for example, are made, and reference has been made to the Atlantic provinces, and experts have been brought in from foreign countries.

The Chairman: Or foreign provinces.
Senator Robichaud: Or foreign provinces, that's right. I noted with interest, for example, in looking at the brief of the faculty of science of the University of New Brunswick, there are four names mentioned, Dr. Burt, Dr. Pajari, Dr. Unger and Dr. Young. Dr. Burt, I understand, is from Ceylon, although he is a graduate of the University of New Brunswick. Dr. Pajari is from the Province of Quebec. Dr. Unger is from Poland. And Dr. Young is from Northern Ireland. I am sure
that the University of New Brunswick has benefitted from the knowledge and know-how of these professors.

The Chairman: What has become of the traditional export of brains from the maritimes? It is the reverse now.

Senator Robichaud: I notice that the maritimes is really importing brains instead of exporting them, particularly to the west coast, as we have been saying so often. The question I want to ask is this, and I would like comments on it: Are we making progress in preparing our own students to take charge or participate in teaching or specializing in certain faculties?

I may say in passing that some of the Atlantic province universities-and I cite the University of Moncton as an example have had most unfortunate experiences in individual cases, where in some cases teachers have been brought in from foreign countries without having, I won't say any information whatsoever on the past histories of those teachers, but having very little information. I had the experience last year when I was visiting a certain part of France where I was approached by people from the government and representatives of universities asking how we could have accepted particular individuals in Canadian schools, and I was given the names of two or three teachers. They said, "Here we call them "indésirables" and then you welcome them in your universities." Could I have a comment on that?

\section*{[Translation]}

Perhaps Dr. Longval could tell us something about it?

Dr. Longval: I wish I could say that when I left Moncton, the Rector did not ask me to speak on his behalf.

The Chairman: He is one of the former students?

Dr. Longval: Yes. However, regarding the problem you mentioned-I am not yet sufficiently well versed in the administration of the University to be fully informed. So I think that if I gave you an answer, I would be putting my foot in it-or it would not be recognized.

\section*{[English]}

The Chairman: But what about the brain drain? Is it as bad as it was or is there any improvement in the maritimes?

Dr. Burt: I wonder if I might ask permission to have one of my colleagues answer this question, one who has some experience in this regard?

The Chairman: Yes.
Dr. Burt: Dr. Unger has done some research on this.

Dr. I. Unger, Assistant Professor of Chemistry, University of New Brunswick, Fredericion, New Brunswick: I actually did my graduate work in New Brunswick, Mr. Chairman. I went to the United States to do some postdoctoral work and then returned to the faculty of science of the University of New Brunswick. I think that throughout the maritimes we have quite a few individuals who have done their undergraduate work and perhaps graduate work at various maritime universities, have gone to the United States and other parts of Canada and the United Kingdom for further studies and experience, and have returned to the maritimes. It seems to be a sort of phenomenon in the maritimes that once you have been there you sort of like to go back.

If I can take this opportunity I would like to support Senator Robichaud's views on the subject of the large number of universities which we have in the maritimes. Now, this is perhaps an historical affair, that we have these fourteen institutions. I think that most of us are aware that this is not desirable because we have too many small institutions with inadequate facilities. I think perhaps some of the cooperation that was mentioned before, which does work very well, is because we have realized that individually we cannot do as much as we can with cooperation.

There are many facets of cooperation that I would like to mention. For instance, the fisheries group at St. Andrew's use the computer facilities at the University of New Brunswick. There is cooperative use of the glass-blower at the physics department at the University of New Brunswick. At the same time the APICS, which was alluded to before, has made a list of all the major equipment available at various maritime universities, which these same universities have said they would be willing to make available. We have been made a list of educational films which are to be made available at various institutions, which institutions have agreed to loan them out to each other.

The Chairman: Thank you very much. I know that Dr. Beveridge has to go now, but before he goes, on behalf of the committee, I would like to thank him very much for having attended this meeting and helping us this afternoon.

Senator Kinnear: Mr. Chairman, I have a supplementary question to Senator Robichaud's. When this committee was at MIT we were speaking to some of the faculty and they said that Canadians studying there, Canadians who wanted to come back and teach here, could not find employment. I wondered if any of the university representatives had had applications and had to refuse them?

The Chairman: Too many Americans already in Canada?

Senator Kinnear: Yes, too many of something.

\section*{[Translation]}

Dr. Longval: While reviewing the files of this year's candidates, I found one in this category, and got in touch with him. He is working in the United States. He was asked whether he was interested in coming to work here in New Brunswick; in reply, he said that he was not, since his salary in the United States was higher than what we could offer him here.

\section*{[English]}

The Chairman: Any other comments?
Senator Kinnear: I think they say now that the salaries are even, that there is not too much of a gap in salaries.

The Chairman: I know that Dr. Laird wanted to speak. I will come back to the others.

Dr. Laird: Mr. Chairman, I am going to have to go back to Senator Robichaud's first question, but I would like to say that the arguments for a second medical school in the Atlantic provinces have already been made and in fact this particular battle has been won some time ago and the first group of medical undergraduates are entering the new medical school at Memorial this September.

Just as a general observation, on the question of a medical school in Newfoundland, I would like to recollect what I said earlier about the isolation of the province. Newfoundland is really a whole lot further away than an hour's flight to Halifax on a good day. And its 600,000 people are scattered
thinly over a pretty large area. A high percentage of them have lived in a state of poverty or near poverty for a long period of time, and the types of public health problems and of disease problems are rather unique. For example, there are few parts of North America where one would find so many people living with a well, no sanitation, and a disturbingly high rate of hepatitis. There are all kinds of problems that are not being solved with matters as they stand. We would hope to see them solved that much more quickly with the stimulus of the medical school which we now have in our midst.
As far as fisheries research is concerned, I would like to make one observation. Quite clearly, because of the type of facilities now available at the Marine Sciences Research Laboratory, we have a magnificent opportunity to become involved in types of study which demand very clean sea water and which demand circulating sea water available all the year round, and that is appropriate to a university rather than to a government agency. We see ourselves increasingly participating in close collaboration with, for example, FRB in types of problems that are crying out for answers right on our own doorstep. And not just in the fisheries field. One of the marine science-related problems we have is that of marine pollution. For many, many years past ships passing by Newfoundland have cleaned out their oil tanks, and the oil has come ashore on the southern shore where not very many people live. In fact, it has been something of the magnitude of a continuing Torre Canyon disaster going on, simply because it is in an area where not really too much attention is paid to it.
We do see as really one of our great research challenges the possibility of becoming very heavily involved in pollution-related research at the national level because we can furnish habitats that are still essentially uncontaminated over a very large variety of types. We have clean water, we have much more clean, fresh water than is available...

Senator Robichaud: Unless a tanker happens to go by.

Dr. Laird: Yes. I am keeping out of that. Our long-term research program is calling for, at this stage, the beginning of work on base line data on selected areas not yet substantially interfered with by human activity at all. So that as new industries are brought in it becomes possible to monitor much more
meaningfully what does happen through industrial pollution through knowing what the situation was like in the first place.

In other parts of the world where pollution has become a serious problem it has already proved too late to get relevant base line data against which the impact of man-made contamination could be monitored. We see ourselves in an exceptionally good situation, again disregarding individual instances of pollution bound up with present industrial ventures.

We see ourselves in a wonderful situation for assuming quite a significant role in pollu-tion-related studies not just in the marine environment but across the whole spectrum of what is coming to be referred to as environmental biology.

So I think it might be perhaps temptingly easy to pick on one or two or three, at first sight, very suitable roles for a particular university to play which in actual fact would cause one to miss perhaps basically more important issues that demand a well-rounded university rather than a university highlighting certain study areas.

Senator Robichaud: Has it reached the stage where it is now the only university in a position to give major degrees in fisheries?

Dr. Laird: We do not give degrees in fisheries as such but we do give degrees in marinerelated aspects of biology, and in increasing numbers. On the other coast, UBC has an institute of oceanography and a rather similar pattern.

The Chairman: Any further comments?
Dr. Keen: A comment on the nationality aspect, Mr. Chairman. It seems to me that as of nine or ten years ago if you wanted to establish graduate studies in a field in which there was not strong Canadian participation you had no option at that time but to go outside. I would say the pattern is changing. By and large now it is possible to get mainly Canadian men trained in these fields and there is much less demand for foreigners to staff our universities in various specialized fields, whereas just ten years ago if you had said, "No foreigners" then it would not have been possible to staff them, say in marine sciences or other aspects of geology, for instance. Canadian trained people in these fields did not exist.

Senator Robichaud: You understand we are not complaining about the situation.

\section*{Dr. Keen: Why not complain?}

The Chairman: It is much better to have this kind of movement than the other.

Dr. Bridgeo: I would like to make a comment with regard to the senator's remarks about the number of institutions. At the first international college and university conference or exposition in January, 1969, in Europe, it was pointed out that there is an institution of higher learning being created every week in the United States. The percentage of high school students going on to university in the United States, I think, is about 30 per cent. In the Atlantic region it is around 12 per cent. A desirable sized sociological unit, if you want, for an institution is around 2,500 to 3,000 . I would suggest to you that all of these institutions we are talking about are coming on to that size very rapidly and the problem is really going to be how to control their size, I suspect, rather than try to consolidate them.

If you consider the problem up to a certain cut-off point, that all institutions that exist should have certain facilities, and the cut-off point, I suggest, as the bachelor's degree or the undergraduate honours degree, then beyond that point I should not speak because we are not very heavily involved. Those that have graduate schools have spoken this afternoon but I can see where really heavy expenditures are involved there and considerations such as the ones raised should at least be aired.

The Chairman: I know that Senator Blois from Nova Scotia is very much interested in universities in his province and in the Atlantic provinces generally. Although he knows most of the answers, does he have a question this afternoon?

Senator Blois: Mr. Chairman, I don't know many of the answers.

\section*{Senator Haig: That is true.}

Senator Blois: I will admit it. Some of my friends from western Canada won't. That is the difference. I am sorry that Dr. Holbrook and Dr. Beveridge had to leave as I had questions I might have asked of them. However, I would like to say this, that I have in the last few years kept quite closely in
touch with the universities of the maritime provinces, particularly those from my own province of Nova Scotia. I am very proud of the fact that in quite recent years the universities have been working very closely with industry. They are doing a lot of work, perhaps uncalled-for work, that they are really not getting paid for. They have been working for the last, say, ten or fifteen years closely with the Nova Scotia Research Foundation and some of the results they have been getting from the research have been really wonderful. Many of these men now are getting so busy at their own universities they have not the time to carry on what they have been doing in the past. The research foundation is endeavouring to set up its own staff.

In the work that has been done at Dalhousie and many of our other Nova Scotia institutions they have worked very closely with various industries, particularly in agriculture and fisheries. And it is the people at the grass roots level who are realizing and getting great benefit from this work.

Something has been said here this afternoon about keeping them there. I am very proud again that Nova Scotia has turned out some very fine science engineers. Some of them go away. Most of them have gone away for postgraduate work, either to the United States or Europe or in some instances to some other place, but they have for the most part come back. However, we have sent out a lot of very able scientists, who hold very good positions in various parts of Canada and the United States.

I feel confident that the things that have been brought forth by these men today are very worthwile. I am hoping that we will have some additional money to carry on the wonderful work that these universities have been doing.

My friend, Senator Haig, to my right, who always wants to give me a dig, said, "Apparently you people in Nova Scotia can do anything if the money is available". I told him, "Yes, and perhaps a little better than in any other part of Canada." I sincerely believe that, on the record of what we have turned out.

The Chairman: We will leave you with your colleague from Manitoba to decide that.

Senator Haig: There is a remark here made in the brief of Acadia University to this
effect; "The prime function of the university is then to educate young men and women; secondly, its staff members should carry on research in order to advance knowledge; thirdly, an appropriate liaison should be formed with industry and with those departments of government mainly involved in applied research and development in order to hasten and ensure the application of fundamental advances. It is a belief shared by many that this liaison ought to be improved."

May I ask any member of the panel how that can be done?

Dr. Burt: Mr. chairman, one way that my colleagues and I did consider could improve this liaison, and we were talking about this considerably last night because so much of this comes down to straight communication between governments, between industries, and between universities, is by opening up conferences on a national basis in the different areas that are of interest to each of the different units, by opening these up and having invited speakers and having workshop sessions.

I was privileged recently to attend a CIPA (?) conference in Toronto about the beginning of this year thinking that here was a chance-you yourself were there, Mr. Chair-man-that here was a chance where one could get all these different viewpoints together, but in fact all the different viewpoints did not come together. It was mainly university and government viewpoints that came together; industry was very poorly represented.

\section*{Senator Haig: Why?}

Dr. Burt: Ask industry, sir. Don't ask me. I don't know.

The Chairman: It was more of an open conference. Everybody could attend, I think. It was not upon invitation. Senator Grosart was there too.

Senator Haig: We have heard today that certain smaller industries have not the financial means to have research departments. Couldn't the universities do something in helping these smaller industries in research problems on a contract basis? You see, in the United States we have found that some of these universities, like Harvard and MIT, do a lot of contract work for the government. Industry presents a problem to them and they
work it out on a contract basis and find a solution. As a result industry is saved and the university or the technical school has a possible use of proven research facilities. Why could that not happen in Canada?

Dr. Bridgeo: I would like to comment to this effect, I have been associated with the Nova Scotia Research Foundation, to which Senator Blois referred. I have been wearing two hats as director of the chemistry division of that foundation as well as carrying on my regular university duties. As Senator Bois has pointed out, the duties are becoming a little heavy, and as a result I am trying to sort them out and am clinging to the university side. However, over the past ten years I have had a lot of experience in working with small industries and have found it was not a simple matter. The communications problem mentioned here a moment ago is paramount. The man in the university very often does not have an appreciation of the problems of the man in the plant. He has to be a certain breed of cat, if I may speak loosely. So I think there is a big problem here in the matter of changing attitudes.

If I had a chance to say only one word here this afternoon I would say what Father Clarke said a moment ago, that it is an educational problem. I do not think it is easy. You can search out people who have the interest and if you give them the opportunity, and these are some things I mentioned in my brief, get rid of some of the roadblocks, it can be done, but you are searching for a certain type of person, not just any university professor. And I suggest also that in rearranging your priorities in science in the country this is one of the big "people" problems you are going to run into, taking men who have worked on pure research for a long time and then trying to get them to work on real applied problems of research. There is a big change in attitude that is necessary.

Senator Haig: Then they have to be educated.

\section*{Dr. Bridgeo: Yes.}

The Chairman: Dr. Longval.

\section*{[Translation]}

Dr. Longval: I spent yesterday and this morning at the University of Ottawa, attending the conference of engineering department heads from Canadian universities. The direc-
tor of industrial research at McMaster University was there, and he emphasized the fact that industry is reluctant to sponsor university work.

This morning, it was suggested that the problem should be studied more thoroughly, in order to arrive at a solution.

In my opinion, the gap between the universities and industry is not created by university staff, but rather by industry's refusal to get involved in internal university affairs.

\section*{[English]}

Dr. Keen: I think there has been another comment which is important, perhaps only to your committee, sir, and that is in connection with the research which is undertaken by industry in Canada or the lack of research which is undertaken by industry in Canada because of foreign domination. You find, for example, that a major oil company based in Calgary-excuse me, with a subsidiary office in Calgary-will close down its computer centre in Calgary and go on direct cable into Tulsa, and once its computer centre is gone the employment office for all Canadian graduates will be located in Tulsa or Houston or wherever. This is of concern to me, involving as it does graduate students directly and the employment of graduate students directly. It seems to me this is a problem which the country must face.

If you are an Englishman working in England and you want to work in a Shell lab, you may, or if you are a Dutchman or an American, but if you are a Canadian geologist, and in this I may be quite wrong but I doubt that you would be able to work in a Shell research lab; you would have to be in an exploration office. It seems to me to be a very important point from the point of view of subsequent employment of our graduates.
Dr. Laird: I wonder, Mr. Chairman, if I could cite a specific example. In the area of pollution-related biology I would suspect that there would be a tremendous future for gov-ernment-industrial-university collaboration. This is an area which tends to arouse the emotions rather rapidly. A lady in Washington who belongs to the Audubon Society and finds a dead robin on the front lawn and known it has died eating DDT-carrying worms, gets very worked up about it, forgetting that the same DDT has been saving very large numbers of lives in other parts of the world where it was the only way of getting rid of insect-borne diseases.

As industry becomes more sophisticated and introduces more and more sophisticated compounds, the by-products of the plastics industry, for example, into waterways there are bound to be yet more complex pollution problems arising, each of which has a very emotional component.

Senator Haig: In five years time they find out what the side results of these new things are.

Dr. Laird: Exactly. My point is that it is possible at the planning stage for industry to provide the money that might otherwise later have to be paid out by way of reimbursement and all the rest of it, to put such money into university research designed to evaluate the effect of particular contaminants on eco-systems, and this might lead to a much happier situation all round and to the promotion of much more effective interrelationships between the three components of government, industry and the university, and a much greater understanding of one another.

Senator Haig: Mr. Chairman, you have allowed Senator Robichaud to embark on a subject which might be controversial. Let's take a specific example, that of placenta Bay.

The Chairman: I certainly hope that controversy is not out of order here.

Senator Haig: Thank you, Mr. Chairman. Before that industry was located there was there no research done as to what the effect of the effluent would be? And, if not, why not?

Dr. Laird: If you are asking me that, I can take refuge in the fact that all of that happened before my arrival in Newfoundland and I am unfamiliar with the politico-legal background.

Senator Haig: Let's assume that this industry was to be established there and it had a certain process. From that process resulted an effiuent. That was, they say, what caused the problem with the fish in that bay. Before that industry was established should not there have been some research done by either industry or the university there or the Fisheries Research Board or some organization to find out what the effect of a certain percentage of that effluent would be?

Dr. Laird: My answer to that would be an unqualified yes.

Senator Haig: That's what I wanted, thank you, Mr. Chairman.

Senator Carter: I want to get in a plug for Newfoundland in a minute. However, first I want to ask anybody this question: How are we doing in the maritimes as compared with the rest of Canada in producing scholars, in producing PhD's? Is anybody doing research into that? And what is happening to the PhD's we produce? Are they part of the brain drain? Do they go to other parts of Canada and the United States? Does anybody know the answer?

Dr. Langstroth: First, let me say that I don't know the answer to the question as to where do the PhD people go.

Senator Carter: How do we compare, first? We were talking this morning about the fact that we are getting the small end of the stick with respect to graduates, some 3 per cent or 6 per cent. How are we doing anyway?

Dr. Langstroth: Well, it is an uphill struggle to establish graduate schools to the PhD level. They are fairly new in the maritime provinces. I speak for my own school. Dr. Burt speaks for UNB. It is expensive. It is timeconsuming. It requires highly skilled specialized staff. We are now beginning to produce output, students are graduating. Some of them stay around. We know that. What happens to the majority of them is something we would like to know and we are setting up machinery to try to keep track of them but I cannot answer the question today.

I suppose it takes at least three years to produce a PhD from the bachelor's degree level. It is more commonly four or five years. At Dalhousie University, in many disciplines, doctoral studies have only been approved in the last three or four years, so it is a little too early to begin to compare our output per unit of whatever input you use with universities in the other parts of Canada.

We now have fiften disciplines in which we offer the PhD degree. We have lots of students wanting to get into the programs in each of these disciplines, and we take that as a good sign. We think we have good students and we are sure, when these people obtain their degrees, they will be well-qualified and will compare very favourably with the products of the other universities in the rest of Canada and elsewhere in the world.

Senator Carter: The general theme this morning was that the maritimes were not getting a fair share or proportionate share of grants, of the total federal funds, allotted for research, that maybe we are only getting about half our share, somewhere between half and maybe three-quarters.

If we got more money, if our grant was doubled, what would we do with it? Do we have projects now that are not 'being developed at all that we just sweep under the rug? I would like to know what is being left undone. I am not thinking about individual students and individual projects where any person can have a good idea and he might go and explore it. That is all very well. But I am thinking of projects, things that you have already started and cannot finish or where you had to curtail your research, that sort of thing. Is that sort of thing going on? Can you give us examples of it?

Dr. Laird: Well, yes, I believe, Senator Carter, in this same area at Memorial we are fortunate in having in the biology faculty three people all of whom have rather senior standing in their particular discipline, not only on a national but at the international level. The man who is setting up our environmental biology centre directed Berkeley's Centre of Environmental Biology before we managed to lure him into St. John's.

However, we are in the rather embarrassing situation at this moment of not having the space to house equipment and nonacademic personnel, which and who could be used to build up a really strong program in this field because before qualifying for a federal negotiated grant the university, as its input, would have to provide space or show it had the space available into which the equipment and other personnel could be moved.

At the present time, simply because no space whatsoever is available, it is not possible for us to back up these good personnel with the sort of equipment they need, and I believe we are running a very real risk, if this is carried on for too long, of some people beginning to lose interest in remaining because they were attracted by the thought of the kind of projects that they could enter into at the site and now find they are not getting the sort of equipment they need to be able to carry out studies that would be relevant to things like the Placenta Bay situation that was mentioned.

Senator Carter: Do you think funds for that should be included in research or should that come under a separate heading, that is funds for accommodation? I can see you run the risk of losing professional talent that you have assembled simply because you have not the funds to provide the equipment and space for them to work. Is that a legitimate charge against the funds to science research? Should that come under another heading?

Dr. Laird: I believe that the prevailing feeling at Memorial is that our special situation does make a case for a measure of capital support that could let us get over this hurdle and into the area of obtaining the kind of support for our research that we would qualify for, having the space. Perhaps it is a special case. Perhaps it is something that is not going to last for very long. However, this is the time when we need the money for capital costs that we haven't got. Perhaps in three or four years time the same money would be of little use from the personnel standpoint.

Senator Carter: I will give you an idea about that after I have heard some of the others.

Dr. Burt: Mr. Chairman, there are one or two points that do come to mind here. Specifically the development of programs in relation to graduate programs is always geared very closely in most science departments to grants from bodies such as the National Research Council, and where these grants are being cut back proportionately, for instance, I think you, Mr. Chairman, made the point this morning that once you are on the list you stay on the list; this is not so any more. It may have been true once. Now it is certainly no longer true. We have many people in our own department within the university, for instance, whose productivity researchwise has not been sufficiently competitive and they have been cut completely.

The Chairman: Well, this assertion was made to us by the Macdonald group last week.
Mr. Burt: I see. Well, I am giving you actual instances in this case. However, we are greatly dependent on these grants. Otherwise we cannot support graduate students. Much of the graduate student's salary at the moment has to be paid out of the research grants which an individual professor gets and if he
is shaky about the amount of money that is going to be promised the following year he will hesitate to commit himself to a program which perhaps can expand at the time because he will say, "Well, perhaps they are not going to give me quite as much." Either that or he goes ahead, finds he has the students but has no money.

The other point, again a specific example here in relation to the University of New Brunswick, concerns the negotiated development grants that were mentioned this morning relating to NRC once more. Here we have a situation at UNB where the chemistry department is extremely strong in relation to natural products, the chemistry and synthesis of natural products. Professor Wiesner for instance, at UNB, who has very recently been made a Fellow of the Royal Society, has tried for two or three years now, I think, to establish an institute. The university supported this grant. This was turned down. NRC did not have sufficient federal funds available to give this negotiated grant. And yet they are just waiting to go.

ADB, as it was before the recent modifications, gave a fair amount of money to help as to the building, so we have the space, but again it is the lack of this negotiated development grant to get the equipment that is holding matters up. So I think there is very clear evidence here that this program could go ahead in the Atlantic provinces without question, given sufficient federal support through NRC.

\section*{The Chairman: Any other comments?}

Dr. Keen: Two comments. First, in terms of funding to universities, particularly by comparison with the other agencies, that is totally inadequate. If you gave the chairman of the science department at Dalhousie University \(\$ 300,000\), he would spend it this afternoon. They would work on three items that we are discussing ways and means of attempting to acquire somehow. It is a matter of inadequate funding. That is the first point.

Secondly, I think inadequate methods of budgeting for graduate work in general prevail. If you are, say, the chairman of an undergraduate department of a university you have a regular university budget and you submit it to the president and in due time, usually late but in due time, it comes back and you know approximately the same
amount of money-or more, hopefully-will come back the next year, and you keep putting forward your budget keeping in your mind this thought, "We will put this much this year and add to it next year." On the other hand, budgets for graduate schools, dependent as they are largely upon National Research Council monies in the case of the sciences, they are put on an ad hoc year to year basis, and I personally find it very difficult to think of budgeting with a sort of fiveyear thought in my head in my own undergraduate department. I find this most difficult.

\section*{The Chairman: Yes, Dr. Langstroth.}

Dr. Langstroth: I would underline what Dr. Keen has said and I think the approach that is taken is to cut the coat from the cloth that is available. Dr. Keen has mentioned three items of the order of \(\$ 300,000\). These are not exotic things, these are basic research tools that anybody in the business doing work in the department concerned should really have at their disposal. Not only does Dalhousie not have them, but Dalhousie does not have access to them elsewhere. It means that research has to be done without the use of these basic tools. It is a hard thing to do.

The other comment I might make is that we are planning at Dalhousie to open a life sciences complex. I believe Dr. Laird has made reference to the Aquatron connected with this part of the university establishment. The Aquatron will be a running sea water facility in the life sciences complex which will house both undergraduate and graduate facilities for teaching research in oceanography, biology and experimental psychology. The experimental psychology will largely be done with sea animals. Building costs are estimated at something of the order of \(\$ 18\) million. We think we can get the building up and opened by late 1970.

If you consider an \(\$ 18\) million building and then consider the simple basic scientific instruments, not the exotic special things but the everyday tools of the trade that need to go into an \(\$ 18\) million building, which is perhaps devoted half and half to research and teaching, or perhaps a little less than that to research, it comes out to a big bill. We are going to be hard-pressed to find that equipment in order to make full use of our building when it is ready.
Dr. Bridgeo: Our geology department is interested in research in natural resources in
the Province of Nova Scotia. The geologists normally take field trips. It is conceivable that the young chaps could go out and over a period of time could-not with the same expediency or despatch as a commercial company-could outline mineral deposits. The chemists in the university are interested in extraction. Now certain experiments in the training of the chemists can be designed around the extraction process so that instead of analyzing something that means nothing they could be getting, over a period of time, a set of data which we can discuss and relate to a resource in the province. In addition to that, the product can be used as the raw material for, say, a polymer. Several students can be put on studies, not publishable because this is training, but studies which are precursors to the final polymer. In addition to that, the final polymer should have properties which will make it desirable as a protective coating for marine atmospheres.
What I am getting at is that through this cooperative effort in the various departments, bringing in student experimenters and a certain number of students on a more concentrated basis, I think you can get across to students while they are studying what is really involved in the total concept of an idea through to a commercial fact. Then when these people get out in the world and become councilmen or MPs or whatever, they are going to be faced with making decisions, and I think this experience will help them know what science is all about in this period we are about to enter.

Finally, if I may make one comment as to our own specific case, to help that along, since you ask what would we do, we would immediately hire a certain number of fulltime technicians to enable us to have the continuity. I think we should look at those people as skilled people being provided with jobs in this area. And I can refer to this, if you want, as the "knowledge" industry. I referred to this in my brief and said it was related to the dissemination and application of knowledge.

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Again, at that same meeting in New York I mentioned before, it was stated by a representative of a financial house that by the end of this century \(50 \%\) of the Gross Na tional Product of the United States of America will come from the knowledge industry. To me, that is quite an expressive figure. So I suggest that we should consider some of this staff that the universities would
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hire really as being people that would be employed by industry.

Senator Carter: Sort of an industry in itself?

\section*{Dr. Bridgeo: Yes.}

Senator Carter: One final question, since it is getting late. I would like to come back to the marine sciences project that Dr. Laird outlined for us. It embraces a number of disciplines. When we were down in Washington we were told that down there they are beginning to get worried about the effects of some products. We were talking about DDT a moment ago. They were beginning to get worried about the effects of new products or new chemicals which come on the scene and appear to be a blessing at first and then after five or six, seven or eight years, we begin to wonder because we see the other side, the disadvantages. They are thinking in terms of trying to forestall this as much as possible, trying to forecast the probable effects of new substances and that sort of thing.

Dr. Laird pointed out, I think, that in Newfoundland we have pure salt water and polluted salt water, unpolluted and polluted fresh water, and.

\section*{The Chairman: A pluralistic society.}

Senator Carter: Yes. We have all the ingredients there to have the base line studies that this type of research needs. I just wondered is that included as a part of your program?

Dr. Laird: Yes, it is.
Senator Carter: Well, that would be on a national scale, I. would think, which might justify you in asking for a little money.

Some Hon. Senators: Oh, oh.
Senator Grosart: Mr. Chairman, I think we should pursue a little further..

The Chairman: Would it be agreeable if we go on until six o'clock?

\section*{Some Hon. Senators: Yes.}

Senator Grosart: Mr. Chairman, as I was saying, I think we should pursue further this question of the percentage of total federal funding of NRC by regions. The figures we were given indicated that at least in the grants area the percentage vis-a-vis population in the maritimes appeared to be very low. No one would argue, I suppose, that the
total funding should be on an exact basis of population, but, on the other hand, this is one of the ways of getting at the total amount that a national science policy should determine as necessary to meet the needs of the public goals of Canada that can be accomplished through research and development. It can work both ways, of course.
Another point that comes from that is the emphasis that arises from funding of postgraduate research only. Dr. Laird and Dr. Loucks both emphasized the importance of funding of such graduate research. I wonder if we could have an idea of the total federal funds that go into undergraduate research? How much of the total now finds its way into undergraduate facilities?

Dr. Loucks: I would think it is a low fraction. You have to get your young man to do the research. Then you might have to hire a summer student for the summer. You would like to have a full-time technician who can give you results through the entire year. APICS provides summer students along this line, but NRC money that would be used in the maritimes now, that finds its way into the hands of undergraduates students, would be a very low percentage. I think it could be much higher.

Senator Carter was asking the question, how could we use more money? I think we could use it effectively by hiring our students in the summer months to conduct research. Sometimes they cannot do the work because they do not have the full qualification, the undergraduate, but they can do some work for you in the summer months.

Senator Grosart: There has also been raised the merit criterion for research. We have heard it said over and over again that all research funds should be directed to researchers of very great merit. This seems to me to be nonsense. Surely we have to develop merit, and particularly in an area such as this. Surely if you are only going to support merit, you are not going to have very much merit before long. Would anybody like to comment on that?

Dr. Burt: Mr. Chairman, I would like to comment on that because it has been the policy of NRC to provide people starting out with a certain amount and to see whether or not they can prove themselves with that amount, and if they can prove themselves, if they do show that they have sufficient merit, then
they will continue with it. I think this is a perfectly sound policy. I think this in effect is the answer. I cannot say any more than that.

The Chairman: But that system would produce, at least if we compare figures on the basis of population, it will produce regional inequalities.

\section*{Dr. Burt: No.}

The Chairman: Well, the figures we were given by Dr. Beveridge this afternoon would seem to indicate that.

Senator Grosart: I think I would say that would only mean there has been too much emphasis on merit on the assumption that no good can come automatically. In other words, there is the concentration of funds in Upper Canada and such places, where there is an assumption that this is the place where all the merit lies.

Dr. Langstroth: I assume we are in this connection talking about merit as it attaches to the individual?

Senator Grosart: Or to the project or program.

Senator Carter: It attaches to all three.
Dr. Langstroth: I think there is need for support for meritorious projects. The young man who has a very brilliant idea and submits his idea for the scrutiny of an eminent panel which may attest to the brilliance of his idea may find it costs \(\$ 50,000\) to get the project underway, and with present granting policies he will have great difficulty in being able to make a start. That is my view.

As to your previous question as to how much of the research money gets into the teaching of undergraduate students, I think it is a difficult question to answer. First of all the money which goes by fiscal transfer from Ottawa to the provinces eventually ends up in the universities and a great deal of that is used in the teaching of undergraduates and such research as may be attached to that teaching.

The money which goes in the form of research grants to individuals surprisingly enough in some institutions also ends up in the undergraduate teaching program because the people doing the research are faily generous with their apparatus on some occasions. If they happen to have a piece of equipment
which is a useful teaching tool and the university cannot afford to buy one for the undergraduate lab, quite often they will lend it for an afternoon or a week. So to that extent there is an application to undergraduate teaching. As to a precise evaluation, I would hate to evaluate how large the effect is in our own university and, of course, I don't know about the others.

Senator Grosart: Since we are mostly concerned with a national science policy in this committee, there does seem to be an assumption that one solution of the constitutional question as to federal invasion of the educational field is that the wnole funding from the federal public purse should be to the postgraduate level. As an element of national science policy would you think that is sound?

Dr. Bridgeo: Well, I tried to point out the need, and I think Dr. Beveridge also made a strong plea, for support for the undergraduate programs, because, after all, these are the feeders. You see, if we do not find these people we are not going to have anybody in graduate school. I will not talk about my own case, I will talk about a neighbouring university, Acadia. Professor McGarry has been extremely successful in his physics program. I know that over the past several years he has developed students to the honours level who have been in strong demand at the best graduate schools on the continent. In one case the chap was offered \(\$ 8,000\) a year to go to a graduate school of his choice, and all he had to do was to work for the sponsor. It so happened that the sponsor was the strongest institution in his particular field of physics, so there was no problem there. This just goes to show that if this man had not been working with these students over the past several years we may have lost, I don't know perhaps six to ten very valuable people. And, of course, once you get a valuable man, as you all know, his influence spreads very appreciably after he is fully developed.

The Chairman: I would like to go around the table now-not to you, Dr. Burt, because you have already expressed your view on this subject-and ask for your opinions about the recommendation made by the Macdonald group that the granting function of NRC should be separated from the lab. You have said, Dr. Burt, you are against this. I wonder if the others here around the table would express some views about that proposal?

Rev. Dr. Clarke: I believe they have already made a separation of sorts. The present system seems to be the one that our group favours.

Dr. Langstroth: I would agree with that.
The Chairman: So there would be more or less unanimous opposition to that particular recommendation of the Macdonald group.

Dr. Keen: May I ask, sir, what difference it would make? It is just either an administrative or bookkeeping thing. Would you call it NRC Section A and Section B or Council X and Council Y? The lab functions do not seem to overlap with the functions of the granting agency.

Dr. Langstroth: I would make this additional comment, if there is separation, in view of fitting the research money into the overall scheme of things in the country, that other disciplines, if you want, even humanities, be represented on the board because there are some people in the humanities who are quite knowledgeable on scientific things.

The Chairman: Well, thank you very much for spending this afternoon with us. We hope that as many of you as possible will be able to stay on in Ottawa for our plenary session next Thursday afternoon. We hope at that time that there will be some people from the Macdonald group present as well, so we will be able to have a full meeting.

The meeting adjourned.

\section*{APPENDIX 61}

\title{
BRIEF
}

TO THE SPECIAL COMMITTEE ON SCIENCE POLICY
OF THE SENATE OF CANADA
BY
THE FACULTY OF SCIENCE
SAINT FRANCIS XAVIER UNIVERSITY

\section*{General Policy}

We believe that as a cornerstone of its science policy, Canada should assign to Research and Development the same proportion of its Gross National Product as do other industrial nations. Some of the many reasons that may be given to support such a policy would be:
(a) It is expected that a sufficient number of young Canadians have the inclination and talents to perform such work, and if the opportunity is not offered to them to do so here, they will continue to emigrate. The loss of scientific and technical personnel deprives the country of many employment opportunities associated with such competent people.
(b) The technical information that would accrue is an exportable commodity, e. g. patent licencing.
(c) We have an obligation to play our part in the universal search for a better life that is gained from increases. in knowledge and technology.

Regional Policy
We believe that the funds expended by the Federal Govern-
ment in carrying out this Research and Development program
should be distributed with due regard to the social impact on
various regions of the country. This viewpoint has been
succintly stated by Harry G. Johnson:

THE GEOGRAPHICAL DISTRIBUTION OF SUPPORT OF BASIC SCIENCE

In conclusion, it seems desirable to draw attention to a facit of policy toward basic science that is important but tends to be overlooked by scientists. This is the implication of the geographical distribution of science support for the pattern of growth of the U. S. economy. The location of scientific research activity in a particular city or region generally constitutes a focal point for the development of science-intensive industries in the surrounding area, and this should be taken into account in deciding on the location of such scientific activity. There is a natural tendency for scientific activity to agglomerate around established centers of scientific accomplishment; and this is probably the most efficient way of conducting scientific research from the point of view of science itself. From the economic and social point of view, however, and perhaps even from the longer run scientific point of view, there is a strong case for encouraging the development of scientific research centers in the more depressed and lower income sections of the country, as a means of raising the economic and social level of the population in those sections. Much of the poverty problem is associated with geographical concentration

> of high-income industries in certain areas and their absence from others, which makes migration the only feasible route to economic improvement. A deliberate policy of locating scientific research in the backward areas of the country to encourage their industrial development could in the long run provide a socially and economically more attractive attack on the poverty problem than many of the policies now applied or considered.
> This point, it should be emphasized, is independent of whether the Nation is spending too little or too much on the support of basic research, that is, of whether the beneficial effects described are worth their cost. So long as public funds are allocated to the support of basic research, the geographical allocation of the funds should take account of the social effects of their expenditure.

\section*{Role of the Universities}

We believe that the Universities should be responsible for the greater part of the fundamental. research that is basic to all Research and Development and also for a substantial amount of the applied research that flows from it. It is acknowledged that the development work should be done by industry.

We have in Canada the anomaly that many of our industries are subsidiaries of foreign companies whose policy is to
1. Basic Research and National Goals. A Report to the Committee on Science and Astronautics U. S. House of Representatives by the National Academy of Sciences. March 1965, p. 140.
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restrict this research to the parent company. Legislation to
force them to do Research and Development in Canada would be
invidious. We believe, therefore, that a compensating
proportion of the total Research and Development expenditure
in Canada should be devoted to that undertaken in the Universities.
Hence, the percentage of the total Research and Development
budget that is alloted to the Universities should be higher
that the equivalent allotment in the United States.
We also find that most of the support for research in at
least the smaller universities is now being provided through
the education budgets of the Provinces. This support is in the
form of salaries of staff, provision of research space, and so
on. We believe that it should be the National Science Policy,
not only to take on this support directly, but also to increase
it substantially.

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\section*{Conclusion}

It is difficult to ascertain exactly the amount of support that should be given to any individual university, but we propose that the following become the National Science Policy:
(a) to make, with due regard to the social implications, a substantial annual basic grant for research to each University,
(b) to provide substantial additional funds through a
national granting agency, such as NRC, for such special projects as Centers of Excellence, Interuniversity Projects, Outstanding Scientists, Large Installations, and the like.

We trust that the above suggestions will be of some use to the Committee in its deliberations, and, if adopted, of some help in increasing the scientific output of Canada as well as improving the economic balance between various sections.

Respectfully submitted,

Dr. J. J. MacDonald
Dean of Science

Dr. E. M. Clarke
Head, Physics Department

\section*{APPENDIX 62}

\author{
A Brief \\ to the \\ Senate Special Committee on Science Policy
}
by

Memorial University of Newfoundland

\author{
Submission to the Special Committee on Science Policy of the Senate of Canada
}
1. Following the request of the Honourable Maurice Lamontagne, in a letter dated December 20th, 1968, officers of the University have given consideration to the broad purposes, policies and mechanisms which ought to be sought and established through the Federal Government's support of university research in Canada. This University welcomes the opportunity to present its views on these important matters.
I. Goals for the Federal Government in the Support of Research
2. We set out below in summary form the broad picture of the goals which we consider the Federal Government should have before it in the support of research.
3. Up to the present time, Canada's remarkable economic and technological developments have been based in large part on research and development activities in other countries.

In an address to the Conference on Education and the Development of Human Resources in 1966, Dr. John Deutsch
remarked: "In the past, Canada has depended almost wholly on other countries for its technology and knowhow. The (Economic) Council has emphasized that the attainment of our goals now calls for a much larger Canadian effort in research and in the use of the latest available techniques."

This is not to decry in any way the unique and outstanding contributions of Canadian scientists, engineers and scholars in a number of fields. Indeed, by their rarity, these highlights stand out all the more brightly. Nor is it to decry the effects of the Federal Government's quadrupling its support for research in Canadian universities since 1960. But we think that the time has now come for Canada to match its economic and technical achievement with a research infra-structure which will enable it to advance still further. Such an advance will not only provide the basis for the further exploitation of the vast natural resources of Canada, and thus continue the upward movement in Canadian living standards, but will also establish Canada in a position of world leadership in certain spheres of research and enable us to repay to the rest of the world the intellectual debt which we have incurred through our dependence on the research of others.
4. Such a research infra-structure must be based partly on
government research institutions, partly on industrial and commercial enterprize, and partly on the universities. In all three places, success should breed further success, not only by holding our own scientists, engineers and scholars, but by attracting talent from elsewhere. The biggest single magnet for the outstanding research worker and scholar is not money, but the presence of other outstanding workers.

In the case of the universities, success has another benefit. It conditions all the youthful potential talent of Canada during the crucial years to a research-orientated way of life. In the long run, our supply of scientists, engineers and scholars for all types of institutional activity, is dependent upon the melieu in which they reach maturity. Unless, therefore, we have in our universities powerful and outstanding schools of research, there cannot be an adequate scientific basis for the totality of our national effort and achievement.
5. It follows that Federal support for research in universities is an essential condition for national development. Indeed, taking a long view, it may well be that the speed and extent of our national development may be directly proportional to the amount of national investment in university research.
6. This is subject to certain vital qualifications. It is possible and indeed easy, to waste money on research of dubious quality. This is why those responsibile for overall research grant-giving policy have in the past tended to cultivate and nurture areas of excellence. Such a policy is sound. But there is a second qualification. It is equally easy to play safe and neglect potential, simply because this potential may not be realized. Here, it is our view that Canada has been far less successful. If potential is to be successfully exploited, it must be sought out and fostered.
7. A third qualification is this. Research effort must be developed within a long-term strategic plan. Examples can be found within any university and throughout Canada where the desire to "keep up with the Jones" has led to reduplication of facilities, with consequent underutilization of available facilities and the spreading too thin of that most precious commodity, skilled technical manpower. Any policy of fostering excellence is bound to lead to some duplication, and this is no bad thing. But multiplication, for example, of accelerators and high-powered computors, simply because the University next door has them, is a costly and wasteful folly.

It follows that co-operation between universities in making
use of costly facilities is essential. In achieving
this co-operation, Federal grant-giving agencies have a vital role to play. They can force would-be expensive prima-donnas to orchestrate their efforts.
8. Canada, by its geography, presents a special challenge to those responsible for planning the totality of our national research effort. As in the U.S.A., and the U.S.S.R., Canada offers an opportunity for planning research within the diversities presented by a country which is virtually a continent. Climatically and mineralogically, she resembles the U.S.S.R. and complements the U.S.A. Canada can be, if it so wishes, the mirror in the non-communist world of the research effort of the U.S.S.R. In the U.S.S.R., research is planned, perhaps indeed overplanned, to meet human need. Given the base-line from which operations started, the U.S.S.R.'s achievement has been spectacular. We start from a far higher base-line. Our achievements can, if we set our sights high enough, be even more spectacular.
9. It may be argued that our relatively small population sets a limit to what we can do. Of course, it does set a limit, but in research, small nations can do great things. Scotland has been the nursery of both medicine and engineering. Sweden and Switzerland have made for
themselves unique positions in the advancement of mankind. Up to now, the people of Canada have displayed their genius largely in subduing the vast territory in which they have found themselves. They have done this so well that they can now, with profit to themselves and the world, devote an increasing measure of their effort to seeing long-term answers to the problems which are posed by their unique geography.
10. Canada is singularly fortunate in that its geographical diversity is matched by a large measure of political and cultural decentralization. In consequence, within each province, there has grown up at least one outstanding university. Each such university strives to have, and indeed ought to have, its own place in the totality of the world of science and learning and scholarship. Insofar as this has been achieved, it is largely the result of Federal fostering of areas of excellence. But each is also a potential centre of regional research. Each, unless it aims to be no more than a liberal arts college, should exploit to the full the unique opportunities which are presented by its own special environment. To some extent, this has been done. But it is in the exploitation of uniqueness that we feel that achievement so far has been inadequate. It follows that it is here that a planned Federal grant allocation policy can reap its richest rewards.
ll. If research is itself the infra-structure of economic and social development, research today is impossible without an infra-structure of its own. It needs costly and extensive buildings which must be furnished, lit and warmed. It needs secretaries. It needs library facilities. It needs highly-skilled technicians and laboratory assistants. It needs services and equipment. It may need animals and animal houses. It may need field workers, for social survey work or for geological or geographical surveys. Often it involves travel. Sometimes it needs boat time or plane time. Without this infrastructure, the individual, no matter how skilled, cannot function. If exploitation of potential is to be achieved, a way must be found of providing this research infra-structure.
12. By and large, provincial governments have been concerned to see to it that their universities have been capable of providing education for the young people of their provinces up to first-degree level. By and large, this has been or is being done. But at graduate level, and it is here that research begins, physical provision has been more meagre. And for the main infra-structure for research itself, it has been more meagre still. Yet it is only when graduate training starts that the real research potential of a community starts to be released. It follows that support for graduate training and the physical and staff infrastructure for graduate training is no less important than the infra-structure for research itself.
13. Provincial effort must largely be a function of provincial wealth. A wise province, despite its poverty, may invest more than pro rata of its gross provincial product, in its university or universities, realizing that its longterm prosperity is dependent on the skill of its human resources. But, with the greater claims on its financial resources which its inherent poverty imposes, there is a limit to what a relatively poor province can be expected to set aside for higher education. So a vicious circle arises. The infra-structure needed for research is lacking. So research itself cannot develop as it should. So the research infra-structure for economic and social development is denied precisely to those places where it is most needed. Unless the vicious circle is broken by the deliberate and purposeful creation of the infra-structure need for research in the universities of the under-developed areas of Canada, their immense potential cannot be released. We shall have a Canada largely parasitic on a few great metropolitan centres, with a vast hinterland of neglect and welfare and wasted opportunity. Of nowhere is this more true than Newfoundland.
14. Two further points must be made to support the contention that Canadian research must in part be diffused over the whole of the nation. First, it is our belief that the people at the periphery are no less intelligent and resourceful than their counterparts at the centre. They
are rugged, independent-minded and resourceful. They can, if the opportunities are available, make a major contribution to Canada's research future. Strangely enough, they like their environment. They believe their way of life is a good one. And most of them are reluctant to leave it. We would be prepared to argue that they are right. By bringing research opportunities to them, not only will they be able to enrich their Provinces, but they will enrich the nation as a whole, and perhaps the world.
15. The second point is this. Life in great cities is by no means Utopia. To commute long distances to work and to be barred from the countryside by miles of suburban development, are heavy prices to pay for amenities of great city life. We believe that the balance is now delicately poised. We are finding it far easier than we expected to recruit to Newfoundland top-flight medical scientists for our Medical School, in part because they are tired of great-city life. Our conception of the future of Canada is a happy and thriving but purposefully limited core, and a no less happy and thriving but purposefully developed periphery. In the achievement of both objectives, we believe that the flow of Federal funds for research will play not merely a large but an essential part.
16. In the above remarks, we have used the term "research" bryow 9 .
to cover research in both the physical and social
sciences. We are particularly conscious of the need 0 .
for and value of social science in the underdeveloped
community of Newfoundland, the more so because, at
Memorial University, research and scholarship in the
humanities and social sciences have been developing
apace. Newfoundlanders have literary and political
traditions which have made substantial contributions
far beyond the boundaries of the Province. Now, within
the framework of modern scholarship and rigorous
scientific method, they are already showing that they
can match the rest of Canada in developing these traditions.

We therefore warmly support the remarks of the late Prime
Minister, Mr. Lester Pearson, to the inaugural meeting of
the Science Council of Canada, when he said:
"I hope also that in your studies you will explore the boundaries of science to ensure that no promising area is overlooked. There is, I believe, a very real danger that, in our complex society, important borderline areas between different scientific disciplines and between science and the humanities, may be left unoccupied - either
 of financial or institutional support. I feel very keenly that the study of science's relationship to society should by no means be the sole province of philosophers and political scientists.
"So I urge you to join with the humanists and others who approach knowledge from a different direction, to ensure together that adequate bridges are established between our pure and applied natural sciences and our social sciences and humanities. For wisdom, surely, must be the composite of all knowledge and all experience."

We would urge the Committee to support Mr. Jean Boucher's
recent appeal for greater federal aid on behalf of the Canada Council's research related activities in the humanities and the social sciences.
17. We have also used the term "research" to cover both pure
and applied research. Again, we quote Mr. Lester Pearson:
"To this end, we want to know that the very best available scientific knowledge and resources are being brought to bear on problems - new and challenging problems - such as water resources and water pollution; transportation; urban planning and development; automation and employment; public health; poverty in all its guises and ramifications .....I hope that you will consider whether we are using the best available knowledge from science and scientific research in dealing with such problems."

In Newfoundland, we are familiar with all these problems.
We are familiar with poverty and the diseases arising from poverty. We are starting to provide biological base-lines for unpolluted water. We are in a special position to explore the science of the oceans, and its development, both as a source of power and as a source of food. We are ripe for urban planning to prevent suburban sprawl. Even automation in our paper-mills is presenting its problems. Yet, in each of these spheres, by solving our own problems by applied research, we can add to the totality of human knowledge in the pure research field.

We recognize the critical importance of some research results which have no practical aim; and we agree with

Mr. Pearson in his assertation that, "in the national interest...........we must continue to support generously those rare intellects capable of unusual discoveries when they are given free rein and adequate resources." We know that Canada has a distinguished record in basic research and that our standing in this area should be maintained. The plea here is rather for a balance in objectives: ".......we would be as wrong to concentrate entirely on this vitally important outer edge - forgetting to put to use the vast body of knowledge that already exists - as we would be to concentrate solely on using what we know, ignoring the challenge to push the edge to new and unknown horizons." Moreover, out of applied research often comes basic knowledge, just as from pure research, applied results of the greatest value may appear quite unexpectedly.
18. Any realistic examination of the Federal Government's support programme for university research must take into account the facts of Canadian political life. Clearly, the Committee has to face the practical limitations of a Federal political structure. But there are, as Mr. Pearson has stated, "bound to be differences of view in a federation as to precisely where the respective areas of jurisdiction begin and end." Despite the many interjurisdictional problems, we know that in real terms education, training
and research tend, in Canadian circumstances, to be mutually reinforcing. Although "education" is assigned by the constitution to the provinces, it nevertheless is true that the Federal Government has a clear responsibility ". ......to devise and apply national policies and measures that are necessary to ensure that the economy of Canada will continue to expand and will become increasingly productive, in order that there may be full employment and an increasing level of prosperity for all our citizens."

Acceptance by the Federal authorities of responsibility in this latter respect justifies the expanded Federal unconditional support for post-secondary education, which was announced at the Federal-Provincial Conference on October23rd, 1966. At the same time, it would appear only fair to both the Federal Government and the Canadian taxpayer, that the amount of the contributions which the Federal Government is making to post-secondary education in the Provinces should be clearly and continuously enunciated, if only to ensure that intent is fully realized.

At the same Conference, and for the same reason, Mr. Pearson rejected the contention that provincial jurisdiction in "education" excluded Federal activity in fields such as cultural affairs, manpower training, adult education, and
research. As regards the latter area, we cite his words:

> \begin{tabular}{l}  "Nor does the Federal Government agree that it \\ is precluded from concerning itself with research \\ by reason of the provincial responsibility for \\ "education", or alternatively that it must limit \\ its support according to subject matter in \\ relation to areas of Federal and provincial \\ jurisdiction. In our view, research, as the \\ means by which we expand the frontier of knowledge, \\ is today one of the most important factors in \\ the economic and social growth of any modern \\ political society. The restriction of Federal \\ aid to research to subject matters that are \\ within Federal legislative jurisdiction would \\ frustrate the purposes of the scientific spirit. \\ "If this country is to have an active and \\ vigorous research programme which will redound \\ to the advantage of all its citizens and add \\ effectively to our fund of knowledge, governments \\ at any level must feel free to sponsor and \\ support research of any kind without being \\ limited by conceivable legal classifications \\ of its results or its end uses. Failure by the \\ Federal Government to play its full share in such \\ a national task could only mean that Canada's \\ ability to take part in the undertakings of today \\ which are shaping the world of tomorrow would \\ be seriously impaired." (Statement by Mr. Pearson \\ for the Federal Provincial Meeting, October 24 , \\ \hline 1966 , pp \(26-27)\). \end{tabular}
19. In the same statement, Mr. Pearson asserted that Federal expenditure programmes on behalf of scholarships or bursaries "to assist people either in carrying out research or in acquiring post-graduate knowledge in the fields of the arts, the sciences, or in the pursuit of certain specialized subjects........ or merely through attendance as students at an institution of higher learning were in no way contrary to the spirit, let alone to the law, of our constitution.....nor.......necessarily any threat to provincial policies with regard to education."

He went on to say that - "We hope to continue (these programmes) in co-operation with the provinces. Such payments to individuals for their personal advancement and improvement are, in our view, a part of the equalization of opportunity that is so central a feature of the Federal purpose." (Our italics, Ibid, pp 27-27).
20. It is clear that equalization policy now rightly influences the Federal approach to post-secondary education, manpower development and research support in universities, as it has shaped its general fiscal relations with provincial governments to an increasing degree during the postwar period.

In spite of the many difficulties of obtaining agreement on a definition of "equalization" in the university research sector, we strongly urge the Committee to bear in mind the explicit Federal objective of ensuring "equal access to education and equal personal opportunity for all our citizens". (Ibid., p.28).

Indeed, Mr. Pearson's reiteration of the equalization principle in his concluding remarks at the Conference leaves no doubt concerning its central position among competing goals: "While there can be differences of definition and of judgment as to the extent to which there is inequality, it must be clear beyond doubt that, so far as the Federal

Government is concerned, its objective is to see that not only is equality real within this country, but the sense of its reality is brought home with conviction and confidence to all our citizens everywhere". (ibid.)

\section*{II. The Universities' Objectives \\ in Conducting Research}
21. Being the sole institution of higher learning in Canada's poorest province, and having to deal with the practical problems arising from geographic isolation, we are particularly sensitive to the reinforcing interactions among higher education, training and research. The lack of a proper research atmosphere and facilities denies those persons whom the university needs, indeed those it must have, the opportunity to carry forward their studies. This condition lowers staff morale, increases the turnover rate of key research-oriented professors, reduces the quality of higher education generally, and prevents the development of many intrinsically viable research undertakings in the provincial setting which would contribute effectively to national scholarship.

Further, the inadequacy of research infra-structure seriously hampers the work of the university in regard to the provision of contract research in the public interest and in assuring adequate training to meet community needs for skilled manpower.

We agree with the view of Dr. John Deutsch concerning the relationship between education, training and research and the long-term performance of the provincial economy.

> \begin{tabular}{l}  "There are also significant differences in the \\ average educational attainments among the main \\ regions within our own country. The (Economic) \\ Council has noted that generally the areas where \\ average educational attainments are lowest are \\ also the ones which have the lowest average \\ incomes. There are wide disparities in the \\ resources which each region is able to spend on \\ developing its educational programmes. Obviously, \\ it will take more than just better education to \\ reduce the longstanding and substantial income \\ differences among our regions, but the gaps in \\ education and skill are clearly one of the most \\ serious discrepancies which must be overcome if \\ our efforts to achieve a better balance of \\ opportunities are to be successful." \\ (Address to the Conference on Education and the \\ \hline\(\frac{D e v e l o p m e n t ~ o f ~ H u m a n ~ R e s o u r c e s . ~ M o n t r e a l, ~ S e p t e m b e r ~}{\text { P, l966, p. } 7 .)}\) \end{tabular}

We recognize the valuable equalization effect of current general federal fiscal, post-secondary education, manpower training and other specific programmes. Indeed, the present development of Memorial University would not have been possible without some of these measures. We consider the ivorg research function to be so critical, however, that further measures of equalization should be embodied in this particular area of federal policy.
22. To this end, we recommend that the Committee consider the development of a supplementary national university research support programme, which would help to diminish locational disadvantage and to provide a stimulus for greater regional balance and specialization in research activity. In devising such a policy there should be recognition of differing levels of need, responsibility, and capacity among universities in the various provinces.

In our view, a more considered approach to university research planning in Canada, together with a properly controlled federal supplementary policy of expanded research development grants, would materially contribute to the achieving of desired ends. In making this recommendation we do not wish to imply that the aim of federal policy should be to equalize research support funds among Canadian universities in accordance with some crude formula. Neither do we believe that such policy should place primary responsibility for the development of university research objectives and programmes in the hands of a federal research agency. But, inevitably, as we have indicated above, local autonomy must be related to a broad national strategy.

\section*{III. Allocation of Funds in} Support of Research
23. Broadly speaking, the allocation of federal funds in support of university research ought to be controlled by an integrated research policy that serves in an appropriate manner the basic objectives outlined in Section I above. Beyond this general directive, it is possible to develop criteria of need based upon such factors as:
(1) total number of individual grants and project applications in the several research areas;
(2) the number of graduate students being trained at various levels in the areas;
(3) estimated total cost per research worker in the areas; research productivity; and regionalprovincial supplementary development needs .
24. It is our opinion that entirely new institutions and new mechanisms for determining and reviewing allocations will be needed in future. We do not, however, recommend that a single omnibus federal research support agency be established.

We believe that the goal of integration can be adequately served through alternative methods of co-ordination and liaison as between the Canada Council and the N.R.C. (or its successor).

In the area of the social sciences, we recommend that some single agency be charged with the responsibility of providing
"clearing-house" functions among university research institutes and personnel, and the many federal agencies active in sponsoring or requiring this type of research.
25. The problem is not purely a mechanical one. We have to evolve, indeed we may already possess in certain areas, a mechanism for the distribution of funds which can operate at optimum real efficiency. Pseudo-efficiency in allocational policies may look good but will not be in the best interests of either the nation or the provinces. We must be concerned that policies are so devised that they reduce rather than accentuate the gross disparities that now exist between one part of Canada and another, between different areas of academic activity, and between disciplines within those areas. Such policies must recognize the essential nature of research in the process of developing higher education and the consequent necessity for each province to sustain at least one major centre of research activity. They must recognize that certain kinds of research are best done in situ; and that research per se, in whatever academic disclpline and whether linked directly to economic goals or not, is a legitimate activity of scholars and one worthy of support.
26. In part, what we propose can be achieved by providing larger sums of money to the Canada Council, and to departments and agencies of the Federal Government who rely upon the universities for research in the social sciences. Such allocations would allow scholars in the humanities and social sciences with legitimate research projects to apply
for grants in aid in the same way as scientists now apply
to the National Research Council, and with like chance of
their applications being approved.
It is of vital importance that major development grants
should be made available in the humanities and social
sciences, as they already are in other areas. The
importance of such grants may perhaps be illustrated by
reference to an area of great potential, which is decidedly
underdeveloped in Canada and is also extremely costly. We
refer to the institutions necessary to sustain effective
behavioural research by academicians.
27. In arguing that the allocation of research funds should take into account the necessity to support individual scholars and the necessity to think, to some extent, in regional or provincial terms, we are not arguing that any attempt should be made to create an important research centre at every university in Canada. Nor do we argue that Federal funds should be distributed across the nation by means of any gross formula that would attempt to make unequals equal.

Certainly, success must be supported and centres with developed facilities for effective research must not fail to receive support so that funds may be diverted to undeveloped and, for this reason, risky enterprises. But neither must we, as we so frequently now do, adhere rigidly to the biblical injunction that "to him who hath much, much shall be given". For such a policy will not only retard
developments in areas where they ought to be taking place, but will be self-perpetuating.
28. Nevertheless, we feel that there is a very strong case for the creation of a supplementary national university research support programme as suggested in paragraph 22 above. Such a programme could play an essential role, particularly in the development of regional research facilities and in the encouragement and support of research which, because of environmental considerations, should be developed at specific universities.

As examples of the first, we suggest the establishment of regional bibliographical centres and regional data banks serving a number of universities and other research centres through sophisticated electronic and inter-library loan services. This would appear to us to be a matter of top priority since the development of an adequate research library is beyond the financial grasp of most universities and, in any case, the large scale duplication of major facilities would appear unnecessarily extravagant.

With reference to the second sort of development suggested above, we believe that developments of regional or local interest should be encouraged by providing help to establish at specific universities institutes whose research activities would be of importance to provincial development. Four specific examples may be cited:
(i) The creation of an institute, suggested by the construction of a large phosphorous plant at Long Harbour, Newfoundland, devoted initially to research in phosphorous and silicon chemistry. This might well help to stimulate the growth of secondary phosphoroususing industry in the region. In time, there might develop a centre for extensive studies in the chemistry of numerous non-metallic elements, for example, nitrogen and arsenic.
(ii) The vast power resources of the Province of Newfoundland suggest the possibility of establishing an isotope separation unit, with the concomitant commercial development, on the lines of the Israeli programme. The involvement here would be with heavy water, \(18_{0}, 17_{0}\) and other isotopically enriched materials.
(iii) The geographical location of Newfoundland in relation to important fishing grounds in the North Atlantic and existing Marine Sciences Research Laboratory suggest the development of a regional institute of cold-water marine biology.
(iv) Ocean orientated research should cover much more than marine biology. Marine aspects of civil engineering provide an outstanding example, as also does marine geology and under-water research techniques. Here research activities can be expected to stimulate future industrial development.

These four examples will suffice to illustrate the point we wish to make. We could add research in natural resource chemistry, in trace element metabolism and in medical genetic abnormalities, in all three of which fields Newfoundland offers special opportunities.
29. In considering the establishment of a supplementary national university research support programme, as outlined above, we must bear in mind that not all Provinces are so fortunate as Newfoundland in having only a single university. For this reason those who plan such a programme must be very careful
not to interfere with Provincial attempts to rationalize their own research support operations. Rather, there must be full co-operation so that the one programme supports and complements the other.
30. In a general manner, we have referred above (Paragraph 24) to the need for new institutions and mechanisms for determining and reviewing federal allocations in support of university research. In the development of a supplementary programme aimed at increasing regional equality, we recommend that all universities be encouraged to supply a five-year projection of their research activities indicating areas of specialization, budgetary requirements, and the degree of university support for staff, library resources and technical services.

Allocations to be approved under this heading should be made only after an appraisal by a visiting committee. Development grants should be awarded for a five-year period, and research projects undertaken in this area should be subject to stringent appraisal by a review committee.
31. There still remains the question of what level of financial support the individual scholar and the individual institution can expect to receive directly or indirectly from the Federal Government. We believe that a system of grants in aid is most equitable to all concerned; for it provides not only for the careful screening of individual researchers and their projects but also places an appropriate part of the
responsibility for supporting research upon the universities and the Provincial Government.
32. This leads us back once more to consideration of the indirect costs of research and how they should be met. It is clearly a matter of logic that the Federal Government's assumption of responsibility for the support of research carries with it the responsibility for support of the indirect costs. In this matter we agree with the recommendation contained in the Bladen Report - "That all Federal Government research grants to universities.......should carry with them a 30 per cent supplement as an unconditional grant to the university."

Furthermore, we propose acceptance of a modified version of another recommendation of the same report, viz. that a general sustaining grant for research be paid annually to universities in receipt of Federal research funds equal to 10 per cent of the aggregate salaries of all members of the academic staff who receive Federal grants in aid of research.
33. In view of the pressing need for well trained university staff and research personnel, the Federal Government should continue to share in the cost of training. The Canada Council pre-doctoral programme should be expanded. In addition, the Council should consider making allocations in the humanities and social sciences comparable to N.R.C. operating grants which provide some indirect support for Master's candidates who are engaged in research activity.

The Council, in our view, should not return to its original policy of awarding M.A. fellowships directly.
34. The kinds of grants required are suggested in the various paragraphs above. More and in some cases larger grants are needed. In the humanities and social sciences there should be a greater number of post-doctoral awards and improved methods ought to be found which would enable scholars to meet a portion of travel costs associated with legitimate projects. In the sciences there is need for an intermediate-sized N.R.C. Negotiated Development Grant having less of a "do-or-die" commitment attached to the award, and being of a value of up to \(\$ 100,000\). In general we accept the principle that N.R.C. grants should be made to individual staff members; but greater efficiency in the deployment of scarce university resources would result if a larger portion of the available support could be made available in the form of a general grant to the University.
35. In the matter of contract research it is our firm belief that the contractor should pay the entire cost, including indirect costs. The danger that exists in this respect is that university staff members in an attempt to keep estimates to a minimum in order to receive contract awards will place an unrealistic value upon the cost of research in general, but in particular upon the indirect costs. For this reason, a standard formula might be evolved for determining overhead
as a set percentage of direct costs.

\section*{IV. Liaison}
36. A great measure of liaison in research planning and policy formulation was suggested earlier. In accordance with the principle of integration, new linkages should be created as between federal and provincial governments, between the Canada Council and the N.R.C., and between universities, government departments and government research institutions. The principle of utilization would be served if arrangements could be made which would promote exchange fellowships and research associateships among universities and government institutions. Finally, there is a clear need for a more comprehensive and more integrated reporting of research undertakings sponsored or supported by government agencies in the social sciences. The Index of Federal Grants in Support of Extramural Research in the Social and

Behavioural Sciences represents a first step in the right direction, but a more general information service on current research undertakings is required.

\section*{V. Review Procedures}
37. We have already referred in paragraph 30 above to review procedures. In addition we recommend that visiting committees appointed by the National Research Council, the Canada Council, and such other agencies of a like nature as may be created, be sent from time to time to review research activities being conducted in universities receiving Federal research support. We recommend a continuation of the present procedures for assessing the merits of applications for negotiated development grants. Moreover, we fully realize the possible impermanence of any structure which may now be established. Within a decade at most, the need for another review will probably arise.

\section*{APPENDIX 63}

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A BRIEF SUBMITTED TO
THE SPECIAL COMMITTEE ON SCIENCE POLICY
OF THE SENATE OF CANADA

\section*{BY}

SCIENCE FACULTY
SAINT MARY'S UNIVERSITY
HALIFAX, NOVA SCOTIA

Dr. W. A. Bridgeo, Dean of Science
Rev. M. W. Burke-Gaffney, S. J., Professor Emeritus, Astronomy
Dr. G. Gordon, Chairman, Psychology Department
Dr. M. Wiles, Chairman, Biology Department

This submission is directed at Sections (c) and (d) of the Terms of Reference for the Special Committee on Science Policy of the Senate of Canada.
(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 policy for Canada.

The viewpoint is that of andergraduate science faculty (honors level)--and a university dedicated to developing the relevance of science to humanities and vice versa. In order to perform our role well or to get meaningful results it is necessary that both our science program and humanities program be of highest quality. It is with an eye to maintaining this quality and graduating a student with a keener consciousness of values in science and relevance of scientific effort to man's development, that the following comments are made.

Federal Assistance to Research and Development Activities
The authors of this brief are aware of the role which the Federal Government has played in supporting research at universities. That role was played mainly through the offices of the National Research Council \({ }^{1}\) (of 47.9 million dollars expended by the Federal Government on all aspects of University Science in

1967-68, 45.3 million dollars or \(94.6 \%\) was provided by the National Research Council). We concur that the Federal Government should play this role and indeed this represents the biggest source of funds for university research in science for all universities in Canada. The development of new knowledge is very expensive and regardless of where it is developed, it is made known to the country as a whole and beyond for application by whoever needs it. This type of effort is thus national in scope and should be supported by the national government at which level efficient allocation of funds can be made so as to prevent duplication of effort on major sized programs.

The existing program does not do enough for science teaching at the undergraduate leve1. For example, of the 45.3 million dollars the National Research Council allocated to University Science in 1967 68 , only 1.4 million dollars ( \(3 \%\) ) was assigned for general scientific activities; the great majority of funds was assigned to professors' research and travel, computers for staff members, post-doctoral fellowships and graduate awards. Obviously then, at the present time, undergraduate science departments can only receive direct Federal help through individual staff research activities, for there will be no graduate awards made and virtually no post-doctoral awards. In addition, the Negotiated Development Grants are awarded to those institutions which are already carrying out meritorious research projects through the agency of research groups, providing that the groups are making significant advances in their fields. This policy of course favours big universities and particularly those in the richer provinces, or those with large endowments.

These grants are of little help to smaller institutions that might justifiably wish to launch a co-ordinated scientific research project involving several researchers.

The one National Research Council policy which is helpful to the smaller university in the initial stages of developing its research program is the Supplementary Grant to the President of the university, amounting to a maximum of \(\$ 25,000\) per year for three years. It is felt that the amount is small in relation to the set up costs involved in establishing research, and when it has to be distributed over the whole university science program. When one considers the overhead charges, technician help, the equipment and supplies purchases, this amount would probably premit work equivalent to one scientist conducting research for one year. We suggest that to have a more meaningful and interesting research effort (integrated with undergraduate education) even in a small university, several professors \((3-6)\) from one department or a similar sized interdisciplinary group from two or more departments should be involved. The research can be scientifically challenging from the points of view of pure and applied science. At the same time it can be relevant to social and human needs. Such activity on the part of a faculty incerested in teaching students and demonstrating to students the application of science to real problems, together with discussions on the sociological implications and human values involved, should play a valuable role in undergraduate education of tomorrow's citizens.

In order to bring this about, good professors must be given the opportunity and facilities to do research. Assuming the university
and the provincial government supply the necessary serviced space it is still necessary to find financial support for operational costs including the salary of full time technicians.

The latter is necessary because the teaching activity is of such importance and is so time consuming at the undergraduate level. Only if the professor has another pair of skilled hands working on his ideas while he teaches can meaningful research be done in a reasonable time. The provision of full time technician help should also be considered as provision of jobs for skilled people in a given area, who in addition, will teach by example because of their close association with the undergraduate students.

The following resolutions, numbers 24 and 26 were passed by the 1967 Annual Meeting of the Association of Universities and Colleges of Canada:
"24. RESEARCH SUPPORT FOR SMALL UNIVERSITIES
That the AUCC encourage support for research in small universities, sufficient to provide on a continuing basis assistants and technical services necessary for efficient research.
26. FULL SUPPORTING COSTS OF RESEARCH

That the AUCC urge agencies which provide research funds to universities to include in their grants the full supporting costs of the research."

It is suggested that:
1) A new National Science Policy include the support of university programs designed to develop the wise use of science--an investment in such science education should be regarded as an investment in the future of the country which will have a very good rate of return. Dr. Peter Muirhead, \({ }^{3}\) Acting Deputy Commissioner of Education, Washington, D. C., reported that Federal Government financial assistance to G.I.'s for their higher education has been returned to the Federal Treasury many times over by virtue
of the increased taxes paid by those educated.
2) The above Association of Universities and Colleges of Canada's Resolutions, 24 and 26 , be implemented by Federal Government Granting Agencies.

We note with approval the decision of the National Research Council's Associate Committee on Experimental Psychology to modify its attitude towards Experimental Social Psychology. We assume that this is the implication of the omission in the Committee's Procedure for Grants in Aid of Research, (Revised 1968) of the phrase, "However, social psychologists are requested to submit their applications to the Canada Council,' which appeared in the earlier Procedures. In 1966 according to the Privy Council Science Secretariat Special Study, "Psychology in Canada, " \({ }^{4}\) the Canada Council gave just seven grants to a total value of \(\$ 58,169\) to psychologists compared with 105 grants totalling \(\$ 590,052\), given by the National Research Council.

We recommend that the Associate Committee extend its support to a broader range of psychological research both basic and applied. The reason for this is that we do not know, at this stage in the development of the subject, what will or what will not prove to be the productive research areas of the future. Granting policies favoring over-specialization of research may lead to a stunting of ghe growth of other, potentially valuable, areas. This is a plea for balance.

Discussion on Some Broad Principles for a National Science Policy
The encouragement of industrial research in Canada is a
difficult task because of the "subsidiary company" or "branch plant"
situation that many of our leading industries find themselves in. Incentive schemes of the Federal Government have not appeared to make a significant change in the growth of industrial research in the country and certainly not in the Atlantic Provinces, when only two companies have participated in the National Research Council's Industrial Research Assistance Program which is the most attractive because of the minimum amount of red tape involved.

It does not seem logical to hope that the vast majority of existing companies will do innovative research for sound reasons:
1) they can buy research results cheaper;
2) they do not have a background in research--such firms are wise enough to know that if a company does not know how to do research it is very risky and as in most activities one pays for the experience of finding out (this statement is a conviction after fifteen years experience with many industries, individuals, and organizations interested in "using" the results of science and technology);
3) tax incentives are not sufficient.

In constructing a National Science Policy which will encourage existing industry to do more research, the Federal Government will have to be selective and offer extensive support to those industries which have the most ability and interest. People and their skills are what count. They must be identified, surveyed, and supported. At this stage in our development a formalistic approach is very apt to be unproductive.

A National Science Policy should attempt to minimize the loss of effective research and development personne1. There is a large loss of competent research and development personnel each time a major project is scrapped such as the AVRO Arrow. The ING could be
another example. We are not questioning those specific decisions, simply pointing out that it is our opinion that the people who do research are the most important ingredient and one must work hard for years to assemble a team of people who are "effective"--not all researchers are effective. It is a serious loss if in one fell swoop their jobs are removed and they leave the country to find appropriate employment elsewhere. There is a common attitude among people in positions of power that they can hire and fire research staff when it suits them and still expect fast results when required-not realizing that the more closely a project approaches pure research the less subject it is to scheduling and planning.

The fact that administrators of science in this country today are scientists is logical, for by and large, they are the only people in the country who understand what science is all about. This situation will become less true as more and more people in other walks of life make it their business to encourage communication with scientists and to learn about science, why it is done, how it is done and who does it. It will be a mistake to let the pendulum swing all the way from government of science by scientists, as is the case in Canada now, to government of science by people or representatives of people who understand very little of what science is. To permit this is like squandering our national resources for the sake of a formalism and we hope and trust it will not happen. It is the opinion of the authors of this brief that serious and able scientists and administrators of science have been aware for the past four or five years at least, of the need to communicate with the general public and to see that the results of science are used
in a constructive way. The T.V. program, "The Nature of Things," is evidence of this. The many programs on space science are more evidence. The move has started, it is only necessary to speed up the process.

If the country needs scientifically and technically trained people to provide the innovation to man a more sophisticated industry, to compete in world markets and keep the economy in a strong position relative to other countries, then:
(1) it must lead in certain areas of industrial activity, the sale of certain natural resources is' a traditional activity in which Canada leads
(2) in addition some way must be found to research, develop and commercialize Canadian ideas and human energies
(3) research in universities which is part of the higher educational process must be more relevant to life in Canada--not entirely but significantly so
(4) employers must be ready to give those who attain higher education opportunities to work and apply their knowledge and skills.

Furthermore, if the existing industrial empire cannot absorb the educated people of our country, then a new type of industrial activity should be encouraged to develop. Universities might be considered as employers of the skills they produce. Research and development companies could be encouraged to grow around university structures effecting economies of operation by using university facilities, developing research results obtained in the university and sharing profits from commercialization with the university. The spin off from joint activity of this kind could be real cooperation between government, industry and university sectors of the national research effort. Approximately twenty years of such a program could
produce a type of industry in Canada which would be research based. It has been predicted that \(50 \%\) of the GNP in the United States in the year 2000 will come from the "knowledge industry \({ }^{3}\) " (the dissemination and application of knowledge).

From the point of view of regional development in Canada, it has been noted that Prime Minister Trudeau hopes to bring prosperity to the Atlantic Region through the creation of a quality environment. It is suggested that a major part of the research on environmental problems affecting this area be done by scientists, engineers, economists, etc. from the area at one or more centers of excellence. Perhaps there should be one center to focus on the marine environment and one focusing on the environment associated with our land areas. Governments, universities and industries should be associated in this research and development. It is very opportune that the Prime Minister should take the stand that he has taken for it is well known that the best way to control pollution is not to allow it to start. The environment in the Atlantic Region is relatively clean now. What pollution does exist can be cleaned up. A science policy for this region will encourage programs designed to clean up existing pollution as well as programs designed to determine the capacity of our environment on a micro scale (a bay, a stream, an area of soil, the air currents over a specific area) to absorb pollutants so as not to exceed permissable and desireable standards.

Over and above the specific example of environmental research the economic growth of the country has regional aspects. It is suggested that a National Science Policy take this into consider ation. Education and science form the foundation of economic
growth for the remainder of this century. In so far as our
economic growth has a regional pattern, education and science policy should be considered in part on a regional basis.

\section*{Recommendations}

It is recommended that:
(1) The National Research Council be the major granting agency for federal financial assistance to university research but that selection committees be broadened to include humanists, economists, and industrialists and that the worth of a program be recognized as well as the ability of the researchers.
(2) A National Science Policy stressing the use of science should include assistance to undergraduate science teaching--the education of science graduates with an orientation on the values in science and its use will make better and more productive citizens in our technological society.
(3) The resolutions, 24 and 26 , passed at the 1967 Annual Meeting of the Association of Universities and Colleges of Canada be implemented.
"24. RESEARCH SUPPORT FOR SMALL UNIVERSITIES
That the AUCC encourage support for research in small universities, sufficient to provide on a continuing basis assistants and technical services necessary for efficient research.
26. FULL SUPPORTING COSTS OF RESEARCH

That the AUCC urge agencies which provide research funds to universities to include in their grants the full supporting costs of the research."2
(4) A new National Science Policy encourage the growth of the "knowledge industry" including research and development companies.
(5) A greater effort be made to encourage research and development in regions where the level of economic activity is below the national standard as a means of encouraging economic growth through mission oriented research and development.

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APPENDIX 64

A Brief
to the

Senate Committee on Science Policy
by

Dalhousie University

\section*{INTRODUCTION}

In order to develop Canadian scientific effort so that it may have impact, becoming more productive and less wasteful, it is necessary that a mechanism be established for the planning of scientific work, in its research, educational and applied aspects, on a national basis. It is preferable that the agency responsible for this planning should draw upon the whole scientific community rather than solely from that part of the community responsible for the funding of science.

\section*{PLANNING}

The planning process should be concerned with the definition of goals and the assignment of priorities for science in Canada. Two things weigh heavily here:
1. Available human and material resources within Canada.
2. The progress of planning for scientific activities in other parts of the world.

It seems obvious and is desirable that the result of this planning should be the creation of an area of excellence for which Canada could gain international recognition. The move toward an area of excellence should be based upon existing strengths in Canadian science and upon evaluation of the gaps which are anticipated in world scientific effort. It would be unfortunate to attempt to develop singular excellence in a field in which Canada would have to compete with countries which are endowed with greater resources and who already enjoy a substantial head start or are committed to the development of specific programmes. Planning should be a continuing process, providing for review and adjustment so that scientific effort may remain consistent with current conditions

\section*{CO-ORDINATION OF EFFORT}

Planning and co-ordination are necessarily related, but it should not be essential that the same mechanisms and agencies be responsible for both activities. The group responsible for co-ordination would be required to determine effective ways for the execution of agreed plans, and would have to evaluate the relative positions of universities, governments and industry.

The co-ordinating mechanism should be flexible in order that suitable provisions might be made for national, regional and individual efforts, and for recognition of these efforts.

However, there is a necessity for a single, central authority to which both the planning and the co-ordinating groups should report.

In order to co-ordinate scientific effort effectively it would be necessary to develop efficient methods for sampling the goals of the universities, governments, and industries withinin the scientific sphere, and to match these goals with known needs on national, regional, and local bases. An effective liaison with planning groups is an obvious necessity here.

\section*{COMMUNICATION}

It is agreed that the problem of communication among all sectors of the scientific community, and between all levels, is becoming acute. Development of effective communication systems is perhaps the single most important element of a useful science policy. It is necessary to optimize the communication network by assessing the cost of fast communication and balancing this against the cost of the time loss attendant upon slower communication.

The planning and co-ordinating groups referred to above must communicate among their own members, and with others. It is necessary that channels be opened so that all elements of the scientific community may introduce their ideas to those responsible for planning and co-ordination. It is desirable that communication be facilitated in both directions.

\section*{INTER-ACTION WITHIN THE SCIENTIFIC COMMUNITY}

The flow of information across the boundaries separating the university, government and industrial sectors of the scientific community has been poor. It is important that workers within these sectors be aware of what other scientists are doing in order to make efficient use of resources and avoid duplication of effort. Considerable effort must be directed to the establishment of channels through which information can flow quickly and easily from the information producer to the consumer. Canada cannot afford time lags of months or years in communicating among scientists the results of research or details of programmes in progress.

It is assumed that in the assignment of priorities for scientific development, due account will be taken of the value of such work to the community at large. For an effective science policy, it is essential that the public be made aware of the values of the scientific work being done by the country, the region, and individuals. The effective flow of information from the scientific community to the general public is presently insufficient.

Much univeristy scientific research is pursued as an end in itself, and because of its value in improving the standards of instruction and education. The academic community will continue to demand freedom of choice in its research problems, but it is realistic to suppose that many elements of the academic community will choose problems having the most general interest. While it is difficult to classify many research problems as being either pure research or applied research, there is no fundamental reason why the university should not become increasingly involved in those types of research for which there may be an immediate application of the results.

\section*{MISSION ORIENTED AND INTERDISCIPLINARY RESEARCH}

It is anticipated that national goals and priorities, as they are established will place more emphasis than is presently felt on applied research and interdisciplinary work. While the university should participate in these activities, it must be stressed that applied and interdisciplinary efforts in universities can only be built upon strong basic science departments. It follows, therefore, that the financial support of research in the pure sciences must be continued and strengthened rather than withdrawn in favour of "mission oriented" efforts.

The universities cannot ignore the expensive types of research since these may be the fields of greatest significance. It is necessary to train, in a university environment, professional people to work in these research areas. This leads directly to the conclusion that the only agency with sufficient resources to provide the necessary financial support is the Federal Government. The responsibilities for the disbursement of federal government research funds must not be delegated to provincial governments. There is, however, the necessity for provincial governments to participate in the support of research using their own funds for projects of special regional interest.

\section*{ROLE OF GOVERNMENT}

The costs of research programmes include staff salaries, indirect costs, building costs, and library services, as well as the direct costs of laboratory operation. Government financial support to the present has largely been concerned with the direct costs of research programmes only, thus placing a heavy burden on the university to cover all indirect costs.

The present support available for research in the universities is neither adequate in quantity nor sufficiently broad in scope. The existing types of grants are essential and must be retained. The necessity for several new types of grants arises from the ineffectiveness of present schemes for the support of research groups within a discipline, or team projects crossing interdisciplinary boundaries.

Programmes for the planned support of new research facilities should be introduced. These might consist of substantial establishment grants for the capital cost of new facilities or the research component of new university buildings, together with the cost of research equipment necessary to make these facilities operative. Such establishment grants could then be phased out in favour of operating grants after the lapse of a suitable period of time.

\section*{REVIEWING PROCEDURES}

The review and continuation of research grants must have their ultimate base in the opinions of the grantees; peers. Formal procedures should impose minimum inconvenience on all parties. It is desirable to develop flexibility in all aspects of granting policies so that the available resources may be distributed in the most effective way, taking account of the points of view of all sectors of the scientific community. Review policies should contain well defined methods for the cessation of research support to programmes which are no longer relevant or are not productive.

\section*{CONCLUSION}

In order to make effective use of expensive facilities, university staff must be prepared to enter into liaison with scientists in the government and industrial sectors of the community. Any such liaisons should be consistent with the goals of all the participating individuals and with whatever science policy is applicable on a local, regional or national basis. Care must be taken to devise mechanisms for the prevention of self-perpetuating institutions, which are created for a specific job and continue after the job is completed. Care must also be taken to protect the autonomy of the university in developing its own programmes and in governing its own academic affairs. The development of regional centres of excellence, in which universities, government and industry would all participate, is an obvious kind of liaison which deserves further study.

\section*{APPENDIX 65}

\section*{A Brief}
to the
Senate Special Committee on Science Policy

\author{
by \\ Acadia University
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Implicit, although not always obvious, in man's plans and projects is the larger goal of improving the quality of our lives, esthetically, culturally and spiritually. A prequisite for progress in this aim, is the elimination of want and the provision of the basic requirements for food, clothing and shelter, and other physical needs. The degrading effects of want on the behaviour of man are well known. Esthetic and cultural values are lost. The highest flowering of these, moreover, is dependent upon a high level of economy supported by the productive efforts of our scientific and technological techniques. These in turn are dependent upon distinctive contributions from the universities, industries and governments. In this brief we are concerned with the role that universities can and should play in the future development of our country.

For many years, universities have been looked upon as storehouses or treasuries of knowledge, whose chief function was to preserve, categorize and transmit the knowledge of the day. During the latter part of the l9th century and more particularly in the 20th century, there developed, with ever increasing rapidity, the realization that a true university had a further function and that was to acquire new knowledge by research and scholarly and creative work. Finally, over the past twenty years, still another element has been added - that having to do with the application of research to the needs of society. The research
and advanced work carried on at our universities have such important implications for society that it is no longer impossible for us in academic life to confine ourselves to what might be termed pure or basic research with no thought whatsoever of application. Under the proper circumstances, there can be no doubt that society has the right to expect that the universities which it supports be cognizant of and responsive to community, regional and national interests. In so doing, however, it is essential that the prime function of the university, that of educating students, be not neglected. The prime function of the university is then to educate young men and women; secondly, its staff members should carry on research in order to advance knowledge; thirdly, an appropriate liaison should be formed with industry and with those departments of government mainly involved in applied research and development in order to hasten and insure the application of fundamental advances. It is a belief shared by many that this liaison ought to be improved. For example, only a relatively small proportion of scientists obtaining an advanced degree accept positions in industry. Furthermore, there appears to be a relative lack of interaction and communication between scientists in university and those in industry. Some remedies suggested for this situation include the use to a much greater extent than hitherto of the so-called sandwich or work-study system of which the best known example in Canada may be that of the Faculty of Engineering
at the University of Waterloo.
Scientists in industry should be invited to present a few lectures in their spedial field to students and conversely, scientists in the universities should be encouraged to visit those in industry to become more fully aware of the difficulties of applying the fruits of research to the solution of production problems. It would be hoped that this interaction would foster a greater respect for those working in industry and would thus lead to a teaching environment that would not prejudice better prepared students against careers in industry. An important by-product of this interaction ought to be a greater mobility of scientists between industry and universities.

At this point, perhaps recognition should be made of the generous assistance provided by certain business firms by way of donations, very often with conditions attached for a variety of purposes, for example, for capital construction of science buildings, equipment, chairs for science professors, fellowships, scholarships and grants for both basic and applied research.

Apart from the role government is playing in helping meet the needs of society through support of the universities, the federal government through its research establishments attached to such departments and agencies as the Department of Agriculture, the Department of Forestry, the Fisheries Research Board of Canada, the Department of Fisheries, the Department of Health and Welfare, the Department of National Defence, the National and Medical Research Councils, etc. provides a great deal of support for both fundamental and applied research and indeed, development. The extent to which
these establishments interact with industry and universities varies widely, but in certain cases, for example the Fisheries Research Board, all three components are well represented and a determined effort is made to maintain such a relationship that the fruits of both basic and applied research are exploited by appropriate development in industry. Such interactions have been greatly facilitated by the establishment of some of the federal research institutions on or near university campuses.

This has been done for a variety of reasons, but undoubtedly in the hope that somehow or other there would develop a symbiotic relationship between such institutions situated in close juxtaposition to one another. As always in such relationships, if they are to become and remain viable, (1) There must be a continuing advantage to both partners. (2) There ought not to be any exchange of funds to have the government-supported investigator present a few lectures in his field or to have a universitysupported investigator cooperate in certain research work being carried on at the government institutions. (3) Similar salary scales for eleven months of work should obtain for equivalent personnel in the university and government-supported institutions.

In any method of cooperation that may be devised for university, industry, and government to meet the needs of society - whatever these may be or however these are defined - certain criteria must be met. Governments through their departments and agents must
fulfill the mandates as prescribed by Parliament; industry to survive must make a profit; the university must fulfill the functions and role determined for it by its appropriate governing bodies. Within these restrictions, it is essential that all three sectors work together to help meet more effectively than in the past the needs of society.

It is our view, that in order for the universities to play their role adequately, the national government should become directly involved in their support and any attempt to provide this support on the basis of the amount of graduate work and research performed is sheer sophistry.

The provision in the British North America Act for exclusive provincial rights in education in so far as it applies at the level of tertiary education, must surely be described as an accident of history. In the December, 1968 issue of the Bulletin of the Canadian Association of University Teachers, R. D. Mi chener calls attention to the fact that at the Confederation Conference at Charlottetown in September of 1864, university education was reserved as a responsibility of the central government but one month later at the Quebec-Conference, this power was placed in the hands of the local legislatures and subsequently retained in the BNA Act.

It should be recalled that at the time of Confederation there were only a few small colleges in Canada and there is no
indication that the Fathers of Confederation gave serious thought to the state of higher education or to the implications of its development on the future of Canada. Furthermore, at that time our country was comprised of widely separated, sparsely populated areas, connected by modes of travel that were slow and tedious. It must be surely apparent that what little attention was paid to the matter of education was concentrated on the local or provincial aspects of primary and secondary education and with due regard for religious rights in this area.

Despite the great emphasis placed upon the provision in the BNA Act with regard to the exclusive jurisdiction of the provinces in the field of education, as one might expect in a situation where it is cimpletely clear that the lack of a federal role in this activity is not consonant with the nation's best interest, a number of measures, largely of a stop-gap nature, have been instituted to circumvent or break through this stricture. The first federal grants made for education to the provinces were made under the provisions of the Parliamentary enactment passed in 1912 for the broad purposes of "supplementing and extending the work of agricultural education and for the improvement of agriculture." Since that time, in a variety of ways, the federal government has entered this field. The most important and far reaching of these was the introduction of the per capita grants system support by the St. Laurent government in the early \(1950^{\circ}\) s.

It is obviously impossible for every province in the country
to provide adequate opportunities in university education to its residents. For example, up to only about 20 years ago half of the provinces in our country had no medical school and even today, three of the ten provinces are still without one. Thus the main responsibility for providing medical doctors for the entire nation, up until a little over a decade or so ago, had to be accepted by five provinces. This is a most anomalous situation, especially when one considers that the federal government has not, and does not yet provide appropriate support to these schools. One might well speculate, or ask at this point, to what extent the lack of formal federal or constitutional involvement in higher education has impeded the development of the universities and consequently of Canada as a whole. Certainly, no one can deny that the universities have fallen behind in their efforts to provide adequate facilities for teaching and research for the numbers of students who are now seeking higher education. This is especially true of medical education. Canada has failed in its task to meet the demand for medical doctors.

What has been said with regard to medical education applies to a greater or lesser degree to a variety of other disciplines. The fact that the federal government in October, 1966, withdrew its direct support for the financing of university work and transferred this support entirely to the provinces, has made it necessary for the planning of higher education at least on a province-wide
basis. It is obvious, too, that there is a great need for the same sort of planning, cooperation, and coordination in the provision of facilities for relatively expensive professional or other faculties on a regional basis. This obviously ought to involve not one, but several contiguous provinces since no one province, certainly in the Atlantic region at least, is large enough to provide for a complete offering of degree programs in university education. The point should also be made that when provincial governments have the responsibility of providing the major financial support to universities there will be a danger that conditions will be imposed creating a barrier for out-ofprovince students. Furthermore, this circumstance may prevent a student from being given an opportunity to take a specific degree programme. The only acceptable solution is one enabling Canadian students to be considered for admission to any university in the country regardless of their official provincial origin or residence.

It is well recognized that universities have not only a provincial function but a national, and indeed an international one. If we continue to regard the support from governmental sources as being purely a provincial responsibility, inevitably the provincial interests served by these institutions will be promoted to the detriment of those of national and international significance.

The enrolments of our universities should be drawn not only from every province in Canada but also from a good many foreign countries. No one would argue the importance of this circumstance,
yet by no stretch of the imagination can this be looked upon as serving a provincial interest. Even in the case of students attending institutions within a province of which they are resident, after graduation, being the most mobile component of our work force, many of them cross provincial boundaries not once, but several times during their career.

To sum up, I look upon an increasing involvement of the federal government in the financial support of higher education as not only justifiable but essential, if Canada is to keep or to advance her position in the hierarchy of nations in the years ahead. Failure to make appropriate provisions in this regard can have but one inevitable result - the relegation of Canada and Canadians to increasingly subservient roles in future world affairs. It was no less a distinguished person than the Father of Confederation, Sir John A. MacDonald, who in 1872 wrote a letter to Egerton Ryerson, " . . . The subject of education has been withdrawn unwisely as I have always thought, from the control and supervision of the general government." This is a statement that is as valid today as when Sir John A. MacDonald first made it, and I would hope that we will soon see established a clear and consistent policy in the field of higher education - not necessarily nationalization of our universities but direct substantial support of our institutions by the central government.

The thesis that research resources should be concentrated in a relatively small number of large institutions, the so-called centers of excellence idea, is one that ought not to be accepted unquestioningly or at least in the sense that this approach should be implemented to the exclusion of all others. The history of scientific discovery is replete with the important advances made by scientists working essentially alone. Although it is agreed that there are certain advantages in the group approach, our resources should not be so allocated that there is no place or support for the individual scientist working in a relatively isolated manner. We believe, therefore, that those working in this way should be given support within the reasonable limits imposed by the need to avoid the undesirable duplication of expensive facilities. If appropriate support is not forthcoming for those scientists who prefer to work in such an environment, science in the smaller universities will be crippled and the deleterious effects will not be confined to science faculties but will be felt throughout. Furthermore, the recruitment of students as research scientists would also inevitably suffer. It is recognized that there are practical limits to the amount of money Canada can devote to fundamental research and that a balance between resources applied to research and development must be reached such that our industries will be able to compete effectively in world markets.

Finally, although most of the foregoing remarks have been just as applicable to the natural and physical sciences as to the humanities and social sciences, it must surely be recognized that by any standard of comparison our record of support for the latter has been abysmally poor. If we are to reap and to enjoy the fruits of our research and development in the realm of science and technology, it is patently obvious that comparable advances must be made in the humanities and social sciences. Only in this way can we look forward with confidence to an improvement in the quality of our life.

Respectfully submitted by Dr. J. M. R. Beveridge, President of Acadia University, on behalf of some of his colleagues in the Sciences, Social Sciences, and the Humanities.

March 12, 1969

\section*{APPENDIX 66}

M.D.B Burt, Associate Professor of Biology, Chaiman
G.E. Pajari, Associate Professor of Geology

I Unger, Assistant Professor of Chemistry
C. Young, Assistant Profesior of Pnysics

First, we strongly recommend that Federal funds to support scientific research in universities should be substantially increased for the following reasons:
(a) The quality of university scientific research is high while the contribution of university scientists to scientific knowledge is substantial and has been made at modest cost.
(b) Only by increasing the number of graduate students can Canada continue to improve standards of education, government, and research at all levels. This improvement of standards, by upgrading scientific positions in most fields, is essential if Canada is to remain a technologically advanced country.
(c) As it is impossible to predict through foresight, which basic research will have useful application at a later time, the continued investigation of basic problems in universities is utterly vital and invaluable to research in its broadest sense and to the eventual success of applied research.
(d) It is vital to our national cause to possess and continually increase the body of research scientists not only for their productive capacity and output of new knowledge, but also for their expertise and technical know-how. This body is the only one available to focus on any problem, fundamental or technical, of national concern.

Brief to the Special Committee on Science Policy
from the Faculty of Science, University of New Brunswick

Introduction
1. highly qualified scientists are doing research in universities. In view of the increasing demands being made on Federal funds to support research and development in several different spheres we welcome this opportunity to present a short brief outlining what we believe to be the most cogent arguments for not only continuing, but even increasing financial support of scientific research in Canadian universities.

University research financing
2. Canada is unique in that almost all funds supporting science research in universities are provided either directly or indirectly by the Federal Government and most are dispensed by a single body, namely the National Research Council of Canada. Once these funds have been allocated by the Government, the method of administrating them is both well known and highly respected throughout the world whereby the most eminent scientists in Canada assess the merit of each applicant, including his research, and divide such funds as are available in proportion to the quality of the work being done. It is our firm belief that this is the best possible method, both for long term and short term planning, in so far as university scientists are concerned. We further believe that there should be no unnatural bias in this assessment in the form of priorities at this level and that individual merit remain the criterion in the allocation of grants. The policy or attitude adopted by N.R.C. in this method of awarding grants has been held in high esteem by university scientists in other countries for many years and, furthermore, has attracted them to Canada.

This can do nothing except raise the general standard of university education, raise the standard of research, and at the same time increase the body of available expertise in Canada.
3. sums of money available to N.R.C. and other Federal award giving agencies have not increased in proportion to the increased demands. These increased demands are caused both by an increase in the number of applicants and by the natural growth of many research programmes in relation to graduate schools. This proportional decrease in funds could effectively stifle many qualified researchers within universities thus limiting seriously the amount of research possible. Furthermore, it not only affects adversely the research potential of the university scientist but at the same time limits the amount of research which might have been done by graduate students. Even more serious consequences are the actual reduction in the total number of graduate students and the possible emigration of many of our best research scientists. Thus, even a slight decrease in funds of this sort can have profound and far-reaching effects on the total contribution of universities. We are aware that some estimates have been made regarding the number of \(\mathrm{Ph} . \mathrm{D}\). graduates produced and the number of positions available and that in one set of figures it would appear that the supply will exceed the demand this year. We feel that such an estimate should be vigorously challenged as it seems most unlikely that such a situation could possibly exist. The demand for better qualified scientists will surely always be greater than the demand for lesser qualified scientists assuming that candidates in both
categories are available. It is obvious, for example, that in the United Kingdom where the output of Ph. D. graduates is high, this is reflected not only by a higher percentage of better qualified scientists engaged in research and development, but also in the higher percentage of better qualified scientists in other jobs such as high school teaching. In the whole of the Atlantic Provinces there are only two high school teachers with a Ph.D. and whereas we would expect the situation to be considerably improved in the more highly developed parts of Canada, this still does not compare with the situation in the United Kingdom where the proportion is considerably higher. In those jobs now, where training to the M.Sc. level is deemed sufficient, it would seem both reasonable and desirable that with a continuing supply of Ph.D. graduates, there would be a continuing improvement of standards. It is only relatively recently, for example, that a Ph.D. degree became a prerequisite to permanent employment in science departments of Canadian universities. Similarly, in many research institutions there are still competent scientists doing competent work without a Ph.D. degree and yet now all present appointments to research staff must have this degree. We consider such a situation, where the standards continue to rise across the board, to be both highly desirable and in many ways inevitable in a country such as ours where the standard of training in all other walks of life also continues to improve.

In this light, then, we consider that any planned reduction in the number of \(\mathrm{Ph} . \mathrm{D}\). graduates could be regarded in the same way as a planned reduction in the number of M.S. graduates and, by extension, even to the number of B.SC.

\begin{abstract}
graduates. Such a consideration would be retrogressive in the extreme. Even as the situation currently exists, the number of graduates at the bacelor level in science and engineering is "only about \(19 \%\) of the total and is projected as a declining population"l over the next decade. This is particularly distressing in view of the increasing variety of positions which demand a scientific education as our Society evolves industrially and technologically.
\end{abstract}

\section*{University scientists}
5. of bodies involved in research, but one which we feel is extremely pertinent to any discussion, concerns the quality as well and the quantity of research accomplished as well as its relationship to cost. While the quality of research can, in most cases, only be judged subjectively it should be recognized, nevertheless, that one of the main criteria used in making appointments to science faculties in universities is the ability of the applicant to do research. This effectively selects a uniformly high standard of research competence along with high academic qualifications for both are essential to teaching many undergraduate, as well as graduate, courses. There is yet another selection factor involved, at least in relation to those university scientists engaged in research and receiving Federal funds, and this is perhaps the most poignant, and most neglected, factor of all; namely, that those doing research are doing it because they really want to. While there is encouragement, there

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\({ }^{1}\) Special Study No. 6. Background Studies in Science Policy: Projections of \(\mathrm{R} \& \mathrm{D}\) Manpower and Expenditure. Jackson, Henderson \& Leung.
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is no actual compulsion to do research in most Canadian universities and, accordingly, those university scientists who do not wish to become involved in research per se can utilize their talents in some other way. In so far as the cost of university research is concerned, it has already been pointed out by the Science Council that while the contribution to knowledge made by university scientists is high, the cost is relatively modest. The low cost may well be due to the fact that in many cases private income is frequently used to fill out Federal grants which cannot quite stretch otherwise to cover the cost of the research in progress. The relatively rapid dissemination of newly acquired knowledge in universities is yet another important factor as it leaves much less room for any unnecessary duplication of research. When good results are obtained, they are usually immediately published and they can thus, due to their accessibility to all other scientists, be used as new starting bases for further research.

It is possible, therefore, to categorize university scientists, who recelve Federal support for their research, in the following way:
1. He must satisfy his own university regarding academic qualifications and research potential to justify his initial appointment.
2. He must satisfy experts in his own discipline, through N.R.C. selection committees for example, regarding both his research capabilities and the merit of his research.
3. He must further satisfy such experts every year he applies which thus imposes a continuous check on his research.
4. He must be utterly dedicated for him to make the sacrifices necessary to do the extra work involved. (Otherwise, why would he voluntarily apply each year for more work the following year?)

Relationship of universities with Government and industry
7.
two categories; namely, fundamental or pure research as opposed to applied research. We believe, as do most serious scientists, that this is an utterly invidious type of separation as in many cases it is impossible to differentiate between them. Thus, any comparison between the amounts of funds supporting fundamental research and those supporting applied research can be thoroughly misleading. This is particularly true if comparisons are made between different countries in view of the fact that certain projects being tackled in the United States of America are there classified as applied research whereas the same projects being tackled in Canada, even by the same investigator, are here classified under the heading of pure research. This further emphasises that the distinction between the two types of research is neither a clear-cut nor an obvious one; and, furthermore, these terms are becoming more meaningless in view of the rapidly decreasing time-lag between the discovery of basic information and its incorporation into practical application. The fact that this time-lag is becoming so short, moreover, is a most alarming one as it indicates all too clearly that fundamental research is not being carried out at a rate proportional to that of applied research. In several areas already, it is all too evident that advances in applied fields are being restricted due to the paucity of fundamental
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knowledge in those fields. A single piece of scientific
information which can be applied immediately to practical
use has often been compared with the apex of a pyramid;
and in the same way that the pyramid apex depends on a con-
siderably larger foundation, so does any piece of practical
scientific information depend on a considerably larger
volume of fundamental scientific information. We believe,
therefore, that it is imperative that fundamental research
receive more financial assistance.

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In view of the quantity of fundamental research necessary for it to make any significant contribution to industry, it is hardly surprising that in most cases industrial agencies are reluctant to provide funds for such research even within their own laboratories. It is thus no less surprising that industry in general does not provide appreciable research funds for university research in this country and, consequently, the burden of support for this type of research falls on the Federal Government. It is our sincere and earnest hope that the Federal Government will continue to operate through the National Research Council and that the actual method of meting out support for individual scientists be left in the hands of those experts who are in the best possible position to determine the true quality of the research being done. We would also strongly recommend that N.R.C. and the other Government award granting bodies be placed in a better position, through an increase in available funds, to serve this vital and important facet of Candaa's requirements.
9. The fact that universities are virtually the only institutions where the type of research only needs to be justified in relation to its quality not only insures that it be of a high standard but also serves as a valuable attraction to many potentially great scientists. However, it should go without saying that the interest of serious scientists will be caught and held by serious problems of national importance. The exact titles of individual research projects will no doubt be influenced by the dissemination of information on specific problems, whatever the source of the problem may be. What is needed more than direct changes of policy is the establishment of broader and more numerous lines of communication between Government, Industry and University.

In so far as the apportioning of Federal funds between industrial, Governmental applied research, and university research is concerned, we recognize the importance of support in all three areas. We fird it difficult, however, to ignore the stand taken by industry that university research should be reduced in order to promote industrial research and industrial growth. The present low figure of support for universities is not enough to support faculty research as well as the training of graduate students, even assuming that it continues at the same rate of increase, but to suggest that it is sufficient to allocate some of this support towards some other type of research is paramount to denying the place universities have in modern society. If the argument is sound, that industrial growth and development should be substantially financed by Federal funds, then this should be done by increasing that proportion of the Gross National Product which is allocated to Research and Development.

The fact that Canada spends proportionally less than many of the O.E.C.D. countries (U.S.A., U.K., France, Netherlands, Japan, Sweden, and F.R. Germany) on research and development further supports this view. However, development of this type should be evolutionary rather than revolutionary and, as suggested earlier, might best be initiated through cooperative programmes involving scientists from Government, industry, and universities. It should be stressed, however, that any such co-operative programmes be financed by additional funds and that these ventures not be envisaged as replacements for existing university programmes. We would suggest further that for Canada to derive optimum benefit from support of industrial development, preference should be given to Canadianowned companies. The findings of the Watkin Report (which showed, based on data from 743 of the largest Canadian operations, over \(60 \%\) of the profits accrued to non-residents) we find staggering if not alarming and would welcome some reassurance from the Government that it does not intend to subsidize foreign research and development at what would be the expense of truly Canadian research and development at this time.

Finally the presence in Canada of many research organizations whose prime concerns are in one or other of the areas of applied research, automatically assures the continued investigation of any problems of immediate practical importance. Such problems, in their eventual elucidation, should clearly involve co-operation between different scientific groups should the particular expertise be spread in different institutions. However, these co-operative programmes should be financed in addition to existing programmes as far as the university's contribution is concerned. Bodies such as Canada
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Department of Agriculture, Fisheries Research Board, Department
of Mines and Technical Survey, Geological Survey of Canada,
Defence Research Board, and others, must obviously have
sufficient funds for them to fulfill their expected role in
contributing to the improved economy of the country. It is
equally clear, however, that this again should not be at the
expense of university support whose overall contribution in
terms of research itself, education, and the specialised train-
ing of graduate students is perhaps the most fundamental and
vital contribution of all. Accordingly, we strongly recommend
that the Government allocate more funds in total percentage
of the Gross National Product to Research and Development as
a whole, and that in particular, more substantial support of
university research and graduate training be provided.

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\section*{CURRICULUM VITAE}

Name: Michael David Brunskill BURT
Date and Place of Birth: January 19, 1938; Colombo, Ceylon
Martial Status: Married, with four children
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Degrees and Qualifications: B.Sc. (First Class Honours) in Zoology with Parasitology as special subject. University of St. Andrews, Scotland, 1961.
\(\mathrm{Ph} . \mathrm{D}\). for a thesis entitled "Parasitological Studies \({ }^{11}\). University of St. Andrews, Scotland, 1967 F.L.S. elected in 1966 。

Academic and Research Experi ence:
1956-1957 University of St. Andrews, Scotland.
1957-1958 Union College, Schenectady, N.Y., U.S.A. on a C. Vreeder Scholarship

1958-1961 University of St. Andrews, Scotland.

1961-1962 Assistant Professor, Department of Biology, University of New Brunswick.

1962 (summer) Research Assistant to Dr. T. W.M. Cameron, Institute of Parasitology, Macdonald College, P.Q.

1962-1964 Research student and senior demonstrator, University of St. Andrews, Scotland.

1963 (summer) British Council Research Scholarship for study at the Université de Neuchâtel, Switzerland under the direction of Professor J. G. Baer.

1964-1968 Assistant Professor, Department of Biology, University of New Brunswick.

1968-present Associate Professor, Department of Biology, University of New Brunswick.

Number of Publications: Nine, on Parasitology

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M.Sc., Cambridge University, 1962

Ph.D., Cambridge University, 1967
Academic and Research Experience:
1964-1965 Lecturer, Department of Geology, University of New Brunswick

1965-1968 Assistant Professor, Department of Geology, University of New Brunswick

1968-present Associate Professor, Department of Geology, University of New Brunswick

Research Speciality: Physico-chemical parameters involved in differentiation of Igneous systems.

Number of Papers: Four

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Name: Is rael UNGER
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Institution: University of New Brunswick
Degrees and Qualifications: B.Sc. Sir George Williams University, 1958 M.Sc. University of New Brunswick, 1960

Ph.D. University of New Brunswick, 1963

Academic and Research Experience:
1963-1965 Postdoctoral Fellow, Department of Chemistry, University of Texas

1965-present Assistant Professor, Department of Chemistry, University of New Brunswick

Member Chemical Institute of Canada
Chairman, Chemical Subcommittee, APICS
Number of Publications: Fourteen

\section*{CURRICULUM VITAE}

Name: Charles YOUNG
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Martial Status: Married, one child
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Department: Physics
Institution: University of New Brunswick
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M.Sc., University of Toronto, 1958

Ph.D., University of Michigan, 1964
Societies: American Meteorological Society
Canadian Meteorological Society
Canadian Association of Physicists
Member of National Research Council Subcommittee on Meteorology and Atmosphere Science

Academic and Research Experience:
1961-1964 Assistant Research Meterologist, Department of MeteoroIogy, University of Michigan

1964-1965 Associate Research Meteorologist, Department of Aerospace Engineering, University of Michigan

1965-1967 Assistant Professor, Department of Meteorology University of Michigan

1967-present Assistant Professor, Department of Physics, University of New Brunswick.

Number of Publications: Five


Wirse Session- Tunenty-eighth Frurksusevt

THE SENATE OT CANADA PFOCEEDINGS

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WEDNESDAY, MAY 28TH, 1969

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First Session-Twenty-eighth Parliament 1968-69

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THE SENATE OF CANADA PROCEEDINGS
}

OF THE
SPECIAL COMMITTEE
ON

\section*{SCIENCE POLICY}

\section*{The Honourable MAURICE LAMONTAGNE, P.C., Chairman} The Honourable DONALD CAMERON, Vice-Chairman

No. 46

WEDNESDAY, MAY 28TH, 1969

WITNESSES:
Dr. Maurice l'Abbé, Vice-Rector (Research), University of Montreal, Montreal, Quebec; Dr. S. B. Frost, Dean of the Faculty of Graduate Studies, and Research, McGill University, Montreal, Quebec; Professor H. M. M. Dutton, Head, Physics Department, Bishop's University, Lennoxville, Quebec; Dr. D. J. McDougall, Chairman, Geotechnical Sciences Department, Loyola College, Montreal, Quebec; Dr. J. R. Ufford, Assistant Dean of Science, Sir George Williams University, Montreal, Quebec; Dr. Larkin Kerwin, Vice-Rector (Research), Laval University, Quebec, Quebec; Dr. R. E. Bell, Vice-Dean, Faculty of Arts \& Science, McGill University, Montreal, Quebec.

\section*{APPENDICES:}

No. 67.-Joint brief submitted by Laval University, University of Montreal and the University of Sherbrooke.
No. 68.-Brief submitted by the Faculty of Engineering, Loyola College.
No. 69.-Brief submitted by the Faculty of Science, Loyola College.

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\section*{MEMBERS OF THE SPECIAL COMMITTEE \\ ON}

SCIENCE POLICY
The Honourable Maurice Lamontagne, Chairman
The Honourable Donald Cameron, Vice-Chairman The Honourable Senators:
\begin{tabular}{lll} 
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 &
\end{tabular}

Patrick J. Savoie, Clerk of the Committee.

\section*{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 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.

\section*{MINUTES OF PROCEEDINGS}

Wednesday, May 28, 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, Cameron, Carter, Grosart, Haig, Hays, Kinnear and Robichaud.-(11)

In attendance: Philip J. Pocock, Director of Research (Physical Science), Gilles Paquet, Director of Research (Human Science).

The following witnesses were heard:
Dr. Maurice L'Abbé, Vice-Rector (Research), University of Montreal, Montreal, Quebec;
Dr. S. B. Frost, Dean of the Faculty of Graduate Studies and Research, McGill University, Montreal, Quebec;
Professor H. M. M. Dutton, Head, Physics Department, Bishops University, Lennoxville, Quebec;
Dr. D. J. McDougall, Chairman, Geotechnical Sciences Department, Loyola College, Montreal, Quebec;
Dr. J. R. Ufford, Assistant Dean, Faculty of Science, Sir George Williams University, Montreal, Quebec;
Dr. Larkin Kerwin, Vice-Rector (Research), Laval University, Quebec, Quebec, and
Dr. R. E. Bell, Vice-Dean, Faculty of Arts and Science, McGill University, Montreal, Quebec.
(A curriculum vitae of each witness follows these Minutes)
The following are printed as appendices:
No. 67.-Joint brief submitted by Laval University, Quebec, Quebec, the University of Montreal, Montreal, Quebec, and the University of Sherbrooke, Sherbrooke, Quebec.
No. 68.-Brief submitted by the Faculty of Engineering, Loyola College, Montreal, Quebec.
No. 69.-Brief submitted by the Faculty of Science, Loyola College, Montreal, Quebec.
At 12.55 p.m. the Committee adjourned to the call of the Chairman.
ATTEST:

> Patrick J. Savoie, Clerk of the Committee.

\section*{CURRICULUM VITAE}

Bell, Robert E. Born 29 November 1918 in England of Canadian parents: lived in Canada since infancy. Education: Elementary and High School in Ladner, B.C. (near Vancouver). University of British Columbia, 1935-1941: B.A. in Honours Mathematics and Physics, 1939. M.A. in Physics, 1941. Three scholarships. McGill University, 1945-1946 in residence, 1946-1948 working on research: Ph.D. in Physics, 1948. N.R.C. Fellowship, 1945-1946. Employment: 1941-1945-Wartime research and development of radar, National Research Council, Ottawa. 1946-1952-Nuclear Physics research at the Atomic Energy Projects, Chalk River Laboratories. 1952-1956-On loan from Chalk River Laboratories to Radiation Laboratory (now J. S. Foster Radiation Laboratory), Physics Department, McGill University, as Research Associate. Left the employ of Chalk River in September 1956 with the rank of Senior Research officer. 1956-1958-On staff of Physics Department, McGill University, as Associate Professor. 1958-1959-Spent a year of work and study at Niels Bohr's Institute for Theoretical Physics, Copenhagen. 1960-Appointed Rutherford Professor of Physics, and Director of the Foster Radiation Laboratory, McGill University. 1964-1967-Vice-Dean for Physical Sciences, McGill University. Memberships and Distinctions: Fellow of the Royal Society (London) 1965. Fellow of the Royal Society of Canada 1955 and Secretary of Section III (Science) 1962-1964. Fellow of the American Physical Society 1954; Councillor 1965-1967. President of the Canadian Association of Physicists 1965-1966; C.A.P. Medal for Achievement in Physics 1968. Member of the Society of the Sigma Xi. Member of the Canadian National Committee of the International Union of Pure and Applied Physics and Corresponding Member of the Commission on low Energy Nuclear Physics. Canadian Centennial Medal 1967.

\section*{Theses, Publications, and Patents:}
1. Theses: "On the Ultraviolet Spectrum of the Hydrogen-Deuterium Molecule" (M.A. Thesis, University of B.C., 1941). "Gamma Rays of Neutron Capture Studied with the Beta Ray Spectrometer" (Ph.D. Thesis, McGill University, 1948).
2. Publications (names of co-authors given in parentheses where applicable): "Disintegration Scheme of 1.7 Year Cesium 134", (with L. G. Elliott). Physical Review 72, 979 (1947). "Experimental Upper Limit for the Mean Life of the 478.5 keV Excited State of Lithium 7", (with L. G. Elliott). Physical Review 74, 1869 (1948). "Lifetime of the 479 keV Excited State of Lithium 7", (with L. G. Elliott). Physical Review 76, 168 (1949). "Gamma Rays from the Reaction \(\mathrm{H}^{1}(\mathrm{n}, \gamma) \mathrm{D}^{2}\) and the Binding Energy of the Deuteron", (with L. G. Elliott). Physical Review 74, 1552 (1948) and Physical Review 79, 282 (1950). "Search for a 3.20 MeV Gamma Ray in the Disintegration of Thorium C"", (with L. G. Elliott). Can J. Research A26, 379 (1948). "Upper Limit for the Lifetime of the \(411-\mathrm{keV}\) Excited State of \({ }^{195} \mathrm{Hg}\) ", (with H. E. Petch). Physical Review 76, 1409 (1949). "Measurement of a \(1.6 \times 10^{-9}\) Second HalfLife in \({ }^{170} \mathrm{Yb}\) ", (with R. L. Graham). Physical Review 78, 490 (1950). "Half Lives of Excited States of \({ }^{120} \mathrm{Hg},{ }^{131} \mathrm{Xe}\), and \({ }^{109} \mathrm{Hg} "\), (with R. L. Graham). Physical Review 84, 380 (1951). "Design and Use of a Coincidence Circuit of

Short Resolving Time", with R. L. Graham and H. E. Petch). Can. J. Physics 30, 35 (1952). "Disintegration Scheme of \({ }^{121} \mathrm{I} ", ~(w i t h ~ R . ~ L . ~ G r a h a m) . ~ P h y s i c a l ~\) Review 86, 212 (1952). "Wide Range Logarithmic Radiation Meter", (with R. L. Graham). Review of Scientific Instruments 23, 201 (1952). "The Disintegration of \({ }^{170} \mathrm{Tm} "\), (with R. L. Graham and J. L. Wolfson). Can. J. Physics 30, 459 (1952). "The Determination of the Half Lives of Some Magnetic Dipole Gamma Ray Transitions", (with R. L. Graham). Can. J. Physics 31, 377 (1953). "Time Distribution of Positron Annihilation in Liquids and Solids", (with R. L. Graham). Physical Review 90, 644 (1953). "Search for a Possible Error in the Measured Half Life of \({ }^{198} \mathrm{Au}^{\prime \prime}\), (with L. Yaffe). Can. J. Physics 32, 416 (1954). "The Thermal Neutron Capture Cross Section of \({ }^{108} \mathrm{Au}\) and the Half-Life of \({ }^{100} \mathrm{Au"}\), (with R. L. Graham and L. Yaffe). Can. J. Physics 33, 457 (1955). "Nuclear Particle Detection: Fast Electronics" (Annual Reviews of Nuclear Science, Stanford, California, Vol. IV, 1954). "Measurement of Short Lifetimes", "Disintegration of Iodine 131", "Annihilation of Positrons in Liquids and Solids (Chapters in Beta- and Gamma-Ray Spectroscopy, K. Sieghahn, editor, North-Holland Publishing Co., Amsterdam, 1955). "The Resolver, A. Circuit for Reducing the Counting Losses of a Scaler", Can. J. Physics 34, 563 (1956). "Cross Sections of (p,xn) Reactions in the Isotopes of Lead and Bismuth", (with H. M. Skarsgard), Can. J. Physics 34, 745 (1956). "Variations in the Amounts of Positronium Formed in Liquids and Amorphous Solids", (with R. E. Green). Can. J. Physics 35, 398 (1957). "Notes on a Fast Time-to-Amplitude Converter", (with R. E. Green). Nuclear Instruments 3, 127 (1958). "Genetic Measurement of the Half Life of \({ }^{297} \mathrm{Bi}^{\prime \prime}\), (with J. Sosniak). Can. J. Physics 37, 1 (1959). "Half Lives of First Excited States of Even Nuclei of Em, Ra, Th, U, and Pu", (with S. Bjørnholm and J. C. Severiens). Matematiskfysiske Meddelelser, Kongelige Danske Videnskabernes Selskab 32, no. 12 (1960). "The Half Life of the First Excited State of \({ }^{298} \mathrm{Tl}\) ", (with E. S. B. Pederson). Nuclear Physics 21, 393 (1960). "Method of Evaluating Delayed Coincidence Experiments", (with R. S. Weaver). Nuclear Instruments and Methods 9, 149 (1960). "More Power for McGill Cyclotron", Canadian Nuclear Technology 1, no. 2, 31 (1961). "Higher Order Events in Coincidence Counting". Nuclear Instruments and Methods 12, 199 (1961). "Cross Sections of (p,pxn) Reactions in \({ }^{187} \mathrm{Au}\) ", (with T. M. Kavanagh). Can. J. of Physics 39, 1172 (1961). "A Simple and Accurate Method for Calibrating Nanosecond Time-to-Pulse-Height Converters", (with R. L. Graham, J. S. Geiger, and R. Barton). Nuclear Instruments and Methods 15, 40 (1962). "Dependence of Line Widths of Scintillation Counters on Integrating Time Constant", (with P. Onno). Nuclear Instruments and Methods 17, 149 (1962). "McGill Discovers New Type of Radioactivity", (with R. Barton and R. McPherson). Canadian Nuclear Technology 3, no. 3 (1963). "Observation of Delayed Proton Radioactivity", (with R. Barton, R. McPherson, W. R. Frisken, W. T. Link, and R. B. Moore). Can. J. Physics 41, 2007 (1963). "Delayed Proton Emission Following the Decay of \({ }^{27} \mathrm{Ne}\) ", (with R. McPherson and J. C. Hardy). Physics Letters 11, 65 (1964). "Coincidence Techniques and the Measurement of Short Mean Lives", Chapter 17 of Alpha, Beta, and Gamma Ray Spectroscopy, K. Siegbahn, editor, North-Holland Publishing Co., 1964. "Three Problems on Random Events", Am. J. Physics 33, 219 (1965). "Decay of Carbon-9", (with J. C. Hardy and R. I. Verrall), Physical Rev. Lett. 14, B553 (1965). "New Information on the Emission of Delayed Protons Following the Decay of \({ }^{17} \mathrm{Ne},{ }^{21} \mathrm{Mg}\), and \({ }^{25} \mathrm{Si} "\), (with J. C. Hardy). Can. J. Physics 43, 1671 (1965).
"J. S. Foster, 1890-1964", Proc. Roy. Soc. Can., Fourth Series, Vol. III, 101 (1965). "Superallowed log ft Values for Transitions Between \(\mathrm{T}=3 / 2\) Analogue States", (with J. C. Hardy and R. I. Verrall). Nuclear Physics 81, 113 (1966). "An Extended Nomogram for log ft Values", (with R. I. Verrall and J. C. Hardy). Nuclear Instruments and Methods 42, 258 (1966). "Comparison of LeadingEdge and Crossover Timing in Coincidence Measurements". Nuclear Instruments and Methods 42, 211 (1966). "J. S. Foster, 1890-1964", Biog. Memoirs Fellows R.S. 12, 147 (1966). "Statistics of a Two-Parameter Analyzer with Associative Memory", Nuclear Instruments and Methods 50, 258 (1967). "Proton Radioactivity", Encyclopaedic Dictionary of Physics, J. Thewlis, ed., Pergamon Press, 1968. "Direct Measurement of the Primary Photoelectron Yield in Sodium Iodide Scintillation Counters" (with A. Houdayer and S. K. Mark). Nuclear Instruments and Methods 59, 319 (1968). "Square Root Graph Paper for Nuclear Spectra" (with R. I. Verrall). Nuclear Instruments and Methods, accepted for publication in 1968.
3. Patents: "Coincidence Circuit", U.S. Patent no. 2,610, 303 (issued September 9, 1952). (Also Canadian Patent issued 1953).

Dutton, H. M. Born August 13, 1919 at Prescot, Lancashire, England. Graduated in 1940 from University of London with a B.Sc. Served in Royal Air Force from 1940-1946, Technical Branch (Signals), including two years in Canada on loan to R.C.A.F. Retired with rank of Flight Lieutenant. Returned to Canada in 1946 and took M.Sc. (with Honours) in Physics at the University of Western Ontario in 1947. Senior demonstrator, University of Western Ontario 1947-48; Lecturer in Physics department University of British Columbia 1948-49; Assistant Professor, Canadian Services College, Royal Roads, B.C. 1949-61; Professor, Bishop's University, Lennoxville, Québec 1961 becoming Head of Department in 1965. Married Joan Brock of Winnipeg, Manitoba on December 26, 1942; 3 children.

Frost, Stanley Brice, born London, England, 17th February, 1913. Educated: Aske's Haberdashers' Hatcham School 1926-32 (Captain of the School, 1931-32). Richmond College, London University. 1932-36) Marburg University (Dr. Williams' Scholar) 1936-37. Degrees: B.D. London 1936; Dr. Phil. Marburg 1938; M.Th. (Biblical and Historical Theology) 1943; Hon. D.D. Victoria, Toronto 1963 ; Hon. D. Litt. Memorial, 1967. Ordained British Methodist Conference, 1939; pastorates in London and Stoke-on-Trent 1939-49; Chair of Old Testament Languages and Literature, Didsbury College, Bristol 1949-56; Special Lecturer in Hebrew, Bristol University, 1952-56; Professor of Old Testament Studies, McGill University, 1956- ; Dean of Faculty of Divinity 1957-63; Acting Dean of Graduate Studies 1962-63; Dean of Faculty of Graduate Studies and Research 1963- . Chairman of University Press Editorial Committee 1962-69. Chairman of University Libraries' Committee 1963- . President of Canadian Biblical Society 1962-63. President of American Association of Theological Schools 196466. President of Canadian Association of Graduate Schools 1964-65. Member, Executive Committee, Association of Graduate Schools in the Association of American Universities, 1967-69. Member, Graduate Record Examinations Board 1967; 68-72. Member, Committee on Rationalisation of Major Library Holdings (A.U.C.C.) 1969. Member, Council of Graduate Schools in the United States, Humanities Conference, 1969. A. Major Publications: Die Autoritatslehre in den Werken John Wesleys, Munich, Ernst Reinhardt, 1938, 112 pp. The Pattern
of Methodism, Methodist Youth Department, London, 1948, reprinted 1952, 109 pp. Old Testament Apocalyptic, Its Origins and Growth. The Fernley-Hartley Lecture for 1952, London, Epworth Press, xiii and 270 pp. The Beginning of the Promise, Eight Lectures on Genesis, London, S.P.C.K., 1960, 98 pp. Patriarchs and Prophets, Montreal, McGill University Press, and London, John Murray, 1963, vii and 231 pp. Standing and Understanding; a Reappraisal of the Christian Faith. The Arthur Samuel Peake Lecture for 1968. London, Epworth Press and Montreal, McGill University Press, 1969, 187 pp. Commentaries on Jeremiah, Baruch, The Letter of Jeremiah, The Prayer of Monasses in The Revised Abingdom Commentary, Nashville (to be published 1969). B. Papers: 1. "Eschatology and Myth", Vetus Testamentum, Vol. II, No. 1, 1952, pp. 70-80. 2. "The Christian Theology of the Old Testament", The London Quarterly, July 1952, pp. 185-191. 3. "The Authority of the Bible", The London Quarterly, April 1954, pp. 90-95. 4. "History and the Bible", Canadian Journal of Theology, Vol. 3, April 1957, pp. 87-96. 5. "Asseveration by Thanksgiving", Vetus Testamentum, Vol. VIII, No. 4, 1958, pp. 380-390. 6. "Visions of the End: Prophetic Eschatology", Canadian Journal of Theology, Vol. 5, No. 3, 1959, pp. 15-16. 7. "The Christian Interpretation of the Psalms", Canadian Journal of Theology, Vol. 5, No. 1, pp. 25-34, 1959. 8. "Psalm 139: An Exposition", Canadian Journal of Theology, Vol. 6, No. 2, April 1960, pp. 113-122. 9. "Towards a Biblical Doctrine of Holy Communion", Canadian Journal of Theology, Vol. 7, No. 1, 1960, pp. 20-31, and The London Quarterly, January 1962, pp. 45-55. 10. "Israel's Wisdom Literature", The Preacher's Handbook, No. 7, 1961, pp. 31-56. 11. "Psalm 118: An Exposition", Canadian Journal of Theology, Vol. 7, 1961, pp. 155-66. 12. "The Role of Myth", The London Quarterly, October 1962, pp. 246-252. 13. "Psalm 22: An Exposition", Canadian Journal of Theology, Vol. 8, 1962, pp. 102-105. 14. "The Ph.D. Degree", Bulletin of Education Procedures, No. 11, February 1967. 15. "Judgement on Jezebel, or A Woman Wronged", Theology Today, Vol. xx, No. 4, January 1964, pp. 503-517. 16. "The Theologian and Contemporary Thought", Theological Education, Vol. 1, No. 1, July 1964, pp. 3-14. 17. "Apocalyptic and History" in The Bible and Modern Scholarship, papers read at the 100 th meeting of the Society of Biblical Literature, ed. J. Philip Hyatt, Abingdon Press, New York, 1965, pp. 98-113. 18. "Reviewing Some Foundations", in Horizons of Theological Education, ed. J. Ziegler, Dayton 1966, pp. 23-34. 19. "The Death of Josiah", The Journal of Biblical Literature, Vol. LXXXVII, Part IV, 1968, pp. 369-382. 20. (with R. F. Schnell) The Psalter Arranged for Christian Worship. A new Selection, Text and Arrangement, commissioned by the United Church of Canada. (accepted and gone to Printerto be published in 1969.) C. Contributions to: The Interpreter's Dictionary of the Bible (1962); Hasting's Dictionary of the Bible (1963); Encyclopedia Britannica (1963 and 1965); The Manchester Guardian; The Gazette (Montreal). D. Reviews: Canadian Journal of Theology; Theology Today; Theology.

Larkin Kerwin. Born in Quebec, June 22, 1924; married Miss Lupita Turcot, June 10, 1950; seven children. Studies: Engineering Certificate, St. Francis Xavier University, 1943; B.Sc. (summa cum laude) St. Francis Xavier University, 1944; M.Sc. (magna cum laude) Massachusetts Institute of Technology, 1946; D.Sc. (magna cum laude) Laval University, 1949. Profession: Professor of Physics. Academic Status: Lecturer, St. Francis Xavier University, 1944; Lecturer, University of Toronto, 1945; Research Physicist, The Geotechnical Corporation, Cambridge, 1945; Assistant Professor, Laval University, 1946;

Lecturer, Laval University, 1948; Agrégé Professor, Laval University, 1951; Titular Professor, Laval University, 1956; Director of the Physics Department, Laval University, 1961-1967; Director of the Mass Spectrometry Research Laboratory, Laval University, 1955-1966; Vice-Dean of the Faculty of Sciences of Laval University, 1967-1968; Vice-Rector of Laval University, 1969. Scientific or Professional Associations: French-Canadian Association for the Advancement of Sciences; Canadian Association of Physicists (Vice-President in 1953-54, President in 1954-1955); American Physical Society; Canadian Association of University Teachers; International Union of Pure and Applied Physics (Assistant Secretary-General, 1963- ) ; Corporation of Professional Engineers of Quebec; Royal Society of Canada (Chairman of the Physics Section, 1967); Canadian Joint Research Organization (Vice-President, 1967- ). Other Spheres of Activity: Founding Physicist of the Radioisotope Clinic (Quebec area); Governor of St. Lawrence College; Chairman of the Advisory Committee on Electronic Research, Defence Research Board of Canada (19591963); Member of the Physics Grants Committee, National Research Council of Canada (1956-1962, 1966- ) ; Committee on the State of Physics in Canada and Medal Committee, Canadian Association of Physicists (1958-1963); VicePresident of the United Nations Association (Quebec section) (1958-1959); Member of the Cercle Universitaire, Quebec; Founding President of the Catholic Parents' Association of Sillery; Member of the Grant Selection Committee of the National Research Council; Member of the Grant Selection Committee of the Department of Education of the Province of Quebec; President of Expo-Sciences of Canada for the 1967 Centennial; Assistant Editor of the Canadian Journal of Physics, 1968- . Honorary Medals: Lieutenant Governor's Medal in 1941; Governor General's Medal in 1944; Prizewinner in the Literary and Scientific Competitions of the Province of Quebec, Prix David in 1951; Médaille Pariseau of the F.C.A.A.S. in 1965; Member of the Royal Society of Canada; 1967 Centennial Medal; Medal of the Canadian Association of Physicists, 1969. Research: Research in atomic and molecular physics: Mass spectrometry; Ionization, dissociation and vibration energy; Study of molecular structure using an electron selector; Ion optics; High energy beam spectroscopy.

Publications: 1. "Use of the Broadcast Band in Geologic Mapping" J. Appl. Phys. 18, 407-413 (1947). 2. "Improved Magnetic Focusing of Charged Particles" Rev. Sci. Instr. 20, 36 (1949). 3. "Further Improvements in Magnetic Focusing" (with C. Geoffrion) Rev. Sci. Instr. 20, 381-386 (1949). 4. "A New Type Mass Spectrometer" Rev. Sci. Instr. 21, 96-97 (1950). 5. "La dose tolérable de radiation" Laval Médical, 16, April (1951). 6. "The Maximum Permissible Exposure of Radiation-I" J.C.A.R. 2, 21-23 (1951). 7. "The Maximum Permissible Exposure to Radiation-II" J.C.A.R. 2, 38-41 (1951). 8. "Note on the Resolving Power of Mass Spectrometers" Can. J. Phys. 30, 503-511 (1952). 9. "Some Mass Spectrometric Data on Phosphorus" Can. J. Phys. 32, 757-758 (1954). 10. "La nature des isotopes" Laval Médical, 19, March (1954). 11. "Mass Spectrometry" Adv. in Elect. and Elec. Physics, VIII (1956). 12. "Le Cobalt 60, agent thérapeutique" Le Livre de l'année (Grolier) (1956). 13. "Some Upper Limits of Isotopic Abundance-I: A, Mn, Cd" Can. J. Phys. 34, 1080-1081 (1956). 14. "Some Upper Limits of Isotopic Abundance-II: Na, Cl, Ga" (with D. McElcheran) Can. J. Phys. 34, 1497 (1956). 15. "Some Upper Limits of Isotopic Abundance-III: C, O, Zn" (with D. McElcheran and M. Cottin) Can. J. Phys. 35, 783-784 (1957). 16. "Mass Spectrometric Analysis of Some Hydrogen Oxides-I" (with M. Cottin) Can. J. Phys. 36, 184-191
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(1965). 46. "1001 Reactions of the Ar and Kr Ion Doublets" with M. Hussain) Can. J. Phys. 44, 57-65 (1966). 47. "Measurements on Polyatomic Molecules using an Electron Selector" Triple Physics Conference-Mexico (1966). 48. "Electron Transfer to Multiply-Charged Ions of \(\mathrm{Ar}, \mathrm{N}_{2}, \mathrm{~N}\), and \(\mathrm{O}_{2}\) " (with Wm. McGowan) Can. J. Phys. 45, 1451-1467 (1967). 49. "Spectroscopie atomique à l'aide d'un accélérateur Van de Graaff: Applications à l'hélium et à l'azote" (with R. Girardeau and R. Drouin) Can. J. Phys. Vol. 47, No. 8 (1969). 50. "High Energy Resolution Electron Beams and their Application" (with P. Marmet and J.-D. Carette), (1969).

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McDougall, David J. 1. Degrees held: B.Sc., McGill University, 1948, Geology. M.Sc., McGill University, 1949, Geology. Ph.D., McGill University, 1952, Geology. 2. Experience-Academic and/or Research in past 5 years: 1963-1967, Assoc. Prof. (and Dept. Chairman), Geotechnical Sc., Loyola College, Montreal. 19661967 (Sabbatical year) Research Scientist, Société Québécoise d’Exploration Mineriere. 1967-1968, Professor (and Dept. Ch.) Geot. Sc., Loyola College. 1963-1968, Continuing research on thermoluminescence and allied solid state phenomena of geological materials. Author of numerous papers on thermoluminescence of minerals and rocks. Editor: "Thermoluminescence of Geological Materials," (Academic Press) London. 1968. (Proceedings of N.A.T.O. Advanced Research Institute, Spoletto, Italy, 1966). Recipient of research grant from N.R.C., G.S.C., D.R.B.

Ufford, John R., B. Eng., M.A. Sc., Ph.D., M.C.I.C. Dr. Ufford was born in Cardinal, Ontario, in 1921. He received the B. Eng. degree in chemical engineering from McGill University in 1943. From 1943 to 1946 he was chief chemist for the Nicholls Chemical Co. in Sulphide, Ontario. From 1946 to 1949 he was a lecturer in the Faculty of Applied Science and Engineering at the University of Toronto. He received the M.A.Sc. degree in 1949 from the University of Toronto. In 1949 he joined the staff of the Chemistry Department at Sir George Williams University in Montreal. In 1960 he received the Ph.D. from McGill University. In 1964 he was appointed Chairman of the Chemistry Department of Sir George Williams University and 1968 he was appointed Assistant Dean of the Faculty of Science. He is a member of the Chemical Institute of Canada of which he is presently a councillor and the American Chemical Society.






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THE SENATE SPECIAL COMMITTEE ON SCIENCE POLICY EVIDENCE
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\section*{Ottawa, Wednesday, May 28, 1969}

The Special Committee of the Senate on Science Policy met this day at 10 a.m.
Senator Maurice Lamontagne (Chairman) in the Chair.

\section*{[Translation]}

The Chairman: Honourable Senators, we have the honour this morning of welcoming the representatives of the Quebec universities. We shall proceed, as we did yesterday, by first asking the delegations of each of the universities to make a short introductory statement.

First, I should like to call upon Dr. Maurice L'Abbé. I asked Dr. L'Abbé to somewhat prolong his sta ement to approximately ten minutes as Dr. L'Abbé will speak on behalf of Laval University, the University of Montreal and the University of Sherbrooke. Following this, we shall hear the statements of the other universities, of the other language, in the Province of Quebec.

Senator Bourget: Mr. L'Abbé is from the University of Sherbrooke?
The Chairman: From the University of Montreal; the representative of the University of Sherbrooke has apparently not arrived yet. At the moment, from the French universities we have Mr. Maurice L'Abbé and Mr. Kerwin from Laval University who also is Vice-Rector in charge of research.

Senator Bourget: And doctor.
The Chairman: Doctor; and now, Dr. L'Abbé.

Dr. Maurice L'Abbé, Vice-Rector (Research), University of Montreal: First, I should like to begin with three rapid comments concerning the brief. As Senator Lamontagne stated, it is a joint brief from the three French-speaking universities in Quebec. Obviously, when we were preparing this combined effort, there were only three French-speaking universities in Quebec. There is now a fourth, the University of Que-
bec, which would have joined us if it had been able, at the time, to partake in our decision.
There were two motives behind the decision to submit a joint brief. First, I feel I must emphasize that it results from the conviction, held by our universities, that all the universities now constitute a complex, an organic unity, where universities are no longer isolated and must essentially co-ordinate and mutually plan their development, particularly at the research level. It was certainly this conviction, in part, which prompted us to submit a joint brief. However, the principal reason is that we feel that common research problems, particularly with regard to a national science policy which may develop, concern the French-speaking universities of Quebec. Needless to say, the idea of a joint brief imposed restraints which have been difficult to surmount and, to a certain extent, this brief represents, therefore, a common denominator of certain views held by our respective universities. It goes without saying, therefore, that, had each of our universities done so separately, they would perhaps have presented slightly different viewpoints. What we have, therefore, are fundamental opinions on the subject under study.

Finally, I should like to make one last comment regarding the position we have taken in our brief. It is obvious that in making recommendations to the Lamontagne Committee on federal research policy, we in no way make predictions regarding the agreements or political changes which may arise between the federal and Quebec governments, or on the constitutional option towards which the Quebec of tomorrow might head. However, in the face of this possibility, we have adopted a realistic and, to some extent, empirical attitude. We confront realities demanding immediate action and have embarked on a study of the present situation by limiting our recommendations to those which we feel may be put into effect under the present political and constitutional system.

I was anxious to make this point to emphasize that this is an attitude common to the three universities in the presentation of this brief.

The brief, essentially, involves three parts. The last is a brief conclusion, or summary.
The first part concerns research and the Canadian society. We therefore attempt to place research in its more general context of the country, of Canada. Briefly, in this part we pointed out that any national scientific policy should take into account the two dimensions of our society, the one being the pluralist nature of this society, the other, the specific nature of its economy.
Regarding the first dimension which we describe as the pluralism of Canadian society, there are perhaps two aspects. First of all, there are the regional disparities in Canada which call for a concerted policy between the federal and provincial governments. In addition to this regional aspect which affects not only science policy but also, as is well known, the economic policy of the country, there are also what one would call cultural disparities. Basically, the cultural plurality of the Canadian society, not to mention its national duality, implies that an overall science policy will not oppose or alter policies which each Canadian cultural community might adopt. The latter aspect, the aspect of cultural disparities, is to some extent complicated by the fact that the French-speaking concentration in Quebec, as we are aware, adds a constitutional and political dimension to this question. Obviously, it is not the purpose of our brief to suggest solutions to the problem or even to analyze it; however, we feel the problem is important and should be studied, provided these particular discussions-the consti'utional debate as it is called today-in no way hinder the development of research in Canada in general.

The second characteristic-what we have termed the specificity of the Canadian econo-my-is well known and I shall not linger over the subject. We must remember, as all do, that our economy is unique in many ways owing to the youth and scantiness of the population spread over a vast expanse of land. We must remember that our economy is essentially subject to many outside influences and, last but not least, that we are the neighbours of a giant, the United States. This specificity of our economy calls for positions which must be reflected in a federal policy. It is clear that at the very minimum we must
plan a balanced development of the various fields of scientific activity essential to any so-called complete society which a country such as Canada must be considered. And yet, this does not appear to be sufficient. In our opinion, a science policy, like any policy, must make choices and benefit to some extent certain areas in keeping with the specificity of our economy. In these chosen areas, we could not only create centres of excellence, but at the same time add an international development to our research effort.

The second section of our brief concerns research in the university. Therefore, in dealing with the particular context which interests us most as university professors, we insist, in this section, on the close and essential relationships between research in the university and teaching. In a way, these are two aspects of the same activity; they are indissociable and mean that the university is not only a centre where research is conducted, but, at the same time, a centre where researchers are trained. The rest of this section emphasizes the need not only for close relations among the universities themselves at the research level, but also between the universities and government research bodies, government or semi-public research laboratories and, finally, private industrial research groups. We feel that these three major sectors, the university, the government and private industry, must co-operate in a research policy, even with regard to the particular goals of the university.

The last and perhaps most important section to our way of thinking places research in the context of the French universities. We are aware that the French-speaking universities have developed more slowly for various reasons which have not always necessarily depended on the English universities. We are also aware that now, from the point of view of quality, the major Quebec universities have attained standards and a development in several areas whereby they compare favourably with their English counterparts in the rest of Canada. We feel, and the facts prove it, that our research workers can now openly compete with their colleagues in the major federal agencies; that the level of graduate studies has almost attained the Canadian average, and that our operating budgets allotted to research have almost reached, or are rapidly reaching, the Canadian average. However, we note that from the point of view of size, from the point of view of extension,
we have largely fallen short of the development we should expect from the Frenchspeaking community.

We give three reasons-and I shall mention these fairly briefly in order to reach the con-clusions-which may explain the slower and partial development of research in the French-speaking universities.

The first is that, until recently, grants by federal organizations were made on an individual basis and, as a result, the Frenchspeaking universities in Quebec faired poorly because they had fewer researchers.

The second reason is that, needless to say, federal organizations have been so composed as to ensure to English Canadians, to some extent, the conirol of the Canadian scientific community. This is reflected, for example, in the composition of the jurys, in the composition of the large organizations which are not always completely representative of, let us say, the proportion of scientists which the French community should represent at the national level.
The third point-and this is important-is that the federal government has established an imposing number of regional laboratories or research institutions through its agencies or departments across the country; and the majority of these laboratories are located in an English milieu with the result that access for French Canadians and, particularly, French-speaking persons of other countries, is made difficult. In fact, we note that the amount of subsidies granted by the federal government to the French-speaking universities reveals a fundamental problem. The amount granted to the French universities represents about 11 per cent of the total amount granted to universities across Canada; that is, in 1967-68, the most recent date for which we have exact figures, the French universities received only 11 per cent although, according to population, we should receive more. But what I wish to make clear is that it is not because of population that further grants are justified. It is simply a matter of fact which has its explanations: it is an example of a disparity which must be corrected.

In order to correct this disparity, we recommend-and I will conclude here, Senator Lamontagne, because I think that I have gone well over my ten minutes-that the federal government's policy in the area of research should be realistic and above all, for French-speaking universities, should bring to bear the pluralistic aspect which we have mentioned.

Consequently, we make two recommendations at the end. We suggest that the federal government, through its agencies, should begin at once to take advantage of the possibility for developing Canadian science which is now offered by the staffs of the universities of Montreal and Sherbrooke and of Laval University. We feel that, in five years' time, these universities should become the sites for several large laboratories or centres, preferably, in certain specific cases, through interuniversity or university-government structures.

As our second recommendation, we suggest that the federal government set up research laboratories in Quebec which are Frenchspeaking only and which are closely linked with the universities.

The last section is a conclusion, in which we rapidly review the guidelines which should provide a framework, as it were, for establishing science policy in Canada.

The Chairman: Thank you very much, Dr. L'Abbé. Now that we have heard the spokesman for these three French-speaking universities in Quebec, I am going to ask the spokesmen for the other universities to present their views to us briefly.
[Text]
I would like first to ask Dr. Frost, who is the Dean of the Faculty of Graduate Studies and Research at McGill University, to give us a statement, as I told him, of about five minutes.

Dr. S. B. Frost, Dean of the Faculiy of Graduate Studies and Research, McGill Universiiy: Thank you very much, Mr. Chairman.

In changing from the one language to the other, it is quite likely that there will indeed be a change not only of accent but also of position. However, obviously, what I have to say is prepared without reference to the remarks we have just heard, and the combination of these two is the concern of the committee.

We welcome this opportunity to make this submission to the committee because we believe that the committee's inquiry is evidence of the federal interest in graduate studies and research in the universities. We think that academic freedom is best preserved and served when the universities are not dependent on one source of Government income only, and, therefore, we welcome the federal presence in the universities at the level of graduate studies and research. This is
a point we made in our brief to the Macdonald committee, and it is one we would like to make again here.

We wish to emphasize strongly the importance to the nation of graduate studies and research, not only in the sciences but also in the humanities and the social sciences. We believe that advanced studies in the humanities act as a leaven, working through academic and governmental and other corporate structures, to maintain and enhance the quality of living, just as technology preserves and advances the standard of living. Research in the humanities and social sciences is not identical with research in the physical and biological sciences, but we believe it to be equally important.

The question is: How should this best be provided for? We have gone on record previously as supporting the proposal that there should be a new social sciences and humanities council, preferably to embrace law also, as distinct from the Canada Council. We are very mindful and appreciative of the helpful role of the Canada Council hitherto, from whom we have indeed derived very great benefits. Nevertheless, we feel that both their history and, in a sense, their commission preclude them from taking the same interest in the universities as institutions as has been traditional with the other councils, the NRC and the MRC. We believe it is in this ins itutional interest in the universities that NRC and MRC have made such a large contribution on the side of the natural sciences, and we would welcome a council on the humanities and social sciences to take that same kind of interest in these disciplines also.

While we are talking about research in the humanities and social sciences, we wish to stress greatly the need for a national policy with regard to libraries.

We think that the main tendencies of the Macdonald recommendations are along the correct lines. There are some provisos that we would add, and one is that you cannot ask any one library to specialize in a particular area, and in that area only, since all specialization needs strength from contiguous areas, and to ask a library to specialize in one subject only is, as it were, a contradiction in terms. We strongly support the regional streng'hening of libraries with the concept of libraries as regional wholes rather than individual units.

We want also to go on record, since we believe it was we who first put the idea for-
ward that the indirect costs of research should be borne by federal funds, seeing that these place a heavy burden on provincial budgets unless this is looked for. We have our own particular approach to this problem, as to how it should be worked out, but we are prepared to accept the Macdonald formula as an alternative. But, we certainly think that indirect research costs should be taken into account.

We also think that a federal policy for graduate studies in research will allow for an intelligent moderation for what must be the prior consideration in all judgments of academic programs, and that is, of course, the academic excellence of the program itself. We think this should be tempered by regional and cultural considerations, and in this respect we support the minority report of Dr. Dugal. We think this is the way in which these interests may best be preserved.

Turning more particularly to the interests of the physical and biological sciences, we want to go on record as saying we believe that research directed towards national objectives or mission-oriented research is not comparable with the research activities of universities. We think that this might possibly get out of hand, but we feel that the academic interests of the universities themselves are enough to ensure that this will not be so. We believe that pure research will not disappear from the universities, and in that regard we think that there is more need than formerly to have a federal agency which identifies and defines those national objectives with regard to which mission-oriented research should be instifuted. The activities of the Science Council, in our opinion, point in the correct direction, although they have not yet become sufficiently specific.

We want to go on record as saying that we would not want to see the research laboratories of the National Research Council divorced from the Research Council itself. We think that any awarding body needs itself to be engaged in research, and we think also that this relationship between the laboratories and the universities has proved a two-way street whereby the academic interests of the University have borne upon the Research Council's laboratories, and vice versa.

Lastly, we want to make a very strong plea that nobody takes too much notice of the suggestion in the Macdonald report that graduate students no longer be supported from operating grants of individual research
workers. We believe that this would be a retrograde step, because it would break the close relationship between the professor and his graduate students.
Those of us who administer these things on both sides of the university know what characterizes research on the science side of the university is its close bond between the professor and his students. You do not get this in the humanities and, to a much less degree, in the social sciences. We would deplore more strongly than I have attempted to say at this moment any weakening of that particular tie.

These are the points, Mr. Chairman, that we would wish to make, and in respect to which we shall no doubt be answering your questions.

\section*{Merci beaucoup.}

The Chairman: Thank you. We shall now hear from Professor Dutton of Bishop's University.

\footnotetext{
Professor H. M. M. Duiton, Head, Physics Dept, Bishop's University: Mr. Chairman, we did not submit a brief to this committee, so I would like to make a brief statement which will put forward the point of view of Bishop's University, which is a rather special point of view in that Bishop's is a very small university with approximately 1,000 students.
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Like other universities we have expanded at what seems to us an incredibly rapid rate. Bishop's is four times bigger today than it was 20 years ago, and many other universities are in exactly the same situation. For Bishop's this is a very large relative change, and the numbers involved are very big. It is only recently that we have reached the kind of threshold where we can contemplate being involved in research programs as opposed to the small efforts made by individual members of the faculty. We would like to do this. We do not contemplate Bishop's being very large. We do not contemplate any expensive doctoral programs, but we would like to generate and sustain programs involving Master's degrees. We think this is essential if we are to continue doing well what we consider to be our main function, and that is the training of undergraduates in both areas of the sciences to the best of our ability.

It is perhaps worthy of note that we consider our best contribution to Canada and to science in general is the production of a quite large proportion of well-trained candidates for the graduate schools. The number of pea-20466-2 \({ }^{\frac{1}{2}}\)
ple in honours programs at Bishop's is relatively very high, and a great many of them go on to graduate schools all over the country. We think that if we are to maintain that kind of performance that we have managed to achieve in the past we have to involve ourselves in some kind of research program.

We need to do this specifically because we must attract staff. Many young men are determined to continue only at places where research facilities are available. So, we have started, and we intend to continue, a graduate program at the Master's level which will satisfy these needs.

I would ask the committee, sir, to remember that the problems of a university that is 1,000 strong, with a limited graduate effort, are not the same as the problems of a very large university with a very large graduate research effort. We think that these facts must be borne in mind in any science policy in Canada, and we are indeed in need of support for this kind of program. Naturally, we would not be in favour of any concentration on centres of excellence. We think that it is necessary to support research at places like Bishop's, and we think that some special arrangements will probably have to be made for institutions such as ourselves.

We think that the special advantages that we can offer have already been mentioned. The contact between the graduate student and his supervisor and the staff generally is very close, especially in the sciences. At Bishop's we like to think that the same contact is found in our undergraduate work. We feel that on a small campus and on a small scale we can continue that kind of contact both between the staff and the graduate student, and between the graduate student and the undergraduate student, and we think that this is a very good thing from the point of view of the training of prospective graduate students at some other university.

The problem, if I may repeat myself very briefly, is to get a place the size of Bishop's over this threshold. We are just about approaching the point where we can make a quite significant contribution, especially in the training aspects of any research program.

Thank you very much, Mr. Chairman.
The Chairman: Next we will hear from Dr. MicDougall of Loyola College, Montreal.

Dr. D. J. McDougall, Chairman, Geotechnical Sciences Department, Loyola College, Montreal: Mr. Chairman, honourable senators,
ladies and gentlemen: much of Loyola's brief to this committee was covered in some of the remarks of the gentlemen from the Atlantic provinces yesterday. The principle problem we find in research at Loyola, which is comparatively small, with a fairly active research program amongst the professors on staff, is that we have no graduate students; we need to use research assistants if we can get and pay for them; we need to do this in order to attract staff and maintain a suitably high level of instruction for the students, because we are certain this has a large bearing on the excellence or lack of excellence of students who graduate from us.

The real problem is that of finding salaries for research assistants and research technicians. In general, the type of grants we have been able to get provide for this in part but not in whole, so we have to find other means of doing it. Some of this can be done through the college, but we are limited in what we can get from this type of source.

There has been expressed by people at the college and elsewhere the opinion, that can be taken for what it is worth, that a good research assistant is worth several graduate students. No doubt some of you will have encountered graduate students who are not very effective. For some of the better undergraduate students we have in geology, physics and chemistry a program whereby they are expected to do a certain amount of research. This is not too dissimilar from what I think those from St. Mary's were suggesting yesterday. However, even here there are problems, and it is no kind of replacement for graduate students; undergraduate students simply do not know enough at that stage; we find it takes them a year to find their feet, and by that time they really cannot get very much done.

Some professors undertake research on their own; some have utilized undergraduates during the summer; they have borrowed, in one fashion or another, graduate students from other universities for summer work. They have hired research assistants. We have one or two post-doctoral fellows. By and large we find that the trained research assistant is almost invaluable. In contrast, the temporary part-time student graduate or undergraduate is not so useful; by the time their training is finished they have to go back to school. That is one of the real problems.

Out of all this we have made some recommendations. First of all, consideration could be given by a granting organization such as
the National Research Council to individual requests to employ assistants. This poses a problem that was mentioned yesterday, that one cannot be sure of continuity; it is on a year to year basis, particularly if hiring a research assistant who is not a student, and cannot be expected to be treated as a student, who does not like being told, "I can hire you this year but I do not know what is going to happen next year."
A second possible recommendation would be to have consideration given to groups of researchers who have more or less common interests, whereby they would be able to employ technicians or assistants on a longterm, probably pooled, basis, something that could be shared. I understand that under the existing regulations for the NRC initiated development research this does not appear to be provided for. This concept of pooling assistants among people who are working in more or less the same area would lead into the idea of interdisciplinary studies and interdisciplinary institutes, which is something that I believe could be considered, particularly for smaller universities, or perhaps groups of smaller universities.
That again leads to a third possible way in which this might be handled, in the establishment of some sort of organization which would have as its objective a form of policy collaboration on research and the relationship between government and industrial laboratories. As you know from the hearing yesterday, the Atlantic provinces have been able to do this. I think we could have something like this on a possibly regional basis in Quebec.
I find myself at a disadvantage in addressing the committee because most of the points I would want to make were discussed yesterday. However, perhaps this serves to indicate how common they are.

The Chairman: It is a new aspect of Canadian unity!
Dr. McDougall: Various people in our college have done something along these organizational lines. They have made arrangements to use other laboratories, and there has been a certain amount of trading of information back and forth. However, this is always on an individual basis. I personally have found that I get remarkable cooperation in some areas and virtually none in others. I have been startled to discover some places where I get lack of cooperation, but this is not an Anglophobe or Francophobe relationship, because some French universities collaborate very
readily and sometimes it is the other way round. It therefore seems necessary to have some fairly formal arrangement established, perhaps on a federal basis or on a regional basis. I am not sure what the answer is.

That in essence is what I have to say. For the smaller undergraduate colleges and universities the problem seems to be closely allied to lack of sufficient help for (to use a phrase used in the report by the Canadian Association of Graduate Schools) the little research program.

The Chairman: I understand that Dr. Catherine Haggart Westbury, from Marianopolis College, is not here. So we will hear finally from Dr. Ufford, Assistant Dean of Science at Sir George Williams University. He will replace, this morning, Dr. Samuel Madras. Thank you.

\section*{Dr. J. R. Ufford, Assistant Dean of Science,} Sir George Williams University, Montreal: Thank you, Mr. Chairman. I would like to take this opportunity to thank the committee for this chance to express some of our views and concerns. One of our big concerns at the moment is that the competition for funds to support research is constantly increasing, and we are afraid that there is a tremendous amount of unwary duplication in the efforts which have been carried out. We would like to see some sort of co-ordination between universities on research projects in order to prevent as much duplication as possible, but we would like to emphasize that in this co-ordination it should be set up in such a way that there is no block to the development of the newer universities.

A second area of concern for us is the current decreasing possibilities for employment of science students. One of our concerns is to try and find some way to develop employment opportunities for graduates of Canadian universities. We feel that if these can be developed we can keep students taking science courses in universities and therefore will not get into problems of decreasing numbers and rising costs. We should like to see a vigorous Government policy to encourage research by Canadian industries in Canada, again to support the employment of undergraduates. We should also like to see the universities turn more attention to applied research and not deal exclusively with what might be called pure research. We would support the suggestions of McGill, that support for research not be confined to one area but that the support be obtained from as
wide an area as possible. Also, we should like to support McGill's opposition to the Macdonald Report in regard to the support of graduate students from operating grants. Thank you, Mr. Chairman.

The Chairman: Now, I would propose that we should proceed first, during our discussion period, with the brief which was presented to us by the French-speaking universities and then deal later with the other English-speaking universities. I think it would be more convenient for the purpose of our discussion.

\section*{[Translation]}

\section*{Senator Bourget?}

Senator Bourget: Thank you, Mr. Chairman.
Dr. L'Abbé, you mention on the first page of your report that you wish to stress the need for close co-operation among the various representatives which you subsequently list. Could you tell us what kind of body you would suggest to establish closer co-operation among these representatives?

Dr. L'Abbé: The brief does not answer this question explicitly. It emphasizes the importance of co-ordination. On this subject, I can give you either my personal view or the view of the University of Montreal.

The Chairman: Am I right in understanding that you are not speaking in your role as general delegate at this point?

Senator Bourget: Are you giving us your personal ideas?

The Chairman: Since Dr. Kerwin is present, he can give us Laval's views.

Dr. L'Abbé: A suggestion on this subject was made to the Macdonald Commission by the University of Montreal when they met; it was made again in a recent brief to another body. This was the suggestion to set up a national committee which would not be federal only but rather a joint federal-provincial committee. Such a committee would thus include both the federal government and the provinces in its representations, because, in view of certains aspects of research, each province should actually establish a policy in this area. The federal government should also establish one, since there should be a policy for Canada as a whole, for the Canadian nation. I feel, then, that the various governments must work together and the idea that a federal-provincial committee could play such a role is one that has already been
expressed. This would make it possible to solve jointly the problems of disparity which I mentioned in the brief; it would make possible concerted action on important scientific developments which are now very expensive for a country and which must be carried out with a great deal of selection. These policies must be very specific, therefore, but they must at the same time be universal and involve everyone.

Thus I feel that the idea of a federal-provincial committee would make it possible to arrange this kind of co-ordination and overall planning more adequately.

The Chairman: Would this be an advisory committee?

Dr. L'Abbé: Yes, Mr. Chairman, but an advisory committee to the governments, and its recommendations might therefore have an influence on federal policy, and, to the extent that certain provinces are also involved, on the policy of these provinces.

Senator Bourget: In your opinion, Dr. L'Abbé, how should this committee be made up? Should there be representatives from the universities only or from each of the provinces only? If there were more representatives from the universities, this committee would be...

Dr. L'Abbé: I do not think that this is necessary. There are other ways of representing all the parties concerned numerically than through us. There is already a Council of Ministers of Education; surely this council could delegate people to represent it as a whole. There are certainly ways to avoid multiplication of this kind, which is ruinous and serves no useful purpose.

The Chairman: Dr. Kerwin, do you have any comments to make?
Dr. Larkin Kerwin, Vice-Rector (Research), Laval University, Quebec: Yes, Mr. Chairman. In reply to Senator Bourget's question, an effort must be made to avoid an organization for preparing the country's science policy, which is uniform and locking in diversity, since such a situation would be static. Research, on the other hand, is dynamic. Since research is dynamic, the structures needed will vary, sometimes from year to year, but particularly from one generation to the next. Thus we in Canada will not be inventing the organization to end all organization for science administration. Other countries before us have tried to do so. Many
experiments have been made in England, France and the United States, and inevitably several structures were established, because, for no matter what area a system is evolved, scientists are ready to invent another, either in competition or in answer to new needs. As a result, the committee suggested by ViceRector L'Abbé would be an excellent idea because it would answer a need which is not satisfied at the moment.

There are other necessities, however, and still others will appear a few years from now. For this reason, a flexible policy is needed. Above all, we must avoid trying to establish a structure which would include everyone and which would attempt to determine science policy once and for all, so to speak. That would not be a science policy at allscience is not like that.

The Chairman: I agree that federal-provin-cial-university machinery which would do nothing but talk and which could not reach any conclusions should be avoided.

Dr. Kerwin: Exactly. Scientists will find something to work on immediately.

Senator Bourget: Dr. L'Abbé, will this committee also concern itself with finances and financial aid to universities, or will it only be concerned with determining science policy?

Dr. L'Abbé: It will naturally be a political body with an essentially advisory role toward the government authorities; it will not itself, however, be involved in research or in distributing funds for research.

Senator Bourget: Following the order of your brief, I see on page 2 the statement that it is of prime importance that the authorities concerned agree to devote a greater part of the gross national product to research. In your opinion, how much of the gross national product should go for this purpose? Do you have any ideas on this subject?

The Chairman: Could you try to give an exact answer?

Dr. L'Abbé: Yes, we naturally considered including figures, but after consultation we decided that, in view of the urgency of submitting our brief, we would not have the time to do so. Basically, we suggested as a goal to reach in five years' time the ceiling of 4 per cent which has presently been reached in the United States. This may seem unrealistic to some people, but...

Senator Bourget: For the next few years, in particular?

Dr. L'Abbé: Yes, perhaps we should say over the next ten years. It seems likely that o her countries may have gone well over this ceiling by that time. Perhaps my colleagues Dr. Kerwin has some clearer ideas on this matter. We had planned to be more exact in this regard and we consulted with one another, but we found that we were at a loss for a decision.

The Chairman: Do you have anything to add, Dr. Kerwin?

Dr. Kerwin: Mr. Chairman, we see no reason why the various calculations worked out by several committees and research bodies should not be referred to. The figure generally given for Canada's expenditures on research and development is in the area of 1 per cent; it varies between 1.2 and 1.5 per cent-agreement must be reached on what that means, but in general these are the limits. Similar studies indicate that in the United States and England-and somewhat less in France and West Germany-the figure varies between 2.8 and 4 per cent. Even though we may debate the fraction, the factor 2 remains. The factor 2 would be an excellent goal to set to be reached in five, or, if we are pessimistic, in ten years' time. However, as long as this factor 2 is not met, I feel that scientists would be well advised to quote Samuel Comber and say that they need "more".

Senator Bourget: You also say, on page 3, that Canadian science policy should be pluralistic. Do you mean by that that there should be no overall policy for Canada or possibly that the Canadian government's policy should take into account regions and provinces? Could you explain what was meant by this statement?

The Chairman: Or perhaps various research centres or sectors were meant, or else government, university or industrial establishments?

\section*{Senator Bourget: That is right.}

Dr. L'Abbé: Yes. Of course, it is both an important and a difficult question. It is perfectly obvious that we do not mean that an overall policy is possible. On the contrary, we hope that there will be an overall policy, but such a policy must take into account this very pluralism. It must not block either regional differences or our attitude on cultural differ-
ences, which perhaps do not have repercussions on science itself, since science is universal, but which do have obvious repercussions on research workers and scientists. This means that in a way the sectors of scientific activity could be distributed. There is no need for everything to be repeated in the various regions, which would be ruinous, or in the various Canadian communities, which would be just as ruinous, when there is no justification for such action. Such great efforts may be made that it will be enough to have one centre in Canada, but it must be an excellent one. There is a whole system of complementarity to be established, but I shall venture to limit myself to the part which concerns cultural differences and the French and Englishspeaking communities. A little more than the pooling of efforts is involved here. To take a concrete example, it makes little difference to the people of the Maritimes whether meteorology is taught as it is at the present time in Toronto, McGill or Vancouver, because, in any case, there are excellent centres in these places. These are English-speaking centres, and a Maritimer can go there and feel at home. It is, however, quite standard that there are no French-speaking meteorological centres financed by the federal government in Canada. Establishments of this kind should be multiplied until there is an adequate number to serve both communities, since here it is a question of research leading to the training of research workers.

In other areas, the problem of communications, the vast field of communications will also have aspects which will inevitably bring in this cultural factor. This cultural factor, however, is far less important in other areas and may be completely ignored; it is possible to imagine a French-speaking centre which would be excellent for Canada as a whole or again an English-speaking one which would be excellent for the entire country, and such a situation, in fact, would be very desirable in certain sectors where a real joint effort would be made to establish international centres of some value.

Senator Bourget: Then, that is actually related to the proficiency centres which you mentioned in your brief and which, in your opinion, would be the proficiency centres which we could have in Quebec because there is some talk of distributing those proficiency centres in different regions. In view of the history of our universities, of which Dr. Dugal's minority report made mention, there
would perhaps be a need to divide up the proficiency centres. Now, in your opinion, what proficiency centres could we set up in Quebec?

Dr. L'Abbé: Hold on. You are asking a rather difficult question. Do you realize that such an answer requires a. .

The Chairman: Yes, whether it will go to Montreal, Sherbrooke or Laval certainly will not be decided this morning.

\section*{Dr. L'Abbé: No, even that we...}

Senator Bourget: I did not specify Montreal, Quebec or Sherbrooke. I am speaking from a provincial point of view.

Dr. L'Abké: Yes, you are asking me a question which will bring in all the political arrangements at the science level, the Canadian level and the provincial level. I would hesitate to make any specific suggestions although there are some.

The Chairman: No, but let us say in Montreal for example. What areas in your university at present seem to be at a first-class level with respect to others?

Dr. L'Abbé: Well, listen here..
The Chairman: That again, it is...
Senator Bourget: In Quebec, for example from a language point of view?

Dr. L'Abbé: If you will allow me I was just about to do so and I am going to let Mr. Kerwin answer. However, I could talk because we are somewhat ahead in mathematics. That is perhaps tooting my own horn to some extent considering that I have returned to the same subject but it is the area I know best. There is already a national mathematics centre planned, which will begin this fall, financed by the federal government and which will be extremely important. It seems to me that there is another area which would be well adapted to the Montreal region. It is that of urban studies. Montreal is a vast, natural laboratory for everything concerning urban problems.

The Chairman: It would be developed around the urban planning department, I suppose?

Dr. L'Abbé: Of course. We already have a highly developed urban planning department, an urban studies section which is rapidly
growing. There is much interest in the Montreal region. Obviously, there are other universities which can take part in it. It seems to me that, urban research and even regional research to some extent as urban regional planning could be an excellent area for Montreal.

The Chairman: Is Dr. Selye's institute independent but affiliated with Montreal?

Dr. L'Abbé: No, it is not independent. It is part of the faculty of medicine but that is a rather special case which involves an area which had-let us say that I refrain from discussing that question. Obviously, it is the whole area of health. The organization of duties is extremely involved. However, there are other areas in which we are somewhat advanced for the Province of Quebec i.e. another area is that of fresh water. Quebec is a natural reservoir of fresh water. Canada in general and Quebec in particular in that regard have rather extraordinary resources for all the American continent. Therefore, it would not be unusual for a water institute, and a fresh water institute in particular, in Quebec to attain a truly international scale. The same thing applies to applied research for hydroelectric power. However that has already begun thanks to Hydro-Quebec.

\section*{Senator Bourget: Thanks to Hydro-Quebec?}

Dr. L'Abbé: Yes, and whom we hope will develop even more because of funds made available not only by the provincial but also by the federal government.

The Chairman: And, obviously with the cooperation of atomic energy.

Dr. L'Abbé: Yes, that is right.
Dr. Kerwin: Mr. Chairman, a few moments ago, I was going to be much less shy than Dr. L'Abbé and tell you that the mathematics centre at the University of Montreal is an excellent example of an area which could become a truly international proficiency centre for Canada. In mentioning water research, Professor L'Abbé also touched on an area where Quebec is highly competent. We have the resources and this is an area of major importance for Canada. I shall mention two others. Even if there are other centres in the country, it is essential for the whole of Canada that, in Quebec, research on the Far North be carried on and developed for there is also fine competence in that field.

Finally, it seems to me that Quebec clearly stands out as one of the important research centres on bilingualism and biculturalism and that applies also on the international scale. We know that there are perhaps twelve largescale centres in the world. There is no reason why Canada should not rank with them one day.

If you will allow me Mr. Chairman, I should like to complete Vice-Rector L'Abbé's idea with an example in order to answer Senator Bourget's specific question about the pluralistic policy for science which will take cultural differences into account. Here is a specific example. Science policy is seen through a multitude of applications and among other things, a system for staffing laboratories has developed in Canada. This system enables us to employ professors, graduate students, post-doctoral scholarship students, research assistants, and so on to form a hierarchy. The system was conceived to meet the needs of laboratories faced with the labour market. However, that market is the North American one and recruitment possibilities are here and there and are reflected in that policy of establishing positions. However our situation in French Canada is very different. We do not have the same recruitment possibilities at all and our recruitment problems are much different from those of English-speaking universities. Consequently, that cultural difference which makes itself known by a recruitment problem must be reflected in science policy by the creation of appropriate frameworks for such a situation. That is a specific example where science policy must demonstrate itself through two forms of structure of policy which take into account the needs and the cultural situation of the two language groups.

Senator Bourget: Is one of the reasons which makes your recruitment a problem due to the fact that you do not have sufficient financial resources or is due to the fact that it is difficult for you to find the competent researchers you need?

The Chairman: Or are needs increasing too quickly?

Dr. Kerwin: No, it is our geographical situation. To repeat the phrase mentioned on countless occasions, we are 6 million people submerged in the ocean of North America. It is not unusual for the English-speaking universities to recruit a good part of their staff abroad. It is good and it is desirable. It is
also good and desirable that we should be able to do the same thing. However, we cannot turn to our neighbours. We must go further. We must recruit on a world-wide scale. Therefore, that must be brought out in the structures and in the patterns.

Senator Bourget: Well then, with the new exchanges especially between France and Quebec, would there not be some way of recruiting the researchers you need in the French-speaking centres?

Dr. Kerwin: Yes, the system which was recently implemented by the National Research Council, on the one hand, and by the National Arts Council on the other, is precisely a partial answer to a policy which will take cultural differences into account. Our brief maintains that the policy must always be before us when elaborating the s'andards.

Senator Bourget: Then, what would be the suggestions you would have to make?

Dr. Kerwin: Well first of all, I am perhaps anticipating your questions, Senator...

\section*{Senator Bourget: Go on.}

Dr. Kerwin: I apologize because it crops up later in the brief. In Canada, we have approximately thirty large-scale federal laboratories. Those laboratories are scattered here and there and are fortresses of strength for both the recruiting and the marketing of scientists. However, only one of the thirty laboratories is somewhat bilingual. That is the Defence Research Board laboratory in Valcartier. And so, just as it is not unusual to have dozens of these laboratories...

The Chairman: Is there not a laboratory at Laval?

Senator Bourget: Yes, it is on the Quebec campus.

Dr. Kerwin: I am sorry. You are perfectly right. There is a small laboratory there also.

The Chairman: We went to Laval too, you know.

Dr. Kerwin: You are quite right. There is that one.

The Chairman: And, in agriculture?
Dr. Kerwin: We have hopes.

Senator Robichaud: Were approaches not also made by certain federal departments to Quebec authorities to set up laboratories in co-operation with Laval University for example and was that co-operation granted?

Dr. Kerwin: In what way, for example?
Senator Robichaud: Fisheries for example.
The Chairman: Fisheries-Senator Robichaud is the former Minister of Fisheries.

Dr. Kerwin: I know that there is our biology department which wants to set up its marine biology research centre and is waiting patiently for the conclusion of the agreements.

Senator Robichaud: Perhaps the federal government is also waiting.

Dr. Kerwin: Then the waiting will end tomorrow morning.

Senator Bourget: Dr. L'Abbé, to continue with that line of questioning, were specific requests made by the universities to set up laboratories, were they turned down and what reasons were given for refusing the establishment of certain laboratories requested?

Dr. L'Abbé: Yes, I do not think that is quite how the laboratories were set up. At present, we are talking about federal laboratories. It is truly the federal government that takes the initiative in setting up and centralizing its own laboratories.

The example is extremely important and I want to underline Mr. Kerwin's comment that the scientific potential of the country is not monopolized solely by the universities but by all employers of scientists. At present, federal laboratories are one of the largest employers and are also a reservoir of scientists who, afterwards can come to the universities that want to hire university graduates.

I wish to point out the existence of postdoctoral scholarships awarded to foreigners, as such non-Canadians, to come to Canada. They have been in existence for a long time. Previously, there were approximately 175 scholarships awarded each year. Approximately fifty of these went to universities and of those fifty, approximately eight went to French-speaking universities. The post-doctoral scholarships were eliminated at the university level and only the others were continued. The others were for English-speaking federal enterprises, thus enabling Anglo Sax-
ons, persons already speaking English and bilingual persons to come to Canada and very often to remain here and to add to the potential of Canadian researchers. However, in that regard we, French-Canadians, were at a great disadvantage because the welcoming environment required, as it were, an Anglo Saxon network to supply it. It is impossible to imagine a French-speaking person arriving at the National Research Council and not speaking English and even in my opinion, at Valcartier where administration is still unilingual. Valcartier is beginning to become bilingual but there is some talk now about making it into a unilingual centre which would be normal in order to compensate the Anglo Saxon unilingual centres which exist and which will not change. However, at the present time and in the past, even rather recently, those possibilities did not exist. It is not a question of university action but of federal government action because it is its own laboratories, answering either to departments or to important Crown agencies, which have that responsibility.

With regard to the research centres which would be proposed by the universities to the federal government, we are presently working together to meet such requests and I am rather optimistic about future results. The mathematics centres is already an example. That of CRAM at Laval is another.

I was talking about urban and regional studies. At present, we have already taken steps to benefit that type of institution.

At the end of our brief, when we mention unilingual federal laboratories in Quebec, we also added the existence of proficiency centres which would be set up either at a Quebec university or in co-operation with several universities and the federal government. Therefore, that is a case of joint bodies, as already exist in the Anglo Saxon field in some places.

The Chairman: As suggested earlier by Senator Bourget, there has not been much pressure, until now and as far as I know, upon the Federal organizations by the French-speaking universities, to do in Québec what has been done elsewhere, and I really have the impression that other universities are relatively often in Ottawa to present their claims, or to exert pressure.

Dr. L'Abbé: That is undoubtedly correct, but this also reflects in a certain sense, the aspect which I mentioned, to the effect that
the Federal organizations are largely under the control of the English community; this is not a reproach, but a reality; it is a fact, and knowledge of future policies concerning possible resources makes the discussions easier; we have not formed a part of the normal network which exists everywhere, so to speak; but we are getting in there, and I think that things are beginning to change.

The Chairman: I believe that even in the past, just recently, it was very difficult for certain Federal research organizations, who also had the function of distributing subsidies, etc.,-it was rather difficult for certain of these organizations, to recruit Frenchspeaking Canadians, because, apparently, they were rareties; I do not know, but...

Dr. L'Abbé: That is entirely correct. I must now say, that we are finding, the three universities combined, in the various fields, the complementation, the necessary resources to exactly find there the candidates that are as qualified as the others, and...

Senator Bourget: It will probably be easier in the future, due to the degree of excellence which you are now achieving, as mentioned in your report. There will, undoubtedly, be some slight difficulties, but I believe that you will be able to overcome them.

Dr. L'Abbé: Yes, but they will probably not be overcome by the simple course of events; corrections will have to be made to establish a certain discontinuity and to guide the future in a different manner. This has already been done, I might say, in certain organizations. For instance, the Canada Council, in my opinion, admirably reflects the bi-national character; it is the only organization, in my opinion, where one can express himself in French and in English, and be understood.

The Chairman: Does this not mean, exactly, that the persons we have trained,-I do not want to speak for my constituency,-but, that the persons we have trained in our Social Sciences Faculty, were more active on the Federal level, as compared to the sciences,the natural sciences, or the human sciences?

Dr. L'Abbé: I have just a short remark to make on that subject; when the humanities are involved, it is obviously more normal that bilingualism is expanded with respect to sciences, because we clearly know that in physics, for instance, English is the language, and that in the scientific field, this is a real-
ity-whereas, in the humanities and also in the social sciences-the requirements are different. But, as you said, it is quite possible also, that particularly the role of Laval has been important from that point of view, and has favored this type; but, naturally, when you are in political sciences, you are mixed up more with politics than when you are a chemist, or a geneticist.

The Chairman: But, is the mentality in the science faculty not in the process of being changed, so that, today, the scientist will have to participate in shaping the scientific policy, because otherwise...

Dr. L'Abbé: Judging by those who are presently occupying themselves in the universities with questions of research, etc., there is quite a change, and our corps of professors also has become much more representative of the various tendencies, from that point of view; it has been enriched by a foreign influence, an international influence, which we have assimilated and they now can easily serve at a level that is certainly international, and, therefore, also national.

Dr. Kerwin: Mr. Chairman, I should like to make three points, if you please. I respectfully submit that I fail to see that a question of mentality is involved, when you make a distinction between the effects upon the social sciences and natural sciences. The social sciences, in general, are a recent phenomena in Canada, and the French speaking universities have achieved a certain maturity, at the same time as the other universities in Canada in this field. Therefore, I would say that they entered the field in plenty of time.

The Chairman: I do not believe that that is true.

Dr. Kerwin: Whereas, in the natural centers, we are quite young; we do not have French Canadian physicians who have died, or who are grandfathers.

The Chairman: The department of economic sciences was founded at Queen's in 1899, and the first economic department founded in Quebec was in 1943.

Dr. Kerwin: It is obviously worse for the natural sciences, because I observe, as far as I am concerned, that scientists are present in Ottawa, and on the committees, and for a long time, but always in proportion to their number, meaning, 10 per cent, and I do not believe that we should dwell on the reasons,
or the blame for that, but that we should observe the facts and should look for remedies.
Thus, earlier, to return to my other point, we did not reach the logical conclusion of the discussion, which involved that question of the Federal government's laboratories established in the Nation. If these 30 English speaking laboratories exist, it is a very precious reservoir for the English speaking universities and for recruiting and for showing off their degrees.

Therefore, in order to have an analogous situation, in order that we may have those possibilities for hiring and showing off our personnel, there should be more French speaking persons, or bilingual persons, scattered equally over the Nation, not necessarily in Quebec, but probably in the area of Winnipeg and in the Moncton region.

Consequently, a scientific policy that takes these cultural disparities into account,-that is another special point that has been raised further in our brief.

So, to come to my third point, Senator Bourget touched on what is for me the essential point of our brief. This is that 30 years ago, it would not have yielded results if they had invested millions for research in our French speaking universities, as it is considered today; we did not have the professors nor the personnel; it had to grow, like the others, and now, we allege that we are ready; we have three universities of stature, with an excellent staff, several of whom have international reputations, and we are now able to play the role that has been played by others for a couple of generations. A couple of generations ago, the circumstances were such that institutions such as Toronto, or MeGill, could serve as centers of excellence for Canada and, thank God, we had McGill in Québec, and Toronto in the English speaking part of Canada; that is what gave us an international reputation and that is also where much of our management was trained. Well, we now have to relive that experience. We could not have gone through that experience in French Canada a generation ago, because we were not ready, but now, we are ready, and there is a resource, a natural wealth, which Canada must now exploit, as it has known how to exploit it two generations ago.
Senator Bourget: I am with you for one hundred per cent.

Dr. L'Abbé: This is an official question and I truly believe that the essential part of our
brief is this, what we find on page 11, which is the end, and which may be the most dynamic and perspective point of our brief, I believe.

Senator Bourget: Yes, you also speak in your brief, Dr. L'Abbé, of close relations, of communications that must exist between the universities and the various agencies of the government; what kind of a mechanism are you providing in order that there may be closer ties between the universities and the various agencies, because it seems that in certain agencies French speaking Canadians are absent. So, would you have a few suggestions in order that our presence be better felt and our needs be better understood?

Dr. L'Abbé: Yes. There certainly are recommendations that can be made for that type of an idea. There is already a committee that was established jointly by the Research Council for Defence and by the National Research Council to study these questions, especially questions of bilingualism and biculturalism as a function of their mission in the two organizations and the universities. That committee, which started to function a short time ago, will submit a report to each of the two councils of those organizations in that respect. It obviously goes without saying that the normal thing is to be represented by qualified persons in these organizations in the same manner as are our English speaking colleagues. But, there again, it seems that, maybe during a transitional period we have to add more, in order to correct the situation. I told you, those organizations will remain unilingual for a relatively long time to come. It is out of the question to go to the Research Council for Defence, of which I am a member, and to speak French. I think you could do it, but we would be understood by a few French speaking Canadians and maybe one or two English speaking members.

Senator Bourget: Do you have simultaneous translation during your meetings?

Dr. L'Abbé: No, no. I believe that the National Research Council works in that direction. It is a palliative. But it is not, in my opinion, sufficient. It would therefore, be necessary that there are, in addition to those groupings, means of a temporary nature, that would operate let us say for a period of 4 or 5 years, and that would commit to committees that operate purely in French, like others operate exclusively in English, in order that-it may look superficial, does it not, to
be able to express oneself in his own language when things are involved that, from all appearance, are quite international in nature, but I think we are making illusions. If you want to express yourself in your own language, you know the types of innuendos you can use, you can understand half a word, you are able, in some sort, to capitalize on the whole culture for which the language is the vehicle. This applies to sciences as it does to other fields.

Senator Bourget: As in politics.
Dr. L'Abbé: As in politics, undoubtedly.
Senator Bourget: We have had that experience. Only, we realize nevertheless, that we must correct the situation, and that is the reason why I am asking you,

Dr. L'Abbé: Yes, it is somewhat to make things sensible and to correct them somewhat, and, therefore, these are not recommendations that would set up permanent separate organizations, but that would provide for a certain period of time, the mechanism to correct that situation. Those things are somewhat improvised, but I wished that there were committees, as there is one on organizations procedure, that stoops and studies, and that makes concrete recommendations of that nature.

Senator Bourget: \(\mathbf{M r}\). Chairman, I would have other questions to ask, maybe, even now, but I see that it is twenty minutes to twelve.

The Chairman: Do you have anything else to add, Dr. Kerwin?

\section*{Dr. Kerwin: No, Mr. Chairman.}

The Chairman: I think, then, that you will nevertheless be able to participate, now that you have spoken to us, the language of confidence, as was said by René Lévesque.

Senator Bourget: Would there be a chance that we come back, Mr. Chairman, because there are still other questions.

The Chairman: Certainly. At any rate, I think that this discussion is ending provisionally on a very optimistic note, in the sense that I have the impression that, from now on, there will be a greater positive participation on the part of the French speaking universities in Quebec in the scientific efforts of the whole of Canada.

\section*{[Text]}

Senator Cameron, do you have some questions to ask either of the English-speaking or the French-speaking universities? You can ask your questions, and I am sure they will be answered.

Senator Cameron: There is one problem that has been bolhering me for some time. How do we deal with the situation of these small universities such as Bishop's and some of the others? On the one hand, we are saying we must have centres of excellence but, in effect we have big establishments with resources in depth of a large number of researchers, and I think we must have that, but this will never be possible in the small universities. So, what is going to be the role of the small university which, from a purely academic standpoint in the fields of mathematics, history, literature, and so on, may do a better job than the big universities? What is their future in the research picture? I would like a little more elaboration on that, and as to how they can get a proportion of the research funds and as to what they can do with what will always be limited resources.

Dr. McDougall: I think I can say something on that, Mr . Chairman, and this is a personal opinion. I do not think that a centre of excellence necessarily connotes science.

Senator Cameron: No, that is true.
Dr. McDougall: I do not think that the small universities, in engaging in selected areas of research, are necessarily going to rock the boat. We can probably individually and as a group work very well in more restricted areas-perhaps in some area of research for which there is not a large amount of funding-and do an excellent job, and even a superior job because they are working with more detail than can be expected from a larger group in respect of which this particular area is only a small aspect of what it is doing.

Dr. Frost: Could I try to answer that question? I would suggest that there is no black and white answer to this. Small university centres, if they have enough workers, may very well do excellent work, but their efforts are going to be tempered by lack of facilities in all the departments. What we at McGill would like to suggest is that the larger university become a kind of umbrella institution for graduate studies and research, so that people who are teaching at the undergraduate
level in the small university can, in certain geographical circumstances, be linked with the larger university for their graduate teaching and their research. We at McGill would welcome this kind of co-operation. This is not always possible for geographic reasons. I think a very good case could be made out for Sherbrooke to develop on its own simply because of geography, but in the case of the Montreal institutions I for one-and I know this is the thinking of my faculty-would welcome the opportunity of having our facilities made available to people other than those on the McGill staff.

\section*{[Translation]}

Dr. L'Abbé: I should like to make one or two remarks on that subject. Mr. Frost has mentioned Sherbrooke in particular, which has started to solve that problem in a manner that, in my opinion, is excellent, by specializing itself in some sort in certain fields and I would like to remark that, presently, the field of medicine seems to be becoming something remarkable, by the introduction of a somewhat revolutionary curriculum and methods, which is even being watched outside our borders, whereas this seemed difficult in our own universities that are somewhat mired in certain attitudes. We have there an example of a regional university, not too well developed, but which strives for excellence in certain fields which it has chosen deliberately and in which it is able to operate in an excellent manner.

Another remark, relevant it seems to me, which could help greatly the universities, the small universities in a centre such as Montreal, which perhaps would not be the solution mentioned by Mr. Frost, to put some of the resources of the large universities at their disposal, is to make some of these resources, in my opinion, communal, so to speak, and nearly decentralize them. And, I am thinking of three orders of resources, libraries. A city like Montreal, I think, should eventually have a single university library, a large library which will be the meeting and working place of all the researchers in the area. These libraries, I believe, should not be the property of any university in particular. They should be a community affair. I do not see any objection to the same being done for what is called the "computing" resources. There again, a researcher in a university, a small university, can be disadvantaged if he does not have access, and every day, or at least in a very direct fashion, to these resources. There is also, because of the volume and of the danger of multiplying very costly re-
sources, the fact that it might be advantageous to have a consortium where these resources would really be pooled. They would not be under the management of any university in particular. A last field of this kind, a last kind of resource which is important to social sciences, for the same reason, is what can be called the data banks which are also subject to large investments and could be the subject of a common consortium.

The Chairman: Dr. Kerwin.
Dr. Kerwin: Senator Cameron, allow me to offer a suggestion to solve the difficulty you have brought up. It happens that, if the small university can have, for instance, on the campus an excellent man, then his presence makes all the difference; and an excellent man knows how to do a lot of good things with poor means. I know because I was educated myself in a small university where there was an excellent man; he is sitting at the rear of the room at this moment. But the problem is that, in general, small universities do not know how to draw such people. Therefore, if the federal government could establish, in each university, a chair of top quality research, with enough remuneration to draw an excellent man, the effect on the small universities would be much greater than on large ones. This is a micro-element to the solution of our problem.

\section*{[Text]}

Dr. Frost: That would make for other problems too, because we would have professors (federal) as opposed to professors (provincial).

Dr. Kerwin: J'ai bien dit «chaire de recherche».

Senaior Cameron: I hope the members of the panel will not misunderstand me. I believe that the small university has a great role to play. Institutions in the United States like Antioch College, and Mills College in California, are doing very good jobs in limited fields, and I think that encouragement must be given to this kind of university in Canada, of which we have a number.

I think it is obvious that in terms of national policy these small universities will have to be told by whatever national body we have: "This restricted area of competence is the only area in which you can develop and get national funds." I would think too that these small universities can do their best work in the areas of the humanities rather than in the big scientific fields.

There is no question but that when a student in the biological sciences and the physical sciences wants to take advanced work in his discipline, he wants to go to a place where there is not just one man. He wants a program in depth, where he has the challenge of many minds. This is really the thing that bothers me so far as the small university is concerned. Certainly, they can have a great man, the ideal teacher-and it is a gift beyond price to have a man like that-but they cannot have very many of them in a small university. In my opinion this is going to pose a real problem in terms of working out a national policy. There is the problem of how we can make it possible for the small university to make its most effective contribution. The suggestion has been made by Dr. Frost that those who live within the periphery of a large metropolitan centre like Montreal can come under one umbrella. They can use the same library resources. This again is a matter to which the committee will have to direct some attention in terms of national policy, because as it is we cannot afford library services without proliferating; we must concentrate on that.

When we consider the area of the computer, obviously the cost of this kind of equipment and its utilization is beyond the resources of the small university, but it could be tied in under the umbrella of a metropolitan centre, just as we can with library services. I wonder how far the new technique of retrieval services can be extended to the small universities. Sherbrooke is not very far away, but what use can it make of the retrieval services? The same applies to similar universities remote from the larger centres. Certainly there could be a computer link, but I am wondering whether this would meet the need of the small university. This again is something to which we have to direct our attention. How do we do it?

Dr. McDougall: In the Montreal area, in some ways I think many of these things are actually being done on a quite informal basis. There is a small computer that is now linked to Ottawa, but prior to that we had one at Sir George Williams and also at McGill. There is a good deal of library interchange.

If I may revert to what Dean Frost said, at one stage, at the level of several departments, we tried to make an informal arrangement with McGill to borrow graduate students to Work in something like the manner Dean Frost was referring to, but it did not work, possibly because it was the wrong time or the
wrong place. This is something I would like to explore myself on a personal basis.

\section*{The Chairman: Why did it not work?}

Dr. McDougall: One of the excuses was that there were not enough graduate students to go round. In a few instances we suggested to some people that perhaps a graduate student could make use of our facilities; we did get one acceptance of this offer, which unfortunately turned out to be one we could not handle.

Dr. Frost: There is a very great deal of cooperation between Loyola and McGill in African studies.

\section*{Dr. McDougall: Oh yes.}

Dr. Frost: And in French-Canadian studies with Sir George. The libraries are now in fairly common use. There is a great deal of work going on in history. As my colleague says, these arrangements are largely informal, but they are very active and very useful.

Dr. McDougall: There is activity in these areas. However, the area in which I would like to see more activity is that of the sciences-geology, physics, chemistry or biology-in which there could be some "backing and forthing" between the institutions, with more use of the facilities and more use of graduate student, whom we do not have and encounter a great deal of difficulty in getting somebody to replace.

Professor Dutton: It is true that in a small university research programs must of necessity be limited. However, this in itself is rather a contradiction in terms. The advantage of the small place is that it is not too highly specialized, not too limited; those who go to such a university do not talk merely to people in the department of physics but talk to others as well. It seems to be a contradiction to suggest that there should be an extreme limitation on the kind of research activities. Obviously we have to restrict them in some way, but if we can restrict them generally it would be much better than limiting them to one particular type. There are programs that can be followed in small universities, though they have to be chosen very carefully.

Senator Cameron: I meant restriction in the sense that you could not have a large research program in mathematics, another in physics and another in biology; you have to be selective.

Professor Dutton: Yes, I think so. Perhaps we have to pick an area in which we could use a mathematician, a physicist, a chemist or a biologist.

Senator Cameron: Dr. McDougall suggested the pooling of research facilities and assistants among the small universities. I can understand how this can be done under the large metropolitan umbrella, but is there much of a problem in McGill or the University of Montreal assigning a certain number of research assistants to, say, Loyola or Sir George Williams?

Dr. McDougall: This is precisely the problem I was mentioning. It has proved difficult to try to arrange some such system as this. In individual cases, very much on a personal basis, it has been possible, but not with any kind of regularized, systematized set-up. I was speaking specifically of pooling resources within a small university whereby there could be a sort of interdisciplinary organization, which would perhaps do a little more towards the research need. At the present time we have technicians for the services of the faculty of science, but their use for research purposes is necessarily somewhat restricted because they have other jobs to do as well. It would help if we could be sure of continuity so that we could hire people whose job was principally concerned with research projects, so that we could have one or more electronics men who could maintain equipment, possibly where we have a small research project in which a full-time research assistant was not necessary, a man who could work on one or two projects, perhaps one in physics and one in chemistry. This has reference to the idea of an interdisciplinary study organization that might be set up in this fashion, so that there could be an interdisciplinary research institute, possibly a materials seience institute, as one finds in some of the comparatively small American universities, where there are people in physics, geology, metallurgy, sometimes biology and chemistry, working more or less under the same roof, using more or less the same equipment, utilizing the same processes and working on a series of studies.

Senator Haig: Pollution would be a good example.

Dr. McDougall: Pollution would be a good example.

Senator Haig: There are many disciplines affecting that problem.
Dr. McDougall: Pollution, oceanography. I would think materials science would be one area for an interdisciplinary group. Chemists could study polymers, metallurgists interests would be in metals, biologists in minerals and crystals, physicists in physical chemistry and so on.
Senator Haig: Would that be a fair example of use for the Montreal area, for a joint, cooperative, coordinated effort between large and small universities?

Dr. McDougall: It might work out.
The Chairman: You mean pollution now?
Senator Haig: Yes.
The Chairman: Not oceanography?
Senator Haig: No, no.
Dr. Frost: We already have a joint university of Montreal-McGill committee on pollution, which has been quite active for some time.

Senator Cameron: Again, in the case of the small university, is there any possibility of a sort of joint utilization of graduate students between the small university and industry, where you have enough work or facilities to employ graduate students full-time? Is there any possibility-perhaps it has been doneto have that person work part-time in the university and part-time in an adjacent industry.

Dr. McDougall: At the present time this is being done in the Chemistry Department at Loyola. There is a man doing research on organic compounds. He spent the last two summers doing research at Loyola and the winters working in industry.

Senator Cameron: I want to come to Dr. Ufford's statement about duplication of resources and the need for some agency to direct and co-ordinate the utilization of funds in university. I would like some further comment about this.

Dr. Ufford: I do not say there is any conscious duplication. Any duplication is surely an unconscious thing and becomes apparent sometimes when it is too late to do anything about it. If there was some way of co-ordinating research projects on a wide scale-it can
be done very easily on a narrow scale. For example, in regard to the chemistry departments at Sir George and McGill we know what is going on in both cases and have little, if any, duplication. We do not know what is going on in detail at U.B.C. or Alberta. We have a general idea, but the details are not known. If these details were co-ordinated in some place, I am sure there could be a cutdown on any possibility of duplication before anything really starts.

Senator Cameron: Does this suggest to you a possible need for a sort of a national inventory of research projects?

Dr. Ufford: I would say so, sir.
Senator Cameron: Do you think it is feasible to have such a national inventory? Some people have said to me that it is not.

Dr. Ufford: I think it is, because it is done in Quebec at the moment. Laval keeps a running inventory of all research projects.

Senator Cameron: In both English and French universities?

\section*{Dr. Ufford: Yes.}

Senator Cameron: I am very glad to hear it.

Dr. Frost: I might say it is a very large document. If we were to have a national one it would be an immensely huge document.

Senator Cameron: When thinking about using computers for retrieval techniques, while we do not want to restrict regional work it is quite possible that several people work on the same idea without any collusion or collaboration. I am thinking in terms of utilization of resources of money, time and plans. We must find some means of having an overall picture of what is going on so that we do not have this duplication.
I think the committee would be anxious to find out what would be the most practical way of doing this. Can we make a recommendation? What are our recommendations? Can it be that some attempt must be made to establish a national inventory of research projects in Canada? This even has implications beyond Canada, because there is not too much value in duplicating something done in the United States, France or Belgium. I realize it is a big job. Is there a practical way of getting this information pooled some way?

The Chairman: Perhaps Dr. Kerwin would tell us, briefly, how their system functions in Quebec?

\section*{[Translation]}

Dr. Kerwin: The system to which you referred has just been started, Senator, and, up to now, I would not dare to say that it has been very useful. It consists, in short, of a complete list, with cross-references, of the theses which are directed by the professors of the six universities.

Well, to find oneself in there is not very easy. I believe that the main usefulness of the system, so far, has been to initiate this cooperation, to set up the personnel necessary to carry out the system, and we hope that our second try will be much more useful.
Personally, I am not very optimistic about the utility of detailed inventory of the research subjects across Canada. It is an inventory which loses its interest after maybe two months, because these projects are very dynamic and change very rapidly.

It would be advisable, no doubt, to make a limited inventory to know the fields that are being tackled, and the centres where this work is being carried out must be known.

What, I think, would be much more useful would be a policy of much higher travelling expenses to allow scientists and humanists, and especially their graduate students, to attend much more often periodical meetings, seminars and congresses, so that they can meet each other, because it is by visiting the laboratory or the shop in the college of the other university that we learn much more quickly and much more efficiently what is being done, when we compare this process to the use of an inventory.

I do not know of any inventory, neither at the International Council of Scientific Unions, nor at the Scientific Unions, nor at UNESCO, which was as useful as expected, and I believe that, unless remarkable progress is made in the treatment of information, within five years, that we should maybe rely more on visits,-and as Canada is a country 4,000 miles long and 100 miles wide, this creates special circulation problems, and I think that our science policy must take it into account.

\section*{[Text]}

Dr. Frost: I am tempted to add that no decent faculty which graduates students has anything less than 10 per cent airborne at any one time. This business of being able to get to scientific meetings and to meet other people in the field is really more important than
having an elaborate print-out of projects. We, at McGill, have issued an index of research which indicates the areas of interest of the different professors. We believe this is another way of tackling this problem. It is an immensely important problem, and I would like to support the suggestion that funds to travel to scientific meetings is an important help in this way.

Senator Cameron: As a university administrator I am appalled at the escalation of travel costs, as it is. What you are suggesting may be perfectly correct, because I believe there is no better way than first-hand contact. However, this is going to call for a tremendous escalation of travel expenditures. In your judgment, is that the most effective way of getting this over-view we need of a national program of research?

Dr. Frost: I would say that of all the ways in which we might get this the most effective way would be through meetings of the learned societies and the various disciplines. I would really like my colleague who is here with me today and who is Vice Dean of Sciences to answer that, sir.

Dr. R. E. Bell, Vice-Dean, Faculty of Arts and Science, McGill University, Montreal: The difficulty with the big list is that it is too big for any one individual and therefore it is not suitable for anybody's use as an individual. Each person has a personal area of interest and the difficulty is to make him acquainted with the situation in that area of interest and as his job changes and time goes by the various changes occur in the dynamism which Dr. Kerwin spoke of as being extreme in these areas.

I support the travel suggestion. I do not know how far short we fall in the idea of travel now. We are doing fairly well in certain areas of travel. I am sure Senator Cameron would be glad to hear this.

The Chairman: Perhaps one thing which is not available is travel expenses to give an opportunity of meeting a group of colleagues, not necessarily at a meeting of learned societies but to visit a laboratory. I have attended many meetings of learned societies and I do not think they afford a proper climate for a very pround exchange of views.

\section*{Dr. Bell: We need something informal.}

Senator Cameron: This is an asset. But are you going to say to a graduate student, working on some problem in biochemistry, that it
would be a good idea for him to visit a western university, one in Saskatchewan or Vancouver, or he could spend a week in Toronto? Do you think this is a good thing?
Dr. Frost: We are doing this to a limited extent.

Senator Cameron: Is it the consensus of this group that a total inventory of research projects is impracticable-that is the first thing-and then, if that is the case, is it possible to establish an inventory of areas of interest where this is being developed? Is there anything of that nature existing in Canada today?

\section*{[Translation]}

The Chairman: Dr. Kerwin.
Dr. Kerwin: Mr. Chairman, I would like to point out that the idea of a Canadian inventory , whether it is extensive or taken in a given field, is not altogether practical, because the scientist of the humanist, who is interested in such a problem, well, it is true that he is interested in what is going on in Alberta or in Saskatchewan, but he is also interested to know what is going on in New York, in Mexico City or in Buenos Aires.

In order to be practical, such an inventory must be global and I would prefer that Canada associate itself with international organizations such as UNESCO and IXOU to elaborate such an international system because, in a given field, there is usually, for the natural sciences, at least some twenty laboratories, of which one or two are in Canada, and then to invest a lot of money to find out about such a small fraction is not worth it.
I would prefer that Canada invest the same amount of money to help international systems.

There is now an embryo system in the United States, and it is, up to now, what we have found the most useful. It is a system by which we receive every week, every Monday, the list of the publications we are interested in; it is done by computers and, for my sector, it is what we have found the most useful. But its strength is that it is international; if it covered only what is being done in the United States, it would already be less interesting.

\section*{[Text]}

Dr. McDougall: I think I can add two more instances to the sources of information on research. We have got one in a geological survey in Canada which publishes a summary
of research in the geological sciences. This comes out quite some time after it has been compiled.
Another one, which comes out at intervals, is a list of research projects in Ontario, published by the Ontario Research Foundation, which covers quite a broad field but is mainly limited to things that the Ontario Research Foundation are interested in. Some of it is industry, some in laboratories and some in the university.

Senator Cameron: I do not wish to monopolize the questioning, but inevitably we will reach a stage where federal plus provincial funds are the main sources of financing of our research; and we are never going to have enough. Unless we have some pretty good idea of what is being done in each field, there is a possibility that some university or some research institute will be overlooked or neglected. We need some kind of guideline as to what is being done, where it is being done, and how much it is likely to cost. This is something that goes right back to the federal agency.
Dr. McDougall: In a very restricted field, of course, you can more or less keep abreast of this sort of thing. One thing which it might be worthwhile considering in some fashion is Something that was done in the United States in the past. The National Science Foundation, starting I think about 1925, was very interested in the development of radioactive dating of geological material. From 1925 until sometime during the war, and subsequently for a few years afterwards, they issued a series of papers which summarized this. They had major papers and they kept a running list of activities in different laboratories, on a worldwide basis, which were considering some of these problems in the radioactive dating of geological material. This is a source back in history of something which might be considered. It took a very dedicated indivdual to carry this out. It meant corresponding with laboratories all over the world. It was on a personal basis, actually, and also took up a great deal of time in abstracting the papers which were sent in. It takes some kind of organization to do this. At that time it provided a very clearcut picture of what is happening on a worldwide basis.

\footnotetext{
Senator Bourget: May I ask if these gentlemen would be in favour of setting up a department of science and technology or if they have thought about it or about some other kind of mechanism which would co-20466-3k
}
ordinate our science policy or science projects here in Canada.

\section*{[Translation]}

Dr. L'Abbé, have you thought about it?
Dr. L'Abbé: After all, like many others, considering the multiplication to-day of the organizations which are engaged in science policy or in carrying out research work, it seems clear that something of the sort becomes essential. Must it take the shape of a Department of Science and Technology, an agency which has therefore not only a consultative role, but also an executive one? Personally, it seems to me that this is a thing toward which we should tend, but maybe not directly, otherwise we always have committees or advisory councils which make recommendations, but, in the end, the decision makers are somewhat dissociated from the motivations which permitted the formulation of the recommendations, and I am afraid that, at that time, the consultative and the executive become too dissociated. It would seem that, eventually, the responsibility should be given to those who were able to convince themselves of the merits of the decisions they will put into effect.

\section*{[Text]}

Dr. Frost: We have talked about this several times at McGill and our opinion has been that the spectrum of interest we covered is so great that one ministry of science and technology could never hope to cope with the whole field. It is true that you do get a certain amount of overlapping between different ministries, and, what is perhaps even more important, you get a number of interstices where they don't actually meet and there is a gap between the interests of the two fields. But, nevertheless, to envisage one ministry which attempted to cover the whole field would, in our opinion, be setting up an organization so gigantic that it would hardly be able to bring itself to bear on the very important and practical points that both science and technology have to deal with.

That, I think, is a consensus of opinion among my colleagues, as much as I have discussed this with them.

Senator Bourget: So one of our duties would be to report to Parliament what kind of mechanisms we should have.

The Chairman: As an alternative to this, do you think we should have a minister mainly responsible for overlooking science policy?

Dr. Frost: That would certainly commend itself much more clearly and, of course, there are examples of that particularly in Britain and on the Continent. To have a minister responsible for the general oversight, I think, would be an excellent thing, but to have one department would be to make this too large and the responsibility too manifold.

Senator Bourget: I am not speaking about one department. I am speaking of one man in charge, a minister or some other kind of mechanism. Through our inquiries since starting this committee, and I think I express the feeling of the members of the committee as a whole, we have found that there is some duplication in our research; so the purpose of it is to save money and then men as well, researchers.

\section*{[Translation]}

The Chairman: Dr. Kerwin then.
Dr. Kerwin: For my part, Senator, I do not like too much the idea of a Minister of Science, and I share the views of Dr. Frost on the matter. Now, there is, none the less, a middle term, and indeed, from what I have studied, this middle term has been found by France. In France, science is the responsibility of a group of ministers, and this group, forming the Science Committee, is chaired by the prime minister himself, and, in general, the work is done by the very important man who is called the Delegate General. But, then, the total budget for French science is submitted to the House by a group of ministers and thus it does not compete with the other departments, and it is sponsored by the prime minister himself. I think that this middle term between on the one hand, one minister and on the other hand, no minister, as is now the case, or a group, this is maybe the middle term which would be suitable for Canada.

The Chairman: Senator Hays.

\section*{[Text]}

Senator Hays: Mr. Chairman, we have an inventory of all the research programs at universities and the students involved in them. Supposing a student at Bishop University is very bright and wishes to do research but there are no research facilities there in so far as his line of interest is concerned, and supposing further that he might very well be at Bishop for four or five years; do the universities give any consideration to calling such a particular student in because he can make a great contribution? Do they feel that he
should not be left at Bishop but should be at McGill or Laval where there are all the facilities to help him in his goal?

If you do have these types of inventories, then what do you have to say with respect to the sort of inventory of the kind of person we are teaching?

Professor Dution: I think this is done consciously, Mr. Chairman. The constant preoccupation of the professor is to get his students to the place where they will get the most, produce the most, give the most and receive the most. I think we do this. It is an occupational hazard of being a professor.

Senator Hays: On the question of the budget, you mentioned, Dr. L'Abbé, that you thought 4 per cent was the goal. I don't know where you got the figure of 4 per cent. Perhaps it was from what the United States had spent in the field of research. You suggested that the goals should be out in three or four years. If my arithmetic is correct, we are speaking of something like \(\$ 3\) billion.

You also mentioned that this should be the responsibility of the federal Government, and I think we are spending something like \(\$ 800\) million now in the field of research at all levels in Canada. This would constitute about 25 per cent of the present federal budget, if we were to spend this amount of money.

Do you think that Canadians can afford to do so? Do you think we are losing by not spending more in the field of research? After all, we are talking about a lot of money when we talk of \(\$ 3\) billion, or a figure close to that.

Dr. L'Abbé: It depends where you start: 1 per cent or \(1 \frac{1}{2}\) per cent. As Professor Kerwin mentioned, perhaps the best idea will be to try to double our effort within a certain number of years, for example five years. You said that we have reached about \(\$ 1\) billion a year now.

Senator Hays: Something less than a billion dollars; approximately \(\$ 870\) million in all fields.

The Chairman: The total Canadian effort is about \(\$ 800\) million at present, but the federal share of research and development would be only about \(\$ 400\) million.

Dr. L'Abbé: But, if you compared development of the national budget over the last five years and projected that, I don't think there would be any difficulty.

Senator Hays: Would you tie it to the gross national product, which is something like \(\$ 68\)
billion, I think, in the federal field? This would be approximately \(\$ 2,600\) or \(\$ 2,700\) million in the field of research.
I am just putting a figure on it rather than tying up the programs. If we said to you that we were going to give you 400 per cent more this year than we did last year, could you spend it wisely? That is the question.
Dr. L'Abbé: We all agree in Canada that the viewpoint is applied science today. This is much more costly, of course, but it is also much more productive. So it looks like a big effort, but it might have lots of gains. Nobody will say that you have to do that for fundamental research. As you said, we perhaps could really accept all that and really feel responsible for it, but I think one has to very much point out that the need is for applied research and in applied research we are weak owing to very peculiar situations.
All applied research is more or less done in the United States. In the industrial plants here in Canada they are not really doing their share in Canada. They are not doing what they should do. Therefore, there is surely a bigger responsibility of the Government for that purpose.
Senator Carter: Mr. Chairman, one of the witnesses earlier mentioned that one of the universities, Laval or the University of Montreal, I am not sure which, had already compiled an inventory for the whole of the province of Quebec for the universities, and what I would like to know is how that inventory is being used. What use is being made of it?

\section*{[Translation]}

Dr. Kerwin: It is not used very much, Senator, because of its primitive form. This exists since last year. A team had to be assembled, the six universities had to agree and then, a way had to be found to produce this document. Thus, this document consists of a complete list of the thesis subjects of all the graduate students at the six universities. This document is divided into parts: there is the list of students; there is the list of the theses; there is the list of the disciplines and fields; there is the list of the thesis directors. It is a document just about so thick. The conclusion we have reached, after this first experience, is that it is not the form, not only not ideal, but it is not even the practical form of the document to be produced. Consequently, our team is now considering the problem of making it much more useful. In particular, it seems to have reached the same conclusion as the one mentioned by Professor Bell that
this document should be divided into disciplines and should supply more details in a field more limited to various professors. We are conducting an experiment, but we do not anticipate that it will he a success; but the test must be made.

The Chairman: I am afraid we will have to come to a close, but before doing so I would like to ask a final question, if I may.

Dr. Ufford has mentioned briefly, a while ago, the problem of employment for university graduates. I wonder if our guests from French language universities have studied this problem. I have been told, for instance, that the number of students in the Department of Social Sciences at Laval University, two years ago, was around 800, and that it is now 1,600 , thus it has doubled during the last two years; I wonder if they have considered that this could become a problem from the point of view of future graduates, in this field as in any others.

Dr. L'Abbé: Will you allow me to give a quick answer to this question, before I cede the floor to my colleague M. Kerwin, maybe.

The Chairman: The same situation probably prevails in Montreal.

Dr. L'Abbé: Yes, the phenomenon is probably even worse in Montreal. We have now more than 2,000 students in the Department of Social Sciences. Well, this year, I would say luckily, because there is really a difficulty concerning the placement of students, temporary maybe, but real; this year, the number of applications for admission is lower, which was anticipated. In fact, we are pacing ourselves to meet this difficulty by the creation of a second degree, a second cycle which would be much more professional. For instance, a doctorate in communications which would be available to graduates of quite specialized disciplines, such as political sciences or sociology, or linguistics, etc. I think that we have failed in not creating this type of a more professional degree which leans more on the profession, and which can more easily find an outlet. At the moment, our graduates, after a first specialized degree, are a little narrow in their knowledge and not too generalized, and thus must often retrain themselves in order to benefit from their first training which is a cultural and general training, but which could bring them on the labour market with a more professional bias.

The Chairman: But in the field, at the Science Faculty for instance, in Montreal, do you anticipate about the same problem or not?

Dr. L'Abbé: No, at the Science Faculty, we do not anticipate the same problem. We are even astonished that the number of applications for admission, and I believe it is worse at Laval, is so low. There is a craze for social sciences and letters which may be to the disadvantage of the science disciplines. With regards to engineering, the trend, of course, all over America, is to develop more and more engineering and especially at the graduate level, and we have not yet made this change, and we have not even taken steps to do it, but inevitably, it will become necessary, because it is certainly not by producing a great number of engineers of the first cycle that we will be able to meet the needs of the market from this point of view.

Senator Bourget: There is the Polytechnical School, where I was a student in 1932; since then, a great evolution took place in the sense that there is much more specialization now than in my time, 30 or 35 years ago.

Dr. L'Abbé: Yes, but it still is not enough at the master's or doctor's level; there are very few doctorates.

Senator Bourget: Yes, very few, unfortunately.

Dr. Kerwin: Mr. Chairman, at Laval, it is the opposite with regard to engineering. Our engineering departments are among those where the rate of research performed is the highest in Canada but, except for this, I agree with Dr. L'Abbé's remarks, we have about the same situations in the human and social sciences. I will add that, sometimes, the evolution of a university is not necessarily logical in its context, and we are subject to social pressures. Thus, until very recently, the labour market has been able to absorb all the graduates in social sciences that we could produce. Now, this is changing and there are a great deal less positions available, and the first reaction of the students who are unable
to find work is to remain in graduate school, which is not logical, but which creates problems for us.

Dr. L'Abbé: Now, Honourable Senators, please allow me to add a remark. In certain fields of social sciences, as we have noticed, we have a very high rate of excellence and this, consequently, would allow our graduates to leave the country, well, maybe not the country but Quebec at least.
The Chairman: As I said yesterday, to go to foreign provinces.

Dr. L'Abbé: Yes. I point out, for instance, that in anthropology, we have, evidently, in Montreal a department which forms a team that is quite remarkable at the international level. Naturally, we do not need a very great number of anthropologists in Quebec itself, but Canada certainly does, and other countries too, and we could certainly, at that time, think of outlets for our graduates which would be, let us say, in the whole of Canada, and in other country, perforce in the underdeveloped countries, in particular those where we would participate actively.

The Chairman: Therefore, you do not see any surpluses developing within these universities, except in the field of letters and social sciences?

Dr. L'Abbé: Well, please note that in letters even, we must be careful because the teachers' market can absorb many, except maybe in certain fields where there is a recession, even at the level of secondary education, considering the options which are being introduced. For example, history loses its value, the classical languages, of course, have nearly disappeared.

The Chairman: I wish to thank our guests this morning. I think we have had a good day during which we have had discussions which, for me at least, were very interesting.

On behalf of my colleagues, I wish to thank everyone around this table this morning for this very interesting discussion.

The Committee adjourned.

SCIENCE POLICY

IN CANADA

A Brief submitted by
Laval University, the University of Montreal and the University of Sherbrooke
to the
Senate Committee on Science Policy

May, 1969

The French-language universities of the province of Quebec have decided to submit a common brief outlining their views on the problems faced by universities in their research activities. In response to the need for a new conception of the nature of the university, and as a result of the major contribution made by the state and by the business community to scientific progress, it is of primary importance that the universities seek to comordinate their own research policies. This brief is a step in that direction.

A research policy of this kind, however, cannot be divorced from an overall science policy. In presenting our views on the problems posed by university research, we wish to emphasize the need for close comoperation between the parties involved in the conduct or financing of research: governments, industry, labour unions and other groups. Such co-operation seems to us essential to the avoidance of useless duplication of effort and expense, and the ensuring of harmonious development in the various fields of research accompanied by the exchange of scientific knowledge, with constant thought being given to the research needs revealed by society.

In so doing, we make no prior judgment whatsoever of any possible future agreements or changes in the political situation involving the federal and Quebec governments, nor of the constitutional option towards which Quebec might lean in the future. Faced with present realities which demand immediate action, we choose rather to analyse the current situation, and in making recommendations, we shall limit ourselved to those which are capable of immediate implementation within the political and constitutional context of today.

\section*{I - RESEARCH AND CANADIAN SOCIETY}

Since numerous studies have adequately demonstrated the importance of research in the achievement of social progress, no purpose would be served by dwelling on the point. That science, and the technology it engenders, have played a prememinent role in the development of the advanced industrial society is a commonly agreed point, and it will suffice to add that the acceleration in that development demands an increased research effort. It is imperative that the responsible authorities - governments, industry and the university community - agree to devote a greater part of the gross national product to research.

We are anxious to stress two features of Canadian society which should be reflected in any science policy, the first is its pluralistic nature, the second is the individual character of the Canadian economy.

\section*{(a) Canada's Pluralist Society}

For historical and geographical reasons, different parts of Canada have developed at different rates, leading to the creation of regional disparities. Only through the implementation of economic policies agreed upon by the federal government and those of the provinces can such disparities be reduced in the future. However, no policy can succeed in obviating the individual needs of the various regions, and it would be il1-advised, if not actually harmful, to attempt to chart a single course for economic development in the Maritime and Prairie Provinces, or in Quebec and British Columbia.

Similarly, a science policy for Canada needs to be pluralistic, both in its objectives and in its implementation, so as not to confine regional policies to a straitjacket.

Two extremes must be avoided: we must not attempt development of every kind of scientific activity in every region, nor must we lead each region to specialize in one field.

Moreover, the cultural plurality of Canadian society, to say nothing of our national duality, implies that any overall science policy should refrain from opposing, or even re-directing, individual policies that may be espoused by any of the cultural communities that together constitute the Canadian people. On the contrary, a science policy for Canada must be based on this objective reality, and must comprise the sum of the directions in which each of these communities wishes to progress.

We are aware that the concentration of the French-speaking community in the Province of Quebec lends a political and constitutional dimension to this question. We do not wish, in this brief, to suggest answers to - or even examine - the question; we merely wish to bring the problem to mind, and to insist that the constitutional debate be prevented from obstructing the development research.

\section*{(b) The Individuality of the Canadian Economy}

Of the factors tending to hamper economic and scientific development in Canada, the following may be cited:
(i) a sma11 and predominantly youthful population;
(ii) territorial vastness;
(iii) an economy that is frequently dependent on outside stimuli;
(iv) the proximity of the United States.

In view of the foregoing, Canadian science policy must establish objectives that will allow us to preserve our autonomy, bearing in mind the resources that are available to us. The primary objective is the
maintenance of balanced development in the various fields of scientific activity that are essential to a complete society. This objective, however, minimal though it is, will not be sufficient to end Canadian dependence on scientific and technological innovation originating abroad.

It is essential that our science policy concentrate on selected areas that are compatible with Canadian individuality. Thus, research in such fields as transport, communications, water use and conservation, northern development and inter-cultural relations would enable Canada to meet her own special needs. Such a policy would also foster the creation of centres where first-rate work would be carried on, thus making a major contribution to the international scientific community.

\section*{II - RESEARCH AT THE UNIVERSITIES}

University research, as an activity involving both the expansion and distribution of knowledge, is an essentia 1 pursuit, closely linked to that of education. The two are complementary and mutually self-generating. The symbiosis between education and research achieves its highest expression in programs leading to masters' and doctors \({ }^{\text { }}\) degrees. This fact offers a reminder that universities are not mere research factories, but provide the best possible environment for training researchers; the importance for scientific progress of the contribution they make in this area cannot be ignored. The effort made over the last few years to encourage students to pursue post-graduate studies must be maintained, and even intensified.

Apart from the expansion of knowledge, research contributes to the greater well-being of society through technological innovations
resulting from scientific discoveries. Universities cannot neglect this aspect.

The time has come to encourage greater merging of the activities of universities with those of government research institutions, with due respect for the proper concern of each - the universities being oriented more towards basic research, government institutions towards appiled research.

In order for them to work in a truly effective way, it will be important for them to estab1ish a system for the exchange of information regarding their findings, as well as exchanges of researchers and trainees. This will involve the maintenance of working arrangements for commication within the scientific community to which they belong. The latter point seems to us to be of crucial importance insofar as inter-discipline research is concerned.

Work in the last-named fie1d has lead to the relatively recent idea of mission-oriented or combined research, and here the distinction between basic research and applied research tends to break down. The subjects of such inter-discipline research, particularly in those cases whe re "natural" scientists call upon "socia1" scientists or vice versa, relate to problems brought on by modern technology and social evolution, such as pollution, urban problems and pubiic hea1th.

The large capital and operating outlays involved in such projects require close \(\infty\)-operation between universities, between the federal and provincial governments and between universities and governments if costly duplication and wasted effort are to be avoided. It is also essential that a system of priorities be established, based on criteria drawn
up not by the central authority alone, but by all the agencies concerned.

The financing of largemscale research programs presents a twofold problem, particularly when they are carried out in an institutional context. Firstly, there must be some sort of guaranteed program financing. We recommend that those in charge of programs be able to rely on subsidies spread over three years; once the three-year initial subsidy has been granted, the subsidizing agency should inform the recipient at the end of each year as to whether the subsidy is to be continued for a further year. In this way, program directors would always have a three-year margin in which to plan for the continuation or cessation of their work.

Secondly, rules would have to be laid down whereby a research program could be terminated if the conditions that lead to its setting up had ceaded to apply, either because its objective had been porrly-defined in the first place, or because changing circumstances had destroyed its usefulness, and therewith its claim to priority.

Major research and development programs also involve a contribution from the private industrial sector. In this field, we believe that Industry must participate in the achievement of the overall objectives of the state. That is, it must involve itself, and must be encouraged to involve itself, in research programs calculated to further the economic and social development of the country; in so doing, it is but ensuring its own survival. It is important for industry to comperate with government and with the universities in order to foster technological innovation. Industry will have to depend more on research that is, or could be, done in the universities; this could be a means of ensuring a decentralization of industry and improved specialization in individual universities.

III - RESEARCH AND THE FRENCH-IANGUAGE UNIVERSITIES
For a complex of reasons that have been discussed in several published works, the French-language universities have developed more slowly than the English-language group, with some notable exceptions in a few subjects. Thanks, however, to efforts to catch up on the part of small groups, and to a policy of individual excellence, these universities are now well supplied with researchers and basic structures and equipment. The proportion of post-gra uate degree students has now reached the average leve1 for Canada, their researchers now obtain just as many individual grants in open competition with their English-speaking colleagues, and the portion of their budgets devoted to research is close to the Canadian average.

This basis must be used for the development of a recruitment policy suited to the establishment of large research centres through the hiring of experienced researchers, in order to achieve a balance in the teaching staff, and to the formation of research teams staffed by the researchers themselves and their assistants and associates. Once these teams are established around well defined programs, they will make it possible to invite researchers from other universities, to attract young scholarship-holders with doctors* degrees and to improve post-graduate courses. In a few cases, where the size of investments and the interdiscipline character of the work require it, universities must be able to set up research centres.

These reforms would have a number of financial consequences, resulting from the recruitment of experienced researchers, the transfer of staff from teaching to research, the acceleration in the training of
research or study directors, or the introduction of students into research teams by means of scholarships. There are certain basic obstacles resulting from present financing methods, because of the inadequacy of the material resources at our disposal and because of the difficulties experienced by younger members of our teaching staff in obtaining grants, under a system which is based on merit and has only recently taken account of historical and cultural differences between institutions located in different comunities.

The individual character of the subsidies granted by federal agencies places the French-language universities of Quebec at a disadvantage, in view of the number of French-speaking researchers in relation to their English-speaking counterparts, and the fact that the criteria on which awards are based do not favour young applicants. The federal government has not made sufficient allowance for the fact that, for historical and geographical reasons, the French-language universities have more difficulty in recruiting the experienced teachers whose high academic standing entities them to the larger research subsidies.

Furthermore, staffing developments in federal agencies very
largely ensure Bnglish-speaking control of the Canadian scientific community. Though those concerned may be unaware of it, this situation works to the advantage of official 1iaison between English-speaking researchers and federal agencies. It must be recognized that this creates a psychological climate that is less than inviting for French-speaking researchers.

Moreover, the federal government has established an impressive number of regional laboratories or research institutes throughout Canada. Capital investment has been vast, and operating costs are considerable.

These regional research centres are a valuable asset for universities located in their vicinity, either through actual co-operation between federal laboratories and universities, through the outlets they provide for students during their vacations, or through their researchers' participation in graduate teaching. One thing is certain: Quebec's share of the benefits flowing from such federal institutions is minimal insofar as the development of research within the province is concerned. Thus, not only have Quebec's taxpayers contributed their fair share to the establishment of federal government laboratories in Ottawa, they have also subsidized regional research activities with federal funds that are spent more generously elsewhere than they are in Quebec.

The total paid by the federal government in subsidies to Quebec's French-language universities reveals a basic problem. The figures for 1967-68, for example, show that out of a national total in federal subsidies of \(\$ 72,481,000\), the three French-1anguage universities in Quebec received \(\$ 8,046,000\), or \(11.1 \%\).

It is important for the federal government's policy to be realistic, and to reflect a pluralistic view of the university research situation. The agencies responsible for subsidizing research should take existing disparities into account, particularly where the French-language universities are concerned.

The French-1anguage universities, then, are ready to experience the growth in scientific activity that occurred in several Englishlanguage universities thirty years ago, at a time when the roots of a number of large growth centres were being laid down. We therefore recommend that the federal government use its offices to capitalize immediately
on this opportunity for expansion in Canadian scientific activity. Laval University and the Universities of Montreal and Sherbrooke must be the sites for the establishment, within five years, of several large laboram tories or research centres; in a few special cases, this could be done preferably through the medium of inter-university or university-government installations. Appropriate precedents currently exist in French Canada, and our recommendation, in essence, is that the present policy be applied on a broader scale. We further recommend that the federal government establish unilingual French-1anguage research laboratories in Quebec, and that close ties be developed between such laboratories and the universities.

\section*{IV - CANADA'S SCIENCB POLICY}

We belleve that the drawing up of a national science policy
for Canada must hinge on the following guiding principles:
1. The cultural and regional plurality of Canadian society;
2. Economic resources and limitations, and the designation of areas of special concern;
3. Exchanges of researchers and information between universities and federal and provincial government agencies;
4. The development of inter-discipline research through comordinated establishment of priorities and financing arrangements by all the parties concerned;
5. Industry participation in research and development programs;
6. Revision of the machinery for granting research subsidies and of the make-up of federal research agencies, in order to take account of the availability and willingness of the French-language universities to participate in scientific growth.

\section*{Canadian University Research Budgets}

\section*{in Thousands of Dollars}

\begin{tabular}{lllllllll} 
A11 & & & & & & & \\
Canadian & 60,772 & \(17.3 \%\) & 350,560 & \(100 \%\) & 79,622 & \(16.7 \%\) & 480,829 & \(100 \%\) \\
Universities & & & & & &
\end{tabular}

Source: Annual Report of the Canadian Association of University

Business Officers (CAUBO)
22-5-1969

\begin{tabular}{|c|c|c|c|c|c|c|}
\hline \multirow[t]{2}{*}{} & \multicolumn{2}{|l|}{Federa1 Total} & \multicolumn{2}{|r|}{Quebec Total} & \multicolumn{2}{|l|}{Tota1, French-Language Universities} \\
\hline & 1966-67 & 1967-68 & 1966-67 & 1967-68 & 1966-67 & 1967-68 \\
\hline National Research Council & 29,158 & 40,268 & 5,180 (17.7\%) & 7,042 (17.5\%) & 2,606 (8,7\%) & 4,066 (10.1\%) \\
\hline Medical Research Council & 12,100 & 17,565 & 3,488 (28.8\%) & 6,203 (35.3\%) & 1,431 (11.1\%) & 2,538 (14.4\%) \\
\hline Defence Research Board & 2,456 & 2,821 & 590 (24.0\%) & 663 (23.5\%) & 237 (9.6\%) & 295 (10.5\%) \\
\hline Canada Council & 983 & 2,102 & 279 (28.4\%) & 455 (25.6\%) & 184 (18.7\%) & 300 (14.3\%) \\
\hline Central Mortgage and Housing Corporation & 141 & 519 & 56 (39.7\%) & 147 (28.3\%) & 56 (39.7\%) & 134 (25.8\%) \\
\hline Atomic Energy of Canada, Ltd. & 461 & 519 & 150 (32.5\%). & 172 (33.1\%) & 113 (24.5\%) & 132 (25.7\%) \\
\hline Fisheries Research Board & 280 & 428 & 19 (6.8\%) & 8 (1.9\%) & 0 (0\%) & 0 (0\%) \\
\hline Departments: & & & & & & \\
\hline Indian Affairs & 427 & 461 & 80 (18.7\%) & 63 (13.7\%) & 66 (15.4\%) & 45 (9.7\%) \\
\hline Agricu1ture & 5445 & 625 & 101 (22.7\%) & 131 (20.9\%) & 31 (6.9\%) & 37 (5.9\%) \\
\hline Energy, Mines and Resources & 410 & 627 & 80 (19.5\%) & 77 (12.3\%) & 46 (11.2\%) & 45 (7.2\%) \\
\hline Forestry and Rural Development & 243 & 351 & 59 (24.3\%) & 115 (32.7\%) & 17 (7.0\%) & 20 (5.7\%) \\
\hline Industry & 1,483 & 222 & 1,442 (97.2\%) & 58 (25.9\%) & 0 (0\%) & 0 (0\%) \\
\hline National Hea1th and Welfare & 4,384 & 4,856 & 779 (17.7\%) & 703 (14.5\%) & 430 (9.8\%) & 37 (7.9\%) \\
\hline Transport & 211 & 313 & 86 (40.7\%) & 101 (32.3\%) & 5 (2.4\%) & 10 (3.2\%) \\
\hline Labour & 113 & 97 & 30 (26.5\%) & 25 (25.7\%) & 14 (12.4\%) & 18 (18.5\%) \\
\hline 0 thers & 458 & 707 & 137 (30.0\%) & 200 (28.3\%) & 65 (14.4\%) & 33 (4.7\%) \\
\hline Total & 53,753 & 72,481 & 12,556(23.4\%) & 16,163 (22,3\%) & 5,301 (9.9\%) & 8,046 (11.1\%) \\
\hline
\end{tabular}

Source: Research Expenditures in the University Community Department of the Secretary of State, Canada (1968)

Apri1, 1969.
(other than departmental)

\section*{National Research Counci1}

A11 1aboratories are located in

Ottawa, except for:

The Atlantic Regional Laboratory
The Prairie Regional Laboratory
(Dalhousie University, Halifax)
(University of Saskatchewan, Saskatoon)

\section*{Fisheries Research Board}

Biological Research Stations:

Oceanographica1:

Technologica1:

Defence Research Board
The Defence Research Bstab1ishment, Atlantic
The Canadian Armament Research and Development Establishment
The Defence Chemical, Biological and Radiation Establishment
The Defence Research Board Telecommunications Establishment
The Defence Research Establishment, Toronto
The Defence Research Establishment, Suffie1d
The Defence Research Bstablishment, Pacific

Atomic Energy of Canada, Ltd.
Chalk River Laboratories
Whiteshill Laboratories

St. Andrews, N.B.
St. John's, Nfid.
Ste. Anne de Bellevue, P.Q.
(English-language)
Winnipeg, Man.
Nanaimo, B.C.
Dartmouth, N.S.
Nanaimo, B.C.
Halifax, N.S.
Grande-Rivière, P.Q.
St. John's, Nfld. Winnipeg, Man.
Vancouver, B.C.

Dartmouth, N.S.
Valcartier, P.Q.
Shirley Bay, Ont.
Shirley Bay, Ont.
Downsview, Ont.
Ralston, A1ta.
Esquimault, B.C.

Ontario
Pinawa, Man.

Apri1, 1969.

THE SPECIAL COMMITTEE ON SCIENCE POLICY

OF THE SENATE OF CANADA

FROM

THE FACULTY OF ENGINEERING

LOYOLA COLLEGE

MONTREAL

\section*{SCIENCE POLICY AND HIGHER EDUCATION}

George W. Joly, Dean of the Faculty

Montreal,
February 27, 1969.

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\section*{1. LEADERS OF THE 1990s}

Those who will be the leaders of society in the last decade of the 20 th century will -- all of them -be preparing themselves in the 1970 s for this leadership. The majority of them will be doing so in an organized fashion -- enrolment in a university -- the only structure at the present time acknowledged to be the training ground for leaders.

\section*{2. THE TASK OF THE LEADERS OF THE 1990S}
1. The nature of the training for leadership which the universities should be offering in the 1970 s may be judged by looking at the nature of society today, and from this forecasting what it might be like in the 1990s.
2. 1. In 1969, our society is one wherein technology has a firm grasp on the citizen, whether he consents to the grasp or not. As a predominantly urban dweller, the citizen must depend on others for his livelihood, and what "others" offer him, is mainly work in industry. Whatever industry the citizen accepts an offer to work in, it will be technologically oriented. If, by chance, it is not, then it will not survive to the 1990s.
2. All societies on the planet, whatever their political nature, have embraced technology. Not only embraced it, but embraced it willingly. Hence, barring an atomic holocaust and a possible consequent return to barbarism, technology W111 still be here in the 1990 s and exert an increasing

\section*{2.2 (Cont'd)}
dominion over men's lives. If it is possible, here and there in 1969, as in agriculture, to earn a livelihood free of technological content, it will not be possible in the 1990s. Agriculture will be by then completely subjected to technology.
3. 1. A citizen in the ' 90 s, who will aspire to lead a society of his fellows for his and their good, will have to know how to control the technology that will be the main contributor to their real or apparent good.
2. To control technology is to make decisions about its objectives. This is, of course, the nature of control over anything.
3. Making decisions about objectives is assigning value to these objectives. Learning how to assign value must, then, be part of the training of a leader.
4. 1. The assignment of value has, traditionally, been the task of humane studies. But the humane arts teach only how to assign value to men's actions because their
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3.4.1 (Cont'd)
proper object is man and his actions. They have not
assigned, and of their nature cannot assign, value
to things.
2. "Things" have no "value" in the humane sense.
Some of "them" may be assigned value in assessing
the value of a man's actions, but such "things" are
elementary: food, clothes, shelter.
3. Technology is "things" and "they" are not elemen-
tary. "They" are complicated. "They" are electronic
circuits. "They" are atomic structures and inter-actions.
"They" are computers and the control that the latter
"things" can exercise over other "things", like the
production of goods.

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4. 1. He who would assign value to the "things" of technology as they bear on men must make the "things" of technology one of the objects of his studies.
2. He who would attempt to assign value to the "things" of technology without first having made them the proper
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4.2 (Cont'd)
object of his study would be making decisions comparable
to the ones about how many angels could dance on the
head of a pin.
3. He who would attempt to assign value to the "things"
of technology without knowing how to assign value to the
men for whom these "things" are made would be making de-
cisions comparable to those of the technologists of China
who in the 1950s set up living communes for the workers
in order to increase productivity by eliminating the
workers' time spent with their families. The goal of
technology, per se, is the 100% efficient use of things -
and of men. Hence the task of a leader in the ' 90 s will be to make decisions about the objectives of technology, based, at the lower level, on his grasp of the nature of its
"things", and based at the higher level, on the value to
be assigned these "things" in their relation to that
greater "thing" -- man.

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5.

\section*{3. THE ORGANIZATION OF THE UNIVERSITY}

\section*{1. INTRODUCTION}
1. 1. To offer young citizens in the 1970 s a formation for the leadership described above would require a re-structuring of higher education.
2. 1. The assignment of value to men and the assignment of value to things that has been postulated above as the foundation of leadership are in the current Canadian university presented in "Two Solitudes". Men are studied in Arts and "things" in Science - Engineering. 2. The relation between these two entities of the university might be described as "foreign".
2. 1. A university structure that might favor the formation of young citizens according to the ideas already described is outlined below.
2. Since no fiat can create a university structure an evolution of the present structures would have to occur, slowly at first, but accelerating, as 1980 approached.
2. UNDERGRADUATE DEGREE

\section*{1. COLLEGES}
1. A College would be an administrative entity for students and program consisting of a Dean and a staff of 25 for each 500 freshmen.
2. The College would be responsible for the guidance of the 500 freshmen for four years, that is, until graduation.
3. A new College would be constituted every September for the freshmen entering and it (academic members) would be dissolved when these freshmen had graduated.

\section*{2. STAFF}
1. The Staff would consist of 25 representatives -
one from each of the major areas described under CURRICULUM, below.
2. Normally, a member of the Staff would remain with the College until its dissolution.
3. Members of the Staff would be promoted by the College itself, subject to appropriate consultation
2.2 .3 (Cont'd)
with bodies outside the College.
4. Members of Staff would be chiefly engaged in undergraduate teaching while members of the College. They might however, present graduate courses.
5. 1. The Staff would be appointed by the Senate and/or the Board of Governors in the year preceding the formation of the College.
2. The 25 Staff members would elect the Dean.
3. At the end of the first year of the College, a majority of the students and a majority of the Staff, jointly, could nominate a replacement for the Dean or any member of the Staff.

\section*{3. GRADUATE DEGREES}
1. DEPARTMENTS
1. Departments would be academic entities consisting
of all members of the Staff of the university working in the same area of knowledge.
2. 1. The department would be responsible to the Senate for the state of the discipline in the university.

\section*{3.1 .2 (Cont'd)}
2. The department would be responsible for
supplying teachers for each college course.
3. The department would be responsible for the
guidance of graduate students in its discipline
by supplying them with directors of studies.
2. THE STAFF
1. The Staff would comprise,
1. Those members of the College working in the department's area.
2. Directors of graduate students.
3. Other personnel, not members of a College.
2. Directors of graduate students, and other persons not members of a College would be promoted by the department.
3. All ranks would be portable to or from a College and a department.
4. All members of a department would elect a Chairman.
4. THE STUDENTS
1. 1. In the long run, students entering university would normally register in a general program lasting four years.
2. The present secondary school curriculum of today would be adequate. However, students aspiring to go on to the university described in this paper would have to be guided in selecting courses that would be prerequisites for university.
2. 1. Normally, entrants would be oriented towards the development of industry, or education, or government.
2. Specialization in any discipline would be offered at the graduate level only.
3. It would be assumed that most entrants would aspire to specialization in graduate school.

\section*{5. THE CURRICULUM}
1. 1. The Curriculum would consist of 30 courses in four areas, Liberal Arts, Science, Engineering, Commerce. 2. At present, the number of courses in most universities varies from 21 in Arts to 35 to 40 in Engineering.
2. 1. The Liberal Arts (12 courses)
1. Empirical: 1. Psychology, Sociology, Communications Arts.
2. 3 to 4 courses.
2. Factual: 1. History, Language as reading and talking, Political Science.
2. 3 to 4 courses.
3. Subjective: 1. Literature in any language.
2. 3 to 4 courses.
4. Speculative: 1. Philosophy, Theology
2. 3 to 4 courses.
2. Science (6 courses)
1. Physics: Light and Electricity \& Magnetism
2. Chemistry: General Chemistry, Physical Chemistry
3. Mathematics: Vector Algebra, Calculus.
2. (Cont'd)
3. Engineering (9 courses)
1. Mechanics and Materials 2 courses
2. Graphics 1 course
3. Electrical Machines 1 course
4. Heat transfer 1 course
5. Fluid Mechanics 1 course
6. Computers 3 courses.
4. Commerce (3 courses)
1. Economics: 2 courses
2. Accounting: 1 course

\section*{6. CONCLUSIONS}

In making a new synthesis of knowledge for tomorrow's leaders, there would have to be a re-organization of the University where the synthesis would be made. Secondary benefits of some value to society would flow from the reorganization.
1. 1. The depersonalization that freshmen claim they suffer on entering university would be arrested. They would become a member of a College of not more than 500 and would remain in it until graduation.
2. They would be guided for four years by the same Staff -the Dean and his 25 teachers.
2. 1. The freshmen would be presented with a long-range objective - leadership in business, education or government and provided with a formation which they could easily see prepared them for the task.
2. The "relevance" of this education to life might bring peace back to the campus.
3. 1. Changing the role of university departments from the formation of undergraduates to the formation of graduate students would free its members from many administrative tasks which they find unprofitable to the advancement of the discipline.
2. The rewards for teaching versus the rewards for research would be equalized. Teachers would seek to join the colleges which would now have become responsible for their advancement.
4. 1. The instituting of a new College every four years would require a fresh approach to goals and curricula, every four years, at least.
2. The dissolution of a College every four years would inhibit the development of vested interests in a status quo.
5. 1. A student attending the university described above would have to commit himself to a discipline of self-organization for four years.
5. (Cont'd)
2. This would demand from others not prepared to commit themselves a serious examination of alternative forms of education, e.g., junior college

\section*{7. RECOMMENDATION TO THE SENATE}
1.

That a national committee of the Senate be set up made up of citizens who are equally at ease in the Liberal Arts and in Technology, to consider the feasibility of iniating in 1970 a pilot project of the program of studies outlined above.
2.

That if such a program were initiated, the Senate consider the feasibility of paying fees for the individual student enrolled in it, in an amount reflecting the true cost to the university of enrolling him.
BRIEF
SUBMITTED TO THE SENATE SPECIAL COMMITTEEE ON SCIENCE POLICY
BY
FACUITY OF SCIENCE, LOYOLA COILEGE
MOMTREAT

The Faculty of Science of Loyola College, is in an unusual but not necessarily unique position among Canadian universitylevel institutions.

Virtually all other Canadian Faculties of Science support, or are in a position to support,scientific teaching and research at the graduate level. Because of this, these other institutions are in a preferred position to attract and hold research-oriented professors. Above average undergraduate students are also more likely to be attracted to such institutions in the belief that the instruction will be superior. The provision of funds for research at the graduate school level is generally more liberal, based partially on the premise that graduate schools provide training for future scientists, and partially on the fact that research programmes may be more productive with the combination of the research-oriented professor to supnly direction and longer-term continuity, and praduate students to carry out snecific phases of the programme.

Despite the current and probable long-term undergraduate character of Lovola Collere, the Faculty of Science has managed to maintain a well qualified staff of professors. However, a number of promising young professors have left after a few years in order to join other institutions with superior research facilities, and other well-qualified individuals have refused appointments because of lack of graduate students to assist in research.

There seems little doubt that one feature which has halned to maintain the high calibre of the teaching staff has been the encouragement by the College of scientific research by members of the Faculty. This has taken a variety of forms, ranging from consideration of a professor's scientific productivity as part of the criteria for advancement, to partial financial support of research projects. Financial sunport by the College has consisted mainly of purchases of specialized equipment, where it can be shown that the eauinment can be used for underaraduate instruction, and salaries of technicians who are primarily conconcerned with the construction and maintenance of equipment for undergraduate instruction, and only secondarily with research projects.

In some instances the College has provided partial or complete salaries for research assistants. However, the onus is generally on the individual professor to obtain funds to carry out his research. The principal source of such funds has been the National Research Council of Canada, with some grants from other government bodies such as the Defence Research Board and the Geological Survey of Canada. In a few instances funds have been obtained from private industry and other sources. As a general statement, operational prants from the National Research Council are small, and it is difficult to obtain major equinment grants or funds to supnort full-time research assistants. As a further general statement, the justification for this granting policy is that, because of the undergraduate nature of Loyola, most research will be done intermittently by individual professors working alone, and that sustained research on a year round basis or large scale research projexts are not feasible.

It is the judoment of a number of the members of the faculty that the policy of the National Research Council towards an institution such as Loyola is generally generous, but in some areas may be somewhat short sighted. A number of members of the faculty have demonstrated their ability tocarry out excellent research programmes on a sustained basis.

Some of them have exnressed the oninion that more major equinment funds should be available in order to imnrove research facilities, but a more common opinion has been that skilled technicians and/or research assistants would be more effective in increasing scientific productivity. Quite probably the increase in productivity would be greater than that obtained from equivalent amounts spent to support praduate students. The rationale of their opinion is that a sincle well-trained technician or research assistant, working on a long-term basis, is probably more effective than a number of praduate students. It has also been surgested that, at an institution such as Loyola, the level of underaraduate instruction and orientation towards praduate-level research may in fact be superior to that at institutions with praduate schools, since our undergraduates are probably more aware of their professor's need to keep abreast of scientific developments, as well as their methods of carryinf on research.

The followin comnosite recommendation is submitted for the consideration of the Special Committee on Science Policy.

A considerable advantage would be arined for scientific research at undergraduate institutions such as Loyola if means could be found to increase the availability of research assistants and research technicians. This misht be effected in several ways:-

1: Greater consideration mipht be riven by granting orranizations, such as the National Research Council, to individual requests for funds to employ assistants.
2. Consideration might be given to groups of researchers with more or less common interests, whereby they would be enabled to employ technicians or assistants on a lonp-term "nooled" basis. The existing regulations
for \(\mathbb{N}\). R.C.Negotiated Develonment grants do not apnear to provide for such an arranfement.
3. Consideration might be given to the establishment of an orkanization which has as its principal obiect the promotion of a policy of collaboration on research between undergraduate collepes, universities, and government or industrial laboratories.

To a considerable extent, this is being done through nrivate arranmements on an individual basis. but the nolicy from institution to institution and from laboratory to laboratory varies considerably. If a uniform nolicy of collaboration could be established, it would appear to have the double advantare of imnrovinf the availability of skilled assistants as well as makine more efficient use of expensive units of equinment.

Respectfully submitted by D.J.McDougall, for the Faculty of Science, Loyola College

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. 47

WEDNESDAY, MAY 28th, 1969
WITNESSES:
Dr. B. M. Millman, Chairman of the Committee on Graduate Studies and Research, Brock University, St. Catharines, Ontario; Dr. G. D. Cormack, Associate Professor, Faculty of Engineering, Carleton University, Ottawa, Ontario; Dr. John Hart, Dean of Science, Lakehead University, Port Arthur, Ontario; Dr. G. A. Harrower, Vice-Principal (Academic), Queens University, Kingston, Ontario; Rev. Dr. Marcel Patry, O.M.I., Rector, St. Paul University, Ottawa, Ontario; Dr. M. Chagnon, Vice-Rector (Academic Affairs), University of Ottawa, Ottawa, Ontario; Dr. G. de B. Robinson, Vice-President, (Research), University of Toronto, Toronto, Ontario; Dr. John M. Carroll, Associate Professor of Computer Science, University of Western Ontario, London, Ontario; Dr. J. F. Hart, Head, Computer Science Department, University of Western Ontario, London, Ontario; Dr. E. L. Holmes, Associate Dean, Faculty of Engineering, University of Waterloo, Waterloo, Ontario; Dr. H. I. Schiff, Dean, Faculty of Science, York University, Downsview, Toronto, Ontario, Dr. Paul B. Hagen, Dean, Faculty of Graduate Studies, University of Ottawa, Ottawa, Ontario; Dr. D. W. Slater, Dean of the School of Graduate Studies, Queens University, Kingston, Ontario; Dr. G. E. Connell, Chairman, Department of Bio-chemistry, University of Toronto, Toronto, Ontario; Dr. A. N. Sherbourne, Dean, Faculty of Engineering, University of Waterloo, Waterloo, Ontario; Dr. J. S. Riordon, Faculty of Engineering, Carleton University, Ottawa, Ontario; and Dr. W. B. Rice, Chairman, Graduate Studies, Engineering Sciences Division, Queen's University, Kingston, Ontario.

\section*{APPENDICES:}

No. 70 -Brief submitted by the Faculty of Science, York University. No. 71-Brief submitted by Dr. John Hart, Dean of Science, Lakehead University. No. 72Brief submitted by the University of Waterloo. No. 73-Brief submitted by the University of Toronto. No. 74-Brief submitted by the Saint Paul University. No. 75-Brief submitted by the Department of Physiology, Queen's University. No. 76-Brief submitted by John C. Robertson, Department of Religion, McMaster University. No. 77-Brief submitted by Laurentian University. No. 78Brief submitted by the Research Advisory Board, University of Guelph. No. 79Brief submitted by Division 11, Faculty of Arts, Carleton University. No. \(80-\) Brief submitted by the Department of Computer Science, University of Western Ontario. No. 81-Brief submitted by the Faculty of Engineering, Carleton University.

\title{
MEMBERS OF THE SPECIAL COMMITTEE ON \\ \\ SCIENCE POLICY
} \\ \\ SCIENCE POLICY
}

The Honourable Maurice Lamontagne, Chairman
The Honourable Donald Cameron, Vice-Chairman
The Honourable Senators:

\author{
Aird \\ Belisle \\ Blois \\ Bourget \\ Cameron \\ Carter \\ Desruisseaux \\ Giguère
}
\begin{tabular}{ll} 
Grosart & Nichol \\
Haig & O'Leary (Carleton) \\
Hays & Phillips (Prince) \\
Kinnear & Robichaud \\
Lamontagne & Sullivan \\
Lang & Thompson \\
Leonard & Yuzyk \\
MeGrand &
\end{tabular}

Patrick J. Savoie, Clerk of the Committee.

\section*{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 wasResolved in the affirmative."

ROBERT FORTIER, Clerk of the Senate.

\section*{MINUTES OF PROCEEDINGS}

Wednesday, May 28th, 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, Cameron, Carter, Grosart, Haig, Hays, Kinnear, Lang, Robichaud and Yuzyk. (11).

In attendance: Philip J. Pocock, Director of Research (Physical Science).
The following witnesses were heard:
Dr. B. M. Millman, Chairman of the Committee on Graduate Studies and Research,
Brock University, St. Catherines, Ontario;
Dr. G. D. Cormack, Associate Professor, Faculty of Engineering Carleton University, Ottawa, Ontario;
Dr. John Hart, Dean of Science, Lakehead University, Port Arthur, Ontario;
Dr. G. A. Harrower, Vice-Principal (Academic)
Queens University, Kingston, Ontario;
Rev. Dr. Marcel Patry, O.M.I.
Rector, St. Paul University, Ottawa, Ontario;
Dr. G. de B. Robinson, Vice-President, (Research), University of Toronto, Toronto, Ontario;
Dr. John M. Carroll, Associate Professor of Computer Science, University of Western Ontario, London, Ontario;
Dr. J. F. Hart, Head, Computer Science Department, University of Western Ontario, London, Ontario;
Dr. E. L. Holmes, Associate Dean, Faculty of Engineering, University of Waterloo, Waterloo, Ontario;
Dr. H. I. Schiff, Dean,
Faculty of Science,
York University, Downsview, Toronto, Ontario;
Dr. Paul B. Hagen,
Dean, Faculty of Graduate Studies, University of Ottawa, Ottawa, Ontario;
Dr. D. W. Slater,
Dean of the School of Graduate Studies, Queens University, Kingston, Ontario;
Dr. G. E. Connell, Chairman, Department of Bio-chemistry, University of Toronto, Toronto, Ontario;

Dr. A. N. Sherbourne, Dean, Faculty of Engineering, University of Waterloo, Waterloo, Ontario; Dr. M. Chagnon, Vice-Rector (Academic Affairs), University of Ottawa, Ottawa, Ontario;
Dr. J. S. Riordon, Faculty of Engineering, Carleton University, Ottawa, Ontario;
Dr. W. B. Rice, Chairman, Graduate Studies, Engineering Sciences Division, Queen's University, Kingston, Ontario
(A curriculum vitae of each witness follows these minutes)
The following are printed as appendices:
No. 70 -Brief submitted by the Faculty of Science, York University, Downsview, Toronto, Ontario;
No. 71-Brief submitted by Dr. John Hart, Dean of Science, Lakehead University, Port Arthur, Ontario;
No. 72 -Brief submitted by the University of Waterloo, Waterloo, Ontario;
No. 73-Brief submitted by the University of Toronto, Toronto, Ontario;
No. 74-Brief submitted by Saint Paul University, Ottawa, Ontario;
No. 75-Brief submitted by the Department of Physiology, Queens University, Kingston, Ontario;
No. 76-Brief submitted by John C. Robertson, Department of Religion, McMaster University, Hamilton, Ontario;
No. 77-Brief submitted by Laurentian University, Sudbury, Ontario;
No. 78-Brief submitted by the Research Advisory Board, University of Guelph, Guelph, Ontario;
No. 79-Brief submitted by Division II, Faculty of Arts, Carleton University, Ottawa, Ontario;
No. 80-Brief submitted by the Department of Computer Science, University of Western Ontario, London, Ontario; and
No. 81 -Brief submitted by the Faculty of Engineering, Carleton University, Ottawa, Ontario;
At 6.00 p.m. the Committee adjourned to the call of the Chairman ATTEST:

Patrick J. Savoie, Clerk of the Committee
\(\qquad\)

\section*{CURRICULUM VITAE}

Carroll, John M. Education: Bachelor's in Industrial Engineering (with highest honours) Lehigh University, Bethlehem, Pa. (1950). Master's in Physics, Hofstra University, Hempstead, N.Y. (1955). Doctorate in Industrial Engineering and Operations Resarch, New York University, New York, N.Y. (1968). Experience: July 1968 to present, Associate Professor of Computer Science, the University of Western Ontario, London, Ontario; Sept. 1964 to July 1968, Associate Professor of Industrial Engineering, Lehigh University, Bethlehem, Pa.; Feb. 1952 to Sept. 1964, Editorial Staff, Electronics magazine, McGrawHill Inc., New York, N.Y., Managing Editor from 1957 to 1964; Aug. 1950 to Feb. 1952, Electronics Officer, U.S. Navy; Oct. 1947 to Sept. 1948, Senior Radio Engineering Aide, U.S. National Bureau of Standards, Washington, D.C.; Aug. 1944 to Oct. 1947, Electronics Technician, U.S. Navy. Publications: 14 books and about 40 articles including: "The Standard Handbook for Electrical Engineers" (McGraw-Hill, 1968)-Associate Editor; author of section on "Electronic Data Processing". "Characteristics of Modern Production" (Alexander Hamilton Institute 1969). "Careers and Opportunities in Electronics" (E.P. Dutton Co., 1967). "Careers and Opportunities in Computer Science" (E.P. Dutton Co., 1962). Research interests are in information systems design including automatic indexing, on-line data collection and analysis, and com-puter-controlled product verification.

Chagnon, Maurice-Born: Ottawa, December 4, 1919. Studies: Primary: Saint-Charles, Ottawa. Secondary: University of Ottawa High School. University: University of Ottawa, Faculty of Arts, Faculty of Philosophy, Faculty of Psychology and Education. Columbia University, New York: Research Scholarship-Royal Society of Canada. Academic Degrees: Bachelor of Arts, Bachelor of Philosophy, Licentiate in Philosophy, Master of Arts, Doctor in Philosophy (Psychology). Positions held: Teaching: Lecturer, Faculty of Arts (University of Ottawa); Lecturer, Faculty of Philosophy (U.O.); Lecturer, Faculty of Medicine (U.O.); Lecturer, School of Social Service (U.O.) ; Full Professor, Faculty of Psychology and Education; Director of Research Seminars in Psychology and Education. Guidance and Counselling: Technician and cofounder of the University of Ottawa Guidance Service (1942); ConsultantDirector and founder of the Richelieu Guidance Centre of the Separate School Board of Ottawa (1951-1965). Research: Technical consultant, Research Branch, Department of Labour (1965). Present Position: Vice-Rector, Academic Affairs. Publications and Research: Two manuals on Ottawa-Wechsler Test; Six articles on Professional and Educational Guidance; 34 papers presented to scientific associations; direction of 66 research projects. Other functions: Association canadienne française d'Ontario: Member executive Committee (1963-65) ; Member of Committee on Education (1964-66); Chairman of the Committee of Social Action of the Diocese of Ottawa; Member of the Subcommittee on Research and Planning of the Committee of Presidents of Ontario; Member of the Board of Governors of the Institute of Pastoral Psychiatry; Member of the Board of Governors of the Ontario Institute for Studies in Education.

Connell, George E. Place of birth: Saskatoon, Saskatchewan. Date of birth: June 20, 1930. Degrees: B.A., University of Toronto, 1951; Ph.D., University of Toronto, 1955. Posts held: Postdoctoral fellow, N.R.C. Ottawa, 1955-56; Postdoctoral Medical Research Fellow National Academy of Sciences held at New York, 1956-57; University of Toronto, Assistant Professor, Department of Biochemistry, 1957-62; University of Toronto, Associate Professor, Department of Biochemistry, 1962-65. University of Toronto, Professor and Chairman, Department of Biochemistry, 1965-70.

Cormack, George D. Born Alberta, September 11, 1933; married; three children. Attended schools in Calgary and in Victoria, B.C. obtained B.A.Sc. (engineering physics) from U.B.C. in 1955. Awarded English Electric Fellowship to study nuclear reactor design in Great Britain (1955-1957). 1957-1959, Project engineer with Computing Devices of Canada Ltd. in Ottawa, Quebec City and Camden, N.J. 1959-1962, M.Sc. and Ph.D. from U.B.C. in physics for electromagnetic shock tube research. Awarded B.C. Telephone Co. Scholarship, NRC Fellowship, and NATO Postdoctoral Fellowship, the latter held at plasma physics research institutes in Munich and Stockholm during 1962-1964. 1964present, Member of the Faculty of Engineering, Carleton University, Ottawa. Author of about 20 technicla papers on plasmas, systems engineering and instrumentation. Acted as consultant on plasmas to NRC and to the Space Science Division of Computing Devices of Canada. Presently consultant on transmission lines to the Research and Development Laboratories of Northern Electric Co. Ltd. and Associate Professor of Engineering at Carleton University, where major concern in with advanced techniques for energy conversion.

Hagen, Paul Beo. B. February 15, 1920 in Sydney, N.S.W., Australia. Nationality: Canadian. Marital status: married, 2 children. Degree: Graduate in Medicine, University of Sydney, 1945. Positions held: Intern, Balmain Hospital, Sydney, N.S.W., Australia, 1945. Medical Officer, N.S.W. Health Department; also Departmental Demonstrator in Biochemistry, University of Sydney and Lecturer in Physiological Chemistry, Sydney Technical College, 1946-48. Lecturer in Physiology, University of Sydney, 1948-50. Senior Lecturer in Physiology, University of Sydney; also Supervisor of Postgraduate Teaching in Physiology (including Biochemistry and Pharmacology) for the Postgraduate Committee in Medicine of the University of Sydney, 1950-51. Senior Lecturer in Physiology, University of Queensland; also examiner for Postgraduate Medical Degrees and Diplomas, University of Queensland, 1951-52. C. J. Martin Fellow in Medical Research, Department of Pharmacology, University of Oxford, 1952-54. Tutor in Biochemistry, Worcester College, 1953-54. Assistant Professor, Department of Pharmacology, Yale University, 1954-56. James Hudson Brown Fellow, 1954-55. Winner of Lederle Faculty Award, 1956. Assistant Professor, Department of Pharmacology, Harvard Medical School, Boston, Massachusetts, U.S.A., 1956-59; also Director NIH graduate training grant program in Pharmacology, Harvard Medical School, 1957-59. Professor and Head of the Department of Biochemistry, University of Manitoba, Winnipeg, Canada, 1959-64. Professor and Head of the Department of Biochemistry, Queen's University, Kingston, Ontario, Canada, 1964-67. Scientific Officer, Medical Research Council (N.R.C. Director), Professor of Biochemistry, Queen's University, 1967-68. Present position: Dean of the Faculty of Graduate Studies, University of Ottawa, Ottawa, Ontario, Canada, 1969. Other activities: Elected Fellow of Chemical Institute of Canada, 1962. Member of Medical Research Advisory Board of the Muscular

Dystrophy Association of Canada, 1960-69. Member of Sub-committee for Biochemistry of the Medical Research Council (Canada), 1962-66. Vice-Chairman of Biochemistry Division, Chemical Institute of Canada, 1962-63. Chairman of Biochemistry Division, Chemical Institute of Canada, 1963-64. Member of Council of Canadian Biochemical Society, 1963-66. Member of Metabolism Committee of Medical Research Council (Canada), 1966-67. Vice-Chairman of the Medical Research Council (Canada), 1967. Recipient of Centennial Medal of Government of Canada, 1968. Member of the Editorial Boards of: Journal of Pharmacology and Experimental Therapeutics, 1960-64. Biochemical Pharmacology, 1961-66. Canadian Journal of Biochemistry, 1964-67. Society memberships: Chemical Institute of Canada; Canadian Biochemical Society; American Chemical Society; American Society for Pharmacology and Experimental Therapeutics; American Association for Advancement of Science; Biochemical Society (Great Britain) ; British Pharmacological Society; Physiological Society (Great Britain).

Harrower, G. A. A native of Flesherton, Ontario, Dr. Harrower obtained his high school education in Englehart, Ontario, and took undergraduate studies in mathematics and physics at the University of Western Ontario. He graduated in 1949 , with a B.Sc., and the university's gold medal in physics. His post-graduate work was done at McGill University, where he was awarded a M.Sc. degree and, in 1952, the degree of Doctor of Philosophy. From 1952 until his appointment to Queen's University in 1955, Dr. Harrower was with the staff of the Bell Telephone Laboratories in Murray Hill, New Jersey. Prior to Dr. Harrower's appointment as Dean of the Faculty of Arts and Science, in 1964, he served as Assistant Dean from 1962 to 1964, and was as well Associate Professor of Physics, teaching in both the Faculty of Arts and Science and the Faculty of Applied Science. In 1969, he was appointed Vice-Principal (Academic). During the spring and Summer of 1969. Dr. Harrower will complete work on the Principal's Committee on Teaching and Learning, and then, at the request of the Principal, will visit a number of universities in Europe and elsewhere to study current developments in the university world. His major academic interest as a professor at Queen's was radio-astronomy, and he was instrumental in establishing the radio-astronomy laboratory at Westbrook, near Kingston. He also designed the observatory for Ellis Hall. During the autumn of 1958, Dr. Harrower was chosen as one of 22 scientists who represented Canada at the conference in Moscow of the International Astronomical Union, held in connection with the International Geophysical Year. Since that time he has attended major international scientific meetings in London, Paris, Tokyo, Washington, San Francisco, Munich, Corfu and Prague.

Hart, John. Born: June 11, 1920, Croydon, England. Married: 3 children. Lakehead University, Dean of Science, 1965; Brock University, Director of Science Studies, 1964-1965; Carleton University, Chairman, Department of Physics, 1957-1964; The National Research Council of Canada, Electricity Section, 1953-1957; The Royal Institution of Great Britain, 1950-1953; University College, London, 1946-1950; Royal Naval Volunteer Reserve, Lieutenant, Communications, 1939-1946; University Degrees: B.Sc. (Special, Physics) London), 1950; Ph.D. (London), 1953. Learned Societies: Fellow of the Institute of Physics; Senior Member of the Institute of Electrical and Electronics Engineers; Member of the American Institute of Physics; Member of the American Association of Physics Teachers; Member of the Canadian Association of Physics. Activities-Current: Chairman NEMA/IEEE, Education Committee
of Electrical Insulation Conference; Member, Board of Governors, Confederation College; Member, CSA Committee on Electrical Insulation; Technical Consultant, U.S. National Research Council Conference on Electrical Insulation. Activities-Past: Chairman, N.R.C. Committee on Electrical Insulation; Chairman, Science Fairs Committee of Canadian Association of Physicists; Chairman, Lectures Committee of Canadian Association of Physicists; Chairman, CSA, Committee on Electrical Insulation; Member of Council of Canadian Association of Physicists; Member of Industrial Physics Committee of Canadian Association of Physicists; Member of Technicians Committee of Canadian Association of Physicists; Executive Member, U.S. N.R.C. Conference on Electrical Insulation; Member of International Electrotechnical Committees, TC. 15 and TC. 28 .

Hart, John F. Head, Computer Science Department, The University of Western Ontario. Education: Bachelor's in Physics, University of Toronto 1946; Master's in Physics, University of Toronto 1948; Doctorate in Physics, University of Toronto 1953. Experience: 1953 to 1959, Assistant Research Officer, Applied Physics, N.R.C. 1959 to 1960, Secretary, Computer Committee, Physics Dept., University of Western Ontario; 1960 to present, Head, Computer Science Department, University of Western Ontario. Other: N.R.C. Grant Selection Committee for Computers 1962-1965. Publications: J. F. Hart \& G. Herzberg: "Twenty-Parameter Eigenfunctions and Energy-Values of the \(2^{3}\) S States of He and He-like Ions", Physik 171, 1963 J. F. Hart \& W. Fraser: "Near-Minimax Polynomial Approximations and Partitioning of Intervals", Comm. ACM, 7, 1964, pp. 486-489. W.J. Cody, W. Fraser, and J. F. Hart: "Rational Chebyshev Approximations Using Linear Equations", Numerische Mathematik, 1968, (accepted for publication late 1968). J. F. Hart, S. Takasu: "Systems and Computer Science", University of Toronto Press, Toronto, 1968. J. F. Hart et al: "Computer Approximations". SI Applied Math Series, John Wiley \& Sons, New York, 1968.

Holmes, Ernest Leonard. Born: Kent, England, January 16, 1933. Marrier with four children. Education: (1) Primary \& Secondary Schooling in Kent, England; (2) University Education: (i) University of Bristol, B.Sc. Physics 1955; (ii) University of Toronto, M.A.Sc. Metallurgical Engineering 1956; Ph.D. Metallurgical Engineering 1959. Posts held: (i) 1966 to present, Association Dean, Faculty of Engineering, University of Waterloo; Professor of Mechanical Engineering University of Waterloo; (2) 1964-6 Administrative Officer, Faculty of Engineering, University of Waterloo; Tutor, University Village Residence; (3) 1962-4 Assistant Secretary, Careers and Appointments Board, University of Nottingham, England; (4) 1960-2 Special Lecturer and Research Associate in Physical Metallurgy, University of Toronto, Canada; (5) 1959-60 Assistant Lecturer in Physics, Medway College of Technology, Kent, England; (6) 1956-7 Metallurgist, Orenda Engines Limited, (Hawker-Siddeley Group), Malton, Ontario, Canada; Evening Class Lecturer in Physical Metallurgy, Ryerson Institute of Technology, Toronto. Publications: Ten publications in various scientific journals in addition to various general articles. Current society memberships: (i) Institute of Physics and the Physical Society. A.Inst.P.; (ii) Association of Professional Engineers of Ontario. P. Eng. Other pertinent activities: (i) Conestoga College of Applied Arts and Technology, Member of Board of Governors. Languages: Some French. Present Interests are related to the development of national science policies and in particular the role of the universities in such development. Publications: (a) Scientific Papers (Co-authored): 1. Growth

Conditions for the Stability of a Cellular Solid-Liquid Interface, Can. J. Physics 1957, 35, p. 1223. 2. Grain Growth in Zone-Refined Tin, Acta Met. 1959, 7, p. 411. 3. Effects of Lead, Bismuth, Silver and Antimony on Grain Growth in ZoneRefined Tin, J. Inst. Metals 1960, 88, p. 468. 4. Normal Grain-Growth in ZoneRefined High-Purity Metals, Can. J. Physics 1959, 37, p. 496. 5. Comparisons Between Free Energies of Activation for Grain Growth, Grain Boundary SelfDiffusion and Liquid Self-Diffusion, Can. J. Physics 1960, 37, p. 899. 6. Effect of Solute Atoms on Grain Boundary Migration in Pure Metals, Can. J. Physics 1961, 39, p. 1223. 7. Effect of Lead and Bismuth on Grain Growth in ZoneRefined Tin, Transactions A.I.M.E. 1962, 224, p. 945. 8. Effect of Solute on Grain Growth in a Pure Metal etc., Can. Met. Quarterly 1962, 1, 2, p. 187. 9. Grain Growth in Zone-Refined Zinc, Can. Met. Quarterly 1963 2, p. 177. 10. Concerning the Distribution Coefficient of Gold in Lead, Can. J. Physics 39, 945, 1961. (b) General Articles: 1. Wanted: A New Unit on a Canadian Campus to Study Science Policy (Science Forum-August 1968). 2. Cooperative Engineering Education at the University of Waterloo (Accepted for Publication in 1969 in the Internatonal Journal of Electrical Engineering Education). 3. Importance of the Orientation of Research to the Solution of Problems Related to the Needs of the Country and Region-Some Views from the Canadian Scene. (with A. N. Sherbourne) Presented at the 3rd Pan American Meeting on Post-Graduate Engineering in Rio de Janeiro, December 1968 (To be published). 4. Research Cooperation Between Industry, Universities and Government, to be published in "Canadian Business". 5. Comment on the "Canadian Organization for Joint Research"-requested by editor of Science Forum, (published 1969). 6. Industry/University Collaboration, to be published in "Advance" October 1969.

Millman, Barry Mackenzie. Born: October 17, 1934, Toronto, Ontario. Married Olive Marilyn Gardiner July 1959. Children: Lynne Mackenzie, born December 1960; Christine Gardiner, born September 1962; Suzanne Theresa, born February 1965. Education: 1947-53, Glebe Collegiate Institute, Ottawa, Ontario; 1953-57, Carleton University, Ottawa, Ontario, B.Sc. degree with first class honours in Physics awarded Governor General's Medal; 1957-61, King's College, University of London (England) Ph.D. degree (1963) in Biophysics (Thesis title: The Mechanical Properties of Molluscan Smooth Muscle). Fellowships: 1957-60, Imperial Oil Graduate Research Fellowship; 1960-61 National Research Council of Canada Special Scholarship. Academic Positions: 19611966, Member of Scientific Staff: Medical Research Council Biophysics Research Unit, King's College, University of London (England); 1966-1967, Associate Professor and Head, Department of Biological Sciences, Brock University, St. Catharines, Ontario; 1967, Professor and Chairman, Department of Biological Sciences, Brock University, St. Catharines, Ontario; 1966-69, Member of University Senate and Chairman of the University Committee on Graduate Studies and Research; University Representative on the Ontario Council on Graduate Studies. Membership in Professional Societies: American Biophysical

Society; British Biophysical Society; Canadian Society for Cell Biology (Treasurer 1968-); Physiological Society of London (Associate Member). Publications: Lowy, J. \& Millman, B. M. (1959), Active state in Mytilus muscle, J. Physiol. 146, 32-33P. Lowy, J. \& Millman, B. M. (1959), Contraction and relaxation in smooth muscles of lamellibranch molluses, Nature, London. 183, 1730-1731. Lowy, J. \& Millman, B. M. (1959), Tonic and phasic responses in the anterior byssus retractor muscle (ABRM) of Mytilus, J. Physiol, 149, 68-69P. Lowy, J. \& Millman, B. M. (1962), Mechanical properties of smooth muscles of cephalopod molluses, J. Physiol. 160, 353-363. Millman, B. M. \& Colvin, J. R. (1961), The formation of cellulose microfibrils by Acetobacter xylinum in agar surfaces, Can. J. Microbiol. 7, 338-387. Lowy, J. \& Millman, B. M. (1963), The contractile mechanism of the anterior byssus retractor muscle of Mytilus edulis, Phil. Trans. B. 246, 105-148. Millman, B. M. (1963), Relaxation in the translucent adductor muscle of the oyster Crassostrea angulata, J. Physiol. 169, 87-88P. Millman, B. M. (1964), Contraction in the opaque part of the adductor muscle of the oyster (Crassostrea angulata), J. Physiol. 173, 233-262. Lowy, J., Millman, B. M. \& Hanson, J. (1964), Structure and function in smooth tonic muscles of lamellibranch molluscs, Proc. Roy. Soc. B. 160, 525-536. Millman, B. M. \& Elliott, G. F. (1965), X-ray diffraction from contracting molluscan muscle, Nature, London. 206, 824-825. Elliott, G. F., Lowy, J. \& Millman, B. M. (1965), X-ray diffraction from living striated muscle during contraction, Nature, London, 206, 1357-1358. Millman, B. M. (1966), Apparatus for simultaneous recording of length and tension changes in muscle, J. Physiol. 185, 12-14P. Lowy, J., Hanson, J., Elliott, G. F., Millman, B. M. \& McDonough, M. W. (1965), The design of contractile systems, In: Principles of Biomolecular Organization, Symposium of the C.I.B.A. Foundation, 1966, pp. 229-253, Ed. G. E. W. Wolstenholme \& M. O'Connor: J. \& A. Churchill Ltd., London. Millman, B. M., Elliott, G. F. \& Lowy, J. (1967), Axial Period of Actin Filaments: X-ray Diffraction Studies, Nature, London, 213, 356-358. Millman, B. M. (1967), Muscle (Biophysics) X-ray diffraction analysis, McGraw-Hill Yearbook of Science and Technology, pp. 256-258. Elliott, G. F., Lowy, J. \& Millman, B. M. (1967), Low angle X-ray diffraction studies of living striated muscle during contraction, J. Mol. Biol. 25, 31-46. Millman, B. M. (1967), Mechanisms of Contraction in Molluscan Muscle. Amer. Zool. 7, 583-591.

Patry, Rev. Dr. Marcel, O.M.I. Birth: At Beaumont, Que., January 31, 1923. Studies: University of Ottawa: 1945, B.A., 1946, L.Ph., 1947, M.A., 1949, Ph.D. (Esthetics), 1950, L.Th., 1955, D.Ph. (Logic). Teaching: Professor at the Faculty of Philosophy of the University of Ottawa, from 1960 to 1968. Secretary of the Faculty of Philosophy of the University of Ottawa, from 1956 to 1968. Since August 1968, rector of Saint Paul University, Ottawa, Canada. Publications: Delineatio cursus logicae, 1955: L'objet et les limites de la logique chez saint Thomas. Mimeographed, Faculty of Philosophy, University of Ottawa, 1955. Réflexions sur les lois de l'intelligence. Fides, Montreal, 1965, 143 pages.

Rice, William Bothwell. Born at Montreal, June 10, 1918. Education: The High School of Montreal, Graduation 1935; McGill University, B.Eng. (Mech.) 1944; M.Eng. (Mech) 1956; Sir George Williams University, B.Sc. 1950; École Polytechnique, l'Université de Montréal D ès Sc. App (Magnum cum laude) 1959. Awards: Commissioners' Scholarship 1932, 1933, 1934; The Workman Studentship in Mechanical Engineering 1940-1944; Northern Electric Fellowship 1958-59; First Canadian elected to the International Institution for Production; Engineering Research (CIRP) 1964. Employment: 1935-1940, Blueprint
operator and draughtsman Northern Electric Co., Ltd.; Summer 1941-43, Junior Toolmaker Northern Electric Company Ltd.; 1944-1946, Active service Royal Canadian Navy, Rank at discharge: Lieut (E); 1946-47, Junior Engineer, Engineer of Manufacture, Northern Electric Company; 1947-50, Lecturer and Assistant Professor in Mechanical Engineering McGill University. Summers: 1948, Design Engineer, Dominion Oilcloth \& Linoleum Company; 1949, Designer, Canadian Industries Ltd.; 1950, Machine designer, Northern Electric Company; 1950, date, Associate Professor and Professor in Mechanical Engineering Queen's University. Summers: 1951, 52, 53, 56, Engineer, Canadian Industries Ltd. and Dupont Company of Canada Ltd.; 1955, Consultant, Pulp and Paper Research Institute. Technical Societies: Permanent president Engineering 1944 McGill; Engineering Institute of Canada, Chairman Kingston Branch, 1961-62; Councillor, 1963-66, Vice President Region V, 1966-68; American Society of Mechanical Engineers; American Society of Tool and Manufacturing Engineers; Canadian Institute of Mining and Metallurgy; American Society for Engineering Education; Association of Professional Engineers of Ontario. Publications: "Metal Cutting-A Research Problem", by W. B. Rice, Trans. E.I.C. Vol. 2 No. 4, pages 149-152. "The Formation of Continuous Chip in Metal Cutting", by W. B. Rice, E.I.C. Journal Vol. 44, No. 2, pages 41-45. "Photoelastic Determination of Cutting Tool Stresses", by W. B. Rice, R. Salmon, and W. D. Syniuta, Tool Trans. E.I.C. Vol. 4 No. 1, 1960. "Force Variation During the Formation of Continuous Segmented Chips in Metal Cutting", by W. B. Rice, R. Salmon and L. T. Russell, E.I.C. Journal Vol. 45 No. 5, pages 59-62. "Some Effects of Microstructure on Chip Formation", by W. B. Rice, R. Salmon and S. N. Chopra, A.S.M.E. Paper No. 62-Prod-7. "Determination of the Pattern of Isotherms in a Metal Cutting Tool Using Infra Red Photography", by R. Salmon, W. B. Rice and P. S. Chandresekaran, E.I.C. Journal, Paper No: EIC-63 Mech. 24; Vol. 1 No. 29, December 1963. "Some Effects of Cutting Fluids on Chip Formation in Metal Cutting", by H. S. Rama Iyengar, R. Salmon and W. B. Rice, Trans. A.S.M.E. Journal of Engineering for Industry. Series B Vol. 17 No. 1 pages 36-38. "Effects of Cooling and Heating Workpiece and Tool on Chip Formation in Metal Cutting", by W. B. Rice, R. Salmon and A. G. Advani, International Journal Vol. 6. "Cutting Fluid Research", by C. S. Sharma, W. B. Rice and R. Salmon, Lubrication Engineering, Vol. 23 No. 12, pages 481-486. "Isothermal Patterns in Cutting Tools of Different Face Length", Annals of the CIRP, Vol. XVI, 1968, pp. 217-222, (with R. Salmon, and G. D. M. McCulloch). "A Study of Chip Formation Using Paraffin Wax to Simulate Metals", Transactions Engineering Institute of Canada, bound with Journal EIC Vol. 51, Vol. 11, No. B-2. "Research in Hydrostatic Extrusion", Canadian Institute of Mining and Metallurgy Canadian Conference of Metallurgy Canadian Conference of Metalurgists, 1966, (with H. S. R. Iyengar). "Fluid-film Lubrication in Hydrostatic Extrusion", International Institution for Production Engineering Research (CIRP) General Assembly Paper 1968, (to be published in Annals of CIRP) (with H. S. R. Iyengar). Special Universities Activities: Commanding Officer 103 University RCAF with rank of Wing Commander (Lt-Col) 1960 to date; Chairman, Graduate Studies Engineering Sciences Division 1964 to date.

Riordon, J. S. received the degree of B.Eng. in Electrical Engineering from McGill University in 1957 and the degree of M.Eng. n 1961. Between 1957 and 1963 he was employed by the Radio and Electrical Engineering Division of the National Research Council, Ottawa, where he worked in the areas of radar
signal detection, transistor circuit design, and narrow band image transmission. In 1963, on leave of absence from NRC, he began studies in Automatic Control at the Imperial College of Science and Technology, London, obtaining the Ph.D. degree in 1967. In 1968 he joined the Faculty of Engineering at Carleton University; his current research interest is in the field of adaptive control. Dr. Riordon is a member of the Association of Professional Engineers of the Province of Ontario, and of the Institute of Electrical and Electronic Engineers.

Robinson, G. de B., Born: Toronto, 1906 B.A.: University of Toronto, 1927. PhD.: Cambridge University, 1931. Department fo Mathematics, University of Toronto: 1931. National Research Council: 1941-45. Visiting Professor, Michigan State University: 1952-53; visiting Professor, University of British Columbia: 1963; visiting Professor, University of Canterbury, Christchurch, N.Z.: 1968. Vice-President (Research), University of Toronto: 1965. F.R.S.C.: 1944. President, Section III: 1959-60; 1961-62. MBE: 1946. Managing Editor, Canadian Journal of Mathematics: 1949. Publications: 3 books and numerous papers. President, Can. Math. Congress 1953-57.

Schiff, Harold Irvin. Personal Data: Born: Kitchener, Ontario, June 24, 1923. Married, 2 children. Academic Qualifications: B.A., 1945, University of Toronto, Honours Physics and Chemistry (First in First Class Honours); M.A., 1946, University of Toronto, Physical Chemistry; Ph.D., 1948, University of Toronto, Electrochemistry Research Director: Dr. A. R. Gordon. Employment: 1948-50, N.R.C. Fellow with Dr. E. W. R. Steacie-Gas Phase Kinetics; 1950-65, Assistant, Associate \& Full Professor of Chemistry at McGill University; 1959-60, Nuffield Fellow at Cambridge, England; 1965, Professor, Chairman of Department of Chemistry and Dean of Science, York University; 1968, Professor, Department of Chemistry, Dean of the Faculty of Science, York University. Scholarships \& Fellowships: Undergraduate: 1941, Edward Blake Entrance Scholarship in Chemistry and Physics; 1942, Class of 1930 Scholarship; 1943, Laughlin Gilchrist Scholarships. Graduate: 1946-48, National Research Council Predoctoral Fellowship. Associations: Fellow of the Chemical Institute of Canada; A.A.A.S.; Sigma Xi; Canadian Association of University Teachers. Offices Held Outside the University: Associate Editor, Journal of Chemical Physics; Editorial Board, Planetary and Space Science; Editorial Board, Journal of Chemical Kinetics; Associate Committee of the National Research Council on Space Research; Executive Committee on the Mass Spectrometry Section of the Association for the Standard and Testing of Materials; Chairman, Physical Measurements Subcommittee of the International Association on Geomagnetism and Aeronomy; Steering Committee of the International Congress of Atomic and Electron Collisions; Defence Research Board Geophysical Research Panel. Previous Offices and Consultantships; 1953-54, Chairman, Montreal Section, Chemical Institute of Canada; 1962-63, Chairman, Chemical Education Division, Chemical Institute of Canada; Geophysics Corporation of America; Ballistics Research Laboratories, Aberdeen Proving Ground, Maryland; Canadian Armaments Research and Development Establishment; National Bureau of Standards, Boulder, Colorado; Environment Science Service Administration, Boulder, Colorado. Awards: 1965, Best Scientific Paper of the Year Award, Boulder Laboratories-N.B. S and E.S.S.A.; 1967, Best Paper in Five Year Period, Boulder Laboratories-N.B.S. and R.E.S.A. 1968, Scientist Award, Boulder Branch of R.E.S.A.

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\section*{THE SENATE}

\section*{SPECIAL COMMITTEE ON SCIENCE POLICY}

\section*{EVIDENCE}

Otiawa, Wednesday, May 28, 1969
The Special Committee of the Senate on Science Policy met this day at \(3 \mathrm{p} . \mathrm{m}\).

Senator Maurice Lamontagne (Chairman) in the Chair.

The Chairman: Honourable senators, we have the honour to receive representatives from the various universities of the Province of Ontario this afternoon. We will proceed as we have done since yesterday afternoon. First of all we will ask the spokesman for each university to make a brief statement under the assumption that if a brief has been sent to the members of the committee it has been read by them.

We will start with Dr. Millman from Brock University.

Dr. B. M. Millman (Chairman of the Committee on Graduate Studies and Research, Brock University, St. Catharines): Mr. Chairman and honourable senators, like many of the other universities we have not submitted a written brief. We have submitted one to the Macdonald Committee setting out our views on the question of research support.

The Chairman: I assume some of your views have been distorted in the Macdonald Report?

Dr. Millman: There are two particular aspects of research support relating to developing universities on which I would like to comment at this time. A number of the points made earlier in the discussion would also apply to our university. Firstly, deeling with research funding for personnel who are not directly involved in graduate studies, I think it is generally acknowledged that research is needed in most areas of the universities by its faculty to provide a suitable undergraduate program. This point has been made previously on several occasions. The funding for such research should certainly be on the basis of
merit, the merit of the researcher and the merit of the project, which is consistent with what is proposed in the Macdonald Report.

There are, however, some problems which arise when one is forced to evaluate the merit of faculty members who are not involved with graduate studies. In the Ontario context, taking the example of a person who is doing research for himself and who receives a research grant of \(\$ 10,000\). He is carrying out that research on his own and that is the total support he has for that project. If, however, he has two Ph.D. students, under the Ontario Formula System, then the university, not the faculty member, receives approximately \(\$ 18,-\) 000 in addition, some of which will be available to support the research project in either a direct or indirect manner. Where the faculty member in the university is associated with the graduate program, it is more likely to be productive than where the faculty member is working without a graduate program. If these two men are being compared on the same basis, it is likely that the person from the university without the graduate program will show up poorly by comparison. This will certainly be the case if quantity of research is the criterion used.

Now, this naturally causes some concern, because I think it is clear to all of us that we cannot develop full graduate programs in all 14 universities in Ontario, and certainly not to the PhD. level. Therefore we are concerned lest the support for good research people should fall off for this sort of reason. This is where the federal government can help by keeping this type of problem in mind.

The second area where there is a problem is that involving junior faculty members who have not yet established a reputation. NRC does have a policy of support for these people for the first few years which seems to work reasonably well. But here again universities with a small operating budgets find it more difficult to supplement funds available to such staff members through providing technical
assistance, through post-doctoral facilities and libraries etc., than universities which have a large proportion of income derived from graduate studies. Perhaps the best way of helping these people is through general purpose grants such as those given by NRC. One of our recommendations to the Macdonald Commission was that this sort of grant through the university be afforded in the humanities and social sciences where such support is not otherwise available.

We are rather disturbed to see that one of the recommendations of that report was that these grants should be discontinued, and I think we should look at this problem rather carefully particularly in the smaller universities because in my view such grants can play a real role in supporting junior faculty members who do not attract support on the basis of their own merit yet.

The Chairman: It seems to us that since yesterday afternoon everybody is opposed to Toronto.

Dr. Millman: I would not like my remark to be interpreted in that fashion but we are, perhaps, a little suspicious of some of the major universities.

The second aspect of the role of the smaller universities in some studies has to do with the term "centres of excellence." This term is now used a great deal, but it usually seems to imply that these centres of excellence must be large centres. We feel that excellence need not be of necessity associated with largeness, and that there is a role the small university can play in developing small areas of excellence in specialized fields, carefully selected, where they can develop up to the PhD level, highly specialized programs of exellence which we hope could compare with or even surpass those from the larger institutions. One of the areas where this might be particularly important was mentioned this morning by a representative from Loyola, and that is where interdisciplinary studies are involved because in a smaller institution it is easier for diverse departments to co-operate and produce a program that would be difficult to establish in the larger universities.

In conclusion, then, we would like urge the encouragement of research excellence in the smaller universities, particularly in suitable selected areas where they can excel.

The Chairman: Thank you very much. And now the spokesman for Carleton.

Dr. G. D. Cormack, Associate Professor, Carleton University, Ottawa: Honourable senators, I would like to present to you some opinions that form the consensus of the members of the Faculty of Engineering at Carleton University. Our brief which we have submitted to you is only three pages in length, so I suppose I could refer to it as a very brief brief. We have had to omit many topics from it, but this omission does not mean disapproval or disinterest where these topics are concerned. An example of this is the topic raised by the previous speaker about grants to faculty members. We do not disapprove of them simply because we have not mentioned them in our brief. Our brief is concerned with three major topics. These are (1) the interface between people and science, (2) the research institute concept, and (3) the fact that we believe that now is the time for major encouragement for technology and engineering.
These three topics are considered in this order in our brief at approximately one topic per page.

I will expand briefly on these three topics. First, the interface between the average person and science. We in the faculty of engineering are concerned about this very human problem, because we have seen so often that average people feel disinterested in and even alienated by science and technology. We believe that a science policy can assist in making science human-oriented and that it can assist in making humans science-oriented. These two objectives should be sought simultaneously, because it is only then that Canadians in all walks of life will realize the fruits of science. Science produces through technology not only labour-saving devices but also a more comfortable and enjoyable world both during working hours and during leisure hours. A science policy that caters to the applied sciences, which include technology and engineering, will serve the Canadian people well, because it will help to smooth out the interface that exists between humans and science.

Our second topic concerns the proposal that the federal Government seek to set up research institutes in certain well-defined fields of interest. Our brief makes suggestions about funding, about the desirability of interdisciplinary contacts, about the desirability of mobility of employees to and from government, universities and industry-that is, to these institutes-and also about the desirability of these institutes operating distinct from
any existing system in Canada. If the fields of study for these institutes are chosen carefully, we believe that they will substantially pay for themselves because of the resultant decrease in fragmentation of research effort, which we are all aware exists to some extent in our universities today.

Our third topic concerns the stature that engineering and technology enjoy today in Canadian society. The people most involved with production problems, with innovation and with product development are the technologists and engineers. A few figures that reveal a problem that Canada faces today are given in the report entitled, "Foreign Ownership and the Structure of Canadian Industry" prepared by the Task Force on the Structure of Canadian Industry. There it states that, as of a couple of years ago, the number of engineers per 10,000 of population in Canada was seven, whereas Sweden had 22 and the United States 25 . A Swedish engineer is not called an engineer until he is the equivalent of a Canadian master's degree student, so these figures are more divergent than they appear on the surface. Surely, this discrepancy bears close scrutiny. An innovative climate can be created by suitable news media attitudes, by education and by a science policy that recognizes the importance of the applied sciences.

Finally, we would like to state that we consider that the Government of Canada should shoulder the responsibility for science policy, as it now does for foreign policy and defence policy. Specifically, the responsibility should not be allocated to a non-elected group such as the National Research Council.

The Chairman: I am sure you will have questions on your last sentence in a few moments. Thank you very much, Dr. Cormack.

Now we go to Dr. Hart, of Lakehead University.

Dr. John Hart, Dean of Science, Lakehead University, Port Arthur: Mr. Chairman and honourable senators, we have taken the liberty of preparing an informal written statement rather than wasting the time of the committee with a rather long, formal statement. The written statement is informal deliberately, because we feel it is sometimes forgotten that science is only one aspect of human activity, and that the personal aspects of science are often neglected. We feel very much that the Macdonald Report can be criticized for its lack of appreciation, at least on the surface, of this fact.

In the statement we make the following points:

First, we believe that the policy of the scientific bodies of all kinds in Canada tends to discriminate in favour of the well-established individual scientists and research groups, and tends to discourage the development of the research talents of all but the most brilliant young scientists, and inhibits the development of research groups in new areas, or in interdisciplinary areas, or in new institutions.

Secondly, we believe that the development of applied science of all kinds is an essential ingredient in the lifeblood of the nation, and we believe that the controlling bodies of science and the industrial community are not exerting themselves to assist applied research which would be of short- or long-term benefit to Canadian industry.

Thirdly, my colleague from Carleton has mentioned the interface between people and science. We believe that there is a desperate lack of understanding of the effects of science and technology, or, indeed, of techniques of all kinds, including business techniques, upon our society. We believe that far more effort should be put into not just the control of the obvious bad effects of our technology, such as the pollution that Senator Haig mentioned this morning, but into the more subtle effects such as the disaffection of our young. We believe that the arrogance of we scientists constitutes a large factor in the turmoil that has developed on university campuses and elsewhere, and we believe that academics and public servants who are interested in this problem should be given far more tangible support. What we refer to here is not the popularization of science or the instruction of the young people in scientific techniques, but a study of the effect of those techniques on the young, primarily, but not excluding the careful study of the present and likely future development of Canadian society in a technical world.

You might ask me for an example, and there happens to be a very simple one developing in north-western Ontario right now. The young people see that Canada has expended several millions of dollars in investigating the ionosphere-and I do not wish to criticize this project; it is a very worthy project run by excellent people. However, in northwestern Ontario the Indian population would like to ask what effect this research is going to have on them, because until a month
ago they had to rely exclusively on the CBC northern service whose antennae are unfortunately beamed in the opposite direction, I believe, and it is only within the past month that the Company of Young Canadians-more power to them-has developed a fleet of transmitters on, I believe, half-ton trucks, and is driving them into Indian communities and is providing them with a service they so desperately need. It seems to me that here is a classic example of the apparent arrogance of our scientists. Thank you, Mr. Chairman.

The Chairman: Now, Dr. Harrower, Dean of the Faculty of Arts and Science, and VicePrincipal (Academic) (elect) from Queen's University. I hope it was not as a result of a general election!

Dr. G. A. Harrower, Dean of the Faculty of Arts and Science, Queen's University, Kingston: No, Mr. Chairman, I think it was a very specific election.

I believe my remarks should be essentially confined to the generalities of the problem rather than attempting to assess those aspects of it we at Queen's share in common with many other speakers. It seems to me the question of science education is only answerable in terms of goals we are attempting to define and, presumably, to achieve. Policy must have some end in view, and I think it goes more or less without saying that what we are really searching for are goals, we hope, of healthy science policy, so that subsequently a healthy state of science in our country will be capable of achievement.

When we talk of the goals of science and scientists, there is often confusion between the goals which individual scientists may legitimately follow and the goals which the society which supports him may have in mind. While I do not necessarily see a conflict, in the sense that the individual works at his subject primarily for the love of it, because of the challenge involved and the sense of personal achievement derived from it, on the other hand, the society which benefits from this in one way or another presumably has in mind other goals having to do with the general welfare of that society, as measured in some reasonable way.

Now, the difficulty here, it seems to me, lies in what is a reasonable way to measure the achievements of science, or of the science policy that brings about these achievements. We are all too prone, I think, to measure the success of any large-scale venture in terms of
such things as the gross national product or some of those other numbers that can be so readily quoted. Thinking of the university context, for example, the university is prone to measure its success in terms of numbers of students graduated, or numbers of papers written by members of staffs, or, as we have been told recently, the number of faculty members who are airborne at any particular moment. These may or may not be criteria by which to measure the programs concerned. I think we have to be very careful that we do not, at the level of our basic assumptions, make mistakes in evaluating science policy as science policy which maximizes some aspect of our economy. It may be good for that reason, or it may not, and it may be good for another and entirely different reason.

To put it in other terms, the goal of our national policies must be the maximization of the welfare of the largest number of people. It seems to me, speaking as a one-time scientist, that scientists are in no sense immune from having individual goals. That is not to say that their individual goals may not be different, as our individual personal goals frequently are. I would like to draw something of a contrast between the natural scientist and the social scientist.

Again, speaking as a one-time natural scientist, I think I am correct in saying that the natural scientist has by far the easiest problems, because he has thrown all of the hard problems out. If you are not entirely persuaded of that then sit down and talk to the sociologist for half a day and listen to the problems he has to deal with.

Natural science is, therefore, a well-structured system of asking simple questions for which there are simple answers. The social scientist faces the more challenging problem of asking complex questions, some of which are not formulated, and of looking for very complex answers which are of significance.

Another difference between the natural and social scientist is that the natural scientist has underlying his work the fabric of the natural universe which serves as a test for all of his ideas, whereas the social scientist lives in an area that is not properly formulated, and he lives in it as it is being formulated.

There is also the fact that the natural scientist at best is inventive in the sense that he is not creating what he studies. He is simply uncovering. Whereas, a social scientist must be creative. He has to create the very substance which he studies.

This difference is sometimes minimized, and I think it is unfortunate that the social scientists sometime ago proposed to call themselves scientists, because I think this is a limitation they could well have avoided.

Policies, then, as formulated for the natural sciences and for the social sciences are inevitably different at the basic level, because of the different natures of the two activities. It would seem to me, to put the matter plainly, that the goal of science, pure and simple-I do not mean "pure" in an exalted sense, but in its simplest sense-is to determine truth, to discover facts, relationships, and so on, with the intention of having these eventually applied to our lives in this particular physical environment.

Science is often confused with technology and engineering, which are equally noble, but fundamentally different. Science asks the basic questions, whereas technology and engineering and many other related activities are attempting to apply answers to the problems which humanity faces. In that sense, then, the social justification for science lies in the application of these principles, and it requires something like a 25 -year lead time. You cannot help technology if you have not 25 years previously helped science. If that was not done then the only possible alternative is for you to buy your ideas from somewhere else. That is possible, of course, but it will not go on forever.

It seems to me that we must keep in mind that although our immediate goals, both social and scientific or technological, have to do with the immediate problems we face as Canadians, we must nevertheless realize that our ability to face these similar problems 25 years hence is going to depend on the health of our basic science in the present and immediate future. The university obviously plays an important role in this process.

I do not need to go through the details, except to point out that the university's business, first and foremost, is education. The carrying out of research is a by-product of education. I claim that it is a necessary byproduct, because it seems to me inconceivable that we can educate people to carry on activities in these areas unless we represent these areas in an active and up to date way within the university itself.

The university has an additional advantage that comes from the fact that often the most productive work is done at the interface of different disciplines, and it is at the university that these interfaces most readily occur,
and where the greatest multiplicity of interconnections can be found. If the university has a role as an institution concerned in research it has that role particularly in the sense of its being an interdisciplinary institute.

Finally, if I may say what I am sure all of you know better than I, Canada has a particular place it seems to me in questions of this sort. The commodity that will command the highest market price will be knowledge. Raw materials of the kinds that we find naturally and free are available in one sense or another, and our economic system makes our materials available essentially on a worldwide basis, but the commodity which will distinguish the forward nations from the backward nations in some future era will be the possession and generation of knowledge. I would claim that Canada cannot afford to neglect that factor. We shall not achieve eminence through size-geographic size, per-haps-in terms of population or the human dimension not at all for a long, long time, but it is entirely possible, in spite of the limitations which we face, to achieve eminence in selected areas of endeavour in the social sciences, in the humanities, and in the natural sciences. I think we must never limit ourselves as to the equality of the work which can be accomplished in these areas, although we must necessarily limit our thinking as to the quantity that may be legitimately attempted.

Therefore, I would close with what I think is an obvious statement, that a country like Canada, limited as it is in some important ways, need not be limited in the quality of the science that it undertakes.

The Chairman: Thank you very much. We shall now hear from the Universite SaintPaul, the University of Ottawa, the University of Toronto, the University of Western Ontario, and York University.

\section*{[Translation]}

Reverend Father Marcel Patry, O.M.I., Rector, St. Paul University, Ottawa: Mr. Chairman, we were very pleased that the Senate of Canada should take an interest in human and social sciences and research in religious studies.

To add to what has been said so far, I wish to say that, because of the interest my university takes in religious studies, we find it particularly...

\section*{[Text]}

Senator Yuzyk: Mr. Chairman, we are not getting an interpretation.

Reverend Patry: Then I will speak in English. At Saint Paul's University we find there is a field of research in the domain of religious studies. When we look at the religious origin of our country and our universities, particularly in the field of law, we find there are possibilities for research in the domain of what we ordinarily call religious studies. We hope that the Canadian Senate will give attention to this area of social science, human science and religious science.

On looking at the Canadian Constitution, especially when we try to define the rights of man, there is a special place for religion in the rights of man, and a place for research in that field of religion. This is why we are glad this inquiry has been undertaken by the Canadian Senate, and we hope it will result in assistance for those who want to conduct research in the field.

\section*{[Translation]}

The Chairman: Thank you, Father. I am truly sorry that our simultaneous interpretation service is not functioning this afternoon; the people are probably tired after this morning; they are not used to it, here in the Senate. However, we thank you for having been able to express yourself in either lan-guage-that is, as they say, either the confidential language or the official language. Dr. Chagnon?

\section*{[Text]}

Dr. M. Chagnon, Vice-Rector (Academic Affairs) University of Ottawa: As the languages bill is only at the committee stage at present, I suppose I shall be doing nothing illegal in switching into English!
The Chairman: It has not reached the Senate yet!
Dr. Chagnon: In order not to take up to much time, may I first say that we did not prepare a brief from the university. The problem was discussed at the university Senate, and in small groups of representatives of different disciplines. Many of the professors and others who have accompanied me here today have worked on the preparation of briefs from different associations and organizations that have already presented briefs here. One could have voiced opinions which may be known to you, the Dean of

Science, Dr. Marion, is presently in Montreal receiving the Montreal Medal, and I will see that you get a copy of his speech, which might perhaps make better reading than listening!

There are four topics I would like briefly to mention. On referring to the terms of reference of this committee we notice that you are concerned to some extent with the problem of structure within the Government itself. We do not believe we are able to suggest to the Government how to set its own house in order-if need be, of course-but we would like to mention one problem that has been faced by many of the universities, or by many of the individual research workers, namely the lack of, I do not want to say centralization, but co-relation (at least from the point of view of an external observer) between the different granting agencies, or the different agencies and organizations or organisms that decide on or have anything to do with research within the federal Government. Whether this co-relation should be so formalized that it comes under the authority of one minister, or should be so formalized that it comes under the authority of a committee of the Cabinet, is I think a question to be answered by the people from within. However, I think we can say that many people in the field feel that there is a need if not for coordination and unification, at least for some co-relation between activities in the Government itself.

The second problem of structure is the structure of the organisms that are granting agencies, such as the Canada Council and the NRC. The suggestions of the Macdonald Commission were analyzed, and the reaction was not unanimous. In general, however, it is believed that the system presently working should not be disturbed too much, but instead progress should be made within the internal organization of the existing agencies rather than change. Besides all the theoretical or logical reasons one can give, there is a very practical reason for that. We have a fear that any major change will require a change of legislation, and it seems to us that a change of legislation may take two or three years. We are afraid of a "freeze" while waiting for the change of legislation, so we would rather work within the existing organism, which would not require a change of legislation to arrive at major structural changes in these agencies.

The third problem is one of the grants, themselves, and I think it has been mentioned or suggested by some of the speakers here this afternoon that it is quite difficult to visualize-and this may be one of the weaknesses of the Macdonald Report-a nationwide recipe that applies to all disciplines and all types of institutions. The needs vary and I think there is a need for more flexibility than we find in the Macdonald Report for the development of regulations governing the various types of grants.

We may point to one special problem, that of grants in the field of humanities and social sciences and the need for revision of this field. It is not universal, but in many cases they are very different from the type of grants that are given in pure or applied science. Very few grants in humanities and social science enable a professor, for example, to really offer substantial financial help to his students, and therefore there is a difference of status in this area between the humanities and social sciences.

The Chairman: You mean that the social scientist is forced to do his own research?

Dr. Chagnon: He cannot use academic slave labour, in other words. The sources also are much more limited when we think of the sources of grants for science that come from outside the Government, such as from industry and so on. The sources are much less varied so there is, I think, in developing both structures and regulations in the field of humanities and social sciences, a need to consider the special requirements and special state of development, especially at this point when humanities and some of the social sciences and humanities, introduction of mathematical models, and so on, is gaining in popularity. There is a need to give these research workers the same facilities that have been given to other fields.

Just one last comment. You are also interested, as a committee, in the development of or in discussing the policy for science in Canada. There is one remark here. It is simply that although we feel there is a need for such a thing at the federal level, we hope that any structure or any regulations given in this area will not kill the spontaneity of research work. That is to say, although we think there is a possibility of giving a policy of science and of giving some guidance, we would not like to see \(d u\) dirigisme en sciences.

I will close with these remarks, Mr. Chairman.

The Chairman: Thank you very much.
Senator Cameron: I am sure this is the first time we have seen so much slave labour around this conference table.

The Chairman: Dr. Robinson from the University of Toronto.

Dr. G. de B. Robinson, Vice-President (Research) University of Toronto: Thank you, Senator Lamontagne. I should like to briefly describe the situation at the University of Toronto. We have an organization which attempts to bring together the problems of the university in the area of research, which was established five years ago-the Research Board. It has three committees, one on the humanities and social sciences, one on the pure and applied sciences, and one on the health sciences, each consisting of roughly 10 people.

These committees discuss these problems and when they are in their particular area, provide the solution, such as internal distribution of funds, and so on.

The Research Board sent a brief to the Lamontagne Committee several months ago. We also sent a brief to the Macdonald Commission. These documents are, to some extent, out of date, now that the Macdonald Report has appeared, but I might just briefly mention one of the points that we made in our brief to your committee. It was trying to be very practical. The former speaker referred to the increasing similarity between problems arising in the social sciences and in the national sciences and applied sciences. These lie largely through the use of a computer and the enormous increase in the problems which this produces. It has been a serious matter of concern to us at the University of Toronto. In that brief to the Senate committee we strongly proposed that granting bodies take into account the amount of computing which would be involved in a project. As of now, the National Research Council does not do this. There is some word that the Defence Research Board is doing this or is going to do it, and that the Canada Council is considering it.

The problems which are created by blocking grants to universities are apparent, I think, if you consider the nature of the case. The granting body may make a grant for \(\$ 10,000\) to an individual and take no account of the fact that the problem which he is considering may involve computing, evaluating
perhaps, at \(\$ 100,000\). It is this difficulty which we believe must be faced right across the board. It has been faced in all the American institutions, and grants from American granting bodies include an evaluation of the project from the point of view of the computing which is required. That was one of the major points which was put into the brief and in view of the fact that it did not seem to have been perhaps sufficient to emphasize, subsequently, I mention it now.

The Chairman: It was right on the line in the Macdonald Report.

Dr. Robinson: It is very important. We had a meeting of the Research Board last week on the Macdonald Report. The time to consider this document has been so short that our discussion of it was far too limited. We produced a consensus of opinion, but I will only briefly refer to this.
The problem of bringing together the necessary copies was solved. They were not sufficient in the City of Toronto. We had to import 60 from Ottawa. The wife of a Member of Parliament happened to be driving down and she was able to bring us enough copies for a sufficient number of people to read the document so as to form some sort of opinion. We do feel that the study has been too brief. The comments which I might make on the report have come up in the previous speaker's summary. It deals primarily with the councils, and in the Research Board in my office of research and administration at the university, and we find that this is perhaps less than half of the problem.

The problems come up with regard to Government departments and also from the outside world. I do not want to go into details here but I think it is essential that the Senate committee look at these problems which come up through the granting by Government departments independently of the Councils. This is not systematized and we would be very happy if the Senate committee could give it a very careful survey. I have made a brief summary of our meeting last week on the Macdonald Report and I will read it and then I will turn the minutes over to you.

The meeting was called to discuss the Macdonald Report, to instruct me as to how to present the opinion of the University of Toronto. I have brought Dr. George Connell from the Faculty of Medicine with me since he supported the motion of general approval given by the research board to the report.

He is able to answer many questions which could be placed and which I would be happy to have him answer.

Our office, through the kindness of a member of Parliaments' wife, was able to procure 60 copies which we distributed prior to our meeting. The report contains a vast amount of very valuable statistical material which is subject to varying interpretations. The academic world has been frustrated in dealing with granting agencies and Government departments largely through our inability in some cases to introduce what we consider to be rational procedures. The importance of the conclusions expressed in these minutes lies in the general approval of the aims motivating the Macdonald Committee.

I think we are all agreed that they had the fundamental issue, namely, to establish right relations between the universities and the Government, deeply at heart.

The limitations on such approval refer to the means proposed principally in Recommendations \(3,4,5\) and 10 for accomplishing an improvement of relationships between the federal Government and the universities.

It is perhaps worth mentioning that Dr. Gordon Patterson suggested that early implementation of Recommendation 6 might provide an opportunity for further discussion of difficult issues. That is, the co-ordinating committee between the councils.

This proposal was accepted without a vote. The fundamental thing is that we are heartily in favour of the work that the committee has been doing and would not like to see it destroyed by a criticism of detail. This is the important thing, as we see it.

The detail, of whether this council or that should be split up or not be split, that can be settled. The very important issue is to establish the relationship between the universities and the governments, and the federal Government, on the basis which will create as little friction and misunderstanding as possible.

The Chairman: I knew that parliamentary wives were very useful to Members of Parliament, at least to most of us, but I did not know that they were also helping Mr . Kierans.

Now, Dr. Carroll, from the University of Western Ontario.

\footnotetext{
Dr. John M. Carroll, Associate Professor of Computer Science, the University of Western
}

Ontario: Mr. Chairman and honourable senators, we see the goals of national policy for Canada as follows: (a) to increase the number of scientific, engineering and technical jobs available to Canadians, (b) to aid in regional development within Canada, and (c) to equip Canada to provide scientific and technical leadership to underdeveloped countries of the Commonwealth and the former French union.

We feel these goals can best be realized by a national scientific effort balanced among three categories: (1) basic research, (2) applied research, and (3) technological development. I will consider each one of these briefly.

Basic research is primarily the purview of the universities, although not their only concern. The present effort in this area is excellent but continuing Government assistance is required to sustain and enhance both its quality and quantity. This assistance may come in five ways:
(1) Support of qualified graduate students. We recommend also that assistance be given to promising pass graduates of Canadian universities who want to upgrade their qualifications to undertake graduate work.
(2) Fellowships to permit Canadian students to travel, study and work abroad or in other parts of Canada, to improve their scientific skills.
(3) Sponsorship of visiting scientists and scholars.
(4) Grants to cover capital expenditures for land, buildings, and non-expendable research equipment required either for research or related educational programs.
(5) Operating grants to establish centres of excellence in critical disciplines.

As regards to applied research, this area has been stunted in Canada, primarily because of the branch-plant problem. For this reason, applied research is largely now in the hands of Government agencies.

The principal agency is the National Research Council laboratory. This centre should continue to be supported and its functions expanded.

Overall, the applied research done by Government agencies should be co-ordinated by liaison between the NRC laboratory and other agencies undertaking work of this nature.

We recommend that several new national science institutes be created. I add parenthetically that these could be within or outside of
the existing NRC structure. These institutes would function both as granting agencies and as centres for intramural research. Some of the key areas of interdisciplinary activity we see as: cybernetics and systems science; educational technology; materials sciences; marine sciences; and scientific and technical information.

I want to enlage briefly on the last field.
This institute would not only conduct research but would also disseminate information, be responsible for standardization, and maintain a real-time on-line computer data bank that would correlate information regarding research projects, maintain a national inventory of scientific skills, maintain a central registry of specialized research equipment, and assist in the planned budgeting of research expenditures.

Finally, in the applied area, we recommend a vigorous program at federal level to encourage industries operating in Canada to establish research and development laboratories here.

In the area of technological development, we believe it should be promoted by an interplay of public and private resources in imaginative new industry-university complexes. Here we suggest performing special developmental work for Canadian firms at cost in government laboratories, and providing government testing and standardization facilities for use by Canadian industry to promote consumer protection, compatibility of technical materiel, acceptance of Canadian products in the export trade, and insurance against environmental pollution by new processes and products.

Other activities might include disseminating scientific and technical information to Canadian industry; encouraging the training and immigration of skilled manufacturing technologists and scientific technicians; and establishing norms for the application of modern manufacturing technology in Canadian factories.
We suggest that the foregoing program be implemented by a cabinet-level Department of Science and Technology which will fix responsibility on a single minister of the Crown. This department would provide a home for the National Research Council and for the proposed new scientific institutes mentioned previously.
The staff of the deputy minister of this department might well be responsible for correlating the experience of federal granting
agencies and maintaining liaison with other government research laboratories in order to advise the minister on long-term science policy.

Dr. John Hart, Chairman of the Computer Science Department of the University of Western Ontario will now enlarge upon our proposals in the area of cybernetics and systems science, and educational technology.

Dr. J. F. Hart, Head, Computer Science Department, University of Western Ontario: Mr. Chairman, perhaps we have used up our allotted time, and I could save my comments for the question period. I would be quite happy to do that so that we would not hold up the proceedings.

The Chairman: We will make sure you come in at some stage, Dr. Hart.

We will now hear from the University of Waterloo.

Dr. E. L. Holmes, Associate Dean, Faculty of Engineering, University of Waterloo: My colleague, Dr. Sherbourne, Dean of the Faculty of Engineering at the University of Water100 and I will be very anxious to participate in the discussion of our brief. As the writer of the brief, I must apologize to you, Mr. Chairman; for, after having seen many of the other briefs, I realize they are much shorter and to the point than ours. However, in order not to be verbose this afternoon, I will avoid repeating what we have said in the brief and will just highlight one or two items included in it and indicate just what we have done about them at the University of Waterloo.

One of the suggestions made in the brief was that there should be more institutional co-operation and co-ordination of effort among the universities. We are working quite hard with some other neighbouring universities to bring this about, and as one example we are hoping to get things on the road in the field of water resources among the consortium of universities, and hopefully with the Inland Waters Research Establishment at Burlington, Ontario.

We are getting together with respect to our efforts in connection with CEDA and relations with institutions in other countries, particularly in the developing countries. We feel very strongly that the ad hoc approach by the filling of teaching slots is not really the best approach to take. It does not benefit either the overseas universities or Canada to the extent it could. We feel quite strongly that, if we can
build up some expertise within certain Canadian universities about certain institutions or countries in the developing world, then we can have much bigger impact, and, to this end, we are co-operating with our neighbouring universities to try to pool our experience and make specific contact with various universities overseas.

Another topic I should like to highlight is the question of the relevance of our research and the questcon of whether or not our PhD's are likely to be wasted.
It appears that as an aggregate the country is pretty well capable of producing all the PhD's it needs at the present time, given the present patterns of usage.

I think we should look very carefully in connection with other ways of using these PhD's and I think this will demand a certain amount of flexibility among PhD graduates themselves and also among the faculties within universities as well as among people in industry and government, with respect to their attitudes regarding the potential usefulness of PhD's in a variety of endeavours.

This is one of the things we dwelled on at some length in the brief in which we referred to possible reappraisals of research structure, the PhD degree, etc. Regarding this question of the arrangement of our research efforts. Within engineering we are attempting to break down some of the disciple orientation of the research and are making arrangements to build on a divisional structure. Certain disciplines are coming together and we are building research divisions. This seems to be paying off extremely well in the fact that for example people in manufacturing sciences are coming into much closer contact with their colleagues in applied mechanics, and I think each is learning from the other. We are developing our work in management sciences, and so on. We are making efforts to diversify our research support sources and are seeking a closer involvement with industry.

I think this is about all I will say at the present time, Mr. Chairman. Our brief was rather voluminous, but my colleagues and I will be pleased to take part in any discussion you may have.

The Chairman: Naturally, your brief will be part of our proceedings. Thank you very much. Now we will hear from Dr. Schiff of York University.

Dr. H. I. Schiff, Dean, Faculty of Science,
York University: Mr. Chairman, members of
the committee, as our university has submitted a brief to this committee I will not repeat anything that is in it. I will ask your indulgence, however, to use this time to make a few random remarks on things which are not official university policy but which are close to my heart.

First, if I will not be accused of patronage, I should like to express my sympathy for this committee. It must be a very confusing thing to try to assimilate data.

As short a time ago as seven years I was present at a presentation by the National Bureau of Statistics at which the chief statistician made a statement to the effect that Canada would not be producing sufficient PhD's by 1970 to meet the needs of universities let alone the needs of government and of industry.

This last year we heard the President of the National Research Council say that we are over-producing PhD's and will have to put the brake on. But that statement has now been countered with the suggestion that we are not over-producing but are under-employing PhD's.
How you make sense out of this sort of data, I am not sure. But just to add to the confusion, let me make a few remarks on that point. It is a question which has concerned me greatly as the university's Dean for the last few years. Perhaps it would be refreshing to the committee if, instead of blaming them or the Government, I were to focus my blame on the universities first.

I think we are very capable for the present situation. I think that part of it comes from our own prejudices. We start inculcating in our students right from freshman year on in our science programs that pure science is the only pursuit; that it should not become polluted or contaminated; and in what we are teaching little relevance to society ever gets into our discussions.

We do this partly as a protective mechanism, because few of us have ever been outside our ivory towers.

We then point out to the students that the honours degree is certainly the only degree and that the ordinary degree is a consolation prize; and, furthermore, that, if they are any good, they must go on to get their PhD's. And then, at the Ph.D. level, the more esoteric the thesis subject the more value it is considered to have.

What we are doing, then, is producing carbon copies of our ourselves, because, after
all, we have turned out so well the best thing we can do for the students is to make them over in our own image. These PhD's find themselves faced with two difficulties. Their first difficulty is in getting jobs, but an even worse one is the fact that frequently they do not want jobs outside. They want jobs in the university. So we have helped to create this monster ourselves. Now I think we have to do something about this. I think what we should do is this; we have to start very early in our educational pattern relating what we are teaching to outside society. Part of the student movement at the present time is, I think, caused by this lack on our part in the past. They do not see the relevence of what we are teaching. It does not "grab them" as they say, and I think this is what they mean.

What else can we do? Take any of our universities at the present time, and in particular take the one with which I am most familiar. This year we will bring in 350 freshmen students in science. Frankly I do not think that there will be 350 professional scientists in the bunch either through interest or ability. I am not saying they are stupid, but they are not that "grabbed" with the subject to want to become scientists in the real sense of the word. Should we hold this program out to them as the program they should endeavour to follow? I think a greater need in this country than that for professional scientists, although there may well be a need for 10 per cent or 20 per cent of that group who will make professional scientists, but, the greater need is for a higher proportion of our people to have based their careers on the science basis rather than on the traditional arts basis. Science is playing a greater role in our society than in the past in decision-making, and if government and industry are to make decisions involving vast sums of money, they must have the necessary scientific background to enable them to make valid decisions. Some though should be given to the presenting of careers in political science, market economics, administration and so forth on a science basis rather than on the traditional arts basis. A larger number of people should enter these professions on a science basis, that is to say on a basis that will make this a more logical process. That is another suggestion I would like to make.

But lest the government is going to feel it is going to get off scot free in what I am saying, I would like to address some of my remarks in that direction as well.

The Chairman: I knew there was a "but".
Dr. Schiff: The thing that has impressed a number of us is the fact that we have been crying about this branch operation in science and \(R\) and \(D\) in this country. By this we mean big science, and one cannot help but wonder where is the little science. Where are the small companies, the innovative companies that you find around route 128 and Boston? We want these in Canada. We do not want to be just importers of ideas from elsewhere. We have the scientific personnel here who can produce the necessary innovations to provide for industry in the future. This has been successful in countries that are not as large as Canada. Is it because our scientists are gutless and that they do not have the nerve in doing these things that the outfits starting in the States have? What is the reason for this? To this end a group of four of us six months ago formed amongst ourselves what we called "Operation Innovation". The members of the group were Dr. Campbell, Director of Research of the Ontario Research Foundation, Dr. Grace, Director of Research of the Dunlop Corporation, myself and Dr. Ham, Dean of Engineering of the University of Toronto. We have been looking into this question to find out what is wrong with the personal or environmental support which prevents this kind of thing from happening here. We have made a survey of some of the companies who have done this and who have succeeded and invariably we were informed that if they had to do it all over again, they would start in the States because the support and the climate here were not conducive to achieving success. As a test we set up a company with bright ideas and we started out to get support for it. Even yesterday I was at the National Research Council to find out what the government does to support new ideas. We all know what they do about the old ones. We wanted to find out what they would do for the entrepreneur who wants to start a new business, or a university professor and some of his students who want to start a company. The answer I received was "we do not have that mechanism". This, I suggest, shows a very serious lack in science policy in Canada.

Finally, I would to caution against another "in" word that one hears a lot at the present time, and that is that all research should be mission-oriented. We have to think about the direction in which a program is going because our resources cannot handle them all. Well, I would like to echo Dean Harrower's remarks
that there is a danger in pushing this too far. I think it is the university's business to be aware of what is happening in society. It does not follow that it has to be involved in leadership, but it must be aware. But our main task is to know what is going to be the payoff in 10,15 or 25 years. I would recommend for reading that wonderful document of Alex Douglas, Director of Physics at the National Research Council in which he gave five ficticious reports of government committees in Canada over the last 25 years in one of which they started off damning aircraft and so forth as not being of any interest. Some of you may have seen the article in the Financial Post some time ago called "Honey of a Memorandum". This was supposed to be a memorandum sent out by Western Union when asked to consider Mr. Bell's invention or idea, and they said it had no practical application whatever.

The Chairman: Thank you very much. Senator Grosart has been silent for almost a day, so I will allow him to ask a few questions.

Senator Grosart: Thank you, Mr. Chairman.
I should perhaps say at the start, for the benefit of those who have been good enough to come here, that if some of us have come in and have gone out it is because we have other committees sitting, and there was an urgent call out for votes pro and con on what is now known as the Hate bill. Some who may have been sitting in this committee all day may have been ducking that vote!

The Chairman: I am sorry, but I am a member of that committee too.

Senator Grosart: I was not referring specifically to you, Mr. Chairman, but I thought that would be of interest to you, that the vote is over.

Mr. Chairman, if I may-because I do not think any of us have had the time to go over all the briefs, because they have come in in rapid succession in the last 24 hours-I would like to deal with two from Toronto, to start with, York University and the University of Toronto. Perhaps this is appropriate, because the University of Toronto is my alma mater. One reason I like to couple these in my questioning is that both seem to be in favour of an overall body. If I may quote the statement
from York University, in their recommendations at the end, on page 12, the paragraph reads:

Is there really a need for a separate MRC, NRC (and we hear) and Engineering Research Council? This seems to be a fragmentary move. It would seem that one science body would far better administer the federal support of scientific research to Canadian universities.

And in the recommendations of the University of Toronto, No. VII is not quite as strong, but it says:

The distribution of government funds for support of research and also the way in which the funds are utilized by government departments, agencies and councils should be the subject of advice and criticism by a duly constituted government body.
I hasten to say that neither of those specifically says that we should have a Minister of Science Policy. They do suggest, however, that there should be one overall body in which there would be adequate, perhaps majority representation from the universities, to provide the essential input of science into Government science policy in this and other areas.
Let us work on the hypothesis, for the moment, that some such body might be the right answer. I would like to illicit some comment as to the kind of body and what its function would be in respect to advice only to the political decision-maker, to the administration of grants and/or contracts, and to the funding activities in departments, agencies and other instrumentalities of Government.

The Chairman: In other words, now you have probably to write a very important part of our report.

Senator Grosart: That is what I am getting at, Mr. Chairman, because I might say this, that to date we have had very evasive enswers to similar questions.
Dr. Robinson: You mentioned York University first..

Dr. Schiff: Not only is the University of Toronto my alma mater, but this was one of my professors.

Dr. Robinson: I do not mind saying what I think personally on this. This is a problem on which it is very difficult to get everyone to
say exactly the same thing, so perhaps I may be permitted to give my own personal views.

The statement you read from our brief was not to say that there should be one granting body, but that there should be a body which would comment on and advise on Government policy. I think there is a difference. I am not saying that the other proposal has not merit, but it simply never was systematically considered in our research board.
The discussion with regard to this balancewheel activity, as one could call it, is, I think, very important. It is hard to know the inner workings of Treasury Board, of the chairmen and deputy ministers in the federal Government, from the outside.

Senator Grosart: It is fairly easy to assess the results though.

Dr. Robinson: Yes, it is fairly easy to assess the results.

What we had in mind there was simply that the problem which the university faces does not come-and this is really what I was referring to in reference to the Macdonald report-to the surface quite so clearly in the research councils, where you have a very clear distinction between the university role and the government role. It does not arise at all in the Medical Research Council or in the Canada Council.
The problem we are thinking of here is the problem which arises through Government granting agencies in the large departments. If you go back to before the war, these problems hardly existed; the National Research Council was the scientific agency which dealt with the universities. The problem has recently been very greatly accelerated in its development through the entry into the field of, say, the Department of Finance, which is in great need of advice on quantitative matters and we have the Institute of Quantitative Analysis which has been growing enormously, and the money from outside has come into the Department of Economics on a scale which none of us even remotely expected. The needs of the Government are such that they practically could buy up the whole department. Let me state another example. The Department of Energy, Mines and Resources has also very great needs, and this problem of pollution is foremost in many people's minds.

The problem that the universities face is that of establishing a relationship where you have the Government planning the rescarch
and the universities being involved in some way in getting the two sides to sit across the table and talk about the problems.

I am reminded of a situation which developed after the war in the United States where the development of atomic energy had led to large accelerators, and the Brookhaven proposal was being made by the Atomic Energy Commission. The proposal was to build this large accelerator, and the eastern universities were asked to participate. They said: "We will not take part in this unless we can be part of the project", and that led to the organization of Brookhaven where the universities and the Government took part in planning the project and incorporating it.

Now, this recommendation that you refer to was designed, or hopefully planned, to introduce this sort of co-operation between the universities and the Government. It is not that the universities want to take over by any means. They want only to be able to say to the Government: "We have students. We are the people who educate the staff whom you want to hire. Therefore, there are certain aspects of the research which can best be done by students in relationship to these projects." If this is to take place in a healthy fashion then it should be possible to talk about it across the table, and it should be possible to plan it without the planning being done by the Government department and then the proposal being put to the university by saying: "Come along and do your work, but on our terms."

That is all that is meant there, and I think that this is a very important thing. That is the explanation of that recommendation.

The Chairman: Perhaps we could have a comment from the student?

Senator Grosart: I would like to make a sandwich of comment here because I would like to quote from the brief of York University. Dr. Robinson, I think you have re-stated the problem. I can speak only for myself, but I would guess that practically all the members of this committee are in sympathy with the aspirations of the universities for a much more workable form of liaison, but we keep coming back to my question: How?.

It seems to me that your problem predicates a decision. It is all right to talk across the table, but somewhere there has to be a decision. The big problem is: Do we leave it to the Treasury Board in the long run, which seems to be what is being done now, or do we
leave it to a minister, or to a committee of the cabinet, to assess all the conflicting claims which is a proper function of the politician, but one that is almost impossible to achieve with any kind of efficiency in the field of science? Do you see this body, or another body, or any body having a useful function in sorting out the claims and presenting some kind of a suggested answer to the conflict to the political decision-maker?

Dr. Robinson: May I answer this, Mr. Chairman?

\section*{The Chairman: Certainly.}

Dr. Robinson: I got carried away with stating of the problem, I quite admit. My own personal view is that it has to be a body as closely related to the cabinet as possible. I do not think it should be only the Treasury Board, I would like to put it in this way, that it has to involve the Government in a very responsible way. It has to involve the universities, and it has also to involve industry.

These decisions, to my mind, impinge on so many areas that I personally would suggest the role that is being played now by the Science Secretariat and the Science Council should be expanded. I am not prepared to go into details here, because I think this is an area which is very closely related to organization.

Senator Grosart: Dr. Robinson, I am not really asking who should do it, but how it should be done.

Dr. Robinson: I firmly believe that it has to be done. I firmly believe that somebody has got to say that such and such a department should not expand indefinitely the in-house research. I believe this is a problem that must be discussed in relation to industry, the universities, and the Government, and I would suggest that a body-I do not want to be any more specific than that, but I think it has to be planned and to have representation in these areas.

Senator Grosart: I should like to direct the same question to Dr. Schiff of York University. I will preface it by saying that I am in complete agreement with the first numbered paragraph in the introduction which reads:

There is still no really informed professional scientific opinion among members of Parliament, the Cabinet nor the Senate.

Dr. Schiff: That was written by a colleague of mine.

Senator Grosart: That is the problem. I do not say that facetiously. How do these people who are going to make the decision become informed?

Dr. Schiff: Perhaps I should, first of all, put the paragraph you read earlier into context with the other one because our concern here was that this tendency to fragmentation of the different granting agencies, particularly at a time when all the talk is going on about the need for interdisciplinary work and the interrelationship between pure and applied science, and when the boundary lines between the classical disciplines has disappeared, and the real action seems to be taking place where physics and chemistry are applied to biology and medicine. You now have the Medical Research Council which seems to be constantly saying to some universities: "We cannot support you because you do not have a medical school."

Senator Grosart: You are stating the problem, Dr. Schiff. I want the answer. We have reams and reams of statements on the problem.

Dr. Schiff: I agree. I do not really think I can write your recommendation for you. All I can do is say I agree with Dr. Robinson that there should be one body, whether it be a national foundation or a national science council, that encompasses all the areas referred to, and that has to be made up of representatives from those three main branches of the community-government, industry, and the universitics. The National Research Council has done a remarkably good job in the natural sciences in being fair and conscientious and not having a conflict of interest in the past between their in-house research and their support of universities. However, I am not sure that they can continue fulfilling that function as equitably as they have been able to in the past.

The Chairman: In order not to limit this to a Toronto dialogue, I would like to ask if other university delegations have some views to express in answer to Senator Grosart's question.

Senator Grosart: Could I just add one more, which may help anybody in answering? Would you see this advisory body as an enlargement in role of the liaison coordinat-
ing body suggested by the Macdonald Commission, sitting over the three councils? Would you see it in some dimension such as that?

Dr. Paul Hagen, Doyen des Études Supérieures, University of Ottawa: This view is not necessarily that of the University of Ottawa, but it is somelhing that I think should be borne in mind. It will not solve or even help to solve the problem posed in Senator Grosart's question, which is a bit more complicated. I believe that anybody concerned with making decisions about the partitioning of money for scientific purposes should not be restricted to the three councils just mentioned, to oversecing the three councils, but should be concerned with the whole federal Government policy. Anybody concerned with university support in terms of three or more councils like that would immediately be identified as a body supporting university rescarch; it would be an educational body; it would become vulnerable to provincial ambitions, of Ontario and Quebec anyway; these provinces would immediately say it was supporting education. Anybody responsible for partitioning federal funds for science support should, first, not be specifically identified with support for university research solely, but should be a body responsible for federal science policy in general, which might include university support.

Secondly, any such body should in fact favour to a large extent the fragmentation of supporting organizations. The more of them we have the less vulnerable they are to provincial takeover-if we are in favour of federalism anyway. The less they can be identified as a single body supporting university research the better. I think this is a political fact of life that we have to live with; the more we fragment them the better. We need some organization that knows what it is doing and can advise the federal Government about this. I think this is a very important consideration to bear in mind.

Senator Grosart: I am very glad that state ment has been made, because I was asking the context of the Macdonald Report. Obviously now we begin to see an American pyramid; we have the three councils, then we have the other councils that the Macdonald Report found necessary to indicate, such as the conglomerative task forces running around the country doing laboratory work.

The Chairman: They call it the coordinating committee.

Senator Grosart: They had a coordinating committee, but they had a bunch of task forces running around the country subsituting for the in-house research of NRC and several others. If we take all these together and put a super university advisory granting council on top, we have to put another on top that decides how much goes into the university side, how much into in-house and how much into industry. That is why on the evidence so far my inclination is to spend most of my thinking on the problem of the one body, and then let us work down. I am not suggesting we should not work up to the one body with all the advice we can get, but I am very glad that observation was made because I did not intend to restrict myself to that question.

Dr. D. W. Slater, Dean of the School of Graduate Studies, Queen's University, Kingston: Senator Grosart has asked whether this body should be purely advisory and have responsibility for grants, should it have the role of being advisory grant-making and coordinating.

Senator Grosart: And administrative.
Dr. Slater: And administrative. My impression is that bodies that are purely advisory have very little long-term impact on things. If they are to be advisory they must have some responsibility such as granting, a combination of granting and advice, and work a good deal better than purely advisory bodies. On the other hand, you have the problem that any granting body playing an advisory role will inevitably have its limitations, and one cannot rely only on this. My guess is that the Treasury Board will have to be informed. There is no substitute for that. The bodics that are granting will have to be informed and in a position to give advice. Then there will clearly have to be some coordinating bodies at least that not only pull together the various federal government departments and granting activities, but also provide some kind of vehicle for communication with provincial activities and Dean Hagen has pointed to the problem of provincial takeover. I think it is an elementary fact of life that for as long into the future as we can sec our provinces will have a very important role in relation to universities and research, and we really must find means of coordinating federal and provincial activities.

The Chairman: Before we continue with this discussion, I would remind you that we have organized a kind of plenary session for tomorrow afternoon at three o'clock with all the university delegations who will be able to attend that meeting. I have just received a telegram informing me that Dr. John Macdonald and Dr. Duprés, who was also very active in the preparation of the Macdonald study, will be with us tomorrow afternoon, so those of you who have not read the Macdonald study might well devote this evening to doing so.

Senator Grosart: My final comment is that perhaps the political solution might be to have this overall top body, perhaps called an advisory body, and insure that the terms of reference make it clear that it has no control of anything whatsoever, but also making sure that the Treasury Board takes their funding recommendations!

The Chairman: Before we go to another subject, and perhaps also to questions from another senator, is there anybody here who would like to comment on this vital issue? It is, it seems to me, vital to the future of our science policy.

Dr. Robinson: I wonder if Dr. Connell would like to speak on this from the medical point of view?

Dr. G. E. Connell, Chairman, Department of Biochemistry, University of Toronto: As Professor Robinson has made clear, the members of the University of Toronto are content with the separate structure of the council as it exists now, and particularly in my own field, which is related to the activity of the Medical Research Council. The work of the Medical Research Council, I think, has been most important for the development of research and, thereforc, for the development of all activities of the medical schools in Canada over the last five or 10 years. I think the recommendations of the Macdonald Commission, that this council should remain in \({ }^{+}\)act, would have full sunport of members of our university.

The Chairman: No other comments? Senator Cameron, do you have a question?

Senator Cameron: This is, first of all, by way of an observation. I was very pleased with the refreshing comment of Dr. Schiff of York University, because I am one of those
who have felt all too long that the universities have not taken as much initiative as they might have in becoming related to industry and to the everyday facts of life. As you know, some members of this committee spent some time in Boston, and certainly one of the highlights of our visit there was the half day we spent with General Doriot of the American Research and Development Corporation. The other half day we spent with the Arthur D. Little Company, to see what these people were doing in translating the ideas from the university into practice of everyday industrial development. I believe we have a Canadian equivalent of the American Research and Industrial Development Organization, but it has done relatively little, at least as far as my information goes.
Now, Dr. Schiff, you have said that you and some of your colleagues have initiated a company which I presume is to do something similar but you are unable to get support. I gather from your remarks that you first came to the Covernment for support, like everybody else. Did you try anybody else?

Dr. Schiff: The answer is no, we did not come to the Government first for support. The first thing we did was to set out a task force, using Government techniques to find out what was available in the community from people who are already in such operations. The answer we got was that banks, for one, are extremely conservative in this country. You can get support on risk capital in the States, but if you have a building in Canada in which to do your research they will mortgage the building, but that is all they will do. They do not know anything about an innovative risk capital sort of thing. We found out there are some companies that are apparently coming into it. Aluminum Company of Canada is interested to some extent. Again, they are just starting on this. The answer we got from the innovative companies was that if you have an idea you can probably find risk capital in the private sector, but they will want, in order to cover their risk, a major portion of the action. It is going to be sort of a \(90-10\) per cent split. If the inventor or the innovator wants to really carry it on to a point where he can justify getting more of the action, there is not this kind of money available in the private sector.

When we came to Government we found that most of the programs now in existence are in support of existing R and D oncrations, that PAIT really comes in at a later stage and
there is not a mechanism at the moment to support the new entrepreneur.

Senator Cameron: From the practical experience you have had, has your group arrived at any conclusions or recommendations that you might make to this committee with a view to getting more of this entrepreneurship established in Canada?

Dr. Schiff: I would like to suggest that whatever this body is going to be that it also makes grants available again. The grants would have to be looked at and assessed by somebody, but grants available for innovation or invention. The group has approached the Ontario Government with some favourable reception to the idea of providing at the Sheraton Park area, buildings which they call incubator buildings and where you can rent a lab to try out your idea. The provincial government seems to be interested in that. They were not, however, interested in getting into making grants for the development of the idea.

Dr. A. N. Sherbourne (Dean, Faculty of Engineering, University of Waterloo): I would like to offer a few personal observations in connection with this particular topic since it bears on the whole question of relevance in education. In connection with the development on Route 128 outside of Boston, I would suggest that this was an outcome of an even greater sophistication and more PhDs rather than less PhDs. This is the first observation. I would like to make another observation as a Professor of Enginecring, that the subject of relevance is very important to enginecring since where science may be international, engineering certainly is a national activity and can be identified as such.

The Chairman: We were also told that ensineers did not read the stuff of the scientists.

Dr. Sherbourne: I beg to differ. I think engineers read the stuff of scientists, but the reverse is not always true. I agree with Dean Harrower of Queen's, that one needs to preserve basic science. It is still, however, a matter of balanced activity where the ratio of support for applied science versus basic science should be in the ratio of four or five to one against the one to two which seems to prevail in the country at the moment.
I can see NRC proceeding in this direction slowly. I think if this is a problem it is a problem because some bad advice has been
tended by the universities to the National Research Council. All the advice on the university support program given to the National Research Council comes from universities. These are the people on grants commissions. These are the people concerned with the education of students and the people conditioned to change things, yet we persist in a policy which our council has learned from representatives of the universities and which is apparently unacceptable to the universities. Also in connection with the centralized body versus the decentralized approach I would suggest that we have in Ontario a system of a highly centralized nature where all universities come under the scrutiny of a single body; none of the universities seem to be entirely satisfied with this approach. Going back to the subject of relevance I would suggest that it really is not important what sort of education we give students, provided we teach them a few basic things, such as initiative, a sense of values and so on. One does not have to take a course in philosophy to be a philosopher. After all, even Bertrand Russell read mathematics.

A lot of highly specialized education has produced a lot of liberal thought. Again, I think the mistake, if there is a mistake, is that the cconomy has allowed our young people to believe that having obtained a PhD in a certain field, they are entitled to work in that field.
I should like to go back to the United States where in 1946 the universities led industry in the production of PhDs . They did not wait to find out what industry needed. They produced PhDs, because they felt PhDs would take the economy and shape into it what was needed. I suggest that Route 128 was just such an outcome and that sophistication followed overproduction of PhDs rather than waiting for governments to hand out grants.
John Deutsch, in connection with the most recent report of the Economic Council, in his remarks to the Association of Provincial Engineers of Ontario meeting at Niagara Falls, suggested that the figures of production and industrial needs are quite incompatible. If, however, we look at the increases of sophistication which may result in our economy, we may perhaps be able to absorb this apparent overproduction of sophisticated manpower. I suspect that we need to inculcate in our graduates the fact that the economy does not necessarily owe them a job until they make it sophisticated to the point where they can find employment of the type they
desire. I do not subscribe to the view that it is necessary to re-orient all our course of instruction.

It is said that this business of changing the face of society involves a greater concern with general education. We all have concern for society. If one wants to change it, however, one needs to think more of educational self-discipline, of education in depth, to achieve certain physical objectives. This is professionalism and cannot be achieved with superficial general courses.

Dr. J. F. Hart: On this problem of technology, the question which is being raised now and which is related to this problem, is how can Canadian science policy be developed so as to give proper emphasis to the emergence of new subjects of development as well as to existing research groups.
I can put this quickly into focus by referring to the development of computer science in Canada, by mentioning several points.
The first point is that there is only a handful of Canadian computer scientists who are known internationally and who are active in promoting computer science policy. The very small number at this meeting would indicate how few those people are.

Secondly, I believe that there are less than half a dozen Canadian universities with adequate undergraduate offerings in computer science.

Thirdly, I would like to point out that this committee has listened to Dr. Lickleiter and he is at the moment present at a conference in Ottawa. He spoke this morning to a program in connection with man-machine communication. There were a number of interesting points that he expanded on, probably relating to what you heard from him.

This was particularly embarrassing for Canadians, to realize that the kind of thing that he is doing is not being done in this country.
Perhaps I could focus on this a little bit by mentioning that he gave an example of how the various sciences can work together to produce something in the field of education and technology.
He has some students in a computer-graphics course and they have all used these machines, which will illustrate a different concept in the scientific ficld.

There are two points about this. This is a group of traditional scientists and their problems, but it is also a good way to promote research in learning.

This supports Dr. Guindon's idea of yesterday that research here could be the work of a whole university rather than the work of special research institutes.

The feeling about computer science today, with the federal-provincial program of educational support:

I see this quarrel with respect to education as a kind of neurosis holding back the profound desire of Canadian computer scientists and educationalists to develop the indigenous field of the research in this area.

I would like to be specific about this. Our department has been engaged four years in relation to work in geophysical mapping in Ontario.

We developed a major research project there.

When it was completed, it was applied, with industry, with the Department of Energy and Resources management. That program went to the Department of Energy Resources for management and has been used to assist in development of plans for drilling in the gas and oil fields in Ontario.

We then decided to get into computer-aid-ed-instruction research inasmuch as it should aid in reaching the new goals set up within the university. We were able to get some small support from the Department of Education and we have a teletype in one of the local secondary schools. This has been going on for some time and we now have some sequences relating to trigonometry, which are being dealt with by the students of the local high school.

We have made a very thorough study of the amount of support in Canada for this kind of thing. We have seen the minister, two of the deputy ministers, the Director of OISE. We have good collaboration with OISE, except to the point where finances are available. We understand in Ontario no money is available for this kind of work.

We have talked to people at the federal level and there is no money there for this kind of work. I have been talking to other people today who are interested in this kind of research in Canada and find that they are concerned about the same problem.

I would refer finally to the statement made repeatedly to this group, to the effect that many American scientists believe that 50 per cent of the research money used goes under educational research to research in the knowledge field.

I would like to close by pointing out the disparity between this kind of development and what is now available or possible in Canada, as a result of the university federalprovincial difficulty.

Senator Cameron: I might assure Professor Hart that the committee was very much impressed with the \(\$ 25\) million worth of equipment we saw there and also with the way his graduate students could play games with it.

The Chairman: They were working for the Department of Defence but they had all the flower power there in the labs.

Dr. J. S. Riordon (Faculty of Engineering, Carleton University, Ottawa): I would like to add a comment to Dr. Hart's statement. The federal Government is in fact interested in 1he large computer construction in the National Research Council. There has been a considerable effort on this. One student section of the engineering division is in this area now quite actively and also in concert with OISE.

The Chairman: Lack of co-ordination, perhaps?

Dr. J. F. Hart: No, sir, it is not. The difference is in the kind of objectives going into educational institutes, available for university, and is such that there is tremendous disparity, even if you compare the development of the NRC with that of the major universities.

Senator Cameron: There was an experiment carried out which you could relate to this, by the University of Waterloo, with industry in the area, whereby engineering students spent a certain amount of time in the plant. That program was carried out for a couple of years. I wonder if Dr. Holmes could give any comment as to how this type of integration between the teaching programs and the application in the factories has worked out, because it relates to what Dr. Schiff has been saying, and some others.

Dr. Holmes: All our engineering undergraduates are on this co-operative program with industry and there are about 2,400 undergraduate students at present on the program, which involves alternating four-month periods in industry.

In addition to this we have a fair number of mathematics students also engaged in cooperative programs and they are working largely with industries, banks, insurance companies and so on. We find that this has a tremendous impact on our undergraudates. They tend to be quite a mature group. They know what they want. They have also had broad experience, in being interviewed by industrial companies, and in being exposed to Canadian industry in general. They seem to be very sure of themselves particularly by the time they have reached final year.

We have a very small brain drain out of the country. We have taken statistics since the beginning of the program and less than one per cent of our engineering graduates have left Canada on graduation, that is less than one per cent of those that have entered industries. We are quite proud of this fact. In fact, the actual figure is .7 per cent of our graduates entering industry have left Canada. The rest have found themselves in positions within Canadian industry, with the exception of about 25 per cent who have gone on to post-graduate work either at Waterloo or at other universities; in many cases, at other Canadian universities.

The Chairman: I know that there are still several questions to be asked. Unfortunately, I have an appointment at 5.30 , and cannot continue as chairman. I hope you will excuse me. I will now ask Senator Cameron, the Vice-Chairman of the committee, to take over on my behalf.

Thank you very much, indeed, and I hope I will be able to see as many of you as possible tomorrow afternoon.

The Acting Chairman (Senator Cameron): Just to reassure the university representatives here, I think I can speak for my colleagues on the Senate committee when I say we are position for a moment. In the opinion of yourquestions, because this is a vitally important exercise. We are taking it very seriously and we want to get all the advice and information we can get.

I should like to come back to you, Dr. Holmes, if I may trespass on this elevated position for a moment. In the opinion of yourself and your colleagues at Waterloo University, has this been a successful experiment?

Dr. Holmes: Yes, senator, this has been very successfull. We started with 74 students about 12 years ago on a co-operative program, and it has grown to the present size of

2,400 in engineering, and we now have an intake of 600 to 650 freshmen engineers every year.

We were able to place every single one of them this summer, despite the difficulties that seem to be arising with respect to student vacation employment. Every single one of our students going out on a work term was placed.
We are very pleased with the system. We are pleased with the effect it has on the undergraduates. It also helps to bring some of the problems of the industry back into the classroom. Moreover, the students now have an appreciation of the industrial problems and the industrial scene and understand the opportunities available to them in Canadian industry.
We have in conjunction with the co-operative program an industrial advisory council which meets twice a year at the university largely to advise on the operation of the cooperative program.

One of the reasons for the success of the program is the fact that we have put a reasonable amount of resources into a department of co-ordination and placement, which supervises the students in conjunction with the co-operative program. We have co-ordinators who visit the companies and visit the students out on the work term. These co-ordinators are spread across Canada. They are not just located in Waterloo. They come back to Waterloo two or three times a term to report in, but most of the time they are out visiting students and companies and establishing relationships with industry.

We are very pleased with the system, and a testimony to this is that we have continued its operation; we have not instituted a conventional program but have stuck with the cooperative program, and Canadian industry and government institutions are continuing to cooperate with us most enthusiastically. The contacts made with industry through the undergraduate involvement are also leading to more contact at the graduate and research levels, particularly through our Industrial Research Institute.

The Acting Chairman: There are a lot of very good engineering schools in Ontario. Are there any other engineering schools following a similar program?

Dr. Robinson: If you are asking me, Mr. Chairman, I don't know of any others.

The Acting Chairman: If not, why not?

Dr. Holmes: Outside Ontario, the University of Sherbrooke has embarked upon a cooperative program, and I think they are adopting a very similar pattern to the University of Waterloo. In fact, the terms have been dovetailed so that any company could take Sherbrooke students or Waterloo students, or pair them, and there are all sorts of arrangements like that possible. Another university about to embark on this scheme is Memorial University in Newfoundland. So far as I know these are the only universities presently engaged in such programs.

The Acting Chairman: Is there any significance in the fact that these are all among the smaller universities?

Dr. Holmes: Well, as to that, I think we have the largest engineering undergraduate enrolment in Canada at the present time. Certainly, we are about the same size as Toronto.

The Acting Chairman: I meant in terms of the total university. In that respect yours is still a relatively small and new university.

Senator Kinnear: What is the total enrolment of Waterloo University?

Dr. Holmes: The enrolment is 9,000 .
Dr. Schiff: That is hardly small.
Senator Carter: I should like to come back to the engineering statistics, Mr. Chairman. I think that Dr. Cormack said earlier that the ratio for Canada, compared to Sweden and the United States, was 7 for Canada, 22 for Sweden and 27 for the United States. Was that the ratio of engineers you were producing?

Dr. Cormack: These are the numbers of qualified engineers in these three countries for the years 1963-64. This was in a report prepared for the Privy Council office. I don't have the latest figures, I am sorry to say.

Senator Carter: What was that based on? Was it per thousand?

\section*{Dr. Cormack: Per ten thousand.}

Senator Carter: Is the enrolment in the arts, then, increasing in Canadian universities? Apparently we are not holding our own on the engineering side. What is happening on the other side? Are there more students enrolled in arts now?

Dr. Riordon: We found in Carleton University that the increase in the past year or so in arts, that is, the increase of new students, has exceeded that of engineering quite considerably. I am not sure of the exact figures, but it is a matter of something like 14 per cent versus 7 or 8 per cent.

Dr. Slater: Let me just put this in perspective. The first thing we do in CanadianAmerican comparisons is to recognize that we have a very much smaller population of people with university degrees of any kind than the United States. That goes for arts, business administration, engineering and all other fields of study. So that in terms of CanadianAmerican comparisons, we have got to take that into account. I am not saying that we may not have an underdevelopment of work in engineering; we may well have; but we also may well have an underdevelopment of work in business administration and other fields, too.

If we were to make a similar comparison, I think a, Swedish-Canadian comparison is something to be taken very much more seriously than the Canada-U.S. comparison, because they are similar in industrial and urban areas and in richness. Indeed, they are a much smaller country, as we are, and so on. I think that is a much more serious comparison.

Senator Carter: May I come back to this earlier question of what is happening about the number of job openings for engineers in Canadian industry. Are the job openings for Canadian engineers increasing or have they levelled off?

Dr. Cormack: Certainly, they are increasing, because the number of students graduating is increasing every year. But I would say that this years' class is having more difficulty than the classes of the previous three or four years. Now, there are many reasons why. There have been some adverse statements in the press. For example, and this is my personal opinion, publicity has been attached to the "over-supply" statements made by Dr. Schneider. I don't think it has helped the situation very much. I think it is going to discourage some students from going into science and engineering. I think this is a great shame. I came from Sweden to accept the position at Carleton, and there there is the position of oversupply of highly trained and highly educated people, but this does not affect the whole country. All it means is that
the people are in competition for the best jobs and they realize that they must do a good job when they finally get it. I would not accept any conclusions too quickly from the arguments presented by Dr. Schneider. Oversupply is not bad for the country.

Senator Carter: I am wondering whether in producing engineers, and there are many different types of engineers, we need engineers with a research background or engineers trained to utilize the findings of research, that is engineers trained and oriented to innovation in design and not to research.

Dr. Cormack: We must have practicalminded people and we must have people who are cognizant of the country's needs, and this means I would agree with your latter statement. We must have more engineers who are innovative but who are also efficiency and economy minded. I think the pure research engineer or the pure research scientist is a man who is maybe too highly esteemed in Canada relative to the man who is a more practical person-an economy and productive man.

Senator Carter: In your opinion or in the opinion of anyone here, are we achieving a proper balance between these two productions?

Dr. Sherbourne: This has been one of the traditional problems in studies of engineering and the emphasis of science and applied science to engineering. Historically the base of activity arose through physics and chemistry and worked its way into engineering through electrical engineering, chemical engineering and others, and as a result most engineering research has been oriented towards science.

Now this has led to a certain lack in some fields such as design where economy comes in. There are also problems such as transportation which never seemed to fit into the picture of physics, chemistry and derivitives thereof. Other things such as accessibility of social problems, industrialized building in housing, and others were also misfits. This is now being corrected. And this is the trend in NRC granting policies and I am sure we will see some significant changes here. When this happens I feel the challenge of these various activities will lead to the recognition of these activities as being respectable for the postgraduate engineer who is not interested in
applied mathematics or the application of pure mathematics. Now I think we will see some significant changes even in the PhD engineer who thinks in terms of economy, design, innovation and production and in terms in the real use of science and its translation into productivity and wealth.

Senator Grosart: Mr. Chairman, I would like to pose for comment three more or less negatives that appear fairly consistently in the briefs submitted by universities. The first is that there should be federal funding only on basic research in universities. There should be no funding on applied science or developments. Any comment?

The Acting Chairman: I do not think they would agree.

Senator Grosart: I just asked for comment and I suppose silence is as good a comment as any.

Dr. Slater: Well, as long as silence is not interpreted as utter nonsense, I prefer to be silent.

Senator Grosart: Well, you will find it in some of the briefs.

Dr. Slater: Very few of them.
Senator Grosart: Very few of them, I agree, but we cannot assume that a suggestion put forward by several universities should be completely ignored.

The second point I am making is that there appears to be an assumption on the part of the federal government in its policy that for constitutional reasons all funding to universities should be limited to the post-graduate level. That is an assumption, and there is the suggestion that it is a very grave mistake. I am asking now if anybody would care to comment as to the percentage of total federal government funding that in any way facilitates under-graduate research and participation in research, and secondly as to whether this percentage should be lower or should be higher.

The Acting Chairman: Well, who wants to back up the policy?

Dr. Robinson: I certainly agree. Certainly in our own university there is very little impact of federal funding on under-graduate work, but this is a little hard to be dogmatic about because federal funding can increase
technical facilities in ways which could become applicable and related to undergraduate courses. So whereas in the first instance it might not necessarily be for under-graduate work, it could well be in the course of time related to under-graduate work. You have a striking example of this in the computer field where the initial computer expenditure would be primarily for graduate research, but more and more computers are being used in under-graduate instruction. This is the kind of change in emphasis which is quite unpredictable.

Dr. Chagnon: Concerning the comment just made, it is not the policy of some of the granting agencies especially in the humanities and some of the social sciences. The Canada Council, for example, in its answer to the Macdonald Report comes out very strongly with the statement that they are not granting to universities; they are granting to research workers. This creates problems for university administrators because you find out that a chap is going on a trip paid for by the Canada Council just the day before classes are due to open. So the policy of granting only to graduate students or graduate departments is not a general policy of the funding agencies. There is a lack of unanimity and co-ordination among the different agencies.

Senator Grosart: You say it is not a federal policy?

Dr. Chagnon: I said it is not a general policy of all granting agencies at the federal level.

Senator Grosart: But are there agencies granting money for under-graduate research?

Dr. Chagnon: The Canada Council grants only to research workers who may be spending 90 per cent of their time at under-graduate work, but if one of them is doing publishing, say in history or something like that, he may get a grant from the Canada Council.

Senator Grosart: Leaving the Canada Council out of it, because it is to some extent independent of government policy, what about departments or agencies such as NRC?

Dr. Chagnon: I tend to agree with you although some of my comments may fall better in the field of science.

Dr. Schiff: There is a problem of semantics here. I am not sure I understand what you mean by "undergraduate research".

Senator Grosart: I would put it this way. We are talking now about federal funding of research in universities. What I am asking is-and I think my question was clear: To what extent do undergraduates participate in the research so funded?

Dr. Robinson: That is a different question.
Mr. Schiff: Yes, I think that is a different question.
Senator Grosart: Then I am sorry. I followed it up by saying: If that percentage is low, is the constitutional assumption one that should be carried on?

Dr. Slater: There is one fundamental point that has to be made here, and that is that the federal Government, under the shared costs program, is paying 50 per cent of the total operating costs of the universities at this time. Since the bulk of the teaching, research, support with respect to undergraduates is met out of this general operating support, the federal Government is, in fact, paying half the cost of all of the undergraduate activitiesresearch and everything else. It may well be that if you took the proportion of the grants in aid of research from the federal Government granting agencies and departments, and asked what proportion of those are directly going to undergraduate students, hiring them as research assistants and so on, that proportion would not be a large one, but I think it would not be insignificant either, at this stage.

Dr. Rice: There is one thing that confuses me. We get into discussions that can go on ad infinitum about what constitutes basic research and what constitutes applied research. I think this may be standing in the way of some very important issues concerning the science policy of Canada. The debate is an old one, and what to one means fundamental to another means application.

The answer to the question Senator Grosart put, I think, is one that was answered by a professor when I started teaching, who had been my professor as a student, and he said, "One of the things you must do is involve yourself in research, to keep yourself from ossifying, and the only way to be an effective teacher is to be an effective researcher." This was in the "sealing wax and string" era; nevertheless it is true today, and what is done in research has a profound effect on what is done at the undergraduate level, so what is spent by the granting agencies has implications far beyond our wildest dreams.

Senator Grosart: I would agree with you on that. However, Professor Slater tended to narrow my question to direct benefit, and I was hoping somebody would make it clear that if you take in the indirect benefitsresearch facilities, labs, computers, and so on-the picture is not as grim as that put to us where, in some briefs, the percentage has been put as low as 3 per cent as the total benefit to the undergraduate body.
The third negative question arises from the very spirited suggestion made in more than one brief that there should be no contract funding of research in universities by the federal Government, and that it should all be grants or grants in aid.

The Deputy Chairman: Is there any comment?

Senator Grosart: Is anyone prepared to comment on that?

Dr. Cormack: In our brief we make a plea for an institute system which is sited primarily with universities, to serve the role of an interdisciplinary institute to bring together people like sociologists, mathematicians and engineers to concentrate in one particular field of study. These institutes would become, or you could construe them as being centres of excellence, but the objection we have had in bringing forth this proposal is one of economy for research. I mentioned earlier the computer science work for computer aid learning going on at one university and at NRC. It would be our opinion this is an ideal area for concentration in a research institute, and that there should be many of these research institutes. It would serve the same purpose as that the University of Waterloo program does at the undergraduate level, but it would extend into the graduate level and make it so that graduate students are subjected to the problems the Government has, because the institutes would have people coming in from Government laboratories. It would subject the students to practical problems, because industry would have an interest in them. It would not be fragmentation of effort, but there would be one institute, say, in the Province of Ontario which would do work in this particular field of computer data teaching; and anybody interested in work in that field would know that is where the experts are, and they would not have to communicate with several other universities or federal research departments.

The Depuit Chairman: I think that Dr. Robinson has a comment to make.

Dr. Robinson: I would like to make a comment on the point Senator Grosart has raised. The problem of distinguishing between a grant and a contract has almost disappeared in the United States. The terms of the document, whether you call it one thing or the other, are the important things. We have not quite reached that stage in Canada. The Government departments are frequently restricted in the forms they can use, and I have visited several deputy ministers in this regard, particularly with reference to the use of the word "publishability."

Senator Grosart: You mentioned that in your brief.

Dr. Robinson: It is a critical thing to the departments that are, perhaps, new at the game. I remember one in particular, and there is no harm in mentioning it. The Depariment of Northern Affairs had a contract for an archaeological dig in the northern part of Ontario where they phrased the document in exactly the same way you would phrase a document if you wanted to have a sewer dug across your yard. They said that they would not be paid unless the job was completed by such-and-such a date, and all the rights and control of the operations were in the hands of the department, and so on. I visited the deputy minister and was received very kindly. I explained the problem of the university, that this was not the sort of document the university would want to accept, and after a little conversation he saw the point and the thing was changed within an hour. I think much of the trouble which is supposed to reside in the notion of a contract can be cleared away in somewhat similar fashion. On the other hand, some departments are more restrictive on this matter of publishability, and the Solicitor General was approached on exactly the same point, and after a full dress rehearsal of the problem, where students were involved and publishability was necessary for a thesis, the problem was narrowed down to one in which the present records could be used, but the names that were involved were to be kept out of the thesis. So, the question of publishability was straightened away without any real difficulty. I do not really believe there is any fundamental difference so long as these points are covered.

Now, a contract under which you have classified work being done is a different thing. I think this is being handled in the universities less and less, and perhaps there are very few such contracts negotiated by Government departments.

Senator Grosart: The objection to the contract seems to be that it involves too much of a mission-oriented project

Dr. Robinson: I do not really think this is so. I cited those two examples of where two departments entered into contracts. I do not know what you mean by "mission-oriented", but I think more and more you must accept the fact that the universities must play this role if we are to enter the outer world and get away from the ivory tower concept.
I would agree entirely with you, and that is why I find the recommendation in the Macdonald report of a research agreement somewhat confusing. It did not seem to me to be the kind of thing that would work, because obviously you are going to have many different missions, and the conditions surrounding those missions are going to affect the kind of agreement that will be made with the universities.

Dr. Schiff: I agree that that particular problem could be worked out. It could be handled by this mutual agreement but the work must be publishable as literature. But, I see that there are two other differences between a grant and a contract. Contracts now allow for the payment of overhead, and grants do not. My solution is that the grant also should carry an overhead cost.
The real danger, and the one that always worries us, is in the other aspect of the contract which makes it different from a grant, and that is the inability to use money from a contract to pay academic salaries. This is the so-called soft money problem, and the American universities have got themselves into real trouble on this issue, where you take on a very large staff which is paid on a contract which may or may not be renewed. When the contract falls through after a certain period of time the university is faced with the problem of what to do with those people.

Senator Grosart: This is one place where our constitutional problems would be an advantage. Is it York University that discussed this at some length?

Dr. Schiff: Yes.

Senator Grosart: I think you say that either the federal Government is ignoring the British North America Act, or they should pay more. Is not that what you are saying?

Dr. Schiff: In the brief I think that reference was to the fact that the Medical Research Council allows the payment of professors off the grants.

The Deputy Chairman: A few minutes ago I said that we could sit as long as we wished, but I should like to point out that I have also learned that the mind will absorb only what the seat can endure. We have been sitting here for nearly three hours, and I suspect that the law of diminishing returns is soon going to apply. Some of us were sitting until after 10 o'clock last night, and we were at it again this morning, as we shall be tomorrow morning.

However, before we close this session I should like to ask one question that has been bothering me. Somebody in Canada within the next few months is going to be in the position of being a member of a board of directors concerned with the allocation of \(\$ 860\) million a year, an amount that will probably be doubled in the next five years. We have been sitting for 15 months and we have had a lot of material thrown at us, but there is one question that has not been answered to my satisfaction, and I throw it out now to the universities with one last desperate cry. We must have some kind of inventory of what is going on in Canada. I do not mean the minutiae of all the different proposals, because that is impossible, but this board of directors must have some overall view of what the \(\$ 860\) million is being used for. This will include, of course, expenditures by Government departments and the universities, and by private industry. We must have a total picture if we are going to plan ahead and obtain the most effective use from the money we spend, in terms of manpower and in terms of plant and equipment. We have been told time and time again that we cannot have this, but I would hope that the universities, with all their expertise and knowledge, can give us some guidance of what we can do in this area.

Dr. Carroll: We mentioned in our presentation that it is our belief that the maintenance of an inventory such as you have described, and the reporting from it as required by the governing body, is definitely within the state
of the computer art today. I have the utmost confidence that such a system could be developed.

The Deputy Chairman: Thank you. The answer that we have been getting is that it is impossible. We have been getting that answer many times, as my colleagues can tell you.

Dr. W. B. Rice (Queen's University): Does the gentleman mean that we shall have a computer as the board of directors? This is not a frivolous question. I am confused by his answer.

Dr. Carroll: I am simply saying that the information would reside within the computer system, and that the human beings, who are, in fact, the directors, would be able to query the computer system and have delivered to them only the information they require in the form in which they desire it.

Dr. Cormack: I would like to direct a question back to Senator Grosart. Would it not be better that direct research be done by the universities, because it aids in the training of students and also the education of the faculty, rather than having it done by the Government in which case it results, as a primary product, in an increase in the size of its labs?

Senator Grosart: I will say that you will have one-eighteenth of my answer when you have our report. I do not know the answer to that question.

The Depuiy Chairman: On behalf of the commitiee I should like to thank all those who have participated in the discussion this afternoon. We are grateful for the time you have taken to come here, and I hope we shall see some of you tomorrow when we shall conclude the representation of the universities.

The meeting adjourned.

\section*{APPENDIX 70}

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BRIEF \\ TO
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THE SPECIAL COMMITTEE ON SCIENCE POLICY OF THE SENATE OF CANADA

FROM

THE FACULTY OF SCIENCE

YORK UNIVERSITY

TORONTO
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\section*{1: INTRODUCTION:}

A small committec representative of the Faculty of Science, York University, was established by the Dean of Science on February 4th, 1969, to prepare a brief to the Special Committee on Science Policy of the Senate of Canada. Having reviewed the terms of reference of the Senate Committee as outlined in Senator Lamontagne's lette: of December 20, 1968, to Mr. Howrarth, Registrar of York University, our committee decided to consider the matter of Canadian science policy from the point of view of scientifically informed Canadian citizens as well as from the particular interests of university scientists.

In spite of the great deal of discussion on science policy in recent months we wish to express concern about the following:
1. There is still no really informed professional scientific opinion among members of parliament, the cabinet nor the Senate. In addition, the government seems inclined to place little weight on the scientific advice it is given via the existing channels.
2. A great deal of public misconception exists on the nature of scientific endeavour and its related aspects, Research (Pure and Applied) Development, Testing, and their long range implications in industrial production.
3. In North America the whole impact of science on society has been blurred by the sociological considerations of Defence Science and the Vietnam war.
4. The intcrelations of the Science-Technology-Industry-Economic complex end their impact on national independence, national growth and national prestige are very complicated and it is a simplistic error to consider any one member of the interrelated sequence separate from the others.

In this brief, we thus summ rize in the next section a number of premises on the place science plays in the life of a developed country such as Canada, and in the final section we make a number of specific suggestions for Canadian Science and Science Policy.

\section*{2: PREMISES}

The following comments are, we hope, self-cvident statements on the place of science in the operation of Canadian society and are the basic assumptions in terms of which the recommendations of the next section are made.

Scientific activity in any developed country is carried out in many ways for many reasons under the auspices of many agencies, and in the end much of it is paid for from public funds of one sort or another. Activity in science is thus a matter of public interest and concern. A "developed country" is, more than anything else, a technologically developed country. This implies that it has the sophisticated and interrelated means of communication, transport, power distribution, health services, primary and secondary consumer manufacturers industry, defence capability, etc.

To maintain and develop this pattern of activity which adds to economic growth of a nation and to its influence in world affairs, the technological base on which all activities depend must be nourished. One recognizes the clusely related technological activity chain:-

Discovery - Innovation - Development-Manufacture and Testing-Marketin (Pure research) (Applied research)

Any technically self-reliant, developed country must have the potential to maintain a significant level of effort in all aspects of this technological activity chain.


In Canada, however, we are technologically dominated by Europe
and the United States from whom we purchase the already developed technology to support our 'branch-office" manufacturing industries, and our armed services. This state of affairs has profound effect on the character of our way of life and economic thinking and to some extent makes a mockery of the idea that Canada is an independent country. This is seen most clearly by the effect that importing technolngy has on any research activities in industry, where research is almost non-existent.

From the short-range day-to-day standpoint of profitability of Canadian industry, particularly for the responsibility to shareholders, the absolute dependence on the U.S. ant Europe for purchased technology is economically sound. Satisfying profits are made and a high standard of sheltered living is
maintained. It is not often realized by the average citizen however, how great our dependence on other countries is. To take a very small example, almost none of the equipment in the York science laboratories was manufactured in Canada. We just don't have the technology to do it. The automobile industry is another good case-in-point. Here we have reached an agreement which, although it ensures the "production" end of the R \& D spectrum, prevents Canada from ever doing any true research or development in this area. Perhaps, however, a population of 21 million in so large a country should not aspire to be independent or to have so high a standard of living as we have.

On the other hand, Canadian pure science is strongly nurtured in university and government laboratories including those which have taken on a "National Laboratory" status. In fact universities are the only institutions which have a substantial commitment to prosecute basic research. This is a very healthy state of affairs on which some recommendations are made later. Canada has a good reputation for pure science which should not be thrown away by a naive over-reaction to demands for hasty re-allocation of funds and priorities to more applied work.

Most of the above facts have been recognized both inside and outside government but we are apprehensive of an unsophisticated overreaction (as for example in Mr. Drury's recent comments) that "Canadian science must be moulded to suit the economic needs of the country \({ }^{\prime \prime}\), and that finances must be re-allocated to emphasize applied and industrial science. This is, of course, a politically acceptable posture and one with which we are in general agrecment. However, there is a danger that such statements can engender a much too simple-minded response to a complex mult-factor situation. A major diversion of rescarch funds to an uncertain industry or to unprepared university teams to stimulate
applied research could easily weaken the existing science activity which Canada has developed over several decades and for which she has rightfully earned an outstanding reputation in the outside world. A science policy decision which concentrates solely on one aspect of science activity without due regard for the others could bankrupt us technologically.

Insofar as the universities are concerned, their role from a scientific standpoint (as well as for other disciplines) is essentially composed of two complementary but often competing activities:
1. Aiding students to learn about the existing state of man's knowledge in specific fields or disciplines, (an activity centred most strongly in the undergraduate program).
2. Aiding students to work with the faculty to extend the frontiers of man's knowledge through research and advanced study, (an activity more strongly associated with programs at the postograduate level).

These two activities are closely interwoven in the fabric of all universities but their separate existence as well as the specific requirements of each must be recognized. This is most important, since often suggestions to optimize one role tend to conflict with the requirements of the other. Both areas are, obviously, absolutely essential to any meaningful science policy in Canada. This is made more apparent when one considers that, in most cases, the same faculty members share the se efforts on both activities.

Some have suggested a separation of these two roles, but in science we feel that this step should be avoicled. There is much to be gained by having faculty and students interacting at all levels. However, this interaction involves a rather delicate balance which could be easily disturbed by abrupt changes in either the eclucational or rescarch policies of the governments.

Since these two activities presently are being controlled somewhat independently at the provincial and federal levels, there is a real need for increased cooperation.

In addition, the university research activity is not only a vehicle for post-graduate education, it is also an important aspect of national progress and prestige in science. Because of past efforis Canada has a good international scientific record. Pure research is relatively inexpensive and is best done by "whim". It is an exercise of the imagination and cannot easily be structured by mission-oriented statements dictated by non-scientists, for such decisions are often made on the basis of short range economic critearia. Overconstrain the system and the many able minds will leave or will never mature. The catastrophic effects of major and rapid diversion of research funds can be seen in recent U.S. experience.

It is falacious economic exercisc to attempt to draw far-reaching conclusions abnat the number of non-Ontario (or non-Canadian) graduate students in our graduate schools and the cost of educating them. One has to consider such ciata in terms of how much Canada draws from the bank of international scientific knowledge and how many people who currently contribute to Canadian science were born and educated outside the country. For some years Canadian scientists have been recipients of significant amounts of U.S. research supports funds.

Insofar as government science is concerned, it too has both pure and applied facets to its work appropriate to the departments concerned. A number of government departments have developed national laboratories of world rank. Any move to disrupt these would be folly. Any serious moves to
reduce markedly the pure research in government laboratories will leave them staffed with second rate personnel. The imaginative people will leave if their working conditions are seriously disturbed. The drift of good government scientists to the universities during the past few years is an index of this. ansemgate National laboratories of world stature now exist in Canada. They should be strengthened. Examples are NRC, Astronomical Observatories, Churchill Research Range, AECL, etc.

Insofar as industrial science and development is concerned, it is largely non-existent because of the overcaution of industry, the domination by U.S. and European head offices and the importation of technology referred to above. (There are a few notable exceptions to this, but compared to other developed countries the statement is true). As a result Canadian scientific effort is unbalanced and the human products of science programs at its universities do not have a strong employment prospect in the industrial area of technical activity.

It is fallacious to assert that we are overproducing Ph. D's.
We are underemploying them. They cannot expect many job prospects in Canadian industry.

\section*{3: RECOMMENDATIONS}

In this section the recommendations for developments in Canadian science activity (which could be implemented in a government science policy) are made.

\section*{SCIENCE AND GOVERNMENT}

Serious consideration should be given to unifying and coordinating the government's present activities in science and technology under a responsible authority whose major responsibility would be to keep a watching
brief on all aspects of Canadian science and technological activity and to administer funds for it, and to advise the government on such matters. We mbloal recognize the problems in implementing such a proposal but the need for improved coordination is urgent. The responsible authority need not be a single individual or committee, provided sufficient power to implement decisions rests with this body.

A most important desideratumis to educate MP's, cabinet 13sle-aon members and government of the impact of science and technology on the life of a \(20^{\prime}\) th century industrial society. The present laissez-faire attitude and apparent apathy towards science is, frankly, frightening. Lack of scientific awareness on the part of legislators is understandable when one considers that few scientists enter the political arena. Can scientists be encouraged to enter public life?

Annual budgeting and related uncertainties of all research greatly limits the overall productivity. Serious consideration should thus be given to the 2-year or 3-year funding of serious scientific projects in government, industry and the universities. The proportion of unproductive time spent on budgetary exercises would thereby be greatly reduced.

Federal and provinnial government laboratories should have clearly defined missions, the interpretation and the implementation of which should be fairly flexible so that the most appropriate blend of pure and applied work for the job at hand can be adopted in the relevant research programs. Change should not be caused just for the sake of changing things, or for the sake of short-term expediency.

Many government laboratories and installations (eg. some NRC
labs, AECL, Chalk River, The Churchill Research Range, the National Astronomical, including Radio-Astronomical, Observatories) have through sustained work of world quality justly gained the reputation as National Laboratories and are important national resources. They should be encouraged, and the use of such laboratories (which should continue to be well-equipped) by the community of science at large in Canada should be formalized. In most of the laboratories non-staff guest researchers from elsewhere have, on request, in specific circumstances, been given generous opportunities to use the facilities. This has been through the thoughtfulness of their colleagues in the laboratories who make the informal arrangements. Any short-sighted move to re-orient all of these. government laboratories towards industrial-oriented applied work would be nothing short of madness. It is in the se laboratories that much of the first rate science for which Canada has received international acclaim has been forged.

\section*{SCIENCE AND INDUSTRY}

In spite of much public and private debate, Canadian industry has in many instances understandably been reluctant to set up its own first class research laboratories for many companies and corporations just cannot afford to undertake the expense. They are often controlled by U.S. or European parent companies from whom the necessary technology for a parasitic copying of the parent's products will suffice. Canada, nevertheless, has a unique geographical, mineral and economic situation for it to develop industries of its own if it has its own self-sustaining technology in say:

Pulp and Paper
Metallurgy and Mining
Applied Optics
Electronics and Communications
Aerospace Engineering
Operational Research

\author{
Computers \\ Agriculture \\ Drugs \\ Petrochemicals \\ Geophysical Prospecting \\ Transport \\ Defence \\ Arctic Exploitation \\ Pollution
}

One way in which basic and applied research in these areas could
be set up to provide a Canadian technological base for its industries is to encourage the formation of a number of research institutes (one in each appropriate technological area). The mission of each would be to be a national repository for information and technology development in the appropriate area. Each would be staffed by one to two hundred professionals and could viably be financed if each industry, which would profit by access to the work of the institute, contributed a significant annual membership fee which could be diverted from corporate income tax. Companies could also set up their own laboratories for proprietary research as necessary, but the mainspring of technology in Canada could be fostered in the research institutes. They would also provide a much needed pool of challenging career positions for the products of Canadian schools in pure and applied science.

Encouragement should be given (by suitable financial incentives) to the development of small "idea" firms such as prosper around highway 128 in Boston or in the San Francisco Bay area. These are small, innovative firms which provide scientific and technological services of a very special kind and can draw on a great strength of university scientists as consultants. Many of the U.S. examples of these have been able to survive by the use of the "study contract" by the Department of Defence in the U.S.

These are only a few specific examples of how we could start to
tackle the major problem of Canada's lack of scientific and technological involvements in industry.

\section*{SCIENCE AND UNIVERSITIES}

The universities should continue to be accepted by Federal and Provincial Governments as the most important source of pure science in the country. The Provincial operating and capital budgets (mainly for undergraduate education) and the Federally supplied research budgets should reflect this, and not just be a sop for professors to play at research in their spare time. In this respect any major move to divert to the provinces the responsibility for fundirg scientific research should be resisted firmly as the temptation to use such funds for other more general purposes will be hard to resist by university financial officers. Research in universities should, of course, be the vehicle for post-graduate and post-doctoral education and training. In this respect much more cooperation between universities and non-university laboratories is needed. Well equipped non-university laboratories should provide the possibility for M.Sc. and \(\mathrm{Ph} . \mathrm{D}\). level research provided reasonable arrangements can be worked out with the graduate schools. The traditional insularity of the graduate schools has to be removed. A number of universities have already mored in that direction.

Insofar as the funding of research is concerned, the administrative procedures associated with annual research grants is extremely time-consuming to the detriment of the programs concerned. Much time is taken up in planning for, applying in and reporting on research. Longer term research grants are very much to be recommended. Similarly, while the adequate support of individuals should never be removed, excellence should always be supported,
and on-going research centres should receive consolidated funds for the persecution of well-conceived programs.

Professors should be encouraged to cooperate with each other within and across departments much more, to share capital equipment, and to use the facilities of national labor atories where necessary. The need for adequate computer facilities cannot be too strongly stressed.

As far as it is able, the National Research Council does a very fine job, not only in its own laboratories, but in the distribution of research grants.

There seems to be a number of anomalies when one compares the operation of the Medical Research Council and the National Research Council with respect to the administration of research support. In this day and age, when much significant life science research can be, and is being, done in pure science departments, as well as in medical schools, it seems to be anachronistic that MRC sh ould nearly always support only faculty who have a medical school appointment. Basic researchers in medical sciences who work in Biology, Chemistry or Physics Departments should also equally qualify for MRC support. It is also anachronistic that in a number of medical schools a number of senior tenured faculty members of associate professor and full professor rank should have a large fraction of their salary paid by MRC fellowships. This is either contrary to the BNA Act, or should apply equally well to researchers in pure science departments. Possibly the recent transfer of responsibility for MRC to the Department of Health and Welfare will change its character.

Is there really a need for a separate MRC, NRC (and we hear) and Engineering Research Council? This seems to be a fragmentary move. It would scem that one science body would far better administer the federal support of scientific research to Canadian universities.

WRITTEN STATEMENT TO
THB SPECIAL COMMITTEE ON SCIENCB POLICY OF THB SENATE OF CANADA
by
Dr. John Hart
Dean of Science
Lakehead University Port Arthur, Ontario.

\section*{INTRODUCTION}

This statement is divided into three sections:-
1) The Difficulty of Getting Started,
2) The Necessity for More Applied Science,
3) The Need for Bducation in the Scoail Bffects of Science, Technology and Technique.

Dr. Hart was for four years a research worker in the Division of Applied Physics of the National Research Council of Canada. He subsequently saw the University grow from a tiny downtown college to a fine institution with a first class physics department housed in its own building. He subsequently went to Brock University where he was responsible for the academic development of the first year of operation, and he has been Dean of Science at Lakehead University for three and one haif years, during which time the Faculty of Science and the University Schools have grown by at least one order of magnitude and are now houm sed in a fine teaching and research building. Dr. Hart is an expert in electrical insulation and has chaired several Canadian and international committees in this discipline.

It is difficult to get started. This is true for a new institution and for a new scientist.

New Universities have always faced the problem of reactions from within. In all three universities in which I have been privileged to serve, there have been reactionaries who wanted to see the institution stay as a small cosy structure providing a pleasant quiet life for its faculty. However, such reaction is always overcome, and by and large, the senates of the newer institutions recognize that the function of the university is both to transmit knowledge and wisdom and to discover or to assist others in discovering, new truths. But in the past two years new dimensions have been added, and the universities find themselves fighting for their rights against extermal bodies. The idea of university autonomy is increasingly regarded with suspicion by provincial governments, and the role of the interaction between teaching and research is not well understood. The universities have, perhaps, not helped this situation by, in some cases, their so-called publish or perish policy, which has resulted in the neglect of undergraduate teaching. Perhaps I should make the point that the small newer institutions devote far more professorial time to undergraduate teaching than the larger institutions. It is usual in the smaller universities for the professorial staff to lecture to first year classes, conduct seminars and laboratories-m this is certainly not so in some of the larger institutions where the first year classes are delegated to teaching assistants and graduate students?

The research function is necessary to a university because without the continuous cha11enge of the research laboratory, a scientist ceases to be a scientist and becames a conveyer of dull facts. The further point could be madem-that if all research were carried out in nonteaching institutions, there would be no passage by which the expertm ise of the scientists could be conveyed to the younger generation, and what a tragic loss that would be.

The superficial attitude toward universities which is widely prevalent outside them is exemplified by the 'Special Study Number \(8^{*}\) of the Science Council of Canada. The introduction to this study states very clearly that it is a personal statement of the views of the Committee and J. P. I. Tyas, but nevertheless, it is published as a Science Council of Canada document and as such must be supposed to have some authority. In Appendix (e) on page 49, it is stated that "The primary function of the university is to teach.". The appendix then goes on to state that "Universities...must specialize on teaching, if necessary
at the expense of inhouse research...". The paradox inherent in this statement, however, emerges in the next paragraph where it is stated that "In the long run, the knowledge emanating from universities that will be most beneficial to society will...be....in the minds of graduates who go forth to work in society...n. It is not made clear in the appendix how knowledge can emanate from universities if the university faculty is not to indulge in research.

Most university scientists take it as selfmevident that a faculty of science must have a research function. Now the methods by which this research function can be achieved are various. There are such devices as research institutes, which I shall mention later, whose function is wholly devoted to research, with the faculty members tending to have their primary responsibility to the institute rather than to teaching. However, I think that most deans would say that in forming a faculty they have to balance these functions as best they can. They will do this by hiring faculty members who are primarily teachers, faculty members who are primarily research workers, and they will hope to obtain the rare paragon who is a mixture of both. A wise dean or departmental chairman will tend to encourage those who are good at teaching to teach and those who are good at research to conduct research, but they will take care that the majority of the faculty members do, in fact, have a foot in both camps. This is a practical and humane policy. The newer institutions are bringing into, or are acting as the vehicle for the return to Canada of some spectacular talent. In our own institution, the Faculty of Science has among it, at least, ten faculty members with international reputations in their specialities. Most of these people, of whom roughly one hald are Canadians, would not have been in the country were it not for the existence of Lakehead University. Our national science policy should make sure that these people are fully supported, particularly during the formative years of the institution. They should be given every encouragement to develop groups within their research expertise, and if they can be persuaded to undertake research which is of obvious direct benefit to Canada, so much the better. It is my contention that this support is not forthcoming because of the restrictive policies of the granting bodies, and the failure of the scientific establishment to recognize that by hard work and a certain amount of luck, a first class group of research workers can exist in a place where previously there was nothing.

The days of string and sealing wax seem to be past. In order to establish a reasonable research facility, it is necessary to first establish the instrumentation that is vital to the work to be carried out. However, the granting procedures of the National Research Council militate against the formation of such a foundation.

Perhaps I should digress at this poing to state that the use of expensive scientific equipment in research laboratories is not usually very efficient. In the Ottawa district, there are certain federal government laboratories where most expensive pieces of equipment, bought by one research worker or a group of research workers, stay idle for weeks on end. However, with the granting policy of the National Research Council, it is evident that major equipment grants are normally made to one person or a small group of people working in a single discipline. This means that the prior development of a facility with a view to attracting people into a research group is impossible. In our particular case, for example, we have developed an instrumentation facility worth, at an approximate guess, some \(\$ 500,000\). We have not once had a National Research Council grant for this facility, and the only interdisciplinary money of any kind that we have received is the \(\$ 25,000\). annually that goes into the National Research Counci1's University Presidents* Fund. This fund is normally used to supplement National Research Council grants where they have proved to be grossly inadequate for the work already in hand, such as in our Department of Mathematics, where almost all applications for money were rejected. Certainly nothing is left over for the starting of an interdiscipinary researchgroup of any kind.

The point is, that the National Research Council granting procedures are not well comordinated, and, as I understand it, the grants are awarded within individual disciplinary areas. This makes it very difficult for work in an interdisciplinary field to be developed and the potential of a new university where departmental interests have not been allowed to develop, is greatly reduced.

At Lakehead University, our contact with the granting structure of NRC has been restricted to the visit of two administrators who came at our invitation some eighteen months ago, and one chemist who is a member of the Nationa1 Research Counci1, and who had more than one reason for visiting the Lakehead. There is both at Lakehead University and eisewhere a great lack of understanding of the means by which grants are determined and there is some resentment that the purposes for which grants are requested are often not understood by the granting body. We also feel that the granting body does not usually have enough information on which to base its recommendations, and the whole procedure needs to be thoroughly overhauled. In particular, we cannot understand how the National Research Council could determine on the basis of one annual report unsupported by a referee, what the progress of research has been. One is, therefore, led to the conclusion that the National Research Council must base its policy on publication, and this of all things is is most detrimental to university work, and has already led, in many

Canadian universities, to the much depiored "publish or perish" policy. We do not have such a policy at Lakehead University, and we do not wish to have such a policy, but we do wish to pursue research of benefit to the Canadian economy. We do not belleve that the present granting system is adequate for this purpose. Lest I be misunderstood, let me hasten to add that it is not the amount of the grants that concern us, at this time, but the method of allocating them. We all recognise that there is a limit to the amount of research support a new university can expect to have.

No doubt most of these points can be answered by the National Research Council, but the point is, surely, that it should not be neccessary for us to feel this way. We have enough difficulties with bodies other than the federal government in getting our research underway, and the lack of information that we have, or at least the feeling that we have a lack of information, is not good for our morale.

Finally, in this section in discussing the difficulty of getting started, I would like to talk for a moment about the young research scientist. There is no doubt that a brilliant man will, unless some disaster happens in his personal life, get underway very fast at an early age and will succeed in establishing his field very quickly. For such a man the assistance comes from one source or another and he will be given the facilities that he needs. However, I think that the Canadian policy towards notmsombrilliant research workers when they first start out should be revised.

It used to be Dr. Steacie \({ }^{2} s\) dictum that a scientist should be as far as possible left on his own to do what he does best. Whether that policy still holds in the National Research Council, I cannot say. However, from the granting structure, it appears that something like this policy must be followed, since most new research workers receive a grant for them to undertake independent research. I would like to challenge this policy, and if I may, call on my personal experience. When I first started to work at the National Research Council, I recognised full well that I was not and was unlikely to become a brilliant research worker but I was perfectly prepared and, I think, was competent to work in the general field of applied physics. However, in the Division of Applied Physics, at that time, there was no direction whatever given to young men and I started to gallop off in all directions. I started some work in dielectrics, I interested myself in the development of AC standards and meter calibrations, and I undertook to wind one of the Canadian standard inductors. This was far too big a task for a young man, and I became frustrated and left the Council. I see
the same thing happening in other young men, both within and outside government research laboratories. I believe that the government should give a lead in helping these young men to restrict their activities. There are several ways in which this could be achieved, and one of them, which seems so obvious, that I cannot understand why the practice is not followed, would be to give some feedback to the grant recipient. In other words, if a grant is refused or reduced, or even if it is awarded in the full amount, there should be some statement with it concerning the National Research Counci1's view of the direction of the research. The lack of feedback from this granting system is a prime example of lack of communication and indeed of an opportunity to strong1y influence the goals of research which, after all, is financed out of public money, a fact that is sometimes forgotten by the research workers concerned. In addition, I believe that funds should be made available to research group leaders or departmental chairmen so that they can, at least, influence their younger people to work in small groups. Immediately, the suggestion is made, the specter of the control of an individual research worker*s freedom is raised. I believe that we have to face up to the fact that if we are to continue to develop our science this freedom has to be restricted both in government laboratories and in universities. In other words, in a university there may be nothing to prevent a research worker investigating a particular field, but he would have to find his own money to do it. I think the dangers are grossly exagerated particularly in the minds of some of the nonscientific members of university senates. I believe that if Canada as a whole paid more attention to the training of young scientists during their early years of independent research (in other words, at the postdoctoral level) the scientific strength of the country would be greatly enhanced.

Finally, I would like to agree with the minority report of Dr. L. P. Dugal in the Special Study Number 7, commonly called the *Macdonald Report* prepared for the Science Council of Canada and the Camada Council. Dr. Dugal appears to predicate his minority report on the problems of French Canada, but I would like to reassure him that English speaking universities do have the same problem. The policy of granting awards, which must be based on the criterion of excellence, is not a realistic policy because of the rapidity with which the country is growing. I believe that there is a strong possibility of the provincial and federal governments acting as true partners in the support of research, a facet of the problem that I shall mention in the second part of this statement. The Macdonald Report and the recommendations appear to me to be very much a report by the establishment.

In addition to agreeing in general with the minority report, I would also like to make a statement about recommendation 26 of the Macdonald Report, namely, that the federal government undertake a comprehensive study of the conditions under which government employees may teach in universities. It is my experience that government employees of ten desperately want to teach. Perhaps, there is a very deep seated reason for thism-they feel a responsibility to passing on the expertise earned during the course of their employment. If this is so, then sure1y the solution is to reexamine the whole nature of government research laboratories. Often, the availability of government workers to lecture in umiversity courses does not strengthen the university but weakens it because the government employees who come in as part-time lecturers really have no stake in the university. The desire to teach is something that should be capitalized on, and it may be that the honourable Senators may wish to examine whether the research that is at present carried out in government laboratories, could not, at least as effectivem ly, be carried out in universities. Alternatively, there is a case to be made, perhaps, for developing extramural campuses under joing pro-vincial-federal support. The Atomic Energy of Canada Limited installation at Chalk River would have a real shot in the arm if some of the arrangements that ABCL makes with individual universities were codified to the point where ABCL became a branch campus with much the same relationship to the main campus of some university not dissimilar from the relationship of the Institute of Aerospace to the University of Toronto. I do not wish to unduly stress this point-all I am trying to convey is the idea that some highly skilled teaching talen is being misused, or, at least, wasted, and that is to the detriment of the scientific development of the nation, surely? This point is made in the Special Study Number 2 of the Science Secretariat in appendix e on page 379, but has received too little attention subsequently.

In Special Study Number 2 prepared for the Science Secretariat by a study group of the Canadian Association of Physicists, the first and strongest recommendation is that special consideration should be given to the strengthening of the research effort in applied physics. It was not in the terms of reference of the study group, but I would suggest that in Canada at the present time a major research effort should not just go to applied physics, but to applied science in general, with particular reference or particular emphasis to interdiscipilnary applied problems. As I said at the beginning of this report, my area of expertise is electrical insulation. I have been working in the field for some twenty years. Among other activities, I have until recently been chairman of a committee of the National Blectrical Manufacturers Association in this field, I have been chairman of the National Research Council Committee on Blectrical Insulation, the Canadian Standards Association Committee on Electrical Insulation, and I have also attended an International Blectro-Technical Commission Meeting as a Canadian representative on electrical insulation. The exact statistics on the annual production on electrical insulation are not available because it is not a very clearly defined product, but it is known to be a biliion dollar industry. Canada has three of the prime resources for the production of electrical insulation-wood, alumina, and petroleum products. Electrical insulation cannot be said to be a popular subject, but there is a small corps of experts in the field, and the Institute of Blectrical and Blectronic Engineers has recently formed such a group in Canada which met in Ottawa yesterday.

One of the recommendations of the NRC Committee was that federal support should be put into the development of a research project in a pulp and paper field with a view to developing good Canadian paper insulation. A great deal of effort went into the Committee and its recommendations were, I think I can say without exaggeration, turned down flat by the National Research Council. At that time, the new National Research Council policy on industrial research was being implemented and the inference was that the new program would take care of proposals of that kind. Now, in fact, despite repeated stirrings on the subject by the people interested, absolutely nothing happened and no assistance of any kind was forthcoming. Government alone is not to be blamed for the situation. About three years ago, the President of one of the biggest paper manufacturing companies in the country deplored the lack of applied research in universities. I wrote to him and offered to put the facilities of the university at his disposal to solve any problem that he wished to name. He did not even reply to my 1etter.

There are two paper mills in Canada that are now turning high grade electrical pulp, one in the Province of Quebec, and one at Dryden,

Ontario. By dint of a great deal of effort, we have now started an extremely small research project on electrical insulation in co-operation with the Dryden Paper Company. Almost all the resources for this project have come from internal university funds, and we have purchased some \(\$ 50,000\). worth of apparatus specifically for the project. The Province of Ontario has provided us with \(\$ 3,500\). for the project, a very welcome indication of the province \({ }^{2} s\) policy in the support of applied research. Last summer, I tried to sell this project in the National Research Council, the Department of Industry, and several other government departments. It turned out that for one reason or another, the arrangement that we wanted to make which was that the research would be done in the university laboratory with the comoperation of the Dryden Paper Company, did not qualify for federal support of any kind. Further, when I applied for my National Research Council grant this year, I stated that I was going to work on this project as opposed to the more pure projects in the past. The grant awarded to me this year is the lowest that I have ever received, and I shall be hard put to it to find the necessary staffing assistance to carry on the project. It may well be that the National Research Council has decided that my research record, whatever the project that I shall follow, does not justify the granting to me of money. If that is so, I would like to know. However, on switching to applied research, my grant has been cut, and since I was active last year, the only conclusion that I can draw is that the particular granting committee within the National Research Council that examined my grant was prejudiced against research in the field of electrical insulation. I would like to make the further point, that by virtue of the method of applying for the grant, I have no doubt that my request went to a committee of physicists: it would have been much more appropriate for it to have gone to a committee of physicists, chemists, and electrical engineers, who really understood the magnitude of the problems that have to be tackled in the field of electrical insulation. I would like to add one final statement about applied research. There is a great deal of suspicion in university senates about the orientation of applied research, particularly when it involves industrial secrecy. I believe that quite often manufacturing companies (I am not referring to the Dryden Paper Company here) are unduly jealous of their trade secrets. University senates are very reluctant to make arrangements for students to undertake secret theses. It occurs to me that my above remariss might be misconstrued. I would like to make it quite clear that we are grateful to the Government of Ontario and the Dryden Paper Company for the co-operation that they are giving us.

One final aspect of the applied research problem concerns industrial research institutes. The directors of these institutes can speak, no doubt, for themselves, but it appears to me that they are not having the success that they fully deserve. This is a pity, because in some universities the formation of the institutes has been a genuine
attempt to make the university of direct community service. There is already enough suspicion among university faculty members of such institutes, as I sald in my first section, because they appear to control an individual faculty member \({ }^{2}\) s freedom, and to some extent this is true. Unless industry can in some way be persuaded to make use of these institutes, the often heard criticism that the universities do not co-operate with industry will surely have to be replaced by the criticism of industry that it is not co-operating with the universities.

\section*{THB NBED FOR EDUCATION IN THE SOCIAL BFFBCTS OF SCIBNCB TBCHNOLOGY AND TBCHNIQUB}

For the past seven or eight years I have taught a course to nonscience students about "What science really is?" and the social effects of science. This course is widerranging in nature, and covers everything from Galileo through to pollution, birth control, overpopulam tion, the effect of technique, including business administration and computer technique, upon our society.

From time to time we have visiting scientists come to that course from government or industry, and these visiting scientists attempt to put their point of view to the students. The students come into the course with a strange enough idea of what science is, and \(I\) must say that with a few notable exceptions, the visit of professional scientists does nothing to dispel their fears.

At the time of the controversy about the intense neutron generator we became interested in the matter as a class project, and we invited one of Canada's most eminent scientists to visit us. It is difficult for me to criticise so eminent a man in public, but the fact is that his statements about the intense neutron generator simply confirmed in the young people the fears th they had of vast quantities of money disappearing into the voracious jaws of an uncontrollable organization devoted to the narrow pursuit of the agrandissement of science. This, of course, is not what the purpose of ING is, but the fact is, that the suspicion of such projects, however worthy they may be, is not recognized by scientists as being a factor in decisions made concerning their research. I would go further and say that the whole development of what Bliul calls "technique" is what is basicaliy causing our national difficultiesm-nor that matter, our worldvide difficulties, and the Science Council would do well to devote a considerable part of its effort to a study of the apparent arrogance of scientists and the inevitability of technique. We are in the grip of a technology which we cannot reverse and there are already strong signs that it is beginning to control us. I think Canada is very well situated, as a relatively underdeveloped country which, nevertheless, has a high level of technology, to examine the problem dispassionately and to perhaps come to some understanding of the problem that may be useful to the whole world. There are some people in the Science Secretariat who appear to have the time and the patience to start an examination of these probleas and they should be encouraged. In addition, the granting policy of either the National Research Council or the Provincial Governments should be changed to make research in this field a possible activity for practicing scientists, and every encouragenent should
be given at all levels of education to teachers who want to convey to their students some idea of the magnitude of the problems that we face because of our technical world. I do not mean by this that school teachers should abandon a study of science per se but that they should be encouraged to understand that the technique of science is not science itself. This cannot happen until there is a marked change in the attitudes of the provincial departments of education and the universities themselves. The problem is truly one of education as opposed to training, and although constitutionally the federal government might feel itself on somewhat shaky ground in attempting to tackie this problem, it has to be done, and fast. I would recommend most strongly to the honourable Senators that in their report that they give some encouragement for the establishment of a working group to develop this theme.
(Signed)
John Hart,
Dean of Science, Lakehead University, Port Arthur, Ontario.

\section*{APPENDIX 72}




BRIEF TO THE SPECIAL COMMITTEE OF
THE SENATE OF CANADA ON SCIENCE POLICY
University of Waterloo
Waterloo, Ontario Canada.


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Summary and Recommendations:
I. SUMMARY

The role of the university might be considered as consisting of three inter-related parts, teaching, research and service. Included in these three facets of the university's role is, of course, the storing and organization of knowledge, the generation of new knowledge, and the advisory or consultant activity of the faculty etc. The service role of the university perhaps has been insufficiently acknowledged although it is by no means a new phenomenon (the service to agriculture of the land-grant colleges of the U.S.A. is a prime example). However, much of the research conducted within the universities must be free from the pressures of the relatively short-term requirements of both industry and society in general. Much of the university research is indeed of long-term interest and must not be sacrificed to immediate or short-term needs of society. This long-term, of ten disinterested research or "quest for knowledge for its own sake" can nevertheless often be not only a source of unexpected scientific advance, but can also ensure some degree of scientific and technological readiness within the country which may assist us in coping effectively with new developments. However, a balance must be established in the universities between this research on the one hand, which is usually based on established disciplines, and problem generated research on the other. One of the roles of government in funding research in the universities must be, in the overall interest of the country, to assist the universities in
maintaining a suitable balance of activity. It must be pointed out bas bas however, that the policy of government support to date in the \(\quad\) th a tran universities has been based on the quality of the individual researcher regardless of the field of interest. This has led to a degree of imbalance in the Canadian scientific effort. Some fields of activity have been relatively oversubscribed as far as the national interest is concerned, while other areas have been neglected, and there has been little positive encouragement for people to enter these new or neglected fields of brat birn endeavour. We have clearly now reached the stage where a more critical appraisal of both the individual researcher and the significance of his


It is also clear that the universities will now need to assume a larger share of the responsibility for the undertaking of research which is problem generated. (Internal reforms in the university. structure will no doubt be required to facilitate this. The various methods of research support from governments can effect pressure for changes within the institutional structure of the universities and granting bodies must have an understanding of this). The initiation \(\mathrm{fa}_{\mathrm{a}}\) a points of much university research are increasingly likely to be found in the problems of government, these problems being either largely related to social programmes or problems associated with economic growth or the generation of wealth in such a way that effective social programmes can be mounted and maintained. In these connections an increased degree of contact, understanding and cooperation between social scientists, engineers, scientists and the other professions is essential and attention must be paid to facilitating such interaction. Attention must be paid to the further development of the social sciences in Canada
and granting agencies be enabled to award funds for group project work. An ability to screen and advise on project research proposals must be developed.

As pointed out by the Science Council in Report No. 4, one of our failings has been in not ensuring that the results of research lead to innovation and that research projects are carried through to this final conclusion. Emphasis on the management sciences is called for and support is needed to induce engineers and scientists with some professional experience to return to university to undertake research and study in the management sciences particularly those directed towards the exploitation of research in science and technology, involving detailed attention to all parts of the innovative chain from research to marketing.

Attention is also drawn to the need for continuing postexperience education. This clearly has a role to play regarding our ability to accept and adapt to new ideas and techniques, and can play a significant part in facilitating the transfer of technology. Attention is also drawn to the need for industry and government to broaden their outlook with respect to the utilization of \(\mathrm{Ph} . \mathrm{D}\). 's and some of the responsibilities of the universities in this regard are highlighted. It is also suggested that the universities could play a much more effective role in relation to Canada's responsibilities to the developing parts of the world.

In conclusion, it is suggested that the government could more effectively make use of the expertise in the universities not only without prejudice to the institutions themselves but indeed to their benefit. The recommendations included in this submission are made basically with this in mind.
1. That the universities be encouraged and given the support to assume more responsibility in the pursuit of research generated by problem recognition. This applied to the social sciences as well as to mathematics, science and engineering.

In order to accomplish this it is suggested that:
(a) All government mission-oriented agencies be provided with substantial funds earmarked for the support in the universities of research which is generated by problem recognition.
(b) In supporting research in the universities, government agencies should consider research proposals in terms of relevance and effectiveness as well as in terms of the calibre of the research worker.
(c) Means be found of ensuring effective collaboration between government laboratories, the universities and industry.
2. That, in devising funding mechanisms for research support, government agencies act to encourage inter-institutional cooperation and coordination of activity. For example, the forming of ad hoc taskforces of people from various institutions to undertake specific studies related to problems of government should be encouraged. The allocation of substantial block-grants to encourage an interdisciplinary team approach to various problems should be considered.

3. That consideration be taken of the fact that present Federal government funds for support of research in the universities are merely grants-in-aid which require supplementation by the universities through the provision of space, equipment, faculty salaries and other services. Granting agencies should be enabled to provide for such indirect costs associated with the research activity.
4. That the agencies granting "untied monies" for university research should be charged with the responsibility of ensuring that there is no neglect of fields of science which are either not currently fashionable or which are not being supported by any mission-oriented agency. We must acknowledge the possible impact of unforeseeable scientific advances and must maintain a technological readiness to respond quickly and effectively to such developments.
5. That granting agencies recognize the need for support of study and research in the management sciences. In particular, adequate support must be found for encouraging graduate engineers and scientists to undertake post-experience study and research in this area.
6. That government initiate more studies on the relation between research and social benefit. The support of research by any government must make economic sense and yet insufficient knowledge is available at this time to assure this.
7. That a body be charged with making a speedy, but thorough appraisal of the state of the social sciences in the universities; after which positive action be taken to provide the resources required to accelerate the development of research activities based on the established disciplines on the one hand and problem generated
research on the other.
8. That a government agency be charged with initiating and participating in an investigation of the likely long-term requirements of industry for continuing post-experience education. Support for research relating to the development of instructional techniques and teaching technologies needed to satisfy these requirements must be made availab1e.
9. That a government agency such as the Canadian International Development Agency (or Department of External Affairs) work with the universities in devising ways and means of more effectively assisting developing countries in the field of education. Interinstitutional arrangements should be more strongly encouraged and supported in order that pockets of expertise about different regions of the developing parts of the world can be built up in various universities in Canada.
10. That attempts be made to clarify and define the means of implementing national science policy. This must include some clarification of the means of integrating this science policy with overall national policy for socio-economic development. Such clarifications will assist the universities in assessing their own role.

\section*{UNIVERSITY OF WATERLOO}

\section*{SUBMISSION TO THE "SPECIAL COMMITTEE ON SCIENCE POLICY"} OF THE SENATE OF CANADA

\section*{ROLE OF THE UNIVERSITY}

It is perhaps most appropriate to begin this submission with an expression of opinion concerning aspects of the role of the university in present society insofar as these are pertinent to a discussion of science policy. At the risk of over-simplification, the mission of a university might be thought of as divided into three parts viz., teaching, research and service. Much has been written regarding the inter-dependence of teaching and research in the universities, but there has been little discussion centering on the service role of the universities or the positive contribution this service can make to the teaching and basic research functions of these institutions. The universities will face a continual need to adapt to changing situations in this complex world. The demands upon the universities to provide advice and knowledge, related to the complex problems to which society will need to address itself, will undoubtably increase. In modern society, as suggested by J. A. Perkins in his well known book "The University in Transition" (1), "there is almost no problem in our society that does not increasingly require expert advice. It is also true that expert advice can be found most frequently and in greater variety in the university than in any other institution". Our society is increasingly acknowledging the existence of the expertise concentrated in our universities and perhaps more importantly, is increasingly aware of the possibility of making use of this expertise on an individual or task force basis to undertake studies of various kinds, often in
conjunction with experts from other sectors of society, and so on. Perkins (1) goes on to suggest two criteria which universities might use in attempting to place this service function in perspective:
(a) "the unique contribution of the university is knowledge, not operating skills, and this should be a limiting factor of great importance. The government and particularly the corporation have been organized in our society to get things done, and it is to these institutions that society normally looks for operational responsibility. The university's social scientists can provide the economic case for a sales tax, for example, but they should not be expected to collect the money. The fact that lines can be drawn between advice on how to do something and assistance in doing it thus constitutes a limiting force which aids the university in its need to preserve its balance and its unity", and (b) "the real integrity of the university is violated when large decisions in one area (teaching, research or service) do not consider the impact on the other two, in fact university integrity is compromised when decisions about any one of the three aspects of university activity fails to strengthen the others". However one interprets Perkins' opinions with respect to particular circumstances which arise in universities in Canada, it is clear that the universities, and by this I mean all the members of these institutions, must perceive quite clearly the various functions they are performing and exercise good judgement in maintaining an appropriate balance of activity within the various institutions. The discussion of the problem of coping with this dilemma is very pertinent to any discussion of the role the university might play with respect to national science policy. The problem really hinges on the difference between the traditional
discipline orientation of the universities as distinct from the mission-oriented society which supports them. Much of the difference is however one of time scale and to sacrifice the long-term needs of fundamental research in the universities to the more immediate perceived needs of society in effect kills the goose which lays the golden egg. The universities must ensure that they play their traditional role of advancing the disciplines, while at the same time seeing that advances in knowledge are communicated in such a way that they can be readily utilized. Before discussing action that might be taken to achieve these ends, it would perhaps be useful to indicate the context in which technology and science policy are being viewed in this submission.

SCIENCE POLICY AND THE UNIVERSITY - SOME GENERAL COMMENTS AND CLARIFICATIONS
It has become very common probably as a result of patterns of discussion of OECD on the matter, to consider science policy in terms of "policy for science" and "science in policy", the one being related to the actions of governments regarding the organization and promotion of the nation's scientific and technological effort, the latter concerning the steps taken to ensure the most effective use of science in relation to the social, economic and political needs of the country. All facets of the university could thus clearly have some contribution to the development and execution of policy related to science and technology and this springs mainly from the fact that science policy is only a part of any overall government policy related to the attainment of our national goals or the sort of society which we would like to build, and which we feel is within our capacity. Being only a part, albeit a very important, perhaps increasingly important, part of governmental considerations, science policy
is not merely a matter for scientists. In the allocation of resources to science (science being regarded as embracing the knowledge of natural phenomena as well as the practical application of this knowledge) on a national scale, the considerations of governments must of necessity be made bearing in mind the broad social and political priorities rather than merely the needs of science itself. However, in these bab considerations, we are far from the position of being able to define our goals in detail, devise explicit alternative strategies for achieving these goals, undertake cost-benefit analyses of these various strategies and follow this by acting along the lines of the optimally selected strategy. We are still too ignorant of the many factors involved to be able to do this effectively, the relationship between, for example, research and social benefit being as yet poorly understood. The whole breadth of consideration of science policy can be further illuminated if we consider the changing nature of technology viewed in its broadest context. (The principles of scientific management when embodied in an organization are just as much technology as an automobile.) Similarly, as pointed out by Harvey Brooks of Harvard (2), "to the extent that social science knowledge is embodied in techniques such as market surveys, public opinion polls, educational tests, programming for teaching machines, or when planning procedures, it is technology. In short technology consists of codified and reproducible ways of doing things derived from rational principles". The "software" aspects of technology appear to be assuming an ever increasing relative significance and this in addition to the human element is good reason for including discussion of the social sciences in our consideration.

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In summary, it is clear that science policy must touch on almost every aspect of our society and requires an increasing knowledge and understanding of this changing and increasingly integrated society. Consideration of the cost and benefits of technological change, consideration of priorities within science, between science and other social demands involves almost the total span of man's knowledge. The humanists and social scientists have their part to play alongside those of the scientist and engineer in ensuring that governments, in exercising judgements on behalf of society have available the maximum pertinent knowledge and information and the most expert advice. It is becoming evident that universities will increasingly be expected to accept greater responsibilities in this regard in addition to their traditional role of teaching and basic research. Universities will be increasingly involved in helping society respond to perceived problems, and indeed also in helping society at large perceive emerging problems. In short as suggested by Kash (3) "the demand is that universities take on a larger share of responsibility for applying the results of basic research to practical needs". This evolution of the role of the university is currently putting demands on the present institutional structures, which are, by tradition, discipline oriented and not in themselves able to cope with this changing situation. Such challenges, however, have arisen before in the historical development of universities and have been overcome.
\end{abstract}

THE EVOLUTION OF UNIVERSITY INSTITUTIONAL STRUCTURES

\section*{Introduction}
A. M. Weinberg (4) has suggested that the mission of society is to
solve its variety of problems, virtually none of which can be resolved by the application of a single discipline. The universities on the other hand rather than being "mission-oriented" are traditionally "discipline-oriented". In addition to this, the rapid increase in knowledge is tending to lead to an ever increasing degree of fragmentation and specialization which in turn is leading to ever increasing difficulties and random delays in communication. At the present time the demand that universities become increasingly involved in the problems of society is acting as a counter-balance to these forces which tend to decrease the connections between university and society. The professional schools such as engineering have, of course, a very important part to play in bringing the knowledge of the universities to the service of society. In its brief to the Macdonald Committee (5) investigating the support of research in the universities, the Faculty of Engineering at the University of Waterloo stated: "we feel that the inter-disciplinary nature of engineering and the fact that engineers are becoming increasingly involved in the planning, development and management of our technological environment should mean that our engineering schools will inevitably take a lead in integrating efforts between society and the universities and enhance university-society interaction on a continuing basis. Engineering schools can in fact become a major bridge between mission-oriented society and the largely discipline oriented universities". It is true that Engineering Faculties have a tremendous opportunity in this regard. However, like all institutions of long standing such Faculties have also developed their own institutional rigidities.
molder The university must identify structures that will assist it in educating "middlemen" who can communicate the results of research to practitioners and who can communicate practical problems to researchers, whether they be members of Faculties of Arts, Engineering, Science, Social Science or Mathematics. In other words, we need people in the universities who can advance their disciplines and who can apply these disciplines or at least communicate the new knowledge generated in these diciplines in such a way that it can be used by people directly attempting to solve the various problems of society.
(b)

\section*{The Social Sciences}

The social sciences are perhaps in a unique position in our universities. Their varied locations within the institutions are largely the results of historical accidents. They are young disciplines with varied degrees of development and the existence of very distinct and differing schools of thought within and between the disciplines themselves lends great complexity to that inter-relationship. In addition to the inter-relations between the disciplines of social science there is a variety of inter-relations possible with other sciences. At the same time, the social sciences are dependent upon the culture in which they are being studied and thus share much common ground with the humanities. The universities clearly have to develop flexible institutional structures that will enable the social sciences to progress and develop as disciplines and yet draw upon and contribute to the development of each other and to the professional fields such as engineering, and also the sciences and humanities. As in many other areas a solution has to be found to the apparent incompatability between the development of the
disciplines and the inter-disciplinary nature of the real world problems that will face those educated in the social sciences.

Many universities are experimenting by forming various new academic groupings of Faculties of Social Science, Schools of Environmental Studies etc. Other universities are developing institutes that do not conflict with pre-existing departmental or Faculty structures, but exist to mobilize the resources of the university to undertake large scale studies connected with, for example, urban problems, resource management and so on the completion of which requires the contribution of engineers, social scientists and other members of the university community. Much effort is being expanded within our universities in finding adequate ways to treat this problem in terms best suited to the various particular institutions. However, there appears to be a strong indication from the social scientists that the resources that our society has allocated to the social sciences has been and still is woefully inadequate in relation to the urgency for modern society to acquire scientific knowledge of itself in this time of change brought about by the advances of science and technology. Until adequate resources are made available to the social sciences, questions of institutional structures are perhaps of a secondary nature. In considerations of funding, governments must nevertheless be aware of the likely impact on the institutional structures of various patterns of resenrch support.
(c) Enyineering and the Sciences

Perhaps the sciences are least hampered by the problem of institutional structure, but even here it must be acknowledged that many
of the growth points in science are appearing in just the areas
where traditional fields intersect. This could clearly lead to
some neglect of these areas, but as far as our development is concerned
at Waterloo the present fairly traditional structure of the Faculty
of Science has been able to respond successfully in supporting such
developments. The Science Faculty has three major departments viz. biology, with special emphasis on ecology, physics with special emphasis on solid state research and the application of solid state devices and chemistry, which has pioneered an applied chemistry programme with a view to the needs of Canadian industry.

The Engineering Faculty also appears to have solved any problems which might have arisen due to its institutional structure. The Faculty of Engineering at the University of Waterloo is currently the largest in the country and offers a wide range of activity and yet it achieves this basically within four main departments and two developing departments of Design and Management Sciences which have to date concentrated upon post graduate activity. A consideration of the activities within the various departments indicates very clearly the inter-disciplinary nature of engineering and the acceptance of this philosophy within the Faculty, which incidentally does not consist entirely of engineers. The activities range from highly theoretical analytical work in solid and fluid mechanics, through the application of knowledge in such fields to manufacturing processes and pollution in the Great Lakes etc. Work also ranges from the investigation of control of forest fires to transportation planning, from materials sciences to resource management and so on. The internal structure of the Faculty has provided no barrier to the development of such diverse activities. Similarly the
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university structure does not appear to have inhibited contact and
cooperation between scientists and engineers. However, the increasing
involvement of engineers with social and economic factors related to the
planning, development and management of our technological environment
demands an increased degree of contact, understanding and cooperation
between the social scientists, the engineers and of course other
groups such as the architects, the medical and legal professions. It
would appear that some communication barriers need to be overcome in
this regard. The tendency of the engineer to quantify means that he is
often talking a language not understood by those social scientists
educated several years ago to an almost totally qualitative opinion type
approach to their subject. This difficulty has perhaps also arisen
within the fields of the social sciences themselves. Clearly, research
in the social sciences can never be limited to the strictly quantifiable
or cven measurable. Nevertheless, the problem of communication remains,
although the common language appearing through the growing acceptance
of the systems approach to the solution of complex problems may provide
a fertile meeting ground for the engineer, the social scientist, the
architect and others, as well as providing a focus for the various
points of view within the social sciences themselves.

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(d) Other Groupings

Attention must be drawn also to the important role that groupings such as Administrative Studies, Management Sciences, Architecture etc. can play in the University scene. The Management Science Groups attempt, for example, use the techniques of operational research developed by the mathematician and apply these techniques

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in conjunction with a knowledge of social sciences, engineering, etc. Schools of Management Sciences can play a vital part at the discipline/ mission interface. The architectural schools clearly can perform a similar function, embracing as they do considerations, economic, social, aesthetic and technical.
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(e) Inter-Institutional Arrangements

There would seem merit in consideration being given to the formation of inter-university institutes to enable task forces to be assembled to tackle certain problems or to make more effective the use of expensive equipment and other facilities and the avoidance of unnecessary duplication. These institutes would be people-centred rather than facility-oriented and would enable the researchers involved to get together, to assess present facilities, staff specialties etc. and exchange information regarding prospective equipment purchases, the hiring of new staff and so on. Involvement of government laboratories in such institutes would also seem to warrant serious consideration.

In conclusion, it is clear that universities must constantly be prepared to adapt their institutional structures if these are to be fully effective. These structures can be influenced by external forces as well as by internal considerations. Relationships and inter-action with government departments and industry, and methods of funding can all influence the pattern. Nevertheless, formal structure should be emphasized only insofar as it can help to create an environment conducive to good communication and cooperation. The prime factor is always the individual, his competence and willingness to work with others.

200 In the sciences and engineering the main source of research monies has been the National Research Council. The universities themselves, mainly from the operating and capital grants obtained anana from the various provincial government have provided the bulk of the facilities necessary for research to be undertaken. Basically the objective of undertaking research in the universities is to provide a vehicle for the education of graduate students, to ensure that the competence of the faculty is maintained, and that the undergraduate programmes remain up-to-date and provide a live educational experience which will prepare the graduate to make an effective contribution to our society. The university is also concerned with the generation of new knowledge and is becoming increasingly concerned with the study of ways of using knowledge. It is in this latter area that the Engineering Faculty in particular indicates a deficiency in the present granting system. It is suggested that with a multiplicity of agencies, particularly the mission-oriented departments of government, committed to the support of university research, then the research conducted within the engineering schools would have achieved a more appropriate balance between basic research, applied research, involvement in design and involvement with industry in development studies. The Faculty of Engineering has argued that the National Research Council has been very effective in providing untied monies for the support of research. But for the system to have been really successful, this support should have been augmented with other funds for research arising from problems of special interest to Canadian industry and other government agencies. Unfortunately this has not been the case, and funds from other sources for oriented basic

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or applied work have to date been small and short range, and industrial support has been almost non-existent. Industry has been very reluctant with possible rare exceptions to support any long-term basic activity. Perhaps one of the major causes of this somewhat unbalanced research pattern is the fact that the growth of secondary industry in Canada is relatively recent and comparatively slow. This has meant that up to now industrial management has been concerned almost exclusively with the many elementary and short-range needs and opportunities for engineering work, and an appreciation of the role of longer range considerations has consequently been slow to develop. Apart from this serious deficiency, the N.R.C. system for providing "untied" funds to the individual research worker where the researcher is subject to the principle of judgement by his peers with respect to his competence and creative output, seems to be generally well accepted particularly within the Faculties of Science. There have been however suggestions that better methods be established within the system of ensuring value for money and the prevention of waste on continuing sterile activity. However, consideration should be given to coordinating the provision of research funds with the availability of facilities, and with the administrative and technical support which the universities themselves can provide. Adequate consideration must be taken of the real cost of the work to the university. In fact, the whole question of suitable overheads on research grants should receive some study.

The role of development and contract work must not be overlooked. The characteristics of work covered in this category are well defined end-products or processes which must be produced within
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a specified period. University engineering schools in particular must undertake a limited amount of work in this category in order to maintain an awareness of commercial realities and the pressing requirements of strongly mission-oriented federal agencies such as the Department of Industry etc. Propriety rights of the sponsor must be respected and the work must be fully funded with respect to overhead costs. It is clear that much of such contract work would not provide thesis work for a graduate student but it must be an integral part of the activity of an Engineering Faculty and can be used as a means of part-time or "summer employment" for graduate students or employment over a longer period for those with industrial experience and family responsibilities, who need to spend periods up to a year in financially gainful employment in order to finance their graduate studies. It is expected that private industry, particularly smaller companies who are not able to employ a permanent staff for research and development work, will begin to look more towards the universities for technical expertise on a task force basis. The an decision of the Department of Industry to establish Industrial Research Institutes associated with various universities is directed at this problem. It is felt too, that the formation of the Canadian Organization for Joint Research may also enable the universities to become more aware of the needs of industry and government agencies, and at the same time enable the universities to become more aware of the needs of industry and government agencies while acquainting industry and government to be aware of the expertise, interests and facilities available in the universities.

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The very limited support for work in the social sciences in Canada clearly needs serious investigation. At the present time it certainly fares badly in comparison with science and engincering. This is no doubt partly due to the stage of development of some of these relatively young disciplines particularly on the Canadian university scene. (Comparison between the support of engineering and science in the universities a decade or so ago would yield a similar pattern. Research in engineering was very slow to develop in Canada but the development over the past ten years has been startling). Present funding would appear insufficient to develop the various disciplines and to develop means of application of the studies in the social sciences. University faculty in these areas draw attention to the short-term nature of the research grants, usually limited to one year, the general inadequacy and the problem of uncertainty regarding any long-term continuity. The lack of support for graduate students in the social sciences appears to be a major factor retarding the development of quality in the social sciences in the universities. The social scientists at the University of Waterloo have suggested that consideration be given to the provision of the following kinds of research support:
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(i) Grants to individuals with prospects of renewal.
(ii) Block grants to interdisciplinary groups for specific major research projects running over a several year period.
(iii) Block grants to Research Institutes or other Faculty bas organizations for non-specific pure research. These grants would make it possible to support investigations that are often too preliminary to make them worthy of


The Science Council and the Canadian Council through the committee chaired by Dr . J. B. Macdonald have been giving this whole question of support for university research serious study and perhaps further discussion of the support question is not warranted at this stage in this particular submission. However, we have indicated what we feel to be some of the major areas requiring consideration. It would appear that a study of the state of the social sciences in the Canadian universities would be in order. It is suggested that the impact and methods of approach of such organizations as the National Institute of Health in the United States regarding the support of work in the social sciences be studied. This is particularly important in regard to the question of the provision of funding for group projects on an area basis and for the development in the funding agencies of the ability to screen research proposals in terms of the project, the group of individuals concerned and the institutional facilities available. Since

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the Science Council has already completed a study on psychology, it would perhaps be appropriate that the Science Council, and say the Canada Council initiate such a study of the social sciences. Attention must be drawn particularly to the research taking place at the what might be regarded as the interface or intersection between the traditional disciplines, whether it be between science and the social sciences, between the sciences and so on. These areas can be exciting growth points and in the development of funding systems particular attention must be paid to these possibilities in order that opportunities are not missed because of somewhat aribitrary or traditional administratively convenient divisions of responsibility in the field of university research support.
\end{abstract}

\section*{PRIORITIES FOR RESEARCH, RESEARCH MANAGEMENT AND COORDINATION WITHIN UNIVERSITIES}

The question of priorities is of course a difficult one.
Governments must develop an overall science policy which can identify priorities. However, as stated in the Carter Report on Taxation, Volume 2, "so little is known about the kinds of research that are required, and who should do it, that it is dangerous to take a firm stand. Canada desperately needs some research on research." It is essential that we establish a study of the measures of social benefits arising from research and developments in science and technology. These measures or benefit functions can then receive public discussion in order that more realistic political decisions can be made regarding priorities
and scales of support etc. than is possible by a centralized choice between areas, specialized committees and vocal pressure groups. In the absence of the results of research on research it is essential that the decisions about research which are made by government be made on the soundest advice available. The various members of the university community clearly have a role to play in this regard.

The individual universities will also have to pay attention to the development of priorities, probably involving some rationalization not only on a Provincial basis but also on a Federal level. This may we11 raise the question of some combined Federal/Provincial body or forum in which these matters can be discussed. The Universities will certainly be required to identify their areas of strength, develop viable research groups, encourage interaction and cooperation between individuals and groups both within the university and outside, choose between possible competing demands on the available resources, particularly space. All this will require a degree of management which is somewhat new to the universities, and problems arising concerning the relationship between Directors of research divisions, groups or institutes and Department Chairmen and Deans will require solution on individual campuses. As mentioned earlier this constitutes a part of the challenge to present university structures and the universities are all presently in various stages of adapting their various structures and methods of operation. It is important that this process be understood by those outside the university who are concerned with influencing or working with the universities in various ways.

Ways must be found of ensuring that effective relationships exist between universities and government laboratories such that competent research personnel from the universities and private industry can have some influence on the research activities carried out in government laboratories. The Sutherland Report (6) in its report on this question on the United Kingdom scene identified five principal ways in which universities and government research establishments might be brought into closer relationship to their mutual benefit and to the national advantage:
(a) Closer staff relationships
(b) Cooperative research projects
(c) Formal association of research establishments with universities.
(d) Recognition of establishment research for higher degrees.
(e) Easier mobility and transfer.

This question is clearly one which merits study within Canada and the whole range of possibilities should be fully explored. The Faculty of Engineering suggested one possible approach to the problem, recommending that:
(a) each government research laboratory or research agency have an advisory committee on research. The membership of this committee is to be composed of active and competent university and industrial researchers capable of assessing the work of the particular laboratory and making recommendations regarding its research activity and that,
(i) these committees are to meet several times per year at the laboratory and have an intimate knowledge of its activity.
(ii) These committees are to submit to the Deputy Minister, responsible for the government department operating the laboratory, a short annual report on the activity containing recommendations for future work.
(iii) these committees are to be charged with investigating means of more effective collaboration with the universities and with private industry.

\section*{CONTINUING EDUCATION - THE COMBATING OF OBSOLESCENCE}

It is becoming apparent that the demands upon the universities will increase in the field of continuing education. It is difficult to forecast the rate of acceleration of this demand, but it will undoubtedly become a significant factor in university development sometime in the future. The American Society of Engineering Education (7) advises for instance that "the profession and academic institutions which serve it, must look forward to a growing activity in continuing engineering studies as a distinct educational function, outside of advanced degree programmes. This is not merely a matter of dealing with current obsolescence, retreading, retraining, or any of the other popularized versions which have been developed, sometimes almost frantically, to satisfy urgent localized needs. It is rather a matter of establishing and maintaining an entirely new dimension of personal development throughout the engineer's career'. Similarly, in the United Kingdom the

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recent report on the "Flow into Employment of Scientists, Engineers
and Technologists" recommends that "more attention should be given
to education and training throughout the career and after experience
of employment". This report goes further in recommending "that industry
should be intimately involved in the planning and conduct of post-graduate
education and training which is intended to meet its requirements." In
Canada, we cannot afford to ignore these suggestions. There are also
many social implications arising from the problems of obsolescence of
educational qualifications. When new graduates from the universities are
notable to communicate with their supervisors, then their potential
effectiveness is reduced and the traditional authority and prestige of
the supervisors and indeed senior management itse1f is undermined. (In
a similar manner many of our problems regarding the "generation gap"
could perhaps be traced to the rapid rate of change in our traditional
values and authority patterns).
The universities will need to react to these situations. It
seems probable that the recent increase in the availability of the
short residential "appreciation" courses," state of the art" courses and
so on are merely the first manifestation of this. This will provide an
increasing challenge to the universities with respect to instructional
techniques especially with regard to meeting the needs of those unable
to attend the institutions for such courses. One can foresee the
universities and other institutions of post secondary education becoming
increasingly involved in application and research into various aspects
of "teaching technology". This latter work will of course require
a clear source of financial support.
It is suggested that a study be undertaken regarding the
need for continuing education which can satisfy needs to upgrade, update

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or diversify a person's education or enable him to add new perspectives to his own field; for example, the practising engineer may wish to gain more knowledge relating to economic, political and social matters which may have some bearing on his professional activity. The Department of Industry, Trade and Commerce or the Department of Manpower are perhaps the agencies of the Federal Government which could initiate and support a study into the requirements of Canadian industry in this matter.

GOVERNMENT AND THE INTERNATIONAL ROLE OF CANADIAN UNIVERSITIES

As pointed out by P.H. Coombs (8) the rampaging forces of change throughout the world have given rise to an educational crisis born of the historic conjunction of five factors viz. (a) the student flood, (b) acute resource scarcities, (c) rising costs, (d) unsuitability of output, (e) inertia and inefficiency. The crisis certainly differs in timing and intensity from place to place. While, of course, we do have serious problems in this regard in Canada, it is in the poorer countries of the world where the crisis is most severe. It is very important that we recognize that a challenge presents itself with regard to the developing countries and that we agree that the universities can play a very active role in meeting this challenge. For example, the universities can "help establish and spur the growth of new higher educational institutions in developing countries, along lines which suit their needs and circumstances and are not simply carbon copies of the assisting universities". There is probably a need for more concerted effort on an institutional basis - the sending of instructors on an ad hoc basis from any university to fill teaching slots is definitely not the most

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effective approach. The need is for individual Faculties or universities to have long-term relationships with individual institutions in developing countries in order that the real problem can be fully understood and a degree of expertise and knowledge be built up in the Canadian institution. Included in such arrangements would of course be a two-way flow of personnel on a term-basis. It is acknowledged that a certain amount of inter-institutional contact is in evidence now (including inter-institutional arrangements between ourselves and universities in the industrialized countries). However, it seems evident from within the universities that representatives of the individual universities should cooperate with government in making a study of ways in which the various institutions can play a more effective part with regard to the nation's responsibilities on the international scene.
\end{abstract}

\section*{GENERAL CONSIDERATIONS}

It is probably appropriate to comment on the manpower output of the universities at the Ph.D. level in view of statements which have been made by representatives of some industrial, government and university institutions. It would appear, at least in aggregate, that our universities are capable of educating at least the number of Ph.D.'s which the country can usefully absorb given the current pattern of utilization. It would seem that we need at this time to consider the creation of an environment in which the skills of these graduates will be effectively utilized. To obtain a return on the current and continuing investment in the education of Ph.D.'s in engineering and science we must either increase our research effort in this country (particularly mission-oriented research and its subsequent application)
or explore other areas in government and industry in which these Ph.D.'s can be usefully employed. This will demand increased flexibility from the Ph.D. graduate too and could also be an inducement to the universities to experiment with various approaches relating to the awarding of higher degrees. For example, the Swann Report (9) recommends on the U.K. scene that "universities should examine the nature and purpose of the Ph.D. degree from first principles, and consider drastic action to bring within its scope other forms of post graduate training more closely oriented to the requirements of industry. The aims of the \(\mathrm{Ph} . \mathrm{D}\). and the implications of possible changes for science and technology and for qualified manpower need to be considered. The time is long overdue for the universities to start experimenting boldly with the Ph.D. and with the regulations which govern the award of this degree". We would be remiss if we did not take note of this recommendation as far as our own universities are concerned. Industry, universities and government will all be required to play their 10 part in ensuring that the output of the universities is appropriate and is used effectively. There is a school of thought of course which regards investment in education as a primary motive force in an economy. J. Herbert Holloman, a former Assistant Secretary of Commerce for Science and Technology in the United States expressed this opinion as follows: "Probably the most significant principle of technological innovation is that it is determined by the educational system. The pressure arising from an investment in education produces more highly skilled people, which, in turn, requires a different productive process, which, in turn, requires capital investment, which, in turn leads to improvement in productivity". To what extent this opinion is valid is difficult to say. It is clearly
a complex relationship and the question of time scales etc. relating to this are probably not well understood and will require further study.

In conclusion, it is becoming increasingly evident that one of the problems of our society lies in ensuring that our policy making machinery remains up-to-date. The rate of advance of technological knowledge is providing our decision making institutions with an enormous challenge. We will likely need to much more consciously make choices regarding social direction rather than merely attempt to adapt our society to new knowledge as we have done in the past. Science and technology while creating problems are also providing many of the means of solving them. Professor Y. Dror of the Hebrew University of Jer usalem has highlighted this in a recent book (10) in which he pleads for the acceptance by universities of "policy science" as a distinct field of study. Policy science being a discipline directed at a study of the means of improving the design and operations of policy making systems and how to increase the role of policy making knolwedge in the operation and improvement of the policy making system. For example, what changes in our policy making system are necessary if we are to use the modern knowledge of the decision or management sciences or say, the new knowledge about the conditions that encourage creativity which is emerging from psychology and organization theory? As Dror points out "to assimilate new knowledge into policy making machinery quickly and skillf \(\mu l l y\), the situation must be analyzed, the changes in it that are both feasible and needed must be pointed out, and steps must be taken to ensure that when changes become possible or needed, they will be made". He goes on to suggest that "it is up to the academicians, who are one of the few
social strata having the necessary time and detachment, to undertake the first part of this task, analyzing the present and as far as possible, the future, and pointing out the main directions in which change and innovation are likely to be needed".

The development of a national science policy, which of course must be a dynamic continuing activity, and the integration of this policy into national policy for socio-economic development will require a very critical review not only of our present capabilities in science and technology but will also require a continual review of our total policy making machinery, including the ways and means of executing and evaluating the various policies devised. Attention must be paid to the long range view and it is here that academics may be able to make the most valuable contribution. However, involvement in more short-term problems is also necessary if these academics are to remain in touch with reality and the "art of the possible". Society must tap the resources of knowledge which are available in the universities and this must be done in such a way as to avoid detrimental long-term effects on the development of the various disciplines. The Science Council has made a start in Canada by introducing a framework for the discussion of science policy and what is now needed is some indication from government of the ways and means being considered regarding the implementation of science policy. Public discussion of this matter will assist the universities in clarifying their own role.

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\section*{APPENDIX 73}

\title{
Brief submitted to the \\ Senate Special Committee on Science Policy
}
by

\section*{1. Goals for the Federal Government in support of research}

First we would define research as a diligent seeking after new knowledge or the rediscovery of old - the systematization and co-ordination of a complicated pattern which will help us to understand the past and present and to predict the future. With this interpretation we would describe the goals of the Federal Government as follows:
a) to enhence the cultural and scientific achievements of Canada on which the quality of our national life, our external prestige and internal prosperity depend;
b) to investigate and determine the conditions under which our natural resources and economic potential could be developed in the national interest;
c) to ensure the development of a strong and flexible research training capacity in the country.

These aims cannot be completely separated since the prestige of Canada abroad is a pertinent factor in attracting talented people, who in turn contribute to our development. But scientific achievement is directly related to the gravih of our technology and so to our prosperity.

We would express our strong feeling that the Federal Government has the main responsibility for the support of research in the country. To relinquish this responsibility to the Provinces, we feel would be disastrous. (Recommendation I)

\section*{2. The universities' objectives in conducting research}

Research cannot be separated from inspired teaching, undergreduate or graduate. We make a distinction between technical or junior colleges as they have developed in Canada and our universities. We feel that research should go on in all universities whether they have a graduate programe or not. Indeed it could be taken as the characteristic of the university professor that he should be continually striving after new knowledge. Such independent activity is necessary if students are to continue to benefit. This is equally true in all areas of schoiarship, not only in the natural and physical sciences, but also in the humanities and social sciences.

The Federal Government has recognized the need by greatly increasing the grant to the Canada Council in recent years. This will go a lone way to correct former inadequacies of support which have been keenly felt in this university.

Training students for research is clearly the responsibility of the university and in many instances it can lead to a graduate degree. However, the University does conauct many other types oi training in many areas from social work to public health and this is part of our contribution to the life or the community. The responsibility is often shared between the Federal and Provincial Government and this is as it should be.

Research in engineering, medical sciences and social sciences will often be directed to the accomplishment of specific goals. These goals should be chosen by the individuals or groups of individuals concerned and they should usually involve graduate studenüs. The National Research Council has done much to stimulate contacts between faculties of engineering and industry but much remains to be done. We must stimulate research and development in industrial laboratories not only in government laboratories.* (Recommendation II)

\section*{3. Implications}

What, we have said so far implies a wish on the part of both government and universities to work together for the common good. With this assumption, what are the implications on both sides? Let us look at the relationship first of all from the point of view of the universities.
a) As we have indicated, external support must conform to the needs and pressures of the academic world. At the University of Toronto we have tried to formulate conditions under which research could be sponsored by an outside body in our pamphlet, a copy of which is attached; the chief points have to do with
(i) the involvement of students,
(ii) the interest of the University in inventions made by members of the stafif, and
(iii) research involving the testing of human subjects.

Systematic procedures have been worked out with reference to (ii) and (iii) but not all government departments aupreciate the need for the University to insist on the publishability of the results of research where students are involved. The university of Toronto belongs to an increasingly large company of universities which feel that classified research should be done in government or industrial laboratories. More generally, that the grantor should not have the right to prevent or greatly delay publication of university research. We attach also a copy of the University of Poronto publication policy.
b) From the point of view of the Government the public good is best served by involving academics in a meaningful way in the evaluation of applications and in the distribution of funds. This has been done to everybody's satisfaction by the Medical Research Council and the National Research Council and it has led to an improved understanding of the need for responsible use of puolic funds as well as the need for co-operation amongst Canadian universities. Recently Canada Council has taken some useful steps in this direction.
* These first two paragraphs of the report were substantially contained in the brief from the University to the MacDonald Comnittee. What follows emphasizes problems which have arisen in the last two years which we see as important to bring before the Senate.

We pass on some specific comments and recommendations on the kinds of grants required. (Recomendations III to V )

The distinction between a grant or a contract has become blurred in the United States. Budgets are required in each case and since the project is usually initiated in the university a formal agreement in contract form has significance largely in cases where some patent or commercial interest is involved. So long as (i), (ii) and (iii) above are satisfactorily covered, the University of Toronto has no great preference for the one form as opposed to the other. We would, however, emphasize the danger of university staff members prostituting themselves and their institution by undertaking research projects of a routine character which have little to offer to the training of graduate students.
c) Overhead

A major problem for the university is to relate Federal and Provincial Government support, since the operating budget of our University comes from the province. We shy away from the practice so wide-spread in the United States of allocating a professor's time between teaching and research. The difficulties here are frustrating for all concerned and we believe that all academic salaries should be paid by the University. In an extreme case, where the needs of the research project are inconsistent with this principle, a part time appointment is preferable or even leave of absence. It follows from this that the Province will share in any research project.

The study of the indirect costs of research has been covered in a brief written on behalf of the AUCC for the Science Council. We quote its recomnendation as our recommendation VI. Uses to which such funds will be put thus become a matter of internal decision. The Board of Governors of the University has declared that such overhead shall not be used to stimulate new research thus adding further indirect costs. We have workcd out a basis whereby the Department in which the rescarch foes on may benefit through the use of such funds for specified costs ancillary to research projects. A portion of such overhead should go directly to the University.
4. Relations between sranting bodies
a) We come now to the crucial paris of this brief and ask the question hor are government funds for the sumport of research to be distributed to government departments, councils and arfencj.es?

Could the Science Council exarcise any real supervision over Government research policy with reference to the question raised above? The alternative is some super committee to advise Ireasury Board not only with recard to the budgets but also on projects of "big science". This subject has been considered at length by the MacDonald Committee and more on it may be found in the O.E.C.D. draft of their Report on Science in Canada. It does not seem useful at this point to attempt to obtain a consensus in the University of Toronto but we would stress the importance of recommendation VII


The problem is twofold in several large government departments (e.g. EMR, Agriculture and National Health and Welfare):
(i) to properly relate "in house" research to University and industrial research and,
(ii) to involve academics in a meaningful way in the distribution of grants and contracts.

We would cite the approach adopted by the National Research Council with regard to both (i) and (ii) as worthy of emulation.

The problems of "bigs science" must be taken seriously and the academic community involved ai every stage. The development of major scientific projects of the "Brookhaven" pattern is a trend which can hardly be resisted. Such involvement could have avoided much of the frustration and dissatisfaction which has followed the cancellation of ING and the QE Telescope. (Recommendation VIII).
b) In Canada there is a continually increasing demand by Government and industry for quantitative studies to which the Universities should be able to contribute. We have been late in coming to this problem, but the following table taken from the report of the U.S. President's Science Advisory Committee which appeared in February 1967 is significant. This table records substantial needs for computer time in major areas of study in American Universities based on Bachelors programs for the years 1963-64.
\[
\begin{array}{ll}
\text { 1. Social Sciences } & 24 \% \\
\text { 2. Ergineering } & 21 \% \\
\text { 3. Biolosy } & 15 \% \\
\text { 4. Business and Commerce } & 14 \% \\
\text { 5. Physical Sciences } & 11 \% \\
\text { 6. Mathematics } & 6 \% \\
& \text { All other }
\end{array}
\]

It should be noted that these figures do not refer to research use but to undergraduate programmes. Nevertheless they are extremely sigrijizicant in that the social sciences, including business and commerce, could soon account for \(40 \%\) of the total. Since nearly all university computer facilities in Canada have been provided by the National Research Council, it is clear that some drastic action mast be taken in the immediate future if the growing disciplines' needs are to be met.

In Ontario, the Provincial Government has begun to support digital computers on a large scale and this places the allocation of time in the hands of the universities. If one accep's the noed for greatly increased instruction at the undergraduate level then Federal granting agencies must takc their share of responsibility for research and they must do so in a consistent fashion. For example, if a given project involves computing then that should also be taken into account in making the crant or contract. The Defence Research Board has recently resumed support of computing involved in a given project but other Government departments show no inclination to do likewise. Unless all Government oranting bodies recognize their responsibility in this area we are heading for trouble. (Recomendation IX)

\section*{RECOMMENDATIONS}

I The Federal Government must maintain its role as primary sponsor of research in the universities if we are to continue to play a significant role in the international scene.

II Assistance and encouragement should be given to industry to develop research in industrial laboratories.

III Strong support is given to the extension of a term of a grant from one year to three years in all areas. It has been suggested that the step funding of prants now in operation in the United States should be adopted for Canadian agencies.

IV There is a wide support in this university for an arrangement which would bring the grant year into coincidence with the univercity year and would make decisions known in the autumn rather than in March or April, so that suitable appointments of staff and students could be planned in advance.

V Current Federal fellowship programmes should be exvanded so that the support of graduate students would be less dependent on research grents made to their mentors.

VI Every government grant or contract for research should carry a supplement of at least \(30 \%\) to cover a portion of the indirect costs. Such supplement should be paid to the University with no strings attached.

VII The distribution of government funds for support of research and el so the way In which the funds are utilized by government departrnents, agencies and counc:1. should be the subject of advice and criticism by a duly constituted government body.

VIII Major scientific projects should be placed in proximity to Universities interested in their use. Such projects should be organized on the Brookhaven pattern or, if Government controlled, arrangements should be made to coordinate Government and University research projects through a council on which academics are adequately represented.

IX All Government departments and pranting agencies must face the problem oi the support of computer facilities in universities which arises from the increasine use of computers in the Humanjities and social sciences.

Since the dissemination of knowledge is one of the primary functions of the University, University research should be such that the results may be freely published. The policy of the University of Toronto with respect to publication is as follows:

Results of research undertaken in the University shall be fully publishable with the following qualifications:
(a) In cases where a Sponsor may have industrial or commercial rights arising out of a research project, the University will be prepared to accept restriction of publication for a period not to exceed 90 days after submission to the Sponsor of the proposed text.
(b) Where the Sponsor wishes to be given an opportunity to publish the results of the research before publication by the University, such right may be given provided that;
1. the University shall, in any event be free to puiblish after 12 months from the submission of the final report to the Sponsor,
2. if there is any change in the Sponsor's publication from the original report, the name of the University shall not be used in connection with the publication without the written consent of the University, and
3. publication of a thesis by a graduate student shall not be delayed by such restriction.
(c) Where by the terms of a contract or grant, the Sponsor agrees to provide data essential to the research, which, at the time it is provided, is labelled "Confidential Data", and where the Chairman of the Department in which the research is being conducted considers the research of such importance to the Department that the general rules with respect to publication should be partially waived, the University will be prepared to accept such grant or contract and observe such confidentiality provided that the results of the research may be published without identifiable reference to the confidential data.

\section*{APPENDIX 74}

\title{
Brief submitted to \\ The Senate Special Committee \\ on Science Policy \\ by \\ Saint Paul University, Ottawa
}
1. Saint Paul University is pleased with the study undertaken by the Senate on the science policy of the federal government. It is particularly pleased with the universal scope of the study which embraces the human sciences.
2. Within the context of Ontario universities, Saint Paul University forms a university federation with the University of Ottawa. Through a mutual agreement within this federation, Saint Pául University has agreed to limit itself to the development of research and teaching in the human sciences, particularly those with religious and ethical implications. These are the sciences relating to the discovery and study of the meaning and value of human life.
3. Considering these sciences as an essential dimension of the society in which we live and aware that they are included in the order of reference of the Senate committee, Saint Paul University wishes to draw attention to these matters so that the complete brief to be prepared at the end of phase III may take this body of sciences into account. These sciences are quitefrequently neglected in discussions on scientific research and, as a result, do not fare particularly well in budgets for research assistance.
4. The present brief will include two parts:
I. Human sciences with religious and ethical implications.

\section*{II. Suggested means for supporting research into the sciences.}

\section*{I. HUMAN SCIENGES WITH RELIGIOUS AND ETHIGAL IMPLIGATIONS}

Not wishing to draw up an exhaustive list on the subject, we feel that the following enumeration and descriptions should give an approximate idea of the extent and importance of these particular fields of research, several of which are inter-disciplinary in nature.

\section*{1. Religious Sociology}

For a number of years, sociology has shown interest in the religious problems of society. The method of investigation particularly favourable to the work of this science has already made it possible to evaluate numerous ills, direct solutions and support research into all areas of social life.
2. Religious Psychology

Psychology has long been concerned withthe religious dimension of man. The discoveries of contemporary psychology have
created still closer ties between psychology and religion. In particular, the psychology of the mind (psychiatry or psychoanalysis) is opening out new paths for research and therapeutic methods.

\section*{3. Religious History of Canada}

No one can deny the religious origins of Canada and the religious influences which have acted on its development. Institutions, colonization, political movements, education have all been influenced by religion. The study of this history has scarcely begun. Here is a vast field which must be explored if we are to know our country. A number of archives contain an abundance of material which needs only to be investigated.
4. Ganadian Anthropology

In Ganada, a number of studies, enquiries and research have been conducted into the field of Amerindian anthropology. This is a beginning.

In the study of athropology, the whole area of community development and urban renewal must be considered. Study and investigation into these aspects are necessary if we are to plan and direct our urban centres of tomorrow.

In both cases, problems of "values" are involved which cannot be left entirely in the hands of economists and architects.

\section*{5. Family Sciences}

Western society considers the family unit as the basis for its survival. A number of scientific disciplines are concentrating more and more on the study of the values of the family. Such studies meet a real and pressing need if we are to cope with our constantly changing world; the technical revolution, the urbanization of vital centres, the rapid means of communication place the family in new situations which of ten cause considerable confusion. The family sciences are concerned with these problems and work in their own way towards safeguarding the values we continue to hold as fundamental.

\section*{6. Religious Law}

This branch of research is very closely related to the study of common law. We cannot delve into the history of our country without undertaking serious studies of religious law as this law has presided over initiatives and efforts which, since the origins of our country, have helped to make us what we are today.
7. Mass Media (Social Communications)

The profound impact of modern methods of communication on the new mentality which is taking shape demands careful study and serious research. The whole problem of values is so intimately
bound up in the development of the mass media that interdisciplinary research into this field deserves special attention.

\section*{8. Ecumenical Movement}

In an age when ways of uniting mankind are of interest to all those working towards the advancement of society, the problem of the division of man on the religious plane should concern any thinking person. The disciplines concerned with the grave questions of ecumenicalism are now in the developing stages. This area will require many more religious thinkers in the years to come. The disappearance of a great many religious prejudices at the source of secular divisions will depend on research and study into this sector.
II. SUGGESTED METHODS FOR SUPPORTING RESEARCH IN THE SGIENCES

We suggest below possible ways to assist research in the sciences we have just described.

\section*{1. Libraries}

Libraries are the first tools for the advancement of research in the human sciences. However, libraries orientated towards the religious and ethical sciences have difficulty in obtaining the assistance they need to develop adequately. The library of Saint Paul University is recognized throughout Canada and the United States. The report of Mr.Edwin E.Williams on "Resources of Canadian University Libraries for Research in the Humanities and Social Sciences" (1962) has this to say about the Saint Paul University library:

\footnotetext{
It seemed desirable... to give some attention to materials on the history of religion that are available in university libraries to supplement their collections in closely related fields. The sampling of periodicals in this subject indicated that Ottawa is in the lead with greater strength than the University of Toronto alone... (p.27)

Ottawa has nationally outstanding collections for philosophy and religious history, with advanced research holdings for work in....mediaeval studies. (p.50)

Indeed, a great number of researchers gather here for advanced study and research. Nevertheless, for one reason or another, those responsible for distributing grants to the research libraries did not feel it necessary, last year, to grant this library the very small help it requested. We feel this is a grave omission; assistance to research should cover the specialized area which we represent.
}

\section*{2. Research,Investigation}

Most of the time, research and investigation are beyond the financial resources of persons or institutions. On the other hand, a number of research projects and investigations, particularly in the field of the human sciences, are likely to be very useful, if not necessary, to the welfare of society and should be included in the major preoccupations of the government organization. We feel it imperative, particularly now when the whole pattern of life is being rethought at all levels, that serious investigations and research into this field be given government support and that projects felt to be important be carried out successfully. To this must be added the necessity of providing adequate information on the possibilities offered both to individuals and institutions.

\section*{3. Publications}

In many cases, it is difficult to succeed in publishing research as such publications are not financially profitable and may not be readily integrated within the ordinary budgets of individuals or institutions. Nevertheless, these publications may be of vital assistance, if not for the public, at least for persons helping to advance society and desirous of pursuing their research in a given field. Here again, public funds prove necessary for researchers and institutions which assume their services.
4. Institutes, Centres, Schools

A number of university agencies or others have spring up during the past few years to study the problems of values; the family, health, morals, law,etc. These agencies do not always develop as rapidly as might be hoped due to lack of funds.Research at any level is rarely immediately profitable. It is in this area, principally, that universities or other similar institutions would consider government help essential if they are to attain their objectives.

Ottawa, February 21, 1969.

\section*{APPENDIX 75}


One of the fundamental needs of any society is for
facilities and personnel to care for the sick. In Canada, government has accepted the major financial responsibility for providing facilities for the delivery of health care and for the establishment and operation of institutions for the education of health care personnel. The Federal Government has assumed a leading role in discharging this responsibility and in recent years has passed two major pieces of legislation affecting the health sciences, one for the creation of Medicare and another for the establishment of the Health Resources Fund. That support for health science research is inseparable from and indispensable to the provision of adequate standards of medical education, health services and health care, has been recognized by the establishment of the Medical Research Council and the provision of a separate budget for that agency. The Liberal Party, in a policy statement issued prior to the last election, recognized the key role of science technology and research in the evolution of our society.

Numerous reports, the latest of which is "Medical Research in Canada, an Analysis of Immediate and Future Needs", (commonly referred to as the Gundy Report, December, 1965) have made it clear that expanded programmes of medical research are urgently required in Canada. Despite this well-documented presentation of the urgent need for increased support of medical research and the clear statement that the Liberal Party recognizes the current deficiency in such support, the present Government has announced that it will not increase its support
of medical research in 1969-70 in any way commensurate with the documented requirements. The spending estimates tabled by the Treasury Board on 4 February, 1969, provide for an increase of only \(14.8 \%\) in the budget of the Medical Research Council to a total of \(\$ 31,273,000\) for 1969-70; these funds will be insufficient to allow for the necessary progression of current research programmes in Canadian Medical Schools and support for new projects will be provided only at the expense of cancelling or grossly cutting back programmes already adjudged worthy of full support. Although the MRC budget was increased by approximately \(33 \%\) in 1967-68 and by \(30 \%\) in 1968-69 and there was an increase in funding to some other Federal agencies for health science education and research, the magnitude 'of these increases fell considerably short of the goals shown in the Gundy Report to be essential to the provision of good quality health care for the Canadian people. In the present atmosphere of austerity and with the announced intention of the Federal Government to reduce expansion in the Health Sciences field (as exemplified by the reduced rate of cash flow from the Health Resources Fund), we are deeply alarmed that cutting by half the rate of increase of funding for the MRC will inevitably produce a major short-fall in the budget of this agency in 1969-70. At this point in time we are convinced that such a short-fall in funds for the support of medical research will have devastating and far-reaching effects on the education of health science personnel and the ultimate delivery of health care in Canada. We deem it imperative not only that the rate of increase in the MRC budget be at least maintained at \(30 \%\)
in 1969-70 but also that the true requirements for support documented in the Gundy Report be re-examined and given the highest possible priority in the current fiscal year.

It would be redundant to re-state the urgent requirements for increased support of health science education and research already documented clearly and exhaustively in the Gundy Report on Medical Research in Canada. This Report is as valid todey as it was in 1965. It should be emphasized that this Report was endorsed by the Council of the Association of Canadian Medical Colleges, which represents the Deans of all Canadian Medical Schools. It was also officially endorsed by numerous scientific societies and by hundreds of medical teacherscientists throughout Canada. It is clear that this Report expresses the opinion of medical research workers and leading medical educators in this country.

Our major concern is that government does not appear to appreciate the truly disastrous consequences of failure to implement immediately a realistic programme of support for medical research commensurate with the needs of the Canadian people. We are already faced with an acute shortage of health science personnel and the implementation of Medicare will make the shortage assume crisis proportions. Without immediate and major increases in research support, the Canadian medical schools will be increasingly unable to retain existing faculty members, to train future teacher-scientists or to attract from other countries the faculty desperately required to increase oun output of health care personnel.


At present some American teacher-scientists have been recruited to fill faculty vacancies in Canadian medical schools because they are prepared to sacrifice adequate research support and the facilities and equipment necessary to conduct major research programmes for freedom from racial unrest and from compulsory military service. Dr. Walter MacKenzie, Dean of the Faculty of Medicine at the University of Alberta and past President of the American College of Surgeons, when discussing the emigration of Canadian scientists to the United States, stated bluntly in the Medical Post (31 December, 1968), "We wouldn't have half the faculty we have now since a lot of the good people we have been getting in the last couple of years have been people who very sensibly have decided that Canada, even with its lesser facilities, is preferable to Saigon. There is no question in the world that our recruitment prognamme has been aided and abetted by the local difficulties in the U.S. and, of course, that nasty war".

It should be emphasized that even a temporary reduction in the rate of increase in health research support which began in 1967-68 will have far-reaching results which will be apparent for many years because of the extended time necessary to build viable research programmes and to produce medical teacher-scientists.

Effective research and the education of medical teacherscientists requires that research programmes be initiated and conducted on a long-term basis with guarantees of continued support sufficient to allow for planned progress toward a research goal, the hiring of support personnel, and an orderly progression of experience and training for graduate students. A decrease in the rate of increase of research
support through the MRC, of however short duration, will, at this point in time, destroy the continuum of many research programmes now reaching a phase of major productivity, interrupt the training of large numbers of graduate students and prevent others from beginning courses of training. Indeed, even the present atmosphere of austerity and the uncertainty concerning the adequacy of research support has made it difficult to recruit new staff and has necessitated a reduction in the numbers of graduate students accepted by many medical departments. The reduction in spending from the Health Resources Fund announced in 1968 was considered by many to reflect the attitude that Government does not consider support for medical research in a realistic way; this view has been confirmed by the recent announcement of the 1969-70 spending estimates for the MRC and other Federal granting agencies. The low priority placed on funding medical research constitutes, in our opinion, a lack of appreciation of the role of health science research in providing the Canadian people with good quality health care.

This brief is respectfully submitted by the Department of Physiology of Queen's University to the Special Committee on Science Policy of the Senate of Canada under the Chairmanship of the Honourable Maurice Lamontagne. The undersigned would welcome the opportunity to amplify and answer questions on the views expressed in this brief if it is considered appropriate for us to appear before the Special Committee.

Respectfully yours,


\section*{APPENDIX 76}

Brief submitted to the

Senate Special Committee on Science Policy
by

John C.Robertson, Jr., Ph.D. Assistant Professor
Department of Religion

McMaster University

March, 1969

\section*{Sma Religion and the Formulation of a Science Policy in the Context of Higher Education \({ }^{1}\)}
1. A genuine dialogue between religion and the physical sciences is possible of course only when the proper locus of their mutual concern is recognized. Much of the uhhappy warfare between science and religion in the past has occurred when one or both of the disciplines overstepped its proper linits: that is, when religion became a cryptoscience or science became a cryptorreligion. To insure that the future of the dialogue is more fruitful than the past the legitimate spheres of competence need to be delineated and observed. For its part, religion must recognize its own non-competence vis a \(\nabla\) is physical science qua physical science. This will involve recognizing that religion has no privileged data or conciusions to supply to science and it has no preferred scientific conclusions. In this sense, it recognizes the full autonomy of the scientific enterprize.
2. Yet it does not follow that religion and science must exist in a state of mutual indifference. To the contrary, a dialogue and confrontation between religion and science is both possible and desirable within the sphere of the values explicitiy and implicitly involved with each. In this regard, the stance of religion vis a vis science must be dialectical.

2:1. To say that the proper stance of religion vis a vis science is dialectical is to say, on the one hand, that there is a positive aspect of the religious stance toward the physical sciences.

2:12. It is positive in the sense that religion recognizes and deeply respects the moral values implicit in and intrinsic to the activities of the scientific community as such. For example, religion notes the genuine loyalty to the cause of truth-teling that characterizes the scientific discipline. Also, religion admires the catholicity of interest innate to science; that is, against intellectual provincialism, science attends to and characteristically investigates a wide range of the created order. And then there is also the scientific attitude of respect for even the most uncongenial of facts, which attitude the religious moralist would interpret as the secular counterpart to humility and repentance. In light of this recognition, religion is concerned that the wider community of men also recognize and respect these values intrinsic to the activity of the scientific community. Practically speaking, religion is concerned, for instance, that the scientist's loyalty to the seeking and commuicating the truth not be subjected to undue pressure by those who want him to corrupt, distort, or suppress the noble autonomy and integrity of his discipline for the sake of the imagined utilitarian considerations of this or that cause. Extreme instances of this pressure have been, obviously, the Nazi attemps to pervert the findings of anthropology, Commanist pressures to bias

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In this paper "religion" will mean that system of bel iefs and practices which revoive around the asking and answering of the question, "What is of ultimate importance to man qua man?" This is intended to be a generic definition not limited to any one particular religious tradition by "science" we are referring to the generic class of those disciplines devoted to the study of physical nature.
}
inquiries in genetics, totalitarian hostility to quantum mechanics and relativity physics, etc. One also notes commercial pressures against inquiries into the causes of certain types of iliness, both physical and psychological (e.g., causes of cancer and the effects of television). Religion is also concerned with the pressures that perhaps unknowingly tend to make impossible theoretical science by demanding that the scientist justify all of his inquiry in terms of practical results. A11 of these tendencies and others must be resisted if the intrinsic values of science qua science are to be conserved.

2:13. Furthermore, religion recognizes and respects the instrumental values of science. That is, religion notes with admiration the commendable role science has played as a part of the broad human striving for the achievement of a more decent and humane state of man. It is clear that the physical sciences have helped considerably to make all of our lives less nshort, masty, and brutish." In light of this, religion is concerned to help scientists resist the many forces that would seek to bend scientific efforts to dehumanizing ends instead of ennobling ones. And religion is eager to be of what help it can to the scientist as he attempts to discern the appropriate practical ways his discipline may serve the human cause.

2:2. However, as the attitude of religion toward science is positive, on the one hand, it is, if not negative, at least cautionary, on the other. And it is hoped that this side of the dialectic will be taken as seriously as the other.
\(2: 21\). That is, while recognizing the genuine moral value intrinsically and instrumentally related to the scientific enterprize, religion must also insist that the value of science is a iimited ralue, one value alongside of other values within the community of beings. Consequently, religion would caution against the dehumanizing effects of the absolutizing of science and the concomitant loss of a universal perspective. Instances of this absolutizing frequently are:
(1) The absolutizing of the scientific method, regarding it as normative and imperious in man's quest for the real.
(2) The absolutizing of scientific conclusions, failing to recognize that scientific truth is not the mole of truth and that truth itself is only part of a manifold system of values which includes also the values of justice and beauty.
(3) The absolutizing of the scientific attitude. This point especialiy requires further comment. The scientific attitude seems necessarily to be one that "objectifies" its data. While this seems to be necessary for science, one should note the possibility of at least two dehumanizing effects:
(a) The first is easy to detect. It is the tendency to see other beings only as means which derive their value by their potential contribution to scientific progress. Most blatant examples of this, for instance, would be the desire to invade the privacy of other beings in the name of science and the desire to use other humans as guina pigs with something less than their absolutely uncoerced and fully informed consent.
(b) The second is less obvious and is mose difficult to detect. Hence it is perhaps the more dangerous of the two. It is the ililcit extension of the process of scientific objectification, which is licit only in a limited context, to all reality. Science often suggests (attitudinally at least) that only what is capable of being objectified is genuinely real. It of ten seems to suggest, for example, that persons are real only insofar as persons can be studies as objects, analyzed as public, external realities, that is, as "its". When religion, along with certain types of poetry and philosophy, protest against this reductionism they are ipso facto dismissed as being "unscientific", obscurrantist, or merely "emotive". Religion then must deplore these tendencies and caution against the absolutizing of science. But this must be done in a way that neither gives comfort to the enemies of science within our culture nor gain-says the genuine limited value of science as a value among others.
3. The scientist cannot, however, be held solely to blame for the potentially dangerous effects of his discipiine. Yet insofar as the scientist has been only a scientist and has not also been a philosopher (in the broad sense of lover of comprehensive wisdom) he has not been adequately aware of the limits and potentially dehumanizing effects of his discipline (nor perhaps, though less importantly, fully aware of its genuine values). Hence he has been, for this reason, unaware of the urgen necessity of the scientific discipline being complemented by the work of other disciplines committed to other methods and aspects of being, to other types of truths and values; and thus he has unwittingiy conveyed the impression that his method, truths and attitudes constitute the whole of what is real.

3:1. Whatever the shortcomings of the scientist, the rest of us must bear part of the responsibility for the unfortunate influences of science in the modern world, for we have been content to be so ignorant of even the most elementary aspects of the scientific enterprize that we have not known how to assess, appreciate and complement the scientist's work.
4. In the Iight of the above theses, certain practical conclusions can be dram:
(A) It follows from theses \(2: 12\) and \(2: 13\) that, while a broad governmental support of the scientific inquiry in the universities is desirable, governmental control is not. The value of more or less disinterested and theoretical inquiry must not be sacrificed for shortrange goals or excessively utilitarian purposes. Further, the autonomy of scientific inquiry must not be distorted by heteronomous interests.
(B) It follows from theses 2:2 and 2:21 that particular care should be exercised in the education of scientists. For example, undergraduates majoring in science should not be allowed to concentrate so heavily in science that they neglect the more philosophical (again in a broad, nontechnical sense of the word) disciplines.

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(C) In this context, we would urge that there is need for the full support of the philosophical disciplines and that in our concern for scientific excelience the "non-scientific" disciplines not be assigned a position of diminishing importance in university education.
(D) It follows from theses 3 and \(3: 1\) that there is a special need for:
1) opportunities for non-specialists to be introduced to certain basic aspects of the scientific discipline and
2) the opportumity to develop inter-discipilnary seminars, studies, etc., invoiving scientists and representatives of the philosophical disciplines for the purpose of reflecting upon the nature and function of science within the context of wider humanistic concerns.

Appendix. Since the above is matten from the standpoint of religion, some further clarification of the role of religion vis a vis science seems in order. In the last thesis above, it was suggested that such disciplines as religion should also receive general public support as a necessary complement to the support of science. This is not the place to do what has been done elsewhere, that is to explain what the academic study of religion involves, etc. But it should be repeated that those nho study religion in the academic context do not confuse their discipline with "apologetics" or "evangelism"; rather, they simply desire to educate the public about the nature and function of religion within the wider human comunity and to make available to the public the wisdom of the religions as a contribution to the broadiy conceived philosophical and humane concerns of all men.

March, 1969.

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\section*{APPENDIX 77}




\section*{SCIENTIFIC INFORMATION IN NORTHERN ONTARIO}
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A BRIE F
to the Special Committee
on Science Policy
of the Senate of Canada.
presented by
LAURENTIAN UNIVERSITY



\section*{Prepared by}

Paul-Emile Filion, S.J., Chief Librarian
in consultation with

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Dr. G. A. Rubin, Head, Physics Department

January 1969.





\begin{abstract}
Laurentian University is deeply interested in the purpose of the survey conducted presently by the Special Committee on Seience Policy of the Senate of Canada.
\end{abstract}

The relatively remote geographical location, the economic and social conditions of the area (resulting in part from the exploitation of natural resources rather than from extensive farming or secondary industry) might not be unique, nor the particular problems and challenges facing higher education and research in such surroundings. Similar observations will probably be expressed by other institutions and we hope that a common pattern of development can be evolved to bring to all Canadian citizens and firms a comparable level of availability of scientific information.

Laurentian University desires, therefore, to contribute fully to the aims and objectives of a National Science Policy by bringing to its teaching and research programme the best scientific documentation available in Canada and by playing an active role in the dissemination of scientific information in Northern Ontario and about Northern Ontario.

The considerations and recommendations we present to this survey might be grouped under three main headings:

1 - the organization and availability of scientific information, specifically adapted to Canada;

2 - the present role of universities, especially of the reference services of their libraries, in the gathering and dissemination of information;

3 - the specific contribution that Laurentian University can make to Northern Ontario.

We consider that the Government of Canada, through its
various departments, should foster a policy of scientific information to include the following elements:
a) the exercise of a strong role in sponsoring nationally and internationally, the wider and deeper indexing of world-wide scientific literature and its availability through appropriate publication, in printed form or otherwise;
b) the creation of a national reference staff, familiar with all fields of scientific endeavours, to interpret and guide through the mass of indexed and non-indexed literature. Even very large universities and research centers can hardly provide such a pool of expertise;
c) the development of a central computerized bank of data in all fields, and especially about the Canadian physical and social reality;
d) the setting up of standards of format for data processing hardware and software to insure efficiency of the local systems and of the national network;
e) the development of translation services for technical matters, available centrally and extending beyond English and French;
f) the inception of a system of grants to permit remote centres to be served adequately, such help compensating for the absence of large research collections and highly specialized personnel.



\section*{PRESENT UNIVERSITY COMMITMENT TO INFORMATION SERVICES}

Laurentian University is called upon to play a double role: that of providing higher education facilities and of serving the intellectual life and scientific needs of the area. Its first purpose is to offer young men and women the opportunities to obtain intellectual preparation and stimulation, whether they elect eventually to live in Northern Ontario or not. The present "formula financing", common to all Ontario universities, barely provides for reaching towards that goal. The commitment of the Library to this basic role restricts it then to the procurement of books and journals for the immediate needs of the teaching programmes and of limited concomitant research.

In the same way, the computer installation (IBM 1130, ultimately 360 ) that has been acquired is geared to the service of the university and is to be used as an administration and local research tool. The Library will use it for accounting-type procedures, possibly also as a bibliographical tool for eataloguing and reference purpose, dealing with subject literature rather than with detailed bits of technical information.

However, a regional university such as Laurentian constitutes also the ideal Documentation Centre for the area, a sub-station of a national network. The teaching and research staff of the institutions are prime customers of information; they belong to and form a substantial segment of the scientific and professional community of Northern Ontario which, in turn, regards the university as its natural bank of apt and accurate documentation.

The authorities of Laurentian University recognize this role of their institution in the complete development of Northern Ontario,from the exploration of resources to the integrated social development of its population.

If the principle of regional "Scientific Information
Centres", based on existing academic facilities, is recommended as part of a National Policy, Laurentian University would prepare detailed projects and programmes. In order to provide appropriate, substantial, and responsible dissemination of scientific information, the University would set up a Regional Advisory Board to help in planning, and reviewing regularly, the Information Service and its operations.

As a tentative preliminary estimate, the cost could amount to approximately \(\$ 30,000\) a year at the beginning, that is \(\$ 10,000\) for acquiring specific books and documents (or photocopies) on Northern Ontario or on topics of special importance to Northern Ontario, plus \(\$ 20,000\) for related processing and reference services. The provision of an appropriate system of communication (direct telephone lines to Ottawa, Toronto, Montreal, in addition to Te lex), would allow the tapping of larger units of information and reduce substantially the possible duplication of materials and services. Similar arrangements between the Centre and the main Northern Ontario towns would permit more meaningful interpretation of requests and answers and also expedite service.

Jnfortunately, Laurentian University cannot fulfill at present this larger role. Given appropriate financial resources, however, the institution could play its share in such a national information context.

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\begin{abstract}
The first role of a Scientific Documentation Centre at Laurentian would be to channel information into the area, as requested, and to keep a record of it for future utilization. But a much more specific aim could and should be entertained, that of collecting in one central location as much pertinent information as possible on Northern Ontario for the benefit of the area and of the rest of the country. Also the Centre would have the responsability of obtaining, preferably ahead of requests and in a systematic manner, the kind of documentation that would contribute more directly to the material and social improvement of the region.
\end{abstract}

In practically all fields of pure and applied sciences, as well as of social sciences, are to be found aspects that are peculiar in some way to Northern Ontario.

In the vast field of ecology, there is need for central information about the meteorology of the region (temperature, precipitation over a number of years, etc.); air and water pollution (including radiation); local flora and fauna and its applied aspects (e.g. conservation practices of the "Northern" regions or countries).

Geological, mining and, increasingly, metallurgical
information on the region or as applicable to the region, is another constant need. This involves also specific problems in chemistry, physics, engineering. Applied mathematics, especially through statistical data and their interpretation, provides a link between the natural and the social sciences.

In human ecology, the need for scientific information is much greater.

The preservation of Indian culture (which supposes
archaeology and cultural anthropology) and the meaningful integration of Indians into the region may be listed among the priorities. Instances of past, present, and possible characteristic contributions of the Indian population to Northern Ontario and to Canadian society should be recorded.

Then, the human problems of settlements, as applied to the region, should be documented: urbanization of small and scattered communities, housing (type, standards, costs); public services (federal, provincial, municipal, educational).

The long-range planning for this region rests on accurate documentation. It involves data on transportation in the area (train, bus, air, roads) and the impact on commerce, schooling, etc.; there are pockets of chronic poverty, and there are isolated communities; there are assets to be developed considerably, especially tourism; the cost of services (domestic and public) relatively to other parts of the country has to be explored and taken into account, etc.

The documentation collected in and about Northern Ontario and concerning similar natural and social conditions in other parts of the country and of the world, would soon constitute the background for a substantial programme of "Northern Ontario Studies" to be developed at Laurentian. In turn, the research preoccupation of students and faculty could become increasingly oriented towards Northern Ontario and contribute positively to the betterment of the region.

Thus, the Laurentian Documentation Centre would achieve
the basic objectives pursued by your Committee.

APPENDIX 78

\section*{Brief submitted to the}

Senate Special Committee on Science Policy

\author{
by \\ Research Advisory Board \\ University of Guelph
}

\author{

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February, 1969.


In this report reference is made for purposes of convenience to three major groups: the natural sciences, the social sciences and the humanities. It should be understood that engineering, agricultural science and veterinary medicine are included for these purposes under the natural sciences and that all the creative activities associated with the humanities are included.

It does not seem necessary to comment on the broad aspects of the significance of research and other forms of creative activity in the sciences and the humanities. The key role played by these activities in the past and their potential for improving the wealth, culture and well-being of a society is well documented. Also, the general problems and needs facing the different areas have been well documented.

The increasing role played by university graduates with higher degrees in shaping the economic, social and cultural welfare of Canada is placing an increasing responsibility on the universities. At present there is a shortage of people trained at the graduate level in the sciences and humanities. In some areas the gaps are being filled by personnel induced to come here from other countries but this cannot be relied on as a permanent source; in other cases there are positions that cannot be filled; and under such conditions of shortage it is likely that some positions are being filled by persons with less than the ideal qualifications for the greatest productivity. The demand in this country for graduates with advanced degrees is increasing rapidly. Hence it is imperative that Canadian Universities continue to expand rapidly in the area of graduate training and research.

One of the greatest needs at the universities is funding for research. Good graduate schools flourish only in those universities deeply involved in research - an environment in which the faculty are able to carry on a significant volume of research of all types including a large share right at the frontiers of the unknown. To accomplish the necessary expansion in graduate training and research the universities must have a level of funding substantially above that available in the past to supply the sophisticated and of ten costly equipment, the supporting staff, and the support for graduate students being trained in research methods and conducting research.

Dramatic increases have occurred in recent years, and are projected, in numbers of faculty members as a result of increases in student numbers at universities. This increasing number of faculty, combined with the increasing number of graduate students conducting research, means that there is a rapidly expanding research potential at the universities. Research from this source can play an increasingly significant role in the total research effort in Canada, provided the funds are made available to exploit this potential.

\section*{I. Goals for the Federal Government in the Support of Research}

A national policy for research is an essential base for the development of a rational and effective program of support for and encouragement of research in each of the three major research agencies - government, university and industry. The need is based on three general considerations.
(a) Economic progress. It is economically necessary, if Canada wishes to retain and preferably improve her competitive position in the North American and world economies, for Canada to establish a level of technology that will assure this. It is well recognized that the level of technology in a modern nation to a large measure establishes the productivity and competitive ability of that nation.
(b) Geographical location. The special geographic location of Canada between two major industrial and political powers that emphasize science and technology - the U.S.A. and the U.S.S.R. - and the great area of this country relative to population density, pose special problems and opportunities for Canada. These special considerations must be reflected in the research policy, research organization and research activity in Canada.
(c) Social welfare and cultural development. Continuing consideration must be given to the environment in which man is placed and expected to live in harmony and produce efficiently. The nation has a responsibility to attempt to understand man and his reaction to different components of the environment and to provide an improved environment for living, working and leisure. Research in the health sciences, social sciences and humanities plays a vital role in this area.

In the development of a national policy for research the following principles should receive careful attention:
(a) The Government of Canada must be responsible for seeing that a national research policy is developed and maintained under continuing review. In order to do this a body should be established, composed of persons qualified in the major areas, i.e. humanities, social sciences and natural sciences, and drawn from governments, universities, industry and the community. It is essential that universities have strong representation on this body.
(b) Areas for intensive research in Canada should be selected on the basis of those most likely to increase gross national product and those most desirable for the health and welfare of the people.
(c) In addition to the areas chosen for intensive research, all areas important to the nation should be provided with at least a minimal number of research, personnel and a moderate level of research. This will assure a bank of qualified personnel who can interpret new developments so Canada can capitalize fully on the research done in the rest of the world.
(d) Level of research and development needed to reach the socio-economic goals of the nation must be established.
(e) Balance among fundamental research, applied research and developmental activities to achieve these goals must be selected.
(f) Location of the research and development for effective use of the funds funnelled into research and development must be determined.

Canada cannot provide enough funds for fundamental and applied research to permit the luxury of the disperson of these limited funds to a multitude of small research centres. It would seem desirable to consolidate research by maintaining only research units of a size which assures viability in modern research. The primary units that need to be supported to the level to make them strong are the universities because of the dual role they perform for Canada - the training of the scientific personnel and the production of research results. Science in Canadian universities has not been adequately funded to allow the universities to discharge these functions at the level necessary.
(g) Location of sufficient research at universities is necessary to provide a strong base for producing the scientists necessary to man the Canadian research and development units. It is important that policy be developed so that the professional manpower required to meet the national objectives will be available.
(h) Provision for the compilation of information which might affect policy decisions in research and development and to make this available on a continuing basis to all agencies involved in research and development should be considered. This should involve developing and making available an information retrieval system to supply information on request to Canadian industries, government, universities and others involved in or planning research and development.

It is essential in the formation of science policy to establish the role of each of the main agencies - government, university and industry, in research. The general views of this University are as follows:

\section*{Role of Government in Research:}
(a) Government is responsible for guiding the development and welfare of the nation (federal) or province (provincial) so must take the lead in encouraging the development of the technological competence and cultural development of the nation or province. Governments at both levels-federal and provincial, are deeply involved and both must assume part of the responsibility. The federal government, however, must take the lead in developind and maintaining the national policy for research involving the provincial governments and other interested groups.
(b) The Government of Canada will need to control the level and type of research in the area of national defence. Some of this research can be conducted by industries and universities and some may be done best in government laboratories.
(c) Both levels of government - federal and provincial - should play an important role in stimulating research and development activities. The federal role must be the major one because research is so vital to the nation as a whole. It can stimulate research in the universities through provision of adequate funds. Stimulation of research and development in industry is possible through such means as direct provision of funds, tax rebate incentives, accelerated depreciation allowances, subsidies and patent protection.
(d) The role of governments in intramural research is one that requires careful scrutiny in Canada at present. Federal government support of research through research in its own laboratories has been high relative to its support of research in universities and industry. This has been a significant factor inhibiting the required growth of research in universities and research and development activities in industry.

There are areas of research that should be conducted by the federal government in its own laboratories, i.e. certain national defence problems, regional research for resource use which cannot be undertaken by provinces, etc. After the above requirements are met the goal in organizing the additional research should be to support as much of it as possible in universities and industry.

The existing federal and provincial government research laboratories certainly should be continued because all research resources now in existence are needed. However, each expansion in intramural research contemplated should be assessed carefully to see where it could fit most effectively into the total picture. When a decision is made to establish a new government research unit, it is strongly recommended that this unit be located so it can be integrated easily with the research and training programs of universities.

Presumably most of the governmental intramural research is relatively closely mission-orented, mainly applied and includes a small developmental component. Consulting for industry should be an important function of the scientists in government research laboratories.

\section*{Role of the University in Research:}

The role of the university is discussed in more detail in Section II.
The main points in the research role of the university are:
(a) Much of the research should be fundamental, aimed at producing new know. ledge on a broad front.
(b) A considerable portion of the fundamental research can be concentrated in selected areas, i.e. broadly mission-oriented. A national research policy would be studied by the universities and clearly would effect a special concentration in high priority areas.
(c) Applied research of a mission-oriented nature should be conducted in the 'niversity to the mutual advantage of the university and the nation.
(d) Consulting activities on the part of the faculty should be provided. This activity is valuable to the program of the university and of real significance to industry.
(e) Development research activities should not be carried out in any volume by the university.

\section*{Role of Industry in Research:}
(a) Industry şhould play a major role in applied research and the dominant role in developmental research activitics. Neither is well developed in Canada at present. Mdst of the industrial activity in this area deals with development although some industries have very significant basic and applied research prograns. A major goal of a national research policy should be to encourage an increase in industrial research and development.
(b) Highly developed industrial research programs will have a content of fundamental research but generally, such research is broadly mission-oriented. Canada has little such industrial research at present. An expansion of co-operative ventures in this area between industry and university, and between industry and governnient research laboratories would appear feasible and highly desirable.

\section*{II. The Objectives of the University in Conducting Research}

The primary objectives of the universities, which they wish to achieve through intramural research, are three:
(a) to help push back the frontiers of knowledge.
(b) to produce the next generation of scholars who in turn will push back the frontiers even farther.
(c) to provide the community with the educated men and women equipped to take their place in all walks of life.

The output of Canadian graduate students is inadequate to meet the needs of the current level of research and development and must be increased substantially to meet the increasing needs. It is essential that research at Canadian universities be well supported and strong in order to interest students in pursuing careers in the natural sciences, social sciences and humanities, to encourage high calibre students to pursue postgraduate studies, and to encourage high calibre researchers to remain in Canada and serve at the universities where they can have an influence on the future personnel and on the calibre of Canadian research.

Objectives of the University in Training:
(a) the graduate education program at the universities should be designed in size and content to produce the natural scientists, social scientists and humanists needed for Canada. Research is an integral part of this manpower training program.
(b) Graduate training programs have as their primary objective the education of students in research methods. Hence the overriding criterion in the selection of a research topic by the geaduate student must be the suitability of the topic for the training of that student.
(c) Fortunately, by careful thought, a topic usually can be selected that will meet this criterion and at the same time produce new knowledge. This is especially so at the doctoral level. As a result the research conducted by graduate students for their theses is an important source of new knowledge.
(d) With the increase in graduate students projected for Canada, the volume of research from this source is of increasing significance relative to total research in Canada.

Objectives of the University in Scholarly Work:
(a) The university setting is ideal for fundamental research aimed at extending the theoretical background for scientific and technological progress as well as the advancement of knowledge in general. This type of research fits in well with the training program for the majority of graduate students, especially doctoral students, and fits in well with the personal research program of the majority of faculty members.
(b) The university campus in Canada should be a major source of the new fundamental knowledge produced in Canada in most areas.

Objectives of the University in Applied Work in the Public Interest:
(a) Universities should accept an important role in applied research. Canada should establish a research pattern which assures that the results of fundamental research will move quickly through the applied research phase :o development and use. One aspect of this pattern would be to establish applied research programs at all centres where there is a volume of fundamental research being conducted and where there is a high level of expertise in theory. Under the proposals made herein the universities would be the centres for a major portion of the fundamental research effort of Canada. Hence universities must, if they wish to be the major fundamental research centres, accept the responsibility for a relatively large amount of applied research. In operation this would mean that some university faculty members conduct fundamental research, some a combination of fundamental and applied, and some applied research. The separation of research into fundamental and applied is based on a fluid line of demarkation and there can be, in fact, no clear line. For example, in the social sciences, it is very difficult, if not impossible in many cases, to separate research that is associated with the expansion of the frontiers of knowledge from the application of such knowledge to the problems of the community as a whole.
(b) An applied research program as part of the total university research program geared to meet the special needs of the Canadian scene will play an important role in feeding new problems into the fundamental research program and thereby increase the effectiveness of that program.
(c) The university graduate education program should be geared to produce the personnel to do the fundamental research in Canada. Of equal importance, it should be geared to produce the personnel to fill the need in missionoriented research and development units operated by government and by industry. The presence of both an applied and a fundamental research program at the university creates a more suitable environment for the educational programs of students preparing for careers in fundamental and in mission-oriented research. The scientist that emerges from such an environment should be reasonably aware of the total scientific community of which he is a part.
(d) There should be no significant amount of development work at universities. Any development work that is needed beyond that done by industry should be done in government units.
III. Allocation of Funds to Various Types of Research
(a) Present allocations
1. The general level of funding research in universities is too low to make the most effective possible use of existing faculty and physical resources and to meet the objectives in II.
2. The cost of equipping a new research unit is high. New research units at emerging universities and new units within established faculties need sizeable equipment grants to initiate programs. Under the present system of funding it takes too long to equip such units.
3. Young faculty members who have just completed their graduate training and who are well trained in up-to-date techniques, full of ideas and enthusiasm and anxious to initiate research, experience difficulty in getting enouch research funds to launch a major program, in contrast to a small program.
4. More funds are needed to support technicians and other assistants in all universities. There is a special need in those universities where the number of graduate students is low relative to the number of faculty. Provision of adequate funds for personnel to assist in research will allow the faculty members to be more productive, and perhaps: relieve the pressure to initiate graduate programs with inadequate resources.
5. Higher levels of graduate student support are needed to encourage a larger number of able students to proceed to graduate studies.
(b) Suggested changes in proportions allocated to various purposes
1. The general level of research expenditures as a percentage of gross national product in Canada is low relative to that of the United States and Sweden as clearly pointed out in the "Canadian Policy for Research and Development" statement by the Engineering Institute of Canada (1967). This also holds relative to the United Kingdom, Japan, The Netherlands, France and Germany.

There does not appear to be excessive research in any subject matter area in Canada. Hence, in discussions of research balance, it is extremely important to establish as a base that research should not be reduced in any area in order to divert the dollars to build up research in an area clearly in deficit at this time.
2. Increases in intramural research by government should be held to a minimum because of the disproportionate amount of such research in Canada at present which is restraining adequate research development in universities and industry.
3. Universities should be allocated a higher proportion of the government funds for research in order to:
(f) develop adequate programs to produce the large numbers of natural and social scientists and humanists with graduate training needed in Canada,
(ii) supply the research funding for the increasing faculty numbers so these resources can be fully exploited.
(i.i) develop special programs to meet special research needs of Canada at this time, e.g. Industrial Research Grants from government to establish an industrial research program at a university.
4. Government policy should encourage industry to expand corporate expenditure on research and development.
5. Research in the social sciences and humanities, historically at a low volume in Canada, has recently begun to move up in volume. Care must be taken to nourish this significant development and provide the necessary sums of money to develop comprehensive research programs in these areas.
(c) Mechanisms for reviewing and determining present allocations

The main comments on this are in Sections VI - VII. The following two points apply to grants-in-aid as they now exist:
1. Policy decisions which result in changes in the proportion of funds to be allocated to each area of research should be publicized widely to research organizations well in advance of the date on which applications are due.
2. A report back to the unsuccessful applicant indicating the reasons why the request could not be granted would be desirable.

\section*{IV. Scope of Support}
(a) Grants-in-Aid or Full Support

The common form of grant-in-aid (modified to include indirect costs) which supplies funds for costs other than salary of the faculty member is a satisfactory system only when the funds being allocated are small. This is not efficient as the only system for the support of research at the level required for most effective use of the research potential in universities.
(b) Indirect costs

It is essential that indirect costs be supplied. If the research level is very low this is not of major concern. However, if the Canadian policy is to make effective research use of the scientific manpower at universities, the volume of research at universities will not be at this very low level. In such circumstances the indirect costs associated with the research will be far more than the universities can bear, and a supply of funds to cover indirect costs becomes mandatory.

The indirect cost level of 30 per cent suggested in the Bladen Commission report is too low. Sixty per cent is recommended. The indirect cost level at the University of Guelph is 42 per cent in 1967-1968 and this will increase in subsequent years because of the new facilities coming into use which will provide more research facilities per faculty member and therefore a higher level of indirect cost for maintenance.
(c) The Federal Government should assist in costs of training for research by providing, through its granting agencies, funds to support the research associated with the graduate progirams. This support would take the form of graduate stipends, research equipment, library and operating costs, special installations for use both for graduate student and faculty research, and funds for computer facilities.
(d) Kinds of Grants Required for Graduate Student Training
1. It is strong1y recommended that the system for distributing funds to provide graduate student stipends be based on a quota established for university with the funds provided as a block grant to the university with the decisions on awards made the responsibility of the university. The block grant would provide funds for the graduate stipend only. Other costs associated with the graduate student program should be provided for in the provincial grant to the university for the educational program of the university.
2. To encourage outstanding students to pursue graduate studies, a university should be free to use up to 20 per cent of its total grant for prestige awards to these outstanding scholars at a stipend level 30 per cent above the general stipend level.
3. Higher levels of graduate stipends are needed to encourage an adequat \(\epsilon\) number of high calibre stidents to proceed to graduate study and research. The stipend level should be related to the average starting salary received by graduate at each level of academic qualification, e.g. at present the relationship might be one-half for the average student and 20 per cent above this level for the outstanding student.
(e) Kinds of Grants Required for Research by Faculty bavatorg babs

Five types of grants are needed for general research support:
1. Grants-in-aid to individual faculty members should be continued with provision for an increase in total funds available to provide for:
(i) grants to increasing number of faculty resulting from the rapid growth of universities.
(ii) indirect costs incurred in using the grant-in-aid.

A very substantial increase in level of such funds should be provided in the social sciences and humanities area to bring these areas up to a funding level similar to that in the natural sciences.

The grant-in-aid should cover the costs of equipment, operating supplies, travel, and supporting personnel - non-technical, technical and professional, including postdoctoral assistants. In circumstances such as certain research in the humanities, which requires the researcher to spend considerable time off campus using special library collections, the grant should provide for part of the additional cost of living incurred by the researcher.
2. Block grants for research awarded to the university should be made available as soon as possible. These should in time become a major part of the government system for supplying research support to universities. Perhaps a suitable goal would be to have the amount of funds supplied in this manner equal the amount supplied through the grant-in-aid component by the end of a five-year period after the introduction of the block grant plan.

The block grant system should include two components:
(i) Component A: A sum of money should be provided to the university to cover direct and indirect oosts of blocks of research which the university would describe in the applications submitted. Research would be described in relatively large blocks, 1.e. a program of a department, of a group within a department or of an interdepartmental group. For example, the university might describe the research program proposed for a department as a whole on the basis of a three- to five-year projection including in it information such as: objectives of the program; general plan for the research indicating the areas being given greatest emphasis; faculty resources - number participating in the research, teaching load, academic qualification, publication list, etc.; supporting staff - number, qualifications; number of graduate students and postdoctoral fellows - current and projected; physical facilities available.

The university would supply also an annual report of progress in each block of research including a narrative and list of publications. The university should be provided with assurance, that, under normal conditions, the support for a block of research will continue from year to year. In the occasional case in which the granting body wishes to phase out support of a particular block of research, there should be a phase-out period of at least three years.

The funds granted to the university for a particular block of research would be assigned to the research group described in the application, and would be used by that group in the manner most effective to accomplish the research goals.
(ii) Component B: A sum of money, 10 per cent of the salaries of full-time faculty members, should be provided annually to a university for the general support of research to be used for any aspect of research within the university as determined by the university. This component is the "sustaining" grant recommended in the report of the Bladen Commission.

> Component A of the block grant would provide the university with a significant budget for research and, therefore, the faculty members with a better base for planning their research. The grant-in-aid system is reasonably satisfactory when the funds to be granted are small but when the level of funds reaches that needed by Canadian universities for research during the next decade, the system becomes cumbersome and inadequate.
3. Grants are needed to develop and maintain an adequate data processing and computing system for the use of universities. Each university requires a basic unit, the size and sophistication depending on the program of the particular university.

Also essential is access to large computing installations which provide specialized consulting services for very sophisticated problems and facilities to handle the large volume of data processing and computing associated with special research programs. For example, the social science area has urgent need for a large scale data bank.
4. Library grants are essential to develop and maintain reasonable library holdings for research at the universities. The Spinks Commission report highlights the library problem in Ontario. It is a severe one and a major barrier to the expansion of graduate training and research programs in Ontario.

The shortage in library holdings in Ontario in 1966 estimated by the Spinks Comunission is \(4,790,000\) volumes. The cost of removing the shortage in terms of 1967 dollars is approximately \(\$ 97,800,000\).

Good library holdings are as essential to good research as is good laboratory equipment. Therefore, it is valid to expect the agencies supporting research to provide library support for that research.

New universities and new programs developing in existing universities have particular difficulty in finding adequate funds to build up the library to the critical point at which graduate programs, especially those at the Ph.D. level, can be initiated. Library grant policy should take into account the special needs of such emerging research units.
5. Special capital and operating grants should be provided to a university for unique research installations and units. In some cases such facilities may be for the use of one university and in other cases may be located conveniently for the use of several universities and perhaps other research groups.

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The grant should cover capital costs and the salaries of the professional and non-professional personnel and other direct and indirect costs associated with the special unit.
(f) Contract Research

Contract rescarch has a place in the university but it should not dominate the university research program. Selected contract research is valuable in making efficient use of the national research resources by more fully utilizing the expertise of particular research groups. It has the advantage to the university of increasing the volume and scope of research on campus and of creating a research environment exemplifying the range of the types of research conducted in society.
V. Liaison Between Universities and Government Research Establishments

It is essential from a national standpoint for the maximum productivity from the research investment to have a close liaison between government and university research units.

It is extremely desirable from the viewpoint of the university that there be a federal policy so that professional personnel in government research units might be available to assist in the training of graduate students, especially in areas in which the federal research laboratories have unique strength not at the universities. It would be an error, though, to develop graduate student training as a major responsibility of the government intramural research laboratories.

> VI and VII Review Procedures and Proposals for Organization Plan for the Federal Support of Research in Universities.
(a) A ministry should be established in the federal government with responsibilities for research in the areas of the natural sciences, the social sciences and the humanities.
(b) An advisory body composed of persons qualified in the major areas, i.e. humanities, social sciences and natural sciences, and drawn from government research agencies, university, industry and community, should be established with responsibilities for adyice with respect to:
1. the establishment and continuing review of a national policy for research in the humanities, social sciences and natural sciences,
2. the level and proportion of funds required for research in the three areas,
3. the policy and procedures for encouraging research and development in the three areas and for distributing federal funds in support of research and development.
(c) There should be a council formed for each area, i.e. natural sciences, social sciences and humanities, with membership from government, university, industry and community where appropriate, with responsibilities for assisting the advisory body in carrying out its functions.

The natural science council should operate through several conmittees or councils based on area of application, i.e. health sciences, agriculture and food, engineering, etc., and one or more dealing with certain fundamental areas and other important areas not covered by the committees (or councils) formed on the basis of area.

\title{
Brief submitted to the \\ Senate Special Committee on Science Policy
}
by

Division II of the Faculty of Arts of

Carleton University

This brief has been prepared by representatives from the Departments of Geography, Political Science, Psychology and SociologyAnthropology. Although some of these disciplines have degrees of overlap of interest with the physical and life sciences, the brief has been designed with the specific purpose of speaking on behalf of the social sciences with respect to Federal Government assistance to research and development in the universities.

It has been estimated for the decade 1966-76, that the growth of social sciences at the graduate level will triple, both in terms of number of graduate students enrolled and number of new staff acquisitions. By the end of this decade, a preponderance of the research in the social sciences will be done within the university setting. It is therefore apparent, in the light of these projections, that significant increases in funding will be necessary. This responsibility will rest primarily with Federal granting agencies, the resources of the provinces already being heavily overburdened with costs of undergraduate programs. In addition, social scientists may no longer rely on U.S. granting agencies for support, this source having in the past constituted nearly \(50 \%\) of the total research funding in certain disciplines. Should the Federal Government falter, graduate training in the universities would become more and more vulnerable to provincial and student pressures. Such pressures

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\begin{abstract}
might adversely affect the quality of postgraduate education in Canada. As a result, an even more serious gap between the quality of research facilities here in Canada and those in the U.S. might develop, with staff and students emigrating and thereby reactivating the "brain-drain" phenomenon. Already approximately \(50 \%\) of social scientists in Canadian universities are non-Canadians, and should they return to their own countries, for whatever reasons, we would be left grossly understaffed. There is therefore an obvious and pressing need for training more Canadians at the graduate level under conditions which would encourage them to reamin here.

10 Canada is currently faced with a multitude of problems 130 t in the areas of mental health, transportation, housing, the economy, environmental pollution, northern development, foreign policy, the use of our natural resources, regional disparities, urban growth, and national unity, to mention only a few problem areas. The social scientist, given adequate facilities, has much to contribute to the solution of these problems. His methodology will be both basic and applied in nature, and he often will be required to collaborate with physical and life scientists. A viable science policy must therefore emerge soon, and to help facilitate this formulation, we make the following seven recommendations.
1. An increase in federal funds for social sciences proportional to the projected expanded growth. These funds would be allocated as they have in the past to students in the form of bursaries and scholarships as well as to staff through grants-in-aid of research and postdoctoral fellowships. We do not wish to imply
\end{abstract}
the existence of a dichotomy between support for graduate students on the one hand and for research projects on the other. These activities are mutually interdependent, and adequate support for both is absolutely necessary for the creation and maintenance of successful graduate programs. We would also recommend the provision of funds for staff on sabbatical leave as well as for

2. The federal granting agencies should provide financial assistance to cover the substantial overhead costs of federally sponsored research and training projects. This is now a well-established practice in the U.S. These costs present an ever increasing strain on provincial governments, especially those which are less well financially endowed. Should overhead assistance not be provided federally, the provincial governments might well consider imposing severe fiscal restrictions on federally supported projects. By setting ceilings on costs of overhead, the provincial authorities would seriously constrict the development of graduate programs in Canada.
3. A realistic representation of social scientists on the Canada Council, the members of which would be responsible for maintaining an equitable distribution of funds across the various social science disciplines and who would be expected to encourage the development of graduate training facilities in the less affluent university centers. This division of the Canada Council, if adequately funded, would also help narrow the gap in research support which now exists between the social sciences on the one hand and the
physical and life sciences on the other. It would also ease the present conflict encountered by scientists within certain social science disciplines who do not clearly qualify for support from either NRC, MRC, DRB or various other agencies.
4. The Federal Government, like their U.S. counterpart, should begin providing compensation for individual research investigators. This would take the form of summer research stipends, occasional salary supplementation to relieve scientists from their teaching duties for short periods of time, and the creation of research chairs.
5. The establishment of research institutes and field stations where academics and others could concentrate, frequently on a long-term basis, on interdisciplinary approaches to the solution of problems in the aforementioned critical Canadian problem areas. In certain cases, the cooperation of provincial and municipal authorities would be desirable. Research libraries, and computer centers with time sharing arrangements, would be necessary integral components of such institutes.
6. Federal Government departments should expand their extramural research programs to include the universities wherever possible. This could be facilitated by the creation of a board consisting of the research directors of relevant federal government departments. This board would function as an intermediary body between federal granting agencies and principal research investigators in the universities.
7. There should be closer ties between the Federal Government and
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the two universities located in Ottawa. This physical contiguity
creates an ideal situation for the exchange of research ideas,
professional staff and students in training. Carleton University
and the University of Ottawa have, for several years now,
maintained liaison by contributing substantially to the education
of members of the Public Service of Canada through their
Extension divisions.

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\author{
Dr. B.J. McCormack (Psychology) \\ Mr. G. Bruce Doern (Political Science) \\ Dr. J.P. Johnson, Jr. (Geography) \\ Dr. Stephen Richer (Sociollegy and \\ Anthropology )
}

\title{
Brief to the Government of Canada \\ The Special Senate Committee \\ On Science Policy
}

Submitted by the Department of
Computer Science
University of Western Ontario

March 14, 1969.

\section*{SUMMARY OF BRIBF}

\section*{TO}

THB SPECIAL SENATE COMMITTTEE ON SCIENCE POLICY

\section*{1. Objectives}

The objectives of a National Science Policy for Canada should be:
(a) To increase greatly the number of scientific, engineering, and technical jobs available to Canadians.
(b) To aid in regional development within Canada.
(c) To equip Canada to provide scientific and technical leadership to underdeveloped countries of the commonwealth and the French Union.

\section*{2. Means of Accomplishment}

These foregoing objectives may be realized in the following ways:
(a) Balance the national research effort; that is, increase the amount of applied research and development performed in Canada while maintaining the quantity and traditional excellence of the basic research presently done by Canadian universities. The national effort in research can be increased significantly by the work of projected new Government institutes (to be described in this brief), while the desired increase in development can best result from an interplay of public and private resources in imaginative new industry-university complexes.
(b) Provide for systematic, large-scale acquisition and management of scientific and technical information and its dissemination to Canadian industry.
(c) Establish a vital and energetic national standards programme to promote consumer protection, compatibility of technical material used in industry, and acceptance of Canadian manufactured products in the export trade.
(d) Develop and operate a nationwide high-speed computer-based telecommunications network, possibly using artificial earth satellites in stationary orbits, to reach all population centres, however small or remote, and facilitate the interm change of scientific and administrative data and information, educational television programming, computer-aided-instruction sequences, and computer-aided-design programmes for use by Canadian industry.
(e) Initiate an intramural applied research programme in cybernetics and systems science furnishing support to the universities for the required basic research in the mathem matical sciences and to industry (including consulting firms) for developmental effort in computer programming and applications in operations research, industrial computer science, and regional planning.
(f) Initiate a corresponding applied research programme in materials science furnishing support to the universities for basic research in chemistry and solid-state physics and to industry for developmental effort aimed at propagating an indigenous Canadian electronics industry.
3. Implementation

It is suggested that the foregoing programme be implemented by a cabinet-level Department of Science and Technology which should include the following:
(a) Representation of the National Research Council at the Ministerial level.
(b) Liaison through the Deputy Minister 's staff with the Defence Research Board, Agricultural Research Stations, Atomic Energy of Canada, Ltd., and Telecommunications of Canada, Ltd. (a Crown Corporation to be established to develop and operate the national telecommunications network mentioned previously).
(c) The Institute for Scientific and Technical Information.
(d) The Institute for Cybernetics and Systems Science.
(e) The Institute for the Materials Sciences.
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1. The basic objective of any national science policy is to further national aspirations that may be diplomatic, military, eleemosynary, or economic. Economic objectives may include providing a national technological infrastructure or stimulating edogenous economic activity.
2. The most appropriate objective of a national science policy for Canada at this time would seem to be furthering her economic and diplomatic aspirations. The wealth of a nation is related to its level of scientific sophistication since it depends upon the output per man-hour: of value added to its products or services, and value is most readily added by scientific and technical workers. Furthermore, it is desirable that a nation's wealth be broadly distributed among its centres of population. It follows, therefore, that the national science policy should further Canada's national economic objectives by:
(a) Increasing the Canadian content of goods and services supplied or consumed in terms of scientific, engineering, technical, and skilled labour.
(b) Contributing to Canada's regional development.

The natiomal science policy should further Canada's diplomatic objectives by providing the ability to furnish scientific and technical leadership to underdeveloped areas within the Commonwealth and the French Union.
3. The industrialized nations of the world can be grouped into three classes:
(a) The scientific leaders: the United States, the Soviet Union, Japan, the German Federal Republic, and the United Kingdom.
(b) Second-class scientific countries: France, Italy, Sweden, the Benelux countries, Switzerland, the German Democratic Republic, and Hungary.
(c) An upwardly-mobile group including, but not limited to: Israel, the Chinese People's Republic, and India.

Overa11, Canada ranks about midway in the second group.
4. In Canada, basic research is done primarily in universities, which is true in most countries except the Soviet Union, where it is done in the various Academies of Sciences.

Canadian applied research is performed by Crown Corporations or Government departments, in universities, and to a small extent, by industry. In the United States and the United Kingdom applied research is done in national laboratories, industrial laboratories (often under government aegis), and in universities.
in Canada, development is carried on principally in Government laboratories. In the rest of the world it is done primarily in industrymeven in the Soviet Union where Ministries responsible for production carry on developmental work in their factories or in special 1aboratory establishments.
5. Canadian basic research has been noteworthy largely in the fields of mathematics, atmospheric studies, medical science, and physics. Productive applied research has been done in nuclear energy, agriculture, health, and computer science. Development programmes have been mounted with some success in the fields of defence, construction, and transportation.

The branchmplant problem has contributed to Canadian weakness in applied research and development as well as to loss to emigration of Canadians trained in engineering and science. Weakness in industrial engineering and operations research occasionally has forced closing of certain branch plants; their owners having delayed developing and installing modern production methods until the plants became uneconomical even with relatively low prevailing wage rates.

Other symptoms of inadequate research effort as reflected in Canadian industry include:
(a) The almost complete absence of a native Canadian electronics industry.
(b) Large-scale activity in the crude extraction of metals (ferrous, non-ferrous, and exotic) from ores but little corresponding activity in refinement of metals and production of technologically novel and important alloys.
(c) Heavy dependance upon U.S. computer manufacturers for programmes (software) widely used both in scientific computation and data processing.
(d) Neg1igible activity in design and production of high-speed aircraft.
(e) Inadequate national communications facilities for real-time interchange of information at high data rates. Requirements for this service are expecially high in remote regions of Canada where they are needed to facilitate educational services (educational television and computer-aided-instruction) and scientific data collection.
6. Broadly speaking, the national science policy should accomplish the following:
(a) Fill gaps in the existing science programme by salient attacks upon selected disciplines at levels not presently reached by efforts of industry and the universities.
(b) Provide assistance to the universities in critical disciplines by means of scholarships, fellowships (including travel and work abroad), sponsorship of visiting scientists and scholars, grants to cover capital expenditures for land, buildings, and non-expendable research equipment, and operating grants for the purpose of establishing centres of scientific excellence.
(c) Provide assistance to industry by means of disseminating scientific and technical information, encouraging selective immigration, granting tax credits to firms which establish research and development laboratories in Canada, performing special developmental work in Government laboratories at cost, and furnishing Government testing and standardization facilities for use by industry.
7. The national science program should be implemented initially by three National Science Institutes reporting to a cabinet-level Department of Science and Technology, and a Crown Corporation charged with maintaining special telecommunications facilities. Each Institute should be empowered to do the following:
(a) Sponsor basic research in universities.
(b) Coordinate this sponsored research, and research in collateral scientific disciplines.
(c) Perform applied research on an intramural basis.
(d) Sponsor developmental work in existing Government laboratories and in industry.
8. The Institute for Cybernetics and Systems Science would sponsor basic research in pure mathematics, applied mathematics, mathematical statistics, computer science, and general systems theory.

It would coordinate collateral work in sociology, medical science, law, engineering, education, (including research in computer-aidedinstruction), psychology, economics, demography, anthropology, and solid earth science.

The Institute would carry on intramural applied research in simulation, mathematical programming, queueing theory, decision theory, and optimization.

It would sponsor developmental work in the fields of industrial engineering, regional planning, urban renewal, national resources allocation, metropolitan transportation planning, educational technology, programme monitoring and evaluation, and computer applications such as computer-aided instruction sequences and computer-aided design programmes for use by Canadian industry.
9. The Institute for Materials Science would sponsor basic research in solid-state physics, quantum mechanics, crystallography, and spectroscopy.

It would coordinate collateral work in chemistry and electrical engineering.

It would perform applied research in ferrous metallurgy, nonferrous metallurgy, high-vacuum technology, and allied disciplines.

The Institute would sponsor developmental work in microelectronics (especially integrated circuits and largerscale integration), lasers, nuclear fuels, and refactory materials for space technology and nuclear science.
10. The Institute for Scientific and Technical Information would sponsor basic research in bulk storage systems (for example, those based on holography), pattern recognition, automatic indexing, search strategy, and applicable computer science.

In contrast with the other Institutes, this one would be responsible for conducting operations such as recording, acquiring, classifying, translating, inđexing, abstracting, and coding scientific information. In this capacity, the Institute would be responsible for monitoring activities outside of Canada as well as collating information developed in intramural and contract research, and by Canadian industry. It would store, retrieve, and disseminate information; perform research and development aimed at increasing the effectiveness of libraries, the patent office, and existing information centres; be responsible for coordinating scientific conferences, displays, and publications; and develop an interactive network for exchange of scientific and technical information among extant scientific and technical information centres.

This Institute would absorb much of the work of the Canadian Standards Association, provide a permanent secretariat for its sectional and working committees, and furnish representation for Canada at international standards conferences.

It would establish national standards for products, processes, materials, and devices so as to provide technical guidance to Government contracting officers and the Department of Consumer Affairs, coordinating existing efforts in these areas. It would evaluate scientific and technical material, and promulgate standards for routine quality control and product verification in industry.

The Institute would perform calibration of secondary standards for industry, Government agencies, and universities; and do nonroutine quality testing to evaluate the characteristics of materials, devices, products and processes.

It would be responsible for publishing and cross-indexing all Canadian standards.
11. An organization to be known as Telecommunication of Canada, Limited should be established as a Crown corporation and assigned the responsibility for planning, developing and implementing a national communications network of high-speed data channels linking all Canadian population centres, especially those in the Northwest Territories and other underdeveloped regions. This network, which would likely make use of telecommunications sateliftes in stationary earth orbits, would be used for exchanging scientific and technical data and information, administrative information, computer programmes, education television programmes, and computer-aided-instruction sequences. The network should operate or interconnect with realtime computing facilities adequate to serve the needs of its users.
12. Organization of the Department of Science and Technology would be as follows:

Department of Science and Technology


The Department of Computer Science, of the University of Western Ontario, 1142 Western Road,
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\section*{REPRESENTATIVES}

JOHN M. CARROLL
Associate Professor of Computer Science The University of Western Ontario.

Education:
Bachelor's in Industrial Engineering (with highest honours) Lehigh University, Beth1ehem, Pa. (1950).

Master's in Physics, Hofstra University, Hempstead, N.Y. (1955)
Doctorate in Industrial Engineering and Operations Research, New York University, New York, N.Y. (1968).

\section*{Experience:}

July 1968 to present - Associate Professor of Computer Science, the University of Western Ontario, London, Ontario.

Sept. 1964 to July - Associate Professor of Industrial Engineering, 1968 Lehigh University, Bethlehem, Pa.

Feb. 1952 to Sept. - Editorial Staff, Electronics magazine,
1964 McGraw-Hill Inc., New York, N.Y., Managing Editor from 1957 to 1964.
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Aug. 1950 to Feb. - Electronics Officer, U.S. Navy.
1952
Oct. }1947\mathrm{ to Sept. - Senior Radio Engineering Aide, U.S.
1948 National Bureau of Standards, Washington, D.C.

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Aug. 1944 to Oct. - Electronics Technician, U.S. Navy.
    1947
Publications: 14 books and about 40 articles including:
"The Standard Handbook for Electrical Engineers" (McGraw-Hi11, 1968)
Associate Editor; author of section on "Blectronic Data Processing".
"Characteristics of Modern Production" (Alexander Hamilton Institute
    1969).
"Careers and Opportunities in Electronics" (E.P. Dutton Co., 1967).
"Careers and Opportunities in Computer Science" (E.P. Dutton Co.,
    1961).
Research interests are in information systems design including
automatic indexing, on-line data collection and analysis, and
computer-controlled product verification.

Head, Computer Science Department, The University of Western Ontario.

\section*{Education:}

Bachelor*s in Physics, University of Toronto 1946.
Master's in Physics, University of Toronto 1948.
Doctorate in Physics, University of Toronto 1953.

\section*{Experience:}
\begin{tabular}{ll}
1953 to 1959 & \begin{tabular}{l} 
- Assistant Research Officer, Appiled Physics, \\
N.R.C.
\end{tabular} \\
1959 to 1960 & \begin{tabular}{l} 
- Secretary, Computer Committee, Physics \\
\\
Dept., University of Western Ontario.
\end{tabular} \\
1960 to present & \begin{tabular}{l} 
- Head, Computer Science Department, \\
\\
University of Western Ontario.
\end{tabular}
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Other
N.R.C. Grant Selection Committee for Computers 1962-1965

\section*{Pub1ications:}
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J.F. Hart et al: "Computer Approximations". SIAM Applied Math Series, John Wiley \& Sons, New York, 1968.
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Brief to the
Committee on Science Policy of the
Senate of Canada
by

\author{
FACULIY OF ENGINEERING \\ 
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It is evident that Canadian society is increasingly based on technology. Thanks to the automobile and jet aircraft, for instance, today's citizen enjoys the benefits of high mobility; conversely, he is often cursed with pollution, noise, and traffic congestion from these same sources. Automation serves to increase his leisure time, but also demands a continual updating of his skills.

We wish to express our concern about policy affecting the Applied Sciences. As a Faculty of Engineering, we believe that science and technology should be used to produce a more livable world as well as a high material standard of living.

Clearly the social and human problems which appear in a technological society are formidable. Solutions call for a concerted interdisciplinary effort from the physical scientists, social scientists, and engineers. It seems to us, then, that an effective science policy must have two objectives. On the one hand, it must encourage the growth of the material well-being of Canadians through scientific and technological innovation. On the other hand, it must seek to guide such developments so that science and technology are the servants of man, and not the reverse.

Desirable Policy
The ultimate concern of Canadian Science Policy should be the well-being of Canadians. Since it is through technology that scientific discovery serves the people, applied research must be a vital aspect of a Science Policy. It is not only pure scientists who discover new scientific truth; applied scientists, spurred by the objective of their research, often discover new relationships required in order to proceed to their goal. Engineering research can point to several examples in this category: information theory, numerical methods, free-radical chemistry, etc. In any case it is illogical to expend resources on basic research without carrying through with applied research and the development of technology. Technology is today one of the most important ingredients of national prosperity. Indeed, the Task Force on the Structure of Canadian Industry links capital and technological innovation together as equally essential for industrial growth.

We believe, as would Professor Arthur Porter whom you interviewed on March 20, 1968, that the people of the nation should become more scientifically and technologically literate. Such literacy surely cannot but improve and enrich the life of the Canadian people, in both human and monetary terms. Dr. S. Okita recently spoke to you pointing out the emphasis placed on technology in Japan as compared to the emphasis placed on pure sciences here in Canada. We do not think that a national science policy involving mainly pure science is a policy that can lead to involvement by the average citizen, because he cannot readily relate this science to his everyday life. A national science policy that is based upon the application of science can help people to take an interest through their ability to relate to most engineering and applied science projects. The need for technical literacy to become generalized is of the highest urgency. It is necessary for the efficient government of the country, since the voters must be able to understand national policy in order to support it. It is necessary for a high level of employment, there being fewer and fewer jobs available that do not require at least some technical competence.

In putting science to work, technology has all too often stopped short of becoming as broadly accessible as might be desired. For instance, the skills and effort required to operate a computer are not negligible to the nontechnical individual. It is today possible to provide him with a telephone connection to a time-sharing machine, which he could instruct in simple words about his income tax data for instance - and which would then complete the requested calculation returning it to him by mail together with a bill-card. This card could be inserted into a card reader connected by telephone to the bank, so that the bill would be paid automatically. This example is merely an illustration of how much smoother some tasks could be made by letting technology come right down to the people. For all the foregoing reasons, and because of the economic considerations discussed further on, it appears to us that the time is long overdue for the establishment of policies concerning applied sciences in Canada.

We believe that research in the universities can contribute significantly to technological and social advances. However, in order that the potential contribution of the universities be fully exploited, we would recommend that Canadian research personnel be encouraged to form strong viable groups according to their research interests in areas of acknowledged Canadian need. Every university today aspires to excellence over a broad spectrum in order to fulfill its obligation in all the fields of education it covers. The result is a dispersion of talent over all the universities, and a dearth of institutions having real depth in specific fields of research. Until a research group reaches a certain size, a "critical mass", its work tends to be fragmented and its output disjointed. Once the critical size is reached, however, it is capable of an output of sustained excellence and impact. We believe that Canada has more than the critical number of people in several areas and, therefore, wish to add our voice in support of the formulation of a policy that would bring these people together and provide adequate facilities to further our progress in such fields as computers, communications, transportation, northemdevelopment, urban development and natural resource development.

To make the most effective use of Canada's research potential, viable applied research institutes, closely associated with universities, should be established. Each institute should have a well defined field of interest relevant to Canadian needs. Where appropriate, each should also be associated with a particular company or industry. The source of funding for these institutes should be contractual so that the institutes do not become simply a further outgrowth of government laboratories. The initial funding may be predominantly from government grants, but the objective of each institute should be to become less and less dependent upon direct funding from this source. By way of examples we might mention the Gas Turbine Laboratory at M.I.T., the Institute of Aerospace Studies at the University of Toronto, and the newly-formed University Institute system in Germany.

Another factor which would render research effort more effective is contact between research workers in different disciplines, e.g. sociology and engineering, and between those in different sectors, e.g. government, university, and industry. We believe that industrial and government personnel should assist with the education of students and that university faculty should participate in the continuing education of people from industry and government, when required. Industrial concerns should ensure that their problems and interests are conveyed to the other two groups to provide practicality and perspective. We would like
to see structures evolve that will bring about these exchanges, and believe that a national program for the exchange of people from the various sectors could be instituted and would be beneficial. We believe that the research institute system will facilitate these aims.

There is a need for publication and dissemination of Canadian applied research results, both at the popular and at the scientific levels. Societies, or associations, exist today in many fields of scientific endeavour in Canada. These function admirably to bring together persons having similar interests. The Federal Government should continue to assist in the formation of such groups. As an example of need, we consider that a national electrical engineering association would benefit the country and, hopefully, would result in the establishment of a Canadian research journal in electrical engineering.

It has been suggested by Dr . W. G. Schneider of the National Research Council in his presentation to your committee that Canada faces an impending oversupply of Ph.D. graduates in Science and Engineering. We would like to state that these conclusions depend upon the continuation of present hiring policies and management decisions regarding the use of these highly trained persons. It is to be hoped that the greater depth of understanding that is usually linked with this advanced degree will be recognized soon by management. Employment of Engineering Ph.D. graduates by industry should result eventually in better leadership as some of these people assume executive positions.

American dominance over Canada's technology has often been cited as a reason for the relative lack of interest in applied science projects in Canada. A Science Policy should encourage all companies in Canada, be they owned by Canadians or not, to carry out research and development in Canada proportionate to the volume of their business. We believe very strongly that the time has come for Canadians to realize that they must do, and are capable of doing, a large amount of original and relevant engineering and applied research, and such work should be publicised and encouraged. At the risk of stating the evident, we would draw attention to the need for thorough appreciation of research work being done abroad, so as not to duplicate identical work unnecessarily, the results of which are freely available.

An effective policy requires a body having adequate responsibility to do the planning and enforce its decisions. We believe that the Government of Canada should assume the responsibility for Science Policy, as it does for Foreign Policy and Defence Policy. Various advisory bodies can be consulted, or instituted if necessary, but the final policy decisions must rest with the Government. The Science Policy should recognize and emphasize the economic and humanistic gains that are to be made when mission-oriented objectives determine priorities. The evaluation of the expected returns per dollar invested in research can be done today on sound technical grounds (cost-benefit analysis), and should form the basis for decisions. This cost-benefit analysis must take into account social, human and economic returns as measures of effectiveness.

Finally, we of the Faculty of Engineering at Carleton University wish not only to contribute by the submission of this brief but also to participate actively in Canadian technological development.












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SCIENCE POLICY

First Session-Twenty-eighth Parliament 1968-69
THE SENATE OF CANADA
PROCEEDINGS
OF THE
SPECIAL COMMITTEE ON

\section*{SCIENCE POLICY}

The Honourable MAURICE LAMONTAGNE, P.C., Chairman
The Honourable DONALD CAMERON, Vice-Chairman
No. 48
THURSDAY, MAY 29, 1969

\section*{WITNESSES:}

Dr. F. A. Forward, Consultant on Research Administration, University of British Columbia, Vancouver, British Columbia; Dr. John F. Postma, Research and Liaison Officer for Academic Development, Notre Dame University of Nelson, Nelson, British Columbia; Dr. A. G. McCalla, Dean, Faculty of Graduate Studies, University of Alberta, Edmonton, Alberta; Dr. James B. Hyne, Dean, Faculty of Graduate Studies, University of Calgary, Calgary, Alberta; Dr. B. W. Currie, Dean, Vice-President (Research), University of Saskatchewan, Saskatoon, Saskatchewan; Dr. A. B. Van Cleave, Dean, Faculty of Graduate Studies, Regina Campus, University of Saskatchewan, Regina, Saskatchewan; Dr. H. E. Duckworth, Vice-President (Academic), University of Manitoba, Winnipeg, Manitoba; Dr. D. R. Moir, Dean, Faculty of Science, Brandon University, Brandon, Manitoba.

\section*{APPENDICES:}

No. 82-Brief submitted by Research and Liaison Office for Academic Development, Notre Dame University of Nelson, British Columbia. No. 83-Brief submitted by the University of British Columbia. No. 84-Brief submitted by the Research Board of the University of Manitoba. No. 85-Brief submitted by the University of Lethbridge. No. 86-Brief submitted by the University of Alberta. No. 87Brief submitted by the Department of Geological Sciences, University of Saskatchewan, Regina Campus. No. 88-Brief submitted by the Faculty of Administration, University of Saskatchewan, Regina Campus. No. 89-Brief submitted by J. W. T. Spinks, President, University of Saskatchewan. No. 90-Brief submitted by the University of Calgary. No. 91 -Brief submitted by the J. B. Mitchell Junior High School, Grade VIII Students, Winnipeg, Manitoba. No.
 Saskatchewan, Saskatoon, Saskatchewan.

MEMBERS OF THE SPECIAL COMMITTEE ON
SCIENCE POLICY
The Honourable Maurice Lamontagne, Chairman
The Honourable Donald Cameron, Vice-Chairman
The Honourable Senators:
\begin{tabular}{lll} 
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.
\end{tabular}

\section*{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 field 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 service 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 wasResolved in the affirmative.

ROBERT FORTIER, Clerk of the Senate.

\section*{MINUTES OF PROCEEDINGS}

Thursday, May 29, 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, Cameron, Carter, Giguère, Grosart, Haig, Kinnear, McGrand, Phillips (Prince), Robichaud and Yuzyk-(14).

In attendance:
Philip J. Pocock, Director of Research (Physical Science) Gilles Paquet, Director of Research (Human Science)
The following witnesses were heard:
Dr. F. A. Forward, Consultant on Research Administration, University of British Columbia, Vancouver, British Columbia.
Dr. John F. Postma, Research and Liaison Officer for Academic Development, Notre Dame University of Nelson, Nelson, British Columbia.
Dr. A. G. McCalla, Dean, Faculty of Graduate Studies, University of Alberta, Edmonton, Alberta.
Dr. James B. Hyne, Dean, Faculty of Graduate Studies, University of Calgary, Calgary, Alberta.
Dr. B. W. Currie, Vice-President (Research), University of Saskatchewan, Saskatoon, Saskatchewan.
Dr. A. B. Van Cleave, Dean, Faculty of Graduate Studies, Regina Campus, University of Saskatchewan, Regina, Saskatchewan.
Dr. H. E. Duckworth, Vice-President (Academic), University of Manitoba, Winnipeg, Manitoba.
Dr. D. R. Moir, Dean, Faculty of Science, Brandon University, Brandon, Manitoba.
(A curriculum vitae of each witness follows these Minutes).
The following are printed as Appendices:
No. 82-Brief submitted by Research and Liaison Office for Academic Development, Notre Dame University of Nelson, Nelson, British Columbia.
No. 83-Brief submitted by the University of British Columbia, Vancouver, British Columbia.
No. 84-Brief submitted by the Research Board of the University of Manitoba, Winnipeg, Manitoba.
No. 85-Brief submitted by the University of Lethbridge, Lethbridge, Alberta.
No. 86 -Brief submitted by the University of Alberta, Edmonton, Alberta. No. 87 -Brief submitted by the Department of Geological Sciences, University of Saskatchewan, Regina Campus, Saskatchewan.

No. 88 -Brief submitted by the Faculty of Administration, University of Saskatchewan, Regina Campus, Saskatchewan.
No. 89—Brief submitted by J. W. T. Spinks, President, University of Saskatchewan, Saskatoon, Saskatchewan.
No. 90 -Brief submitted by the University of Calgary, Calgary, Alberta.
No. 91 -Brief submitted by the J. B. Mitchell Junior High School, Grade VIII Students, Winnipeg, Manitoba.
No. \(92-\) Brief submitted by B. W. Currie, Vice-President (Research), University of Saskatchewan, Saskatoon, Saskatchewan.
At 12.35 p.m. the Committee adjourned to the call of the Chairman. ATTEST:

Patrick J. Savoie, Clerk of the Committee.
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\section*{CURRICULUM VITAE}

Currie, B. W. Dr. Currie is renowned for his extensive work on aurora borealis and is director of the University of Saskatchewan's Institute of Upper Atmospheric Physics. In 1958 he was in Moscow for two weeks for meetings connected with the International Geophysical Year. He has been president of the Canadian Association of Physicists, a member of the American Geophysical Union, and the American Meteorological Society. He is a fellow of the Royal Society of Canada and the Royal Meteorological Society. Professor Currie has served on numerous associate committees of the National Research Council and the Defense Research Board, in particular the Associate Committee on Geodesy and Geophysics; Associate Committee on Radio Science; Extra-mural Electronic Panel of Defence Research Board; Leader, Canadian Delegation to 1960 Assembly, International Union of Geodesy and Geophysics. Dr. Currie is a graduate of the University of Saskatchewan. He received the degree of bachelor of science (B.Sc.) in 1925 and the degree of master of science (M.Sc.) in 1927. Three years later he received the doctor of philosophy degree (Ph.D.) from McGill University. Dr. Currie joined the staff of the \(U\) of \(S\) in 1929. He was on leave from the university from 1932-34 to serve as a meteorologist in the Canadian Meteorology Service. In 1952 he became head of the physics department (a position he relinquished Sept. 1961 in order to allow him more time to devote to his increasing responsibilities.) On July 1, 1959 he was appointed Dean of the College of Graduate Studies. In June, 1962 he was awarded the Canadian Association of Physicists gold medal. The medal is awarded annually by the association for achievement in physics and Dr. Currie was the seventh person to receive the award. He has published numerous papers in his special field, the aurora borealis, as well as papers on earth currents and meteorology. He was president of the University of Saskatchewan Alumni Association for two terms, 1945-46 and 1946-47, and was president of the Faculty Club in 1958. Dr. Currie was born in Helena, Montana, and attended high school at Netherhill, Sask. He is married and has a son and two daughters. Dr. Currie was appointed dean of faculties in December, 1964. This appointment is an administrative one which may be considered to take the place of a vice-president (academic) for the Saskatoon campus. Dr. Currie was named vice-president (research) in April of 1967 .

Duckworth, Henry Edmison. Born: Brandon, Manitoba, November 1, 1915only child of the late Reverend Henry B. Duckworth, D.D. and Ann Edmison Duckworth. 1935, B.A. (University of Manitoba) ; 1936, B.Sc. (University of Manitoba) ; 1937, Teaching Certificate (University of Manitoba); 1937-38, Instructor in Mathematics, Stonewall (Manitoba) Collegiate; 1938-40, Lecturer in Physies, United College, Manitoba; 1942, Ph.D. (University of Chicago); 1942-45, Defence research work at the National Research Council; 1945-46, Assistant Professor of Physics, University of Manitoba; 1946-51, Associate Professor of Physics, Wesleyan University, Connecticut; 1951-65, Professor of Physics, McMaster University, Hamilton, Ontario; 1956-61, Chairman, Department of Physics, McMaster University, Hamilton; 1961-65, Dean of

Graduate Studies, McMaster University, Hamilton; 1963-65, Member of Board of Governors, McMaster University, Hamilton; 1965-66, Vice-President (Development), University of Manitoba; 1966, Vice-President (Academic), University of Manitoba. 1954, Elected to Fellowship in the Royal Society of Canada, Elected to Fellowship in the American Physical Society; 1955, Nuffield Travelling Fellowship; 1961, University of Manitoba Jubilee Award; 1964, Medal of the Canadian Association of Physicists; 1965, Tory Medal of the Royal Society of Canada; 1966, D.Sc. (University of Ottawa); 1966, Honourary Fellow (United College). 1956-62, Editor of the Canadian Journal of Physics; 1961-67, Member, Honourary Advisory Council, National Research Council; 1963, Leader of Canadian Delegation to General Assembly of International Union of Pure and Applied Physics, Warsaw, Poland; 1960, President, Canadian Association of Physicists; 1964, President, Section III (Science Section) of the Royal Society of Canada. Member, Defence Research Board; Member, Manitoba Research Council; Chairman, Committee on Extramural Research, Defence Research Board; Chairman, IUPAP Commission on Atomic Masses and Related Constants; Director, Manitoba Institute of Management. Publications: 1958, "Mass Spectroscopy", in the Cambridge Monographs on Physics Series, Cambridge University Press, England 206 pages. 1960, "Electricity and Magnetism", Macmillan Company of Canada (Tor.) and Holt Rinehart \& Winston (New York), 424 pages. 1960, (Editor of) "Proceedings of the International Conference on Nuclidic Masses", University of Toronto Press, 539 pages. 1963, "Little Men in the Unseen World", Macmillan and Company Ltd. (London and Toronto), 149 pages. Numerous scientific articles.

Forward, Frank Arthur, B.A.Sc., P.Eng., F.I.M., F.C.I.C., M.Inst. M.M. M.C.I.M. D.Sc. Dr. Forward was born in Ottawa in 1902, attended Ottawa Model School, Lisgar Collegiate and University of Toronto where he received the degree of B.A.Sc. (Honours) in Chemical Engineering in 1924. From 1924 to 1929 he was a smelter operator and research metallurgist with Consolidated Mining and Smelting Companty of Canada Ltd. at Trail, B.C. Moving to Australia in 1929 he was Assistant Smelter Superintendent, Mount Isa Mines Ltd., Mount Isa, Queensland, until 1934 when he returned to Canada, spending one year as metallurgist with B.C. Nickel Mines Ltd. He joined the University of British Columbia as Assistant Professor of Metallurgy in 1935, became Professor in 1941 and Head of the Department in 1945 a post he retained until 1964 when he was granted leave by the University to go to Ottawa to become the first director of the Science Secretariat in the Privy Council Office. In this post he was responsible for the initial organization of the Science Secretariat and the preparation of material for the Science Council Act, and the organization of Science Council staff. He retired from this post, and from his university position, in 1967. Since July 1967 he has been Consultant on Research Administration, The University of British Columbia and Consultant to Sherritt Gordon Mines Limited. In the period since 1937 he has acted as consultant to Sumitomo Company, Niihama, Japan; Algoma Ore Properties; B.C. War Metals Research Board (Technical Director); Freeport Sulphur Company, New York; Chinese National Resources Commission, Formosa; Sherritt Gordon Mines Limited; Canadian Uranium Research Foundation (Director of Research). He was the first Chairman B.C. Chapter, American Society for Metals in 1941; Vice-President Canadian Institute of Mining and Metallurgy, in 1943-44; President, B.C. Association of Professional Engineers, 1948; President, Dominion

Council of Professional Engineers, 1949; Member, Canadian Delegation to First Atoms for Peace Conference in Geneva, 1955; Member, National Research Council, 1962-64; President, Canadian Institute of Mining and Metallurgy, 1965. In 1955 he was awarded the Leonard Medal, Engineering Institute of Canada; the Inco Medal, Canadian Institute of Mining and Metallurgy; and the McCharles Prize, University of Toronto: in 1959 the Mining World Achievement Award; 1960 the John Scott Award by the City of Philadelphia; in 1962 the Gold Medal of the Institution of Mining and Metallurgy and the R.S. Jane Memorial Lecture Award by the Chemical Institute of Canada; 1963 the Engineering Alumni Medal, University of Toronto; in 1965 the James Douglas Gold Medal, A.I.M.E. and the honourary D.Sc. degree by the University of British Columbia; 1966 the Institute of Metals Platinum Medal and in 1967 the American Academy of Achievement Golden Plate Award. Dr. Forward is a Fellow of the Chemical Institute of Canada and of the Institution of Metallurgists (Gt.Br.), a member of the Canadian Institute of Mining and Metallurgy, American Institute of Mining, Metallurgical and Petroleum Engineer, Australasian Institute of Mining and Metallurgy, Institution of Mining and Metallurgy (Gt.Br.), Institute of Metals (Gt.Br.), Gesellschaft Deutscher Metallhutten u. Bergleute, Canadian Research Management Association. Author of some 30 technical papers including section on "Hydrometallurgy" in Encyclopedia Britannica, 1961 ed. Inventor of pressure leaching process for nickel ores and processes for recovering tungsten, uranium, lead, zinc, tin, resulting in considerable number of patents. Married, 1927, to Dorothy Christina Ransom, they have four sons.

Hyne, Dr. James Bissett. Dr. James Bissett Hyne, chemist, was born in Dundee, Scotland, Nov. 23, 1929, the son of William and Winnifred (Bissett) Hyne. Dr. Hyne came from Scotland to Ottawa, Ont. in 1954. Dr. Hyne married Ada Leah Jacobson of Boston, Mass. U.S.A. on Sept. 3, 1958. He received his public school education in Dundee, Scotland and high school at Morgan Academy, Dundee, Scotland. He attended St. Andrews University and obtained his B.Sc. (Honors) in 1951; in 1954 his Ph.D. at the same university; Fellowship in Chemical, Institute of Canada (F.C.I.C.) 1964. He is a member of Sigma Xi fraternity. From 1954-56 he was post doctorate fellow chemist with N.R.C. (National Research Council), Ottawa, Ont.; 1956-59, instructor of chemistry, Yale University, New Haven, Conn., U.S.A. 1959-60, assistant professor (chemistry), Dartmouth College, Hanover, N.H., U.S.A. In 1960 Dr. Hyne joined the Faculty at the University of Alberta (now University of Calgary) as an associate professor of chemistry, and administrative officer (dept. of chemistry). In 1963 he was appointed head of dept. of chemistry. In 1964 he became full professor of chemistry, and 1966 to present he is Professor of Chemistry and Dean of Faculty of graduate studies. He is also research director, Alberta Sulphur Research Ltd., 1964 to present, consultant chemist, and a small rancher. Dr. Hyne served from 1947-54 in the U.K. Territorial Army, and joined as private and was discharged with the rank of Company Sergeant Major. From 1954-58 he was in the Cameron Highlanders of Ottawa, Ont. with the rank of second lieutenant. Active in business and professional organizations he is a fellow of the Chemical Institute of Canada and was secretary and treasurer of the organic division, 1963-65; member, American Chemical Society; Faraday Society; Canadian Association Graduate Schools, Interim Faculty Representative Board of Governors, University of

Calgary, 1968. Dr. Hyne has published fifty scientific papers to date. He was the recipient of a Medal in Geology in 1948 at St. Andrews University; 1951-54 University Research Scholarship at the same University; 1954-56 Post Doctoral Fellowship, Ottawa with the N.R.C., and in 1967 he received the Canadian Centennial Medal.

McCalla, Arthur, G., B.Sc., M.Sc., Ph.D., F.R.S.C., F.A.I.C. Born, St. Catharines, Ontario, in 1906. Received the B.Sc., (Agriculture) in 1929 and the M.Sc. in 1931 from the University of Alberta, and the Ph.D. in 1933 from the University of California (Berkeley). From 1933 to 1939 was Research Assistant in the Department of Field Crops, University of Alberta. The year 1939-40 was spent on post-doctoral research at the Institute of Physical Chemistry, University of Uppsala, Sweden, working on the physical-chemical properties of wheat gluten. Appointed Sessional Lecturer at the University of Alberta for 1940-41; Professor of Field Crops in 1941; Professor and Head, Department of Plant Science 1944-51; Dean, Faculty of Agriculture, 1951-59 and Dean, Faculty of Graduate Studies, 1957-present. Fellow of the Royal Society of Canada and the Agricultural Institute of Canada. Member of the National Research Council of Canada 1950-56, and member of various N.R.C. committees for many years. Member of the Canadian Commonwealth Scholarship and Fellowship Committee since its inception in 1959. Research interests concerned principally with the study of the physical-chemical properties of plant proteins with special emphasis on wheat proteins.

Moir, D. R. Attained degrees: B. Sc. (Hons.) U of Manitoba; M.Sc., U of Manitoba; Ph.D., U of Manitoba. Research Interests: Plant Morphology, Taxonomy, Atmospheric Pollens. Research Experience: Extensive floristic research ranging from New Mexico to the subarctic zone of Canada; research grants from N.S.F., A.A.A.S., Arctic Institute of N.A. Position: Dean, Faculty of Science Brandon University.

Postma John F. Born October 14, 1926. The Hague, The Netherlands, in which country he received his elementary and secondary schooling as well as most of his undergraduate level university education. Came to Canada in 1951, did three years of graduate level work in theology at St. Augustine's College in Toronto, moved to Nelson, B.C. in 1954 to assume the post of Superintendent of Buildings and Grounds at Notre Dame University. Became a Canadian citizen in 1956. Earned a Master's degree in Philosophy from the University of Ottawa and a Master's degree in Political Science and Public Administration from Carleton University (1960-61; 1965-67), including graduate level work in the areas of sociology and law (administrative and constitutional). Versant in five languages. Over a decade of experience in uinversity teaching in the departments of language, philosophy and education at Notre Dame University. Ten years administrative experience at this University in the positions of Superintendent of Buildings and Grounds. Bursar and Dean of Men (until 1965). In the Fall of 1967, appointed as Research and Liaison Officer for Academic Development. This has included work for this University in the area of administrative and academic structuring and planning, as well as work on 'briefs' submitted by Notre Dame to a variety of Commissions and Special Committees at the national and provincial level. In this capacity I have also represented the University at
various meetings of an official or public nature. Has extensive experience in youth work and a 3-year experience in newspaper work as editor-in-chief and business manager of a weekly newspaper for the Southern Interior of British Columbia. Hobbies actively pursued include music, drawing and painting, snowskiing, waterskiing, fishing, tennis and hiking.

Van Cleave, Allan Bishop. Born: Medicine Hat, Alberta, August 19, 1910. Married: Dorothy Elenora Yeo, Regina, August 16, 1934. Children: Galen M. (1939), M. Elaine (1940), Dalton C. (1942), Carol M. (1945). Education: Estuary, Saskatchewan, 1918-1924, Elementary School; Empress, Alberta, 1924-1927, High School; University of Saskatchewan, 1927-1931, B.Sc. (Honours Chemistry) ; University of Saskatchewan, 1931-1933, M.Sc. (Physical Chemistry) ; McGill University, 1933-1935, Ph.D. (Physical Chemistry); Cambridge University, 1935-1937, Ph.D. (Surface Chemistry). Scholarships: N.R.C. Bursary, 1932-1933; N.R.C. Studentship, 1933-1934 (Resigned); 1851 Exhibition Scholar, 1935-1937. Honours: Centennial Award, National Science Teachers Association, North East Section, Toronto, 1967; Centennial Medal, 1967; Chemical Education Award, Chemical Institute of Canada, Vancouver, 1968. Experience: Laboratory Instructor, McGill University, 1933-1935; Instructor, University of Saskatchewan, 1937-1938; Assistant Professor, University of Saskatchewan, 1938-1946; Associate Professor, University of Saskatchewan, 1946-1952; Professor, University of Saskatchewan, 1952-1962; Research Associate, A.E.C.L., Chalk River, Ontario, April-Sept. 1955; Research Associate, Cominco, Trail, B.C., April-Sept. 1957; Chairman, Division of Natural Sciences, University of Saskatchewan, Regina Campus, 1962-1969; Director, School of Graduate Studies, University of Saskatchewan, Regina Campus, 1965-1969; Dean, Faculty of Graduate Studies, University of Saskatchewan, Regina Campus, 1969- . Research Interests: Area: Physical Chemistry-Chemical Engineering. Sub area: Surface Chemistry-Analytical Chemistry-Mass Transfer. Specialty: Beneficiation of low grade uranium ores-flotation characteristics of pure minerals-X-ray fluorescence analysis. General aim of current research is to accumulate sufficient information on the surface characteristics of minerals to predict successful procedures for separation by flotation. Professional Society Membership: Chemical Institute of Canada, Fellow, 1940- ; Faraday Society, Member, 1939- ; Royal Society of Canada, Fellow, 1963- ; Nuclear Science Association of Canada, Member, 1957- . Offices Held in National and Provincial Organizations: President, University of Saskatchewan Alumni Association, 1948-1950; Councillor B, Chemical Institute of Canada, 19481951; Chairman, Chemical Education Division, C.I.C., 1952-1953, 1965-1966; Member, Canadian Services Colleges Advisory Board, 1960-1965; Chairman, Canadian Services Colleges Advisory Board, 1964-1965; Member, Defence Research Board, 1966- ; Member, Saskatchewan Research Council, 1968-
Publications: 1. Silicon Hydride, Monatomic, or Triatomic Hydrogen, A. B. Van Cleave and A. C. Grubb, J. Phys. Chem. XXXVI, 2817-2868, 1932. 2. Active Hydrogen, A. C. Grubb, A. B. Van Cleave, J. Chem. Physics, 3, 139-145. 1935. 3. The Molecular Diameter of Deuterium as Determined by Viscosity Measurements, A. B. Van Cleave and O. Maass, Can. J. Research, 12: 57-62. 1935. 4. The Thermal Conductivity of Deuterium, A. B. Van Cleave and O. Maass, Can. J. Research, 12: 372-376. 1935. 5. The Variation of the Viscosity of Gases with Temperature over a Large Temperature Range, A. B. Van Cleave and
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\section*{THE SENATE}

\section*{SPECIAL COMMITTEE ON SCIENCE POLICY}

\section*{EVIDENCE}

\section*{Ottawa, Thursday, May 29, 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 are meeting the west this morning, the other region which wants to separate, but I am sure that the representatives from the universities that we have this morning still want to participate in the national science effort. We are very pleased to have them with us.

Since we have eight representatives from universities we will proceed in two shifts and we will hear first the statement from Dr. Forward of the University of British Columbia who, as you know, was the first director of the Science Secretariat when it was created in Ottawa.

Dr. F. A. Forward (University of British Columbia): Thank you, Mr. Chairman and honourable senators: I am very pleased to have the opportunity to come and talk about a topic that has been very close to my interest for a great number of years. I have the feeling that the first time I talked about this was in 1940, when I wrote a paper which I had been thinking about for some time.

I bring the regrets of Dean Armstrong who had hoped to have been here today but who is engaged in the convocation ceremonies at the university.

The brief from the University of British Columbia was prepared in consultation with the UBC's president's research policy committee, of which I am chairman. The draft was examined by the department heads in the science faculty and presented to the committee of academic deans, and also to a number of the department heads in engineering.

This, therefore, cannot be said to be the consensus at the University of British Columbia. I do not suppose there is such a
thing, but it seemed to be a practical way to try to get some view of what a number of people who are interested in this think. Anyone interested in science policy in the university had the opportunity to contribute to it.

There are really two components in the UBC brief. The first comprises excerpts from the briefs that were presented to the Macdonald study group. The second, then, is a statement of structure. This is derived from a brief that was prepared at the end of last year as a result of a study that I had made for some other purposes.

I will recount just very briefly the items that are contained in the list-it is not a complete list-of the things that we suggested to the Macdonald Commission:

The first was that the federal government should reaffirm its position taken at the feder-al-provincial conference in October, 1966, that the federal government intends to remain in the business of supporting research. We believe that this should be re-affirmed and strengthened.

The second point is that the federal funds should be allocated for capital purposes, rather than as at the present time where none of the research funds that come from federal sources are really available for this purpose.

\section*{The Chairman: Always related to research?}

Dr. Forward: Related to research, yes; I am not talking about education in general. It is funds for research. As a matter of fact there is some suggestion on the part of one or two of the people in the University of British Columbia who are concerned with this that perhaps we have almost adequate funds for operating. The thing that is going to hold up the advancement of development of research in the universities is space to do the work in.
The third point is that we feel that there should be an extension of the federal advisory committee structure, that there should be more committees on which university people
can serve and participate, not only in the National Research Council and medical research and so on, but in many of the other agencies and departments of government.

We feel that the "centre" concept should be expanded. We have talked about centres of excellence, but this refers generally to the method of handling and operating centres in universities. We feel that these centres might be associated with the government agencies or departments.

The fifth point is that we feel that the mutual arrangements for accommodation of research personnel could be expanded, that government people might work in university laboratories and, of course, university personnel could work in government laboratories.

In No. 6 we state that we feel that there is a place for mission-oriented research.

In No. 7 we state that there is a growing need for "institutional" type research grants, rather than just project grants to individuals.

In No. 8 we state that we are very much concerned that there should be a uniform procedure in respect of research contracts in universities. There was some talk yesterday about the desirability or otherwise of contracts. We feel rather strongly that the contract is a useful form; it need not be very formal. Sometimes it is used, but the trouble now is that every government department has its own ideas of what the contract ought to be like. This keeps the university lawyers, the accounting people, the department heads, and myself in research administration, busy trying to figure out what each of them wants. Surely this can be simplified and put on an ordinary basis.

We believe too that there should be a direct policy on "out-of-pocket indirect costs" in the universities for research. We suggested too in the brief the establishment of councils, particularly for fields not now supported. We suggested a number of councils, perhaps more than Dr. Macdonald has recommended in his report, but this is a matter of detail. We feel that there is a place for these councils that is rather different from what we see at present.

Then, the final point of those that we submitted to the Macdonald group is that related to the need for library and other services for people in the arts faculty.
I would like to say something about the structure for providing advice on science policy in Canada, the second point in the brief. This is again something that I have been interested in for a very long time. I had
the opportunity last autumn to make a study of the structure that exists in other countries. There has been some mention here of the structure in France. I had some correspondence with people who are familiar with the Russian structure. I have also had access, as everybody has, to the material of France, Japan, Britain and the United States, and some private correspondence with people in the United States.

It turns out that when you look at these there are really five components in the structure for forming science policy. One is the top level decision-making group at the ministerial level. This finds its counterparts in nearly every other country. In France you have the Committee of Ministers. In Russia there is the Council of Ministers. In the United States, of course, there is the President and the Cabinet. In Japan there is a somewhat similar group.

The second group that appears substantially everywhere is what you might call the scientific advisers to government. These are people who are part of the government in a way. They are independent people appointed for their own personal qualities. The counterpart of that in France is the so-called Advisory Committee for Scientific and Technical Research, sometimes referred to as "the Twelve Wise Men". In the United States the President's Science Advisory Committee, PSAC, is the nearest counterpart to this. We do not have exactly the same thing in Britain.

The third group that appears uniformly in every country is the so-called "In-house" Government Research Advisory Group. In the United States this is the Federal Council for Science and Technology; in Japan, the Science and Technology Agency. There are others, not quite exactly comparable, in France and Russia.

The fourth component in the structure for science policy in every country is some method of getting advice from the scientific community. In this way people throughout the country who are interested in science have an opportunity to have their views transmitted. They also know they are being transmitted to this decision-making group at the top.

In Japan this is the Science Council of Japan, which is a unique organization, as I am sure some of you will realize. In the United States this is done by the National Academy of Sciences through their Committee on Science and Public Policy, COSPUO, and by congressional committees.

There are some less formal arrangements in France and Russia but there is really not anything very positive about them. I think it is the "old boy" Network in Britain, rather than anything positive.

Finally, there is in every country a small body of full time professionals in government service who assemble information from these groups, and present these views to the deci-sion-making body.

Looking at this, it occurred to us that we might see how we compare in Canada. We find, of course, that we do have some of these components here. One is the Privy Council Committee. This is the committee of ministers, the political decision-making group.

The Chairman: The cabinet committee.
Dr. Forward: The Privy Council Committee on Scientific and Industrial Research, yes. This is the committee of ministers. It is at that level, at least, where the political decisions are taken.

The Chairman: It is where they are supposed to be taken.

Dr. Forward: No comment. We also have in Canada the third group. I will leave the second one for the moment.
We have another inter-departmental committee on science and technology. In effect there is an inter-departmental panel of deputy ministers, or senior officials of sciencebased agencies in government which exists now. It has been commented on by the Glassco Commission. It does not meet very often, and it does not do very much. I do not know whether that is the counterpart of the Federal Council on Science and Technology in The United States, and I do not know how successful they are in getting deputy ministers together in the United States.

The Chairman: We heard a little bit on this during our last trip.

Dr. Forward: Ours has not met very often. The other one that we have here is the Science Council of Canada. I will say a word about that now. This really is the counterpart of the National Academy of Sciences in the United States. The fifth one that we have, which is the government group, is the Science Secretariat.

The one that is missing-although I sense in the presentations that have been made, and the discussion that has taken place before this committee in the past months and to 20470-2
some extent yesterday, we are getting very close to it-is the counterpart of the President's Science Advisory Committee or "the Twelve Wise Men" in France. We do not have a group of people who are simply there as individuals, without any axe to grind, except their own personal convictions about scientific things. That I think we should have. So, in the brief from the university we have suggested the formation of a science advisory committee.

If I may take just a moment to read it, we have said:
...this would be a new committee comprising twelve to fifteen top level scientists, technologists, sociologists, humanists chosen from outside government who would serve in a voluntary, but confidential, capacity. The committee should have access to privileged information...
In this respect it would be different from the Science Council.
...should meet at least monthly, and should be prepared to advise on proposals arising from government departments, Science Council, university granting groups and other sources in the community.

This would be a completely objective group of people; not all scientists. This is the suggestion which we have made for the formation of a new committee.

The Chairman: Would it be more or less similar to what they have in the United States?

Dr. Forward: It is the counterpart of the PSAC, yes. These people are like Caesar's wife; they are highly regarded in the community and they are grinding no axes.
We have some views on the formation and function of the Privy Council Committee, and of the relationship of the National Research Council to that committee. We have some other strong views about the composition of the Science Council of Canada. We have some rather strong views about the accounting for public funds, about the character of university research as between pure and applied science, about indirect costs, and about this matter of university-industry collaboration.

I do not want to take more time now, Mr . Chairman, but if anybody wants to ask any questions in this area I will do my best to express my own views.

The Chairman: Thank you very much. We could spend, I am sure, a week asking questions about all the issues you have raised but, as you know, we do not have that amount of time, so we will try to concentrate on major issues.

We will hear now from Doctor John Postma, who represents Notre Dame University of Nelson.

Dr. John F. Posima (Notre Dame University of Nelson): Thank you, Mr. Chairman, and honourable senators. I will not read our brief, which is short. You have a copy of it and I am sure you have read it.

Matters of time and other considerations forced us to limit this to going over some of the basic distinctions, roles and identification processes that we felt are so necessary in order to achieve some kind of a defensible rationale with regard to all these problems. We feel that somewhere along the line there have to be decisions on the interpretation of terms that we keep on using here from time to time.

It is going to be inevitable on the part of the committee that the proposals you make, and the eventual policies that will come as a result of them, will reflect in one way or another the traces of one interpretation or another regarding some of these distinctions. Or, I suppose we can expect them to reflect in a model sort of a way an indiscriminate mixing up of interpretations and concepts, with all the practical consequences that flow.

A case has been made about the university role in relation to political and social problems of the kind that the Senate Committee is concerning itself with to the effect that certainly one important contribution that the university should make is perhaps not to be immediately, or in the first place, concerned in bringing up practical proposals or conclusions.

The university should in the first place, but not exclusively, concern itself with the area of premises, because in the final analysis we feel that your final conclusions are going to be political decisions in the broadest sense. This is inevitable. This is the preoccupation of politicians and people in the government, but that is certainly the first contribution that universities should make to this process of decision-making. If we are concerning ourselves with the area of premises, then I think we have to concern ourselves with a great deal more precision about a number of dis-
tinctions, interpretations of roles and identities, and so on that we at times make and then forget about for one reason or another.

This makes the whole thing rather insecure and uncertain. I suppose there will always be insecurity and uncertainty with regard to these problems that are in the practical area.

For instance, as a simple example-we really have not become serious, for instance, about a definition of research, which is what the whole thing is about. I think a number of very interesting and important consequences could flow from one or another interpretation of the word "research".

This is somewhat disconcerting to me, because, as I say, I feel that the university contribution in the first instance has to be in the area of premises. The validity of premises to a large extent depends upon the interpretation and use of terms.
So, our brief to a large extent consists of a plea for more precision, for the making, and the maintenance in a consequent manner, of distinctions that are going to be very helpful, or not so helpful if we forget about them.

Research is in relation to study-the element of newness in research, the public and the social aspects of research, and so forth. It is not just a matter of semantics, even though we can be tempted to relegate this for the sake of convenience to that area. It is easy to say: "Well, that is just so much semantics." I just do not operate this way and I find it rather disconcerting when we lack precision in this sort of thing. The distinction between science and technology has been referred to many times during the last three days. Many of us could probably arrive at some kind of a consensus as to an interpretation of the difference between these areas but, again, the fact of the matter is that after we make these distinctions we then proceed to forget about them in tackling the practical problems. I think this hurts the practical process.

We talk about university work globally and generally, without maintaining the distinctions that have to be made between undergraduate level work and graduate level work, and between universities.

The second recommendation of the Association of Graduate Schools of Canada, if you recall, made an interesting point inasmuch as it recommended that universities themselves in the first instance should take time out to identify themselves in roles as individual or particular institutions, or as area institutions
in relation to the total university effort. Very little of this is done. We tend to deal with these subjects in generalities, and I think this hurts the practical problem-solving process.

If we are going to deal with relationships between universities, governments, industry, professions, all of whom have interests in and engage in research of one kind or another, then until such time as you have an idea that you somehow or other try to maintain about the role of the university you cannot really make a great deal of sense in talking about the relationships between the university and some other institution.

We have to go back to some of the more basic considerations with regard to professional responsibilities, industrial responsibilities, governmental responsibilities, and university responsibilities at the graduate and undergraduate levels.

Our brief to a large extent was a plea for more clarity and decision on that score. This kind of interest goes back to my background in philosophy. On the other hand, I have a real bent towards worrying about the mechanics of this because I have a background in political science and public administration. Inevitably, when we come to deal with questions like this, we are going to have to fall back on one interpretation or another of federalism, and of social and political philosophy of one kind or another. As I say, we do not really use a great deal of precision sometimes, but we do end up with one or another interpretation that we, perhaps with very little defence, decide upon in the process.

For instance, there are federal and provincial responsibilities. I would be very interested in seeing some work done by the committee with regard to the federal responsibility in education. I think sooner or later this issue has to be tackled in a formal way, and we cannot keep on running away from it, or postponing it, because the BNA Act happens to have been written in one way or another. As you know, the earlier decisions of the Judicial Committee of the Privy Council had recourse to what was called the dimension doctrine, or the aspect doctrine, of constitutional interpretations. I think we should raise the question again as to how valid these decisions were. If they could be valid today we could then end up with the possibility of viewing the federal, provincial, and local levels of responsibility as supplementary to 20470-2 \({ }^{\frac{1}{2}}\)
one another, instead of going from the generic down to the specific on the particular with regard to an area like education.
It is to me a strongly defended opinion that we are always preparing what is, in my mind, an impossible separation of powers approaching federalism. This is about as unrealistic as the separation of disciplines approach in "multiversity", for much the same or similar reasons. I also think that if we are going to talk about grants we have to keep on maintaining distinctions about the kinds of grants, incentive payments, conditional grants, supplementary assistance and so on. The debate loses a great deal of its force and its coherence to the extent that we forget about this.

That was just a reference to our brief which concerned itself with the demands that we should legitimately make of ourselves as academic people if we are going to make a contribution as academic people.

We did not go in to the matter of the structure and economics of this, except in the last two or three paragraphs. The suggestion was made the day before yesterday-and I think a very interesting debate came about as a result of it-as to some kind of structure that would incorporate governmental agencies, people in the professions, people in industry and people in the universities.

Depending upon one's interpretation of federalism, the idea appeals to me. I think it is necessary to think of some kind of a body that has this pluralistic representation on the part of all those engaging in research. Then again I think we would have to face the possibility of having to duplicate this to some extent at the provincial level. I think you will also then run into difficulty between businesses. Some of the most important ones of them are provincially incorporated, and others are foreign-owned and so on, yet much research originates with business.

We would have to try and keep all these difficulties in mind. If the Senate Committee is concerning itself with federal policy, in my scheme of things these policies should be of a generic nature, seen against the whole background of the federal picture. There are diffculties in some interpretations, so we need general federal policies in the area of education generally and in the area of research-whatever that means.

Apart from going into any details to the extent this might be possible, they should concern themselves with some long term or
general propositions, such as long term budgeting requirements on the part of industry, government, or university and so on.

The degrees of communication in the inventory requirements struck me as a very useful area yesterday when we got to talk about that. Federal policies would have to deal with those general aspects of research to some extent, but to what extent is not too clear to me.

Perhaps certain types of support could be conditional upon coordination. The structures could be set up, certainly at the federal level, and perhaps they should be duplicated at the provincial level to incorporate people in the government, people in industry, people in the professions, and people in the universities. Perhaps the possibility of the ear-marking of tax transfers should be considered as part of that general policy area.

At the same time, apart from all these things, if we could discuss again in the general session this afternoon the mechanics of the subject and concrete proposals it would be of benefit.

I am aware of the fact that in the last analysis the final decisions will be political decisions in the broadest sense. The government, even in its research policies, is going to have to take into account things that are perhaps academic. It is going to have to overlook things such as the cultural problems, the area development problems, the small university problems and so on. We are fully aware, of course, that somewhere along the line the final recommendations will have to involve a large element of accommodation to the practical requirements of the case.

I think that is about all I have to say.
The Chairman: It will be a long time before we reach decisions. Thank you very much for this plea for logic and some kind of co-operative federalism.

Now we will hear from Doctor McCalla, who is professor of plant biochemistry and Dean of the Faculty of Graduate Studies at the University of Alberta. He is accompanied today by Dr. Hunka, Professor of Educational Psychology and Director of Educational Research, and Dr. Robinson, Professor and Chairman of the Department of Chemical and Petroleum Engineering of the same university.
Dr. A. G. McCalla (Dean, Faculty of Graduate Studies, University of Alberta): Mr. Chairman and honourable senators, the brief of the University of Alberta has been in your
hands for some time. We want only to underline a few of the most important items, but we consider the brief as a condensed summary of the opinions at our university. Let me stress the following:
1. The principal thesis underlying our brief is that individual scientific creativity in Canada must be encouraged as an essential element of the total Canadian research effort. A formal national science policy, which puts major emphasis on a few mission-oriented projects, is essentially an attempt by government, or committee, to channelize creativity of its scientists towards the realization of preconceived national goals. True creativity does not easily conform to the transient polilical goals of a nation, and excessive emphasis on channelizing this creativity may destroy or drive it from Canada. A science policy must therefore provide for the encouragement of this creativity by providing for more than mission-oriented research.
2. I call special attention to this document, which is called "Traces"-Technology in Retrospect and Critical Events in Science. A study of this should provide ample answers to such suggestions as: "Expenditures on basic research are not in the best interests of at least the economic development of any country", as stated by Senator Lang, quoting another work, in an early hearing of this committee. The document also shows the futility of attempting to separate the sequence of basic and mission-oriented research. We commend this document to you for study if you have not already seen it.
3. We agree that the whole series of research steps, basic, applied, developmental to innovation and production, which has not been mentioned much really in these hearings, must be provided for. You can have all of these steps adequately financed and innovation result, but, unless there is the necessary risk capital to put the innovation into production, the whole sequence has failed to benefit Canada and that is what we believe that a Canadian science policy should do.
4. Any national science policy must recognize that the universities have a unique role in research and this is the education and training of the researchers of the future. We must have the means to do this adequately.

Now I would like to make a few comments on the Macdonald report, which was not available when this brief was prepared.
1. This report deals inadequately with graduate student support. It recommends ten
per cent of graduate students on national scholarships, but none on research grants. At Alberta we have 13 per cent of our more than 1,800 full-time graduate students on national scholarships, and 20 per cent appointed on research grants. The province of Alberta and the University of Alberta provide support for nearly all the remainder or two-thirds of the total. But we cannot afford to lose any of the one-third from federal sources. We think it should be higher if all disciplines are supported. The University of Alberta believes this matier needs further consideration and, furthermore, believes that the Canadian Association of Graduate Schools should be one of the groups to take part in any further consideration.
2. We are flexible on the number and form of granting agencies, providing that the following objectives are achieved: (a) Support for all disciplines; (b) decisions re individual awards and grants are made by those who are knowledgeable in the disciplines; (c) there be a person, whether a minister or not, who speaks for Canadian science, including the humanities, and has direct access to the Cabinet; and (d) a single advisory body be set up to oversee the general operation of granting bodies and I take it that this is much the same as the UBC advisory committee.
3. We oppose recommendations No. 48 and No. 55 of the Macdonald report, that all rates of remuneration be based on the university's policies and that there be no ceilings. This can only work to the advantage of the wealthier universities. We would like to see reasonable ceilings, but also the right of a university to pay less if they wish and can get satisfactory holders for the awards or jobs. This works very well in our own graduate assistant programs.

The Canada Council has commented on the Macdonaid report, and we wish to deal with three of these comments:
1. No. 7, on page 4 of the Canada Council commentary: Canada Council does not agree that it should be relieved of its responsibility for the humanities and social sciences, and that a humanities and social science research council be formed.

We believe that the Canada Council does not serve the universities as efficiently in its fields as NRC and MRC do in theirs. It is almost impossible to compare the pre-doctoral fellowship program with grants to symphony orchestras, and we think that one body, with
the best will in the world, will not handle both jobs well.

We therefore support McGill University's submission in its support for recommendation No. 5 of the Macdonald report.
2. We question the statement in No. 14, page 12, that:
...the Council's experience has shown that the balanced arrangement...
And this arrangement is a lay decision-making body and two large panels.
....is by far the best device yet found to ensure due appreciation of the needs of a highly-specialized public as well as continued acceptance by Parliament of the measure of autonomy with which the agency is entrusted.
3. No. 31, page 26 , says the Macdonald report infers that the Council's partnership is with the universities rather than with the research scholars and Canada Council obviously disagrees. One of our serious complaints about Canada Council policies is that they award research leaves, fellowships and travel grants without requiring university approval. We strongly support recommendation No. 37 of the Macdonald report that, without exception, all federal funding applications of any kind be approved by the university and be channeled exclusively through the universities.

Now, Mr. Chairman, in the discussion-I think it had better wait until then-Dr. Hunka would like to make some comments about a new computer.

The Chairman: This is a new addition to the republic of science, and I do not think that the citizens of that republic will accept this veto power of the universities.

Dr. McCalla: May I make one comment on this, Mr. Chairman?

The Chairman: Yes, please.
Dr. McCalla: There was a reference to veto power. It is not veto power we are talking about at all. What it is is that the universities know. Somebody yesterday made the remark that it was quite possible under Canada Council leave fellowships for a man to be taken off just about at the beginning of the term without his dean even knowing about it. What we are asking for is that some responsible person in the university, and this is what the Macdonald committee said, should at least
sign the document. We are not talking about veto power.

Dr. Forward: Mr. Chairman, may I support that one hundred per cent.
The Chairman: I think we have to hear now from Dr. Hyne, from the University of Calgary.

Dr. James B. Hyne, Dean, Faculty of Graduate Studies, University of Calgary: Mr. Chairman and honourable senators, one of the difficulties in speaking to a brief that was prepared several months ago is that in the intervening period many very important bodies and individuals have commented on the whole question of the science policy for Canada.

What I would like to do this morning in the course of some ten minutes is to go through the various points that were raised in the brief of the University of Calgary and try to relate them to the comments that have been made in the period intervening between its preparation and today.
I feel that I shall be referring most frequently to one or more of the following documents, or sets of documents: The Macdonald committee report; the Canada Council commentary thereon; the Science Council Report No. 4, which some of you may recall was the one which really raised the mission-oriented question into a place of prominence; and, of course, the various reports and comments that have been made and have emanated from the hearings of this Senate committee.

The first thing I would like to turn to, sir, is the question of the mechanism of the provision of support from government to universities, from federal government to the universities.
May I make a plea that we not move in the direction of channeling all federal government support through the provincial government? I am sure that members of the Senate, the university community, and provincial government authorities are well aware of the fact that virtually every university in Canada is already very highly dependent on provincial government support.
If the federal government agencies are to channel their support, even indirectly, through provincial government control, then universities will be in the position where \(100 \%\) of their support will be controlled directly or indirectly, by provincial governments. This I feel would be bad. I think one
of the basic reasons that the federal government is in the business of supporting universities at all is because a sizeable proportion of university activity is national, not provincial. Therefore, the national body should have the dominancy in how its money is to be used.

On the question of how the federal government should adjudicate the disbursement of its support to universities I am afraid that I am a little more hesitant than Professor Forward was in his statement about the generation of more councils.
I do not like holding the chairman to statements made about him in the press...

The Chairman: I was probably misquoted.
Dr. Hyne: This is a cutting from yesterdays' paper. I just draw your attention to the headline, which I think is very true: "Canadian Science lacks Coordination". I think one of the quickest ways to make coordination even more difficult is to generate more bodies that have to be coordinated.
While I am not saying that there is not room for a few other organizations to assist the federal government in the disbursement of its research funds, I would again plead for caution here, that if we have too many councils then we will be going backwards in the matter of coordination, not forwards.

On the matter of the Macdonald committee's recommendations regarding the future role of the existing agencies I would again plead that we not throw the baby out with the bath water.
I agree with Dean McCalla in his statements, and those of his colleagues from our sister campus in Edmonton, that all is not well with the federal granting agencies. I can remember, as I am sure many others in this room can, the days, not so very long ago, when the situation vis-à-vis the relationships between the universities and the federal agencies were far worse than they are today. I would rather try and improve the relationships with the bodies that we do have than run the risk of finding ourselves operating with a new organization that we do not know anything about.

I feel that the matter of intercommunication between the federal agencies is a crucial one that has to be clarified in any future definition of Canadian science policy. In this regard I would be favourably disposed towards supporting the inter-council committee that was recommended by the Macdonald
committee. This would serve a very useful purpose. Notwithstanding the comments made in the Canada Council commentary on the Macdonald brief that they are in fact supporting now all these areas that used to fall between the stools, this is not so. Mind you, they try very hard, but every year there is a new inter-disciplinary area that emerges and the Canada Council cannot keep up with it all the time. Archaeology is a magnificent example of not knowing whether to apply to Wellington Street or Montreal Road-usually what happens is that they finish up in the Ottawa River. So I feel that some kind of formal inter-council committee is certainly needed.

May I now turn to the question of the use of the federal support in order to implement science policy, the use of federal support dollars for the training of the scientists of tomorrow, who are the graduate students of today.

I was shocked to read one of the Macdonald recommendations that said that the federal government and its agencies should plan to support ten per cent of the full time graduate student body in Canada.

In fairness to the Macdonald committee I must also add that this was immediately after the recommendation that provinces be allowed to add into their allowable cost computations for federal government matching support provincial money that was used for graduate scholarships. This, of course, means channeling more money through the provincial governments, but ten per cent...well, the figure for 1968-69 is 37 per cent. There were approximately 20,000 full time graduate students in Canada in 1968-69. Canada Council had 2,500-these are all rounded off figures-full time in pre-doctoral fellowships. The National Research Council, through its fellowship and bursary program, had 3,500 .

Now, this does not take into account any of the money that was used from professorial grants to support graduate students. You have already got 6,000 of them out of 20,000 supported and ten per cent would be a reduction of more than 100 per cent. This is just incomprehensible to me.

The Chairman: You might have an explanation this afternoon.

Senator Bourget: They were counting on inflation I suppose.

The Chairman: On deflation.
Senator Bourget: Well, whatever it is.

Dr. Hyne: I endorse Professor Forward's recommendations for some kind of clarification of the contract position wholeheartedly. We handle this at some length in the Calgary brief. More than one government agency at the moment is using the contract method of supporting research in universities simply because the federal government does not authorize that agency to give grants in aid.

I do not think I should name any names, but they are there and they are a headache because the money is used and applied for in almost exactly the same way as a grant, but it comes under all the restrictions of contract work.
I turn now to the question of overhead, which has always been a sore point with universities. This was first raised by the Bladen commission two years ago and is still with us. There is no doubt in my mind and, I would hope, in any university administrator's mind, that contracts must be fully covered as far as overhead is concerned. That is the essence of a contract. In the corporate world nobody would even consider tendering on a contract unless he knew that he could make a profit. That means that he builds in all his overheads and all his real costs. I think the universities should do the same thing.

As far as overhead on grants is concerned, this is a little trickier. I certainly think that the grants should have some built in dollars for universities. These dollars might be channeled through what the NRC now uses, the president's NRC grant, rather than actually putting it in as a straight overhead cost.

There is no doubt in our minds at the University of Calgary that the federal government has got to interest itself far more directly in the establishment of the repositories of knowledge in this country, namely the libraries.

Some of us who deal directly with the agencies through the graduate schools were shocked and horrified last year at the suggestion from one of the agencies that the rather minimal support that they were then giving to libraries at universities in Canada might be terminated. This is one of the biggest costs and the biggest hold-ups in development of any kind, be it science or social science, in Canadian universities.

My colleague from Notre Dame University of Nelson raised the question of definitions. I know that I should have a better understanding of the English language, but the words "mission-oriented" still defy me as to their
precise meaning. I know that it is supposed to lie somewhere between pure research and applied research, but if we are going to start trotting out phrases like "mission-oriented research", then somebody had better define them in a great hurry, otherwise the usual game-playing will start. One group will say: "'Mission-oriented' means this, and, therefore, we are right", and the other group will say that "mission-oriented" means something else. I think it is a good concept. There is an area between pure and applied which can properly be followed as a research discipline. "Mission-oriented" is as good a phrase as any, but let us have it defined a little more closely.

My last point, sir, is a political hot potato, but I do not think that there is any better place to raise a political hot potato than in a political hearing.

The Chairman: And here we have the long view.

Dr. Hyne: That is the question of centres of regional excellence. I think it is fairly obvious, whether one is talking about massive libraries, or massive computers, or massive pieces of scientific equipment, that with 20 million and an expectation of 40 million within the next half century Canada simply cannot put pieces of equipment each costing \(\$ 10\) million in every major urban centre in Canada.
This inevitably means centres of regional excellence. It also unfortunately means that some group of people are going to have to have the guts to turn around to somebody and say, "We are awfully sorry but we can only afford one, and you have lost out". Now, maybe the next time around, or something else, you will win. But you cannot say: "There is \(\$ 10\) million. We could spend it all on one piece of equipment but politically that would be suicide, so we have got to spend four times \(\$ 2 \frac{1}{2}\) million". With \(\$ 2 \frac{1}{2}\) million nobody gets anything.

This country is so large, and its climate, activities, and culture are different enough from the Atlantic to the Pacific, that we do have at least some guidelines.

There is no sense whatsoever-and I apologize to the marine biologists and the petroleum engineers for using them as examples right now-for in establishing marine biology in Saskatoon, or Edmonton, or Winnipeg. Marine biology is marine biology; there are obvious places for marine biology.
Likewise I do not see any real reason why anyone should set up petroleum engineering
research institutes in Ontario or Quebec. There are places in this country that have established resources that are more directly related to these activities. These are only indications of how one can at least begin to look at regional excellence, but it is a political hot potato.
I am disturbed that the Macdonald committee did not spend more time on this one, because this is a way in which the government of this country can really save money.

I am sure that the senators are getting a little tired of hearing university people appeal for more and more money. Unfortunately the barrel is not bottomless and we have got to stop somewhere. Here is one way where I think this country can save money.

My final question, sir-and I thank you for allowing me to go a little over time-is: Is it really sensible to think of one policy that encompasses such a wide diversity of activities as science, social science and the humanities? I do not necessarily endorse C. P. Snow's two cultures, but I am sure the humanists will not buy some of the policy concepts that are applicable to the sciences; vice versa it will also be true. Perhaps we should not feel too disappointed if we have to settle for two policies, or three policies.

Thank you very much.
The Chairman: Thank you very much. We are running a little bit behind in our schedule; we will have to proceed a little more quickly and have our second shift, so I will call on Doctor Currie, Doctor Van Cleave, Doctor Duckworth and Doctor Moir.

We will begin this second phase by hearing Doctor Currie, who is Dean of Graduate Studies, and Professor of Physics from the University of Saskatchewan.

Dr. B. W. Currie, Dean, Vice-President (Research) University of Saskatchewan: Thank you, Mr. Chairman.

The Chairman: Before the beginning of the space program?

Dr. Currie: No, I was involved in this one. Actually I am speaking on two briefs here. One was prepared by our president, Dr. Spinks, who has had of course a long experience in matters scientific and the policies related to them, and the other is a brief which I should perhaps describe as a personal brief. It is very difficult, of course, in things like this to avoid being repetitious. I am really going to pick out key points in the brief.

First of all I might say that I think I agree completely with Professor Hyne and I think our group in Saskatchewan does, about his comments on the Macdonald report.

We had a meeting yesterday morning at which this was discussed in some detail and I think that we could agree almost wholeheartedly with him. I would stand to be corrected by Dr. Katz, who is also present. Our feeling at that time was that this should be treated as a working paper, a position paper.

You always need this sort of thing in order to expedite discussions. As long as it is taken in this concept then it is a very valuable document, but if you take it that these recommendations are God speaking, then you are into troubles.

First of all, concerning Dr. Spinks' brief, it is entitled The Role of the Universities in Research Towards a Systems Approach. There is a considerable amount of material which, of course, emphasizes the importance of the university both in the training of people for research or scholarly work in the country. In other words the universities in Canada become one of the big industries, which he refers to as the knowledge industry. His plea is really for a systematic approach which will produce the best results, with the minimum expenditure of dollars.

He quotes various documents related to this and I am just reading odd headings here: Thus greatly increased federal research support, both operational and capital, is required. In addition the method of giving this support to ensure that it is used in the best interests, that is in the best interests of the recipient insitution and the province within which the institution is established, needs a thorough re-examination.

There is a section on federal-provincial liaison: While the federal government has exhibited a concern for science and technology for the last century, it is only within the last two or three decades that the provinces have shown a corresponding interest.

He refers to the provincial research councils and the federal government in the establishment of a science council. He concludes that the role of the provincial research effort in the overall national research effort is still far from clear. To date no obvious steps have been taken to integrate or coordinate provincial research plans to the federal government's grants assigned to science and technology.

In a country the size of Canada more, not less, coordination of effort is clearly indicated. If Canada is to find its proper place in the world dominated by highly sophisticated technologies collective autonomy should be the slogan.

Then he goes on: It is strongly recommended that the federal government take immediate steps to strengthen its science policy-making machinery, at the same time assuming a leadership role in promoting a more effective coordination of the scientific efforts of the provinces.

Another point which he emphasizes is planning with respect to research in the execution of those plans to help in the establishment of a medical research council or a health science research council, reporting directly to a minister of the Crown.

I think this has been taken care of. It is strongly recommended that the federal government take immediate steps to strengthen its policy-making machinery with respect to the arts, social sciences and humanities and at the same time assume a leadership role in promoting a more effective coordination of activities in the humanities and cultural activities of the provinces.

Then there is a long section on the coordination of the inter-provincial research efforts. He introduces the point that you need coordination within each province. We are, of course, in Saskatchewan a great believer in the uni concept; we are trying to borrow the California or New York procedure of having one university with two and possibly eventually three campuses.

There is a very real attempt to coordinate or collaborate so that we make the most effective uses of our resources for the benefit of the province. Many of the things which are of benefit to the province of course eventually become of benefit to Canada as a whole.

This inter-provincial collaboration, or coordination, is progressing in a rather slow way at the present time between the three prairie provinces, where I think the deputy ministers and the principals and presidents of the universities meet.

Again, this is talking about such matters as Professor Hyne brought up, centres of excellence to avoid duplication, to try and avoid duplication of research efforts and, of course, the unnecessary expenditure of dollars.

At the same time we endeavour to make the most effective use of the effective, or potential potential that exists within the universities.

I do not think I need to take your time up with some of the documentation. This, of course, with a number of universities can conceivably be done by a university grants committee such as they have in Ontario and I think in Manitoba, do they not, Dr. Duckworth, and Alberta. We still think we are better off working as a unit, one university, and discussing these matters with our treasury officers and the minister of the treasury and so on.

The Chairman: You prefer centralization rather than coordination.

Dr. Currie: Well, it is a combination of coordination and centralization, but I think the various campuses do better in this way, in settling our own problems rather than having a sort of external committee go out and do this.
I think that some of the universities do work with these external committees for the distribution of funds.

The Chairman: It at least reduces the demand for university presidents; they are becoming a scarce commodity now.

Dr. A. B. Van Cleave, Dean, Faculty of Graduaie Studies, Regina Campus, University of Saskatchewan: On the contrary, Mr. Chairman, we have to have three instead of one.

Dr. Currie: Dr. Van Cleave may not agree with me; he is from our Regina campus.

The section on inter-provincial coordination of higher educational activities has only just started at the inter-provincial level through agencies such as the Association of the Universities of the Atlantic Provinces and this one which we have on the prairies which I have mentioned.

In this respect Canada lags far behind such countries as the United States of America, where there has been for a long time now a very powerful federal agency for the support of higher education.

Educational liaison at a rather more general level takes place in Canada through the recently formed conference of ministers of education.
Then he makes the point that these various methods of coordination of university activities on the provincial-national scale are the first stirrings of what might be called the systems approach to higher education.
There is a final sentence in this paragraph: Strong federal leadership is imperative. Then
he goes on to some sections on centres of excellence, which I do not think I need mention; federal fiscal transfers in relation to higher education, which he ends up with the statement that the establishment of a powerful federal office on higher education which might be expected to assume a leadership role is long overdue.
There is a lot of supporting material and so on, sir, but I do not think we need to take up time with that.

The Chairman: The brief of course will be part of our proceedings.

Dr. Currie: Yes. My own brief originates perhaps from a very long experience in Saskatchewan and some knowledge of what has taken place within the province. I start off with the current discussions on a science policy for Canada failing to recognize the responsibilities and potential capabilities of our universities for research and consultative services related to the needs of the community or the province in which each is located.

They are limited generally to broad aspects of an overall policy designed to meet the economic and cultural needs of Canada as a whole.

Then I go on further: Universities located in many parts of Canada are the most immediate sources for know-how to investigate problems peculiar to their respective locations and to provide consultative services to small industry.

I think, sir, that you find this more so in what we might call, I hesitate to say, the deprived provinces but you find this in the prairie provinces and I think you may also find it in the maritime provinces.
I emphasize that any integration that exists between their activities and those of neighbouring universities depends largely on casual arrangements, rather on a well-recognized policy for Canada.
I have a number of examples here which point out that the usual practice of recognizing the small problem within your community, which is in fact one of the services which universities must provide, can in fact lead to notable advances which are of benefit to Canada in particular.

I mention in particular the work of Dr. C. J. Mackenzie which, of course, we well know. He recognized in this area that there was a need to do research work on concrete, which deteriorates under the influence of alkali. There was work initiated on improved types
of concrete by Dr. Mackenzie and Dr. Thorwaldson in chemistry. This was one of the notable things that was initiated and which played an extremely important role as far as economic development in western Canada and in the world as a whole is concerned.

We also had the work of W. P. Thomson, who was in biology. He came to the university at the time when rust research was extremely important. There was the problem sitting on his doorstep. He went to work on it and many of eminent crop breeders in Canada in the past three decades are people who worked with him.

Of course we got these rust resistant varieties and some idea of what to do, which was of enormous benefit to Canada.

I go on and say something more about this. You can have collaboration; this is the same point I am emphasizing. I think our dollars are limited. I am very much of the opinion that we must have close collaboration between universities, provincial laboratories and dominion laboratories. Some of them are situated on university campuses.

We have had one or two examples in Saskatchewan of this close collaboration. In the very early days of the soil survey we had our own university group, we had a provincial group and we had a dominion group. They had to work in the same offices, because this space was very limited, so we never knew who worked for the province, who worked for the federal government and who worked for us. Through this has developed an extremely valuable knowledge, not only of basic soil science, but of the effective utilization of fertilizers.

If you read the western papers you will probably discover that our crop yields in the last few years have been much greater than the precipitation would suggest. This has been due really to the effective use of fertilizers.

Here was a multi-collaboration between university, province and federal people. I am not prepared to argue that this increase in grain production is good; certainly we have too much at present.

The Chairman: I was going to say that it is not necessarily a blessing.

Dr. Currie: No, I would hesitate to say that. I can quote a number of other points, but I make out eventually that there are well recognized series of steps as you start from (a) recognition of a local problem with some
economic implications; (b) initiation of research both fundamental and mission-oriented with respect to it; and (c) the application of the results of the second, (b), by industry.
Step (a) is generally obvious to the university researcher. If he is on the bit, as it were, he is in this community, he has a service to the community, he generally sees these problems.

First of all he has to have financial support to get on and there is a stage of fundamental research, some innovation. The next step, of course, is further development, innovation and so on, which seems to be divorced completely from the universities.

Yet, you can see in some of these provinces like Saskatchewan and so on the possibilities, because small firms and so on come to you for advice; they have got no other place to go. If you had some machinery by which you could do what I would call development work to help with this innovation, financial support, there are many cases where you could build up a small industry which could eventually blossom into quite an important unit, not only in the provincial economy but in the dominion, as far as Canada as a whole is concerned.

This is something, of course, which simply does not exist at this time.

One may argue that all problems in particular parts of Canada have been recognized and are receiving adequate attention from universities and various government organizations.

I just point out that there is little support for such an argument. We have a lot of potash \(2,000,3,000\) feet below the surface. There are many problems here which, because they are at hand, we should be operating on. A great portion of our province borders on the north and there is an unlimited number of problems that need investigation.

Since we are bordering on these and, of course, our friends in Alberta and Manitoba also do, I think that we have an interest there and should be participating more actively. Again, this invoves dollars; it is partly because it involves more than fundamental research, it does involve government agencies and so on and you get into this, which is very expensive.

Now, I have not mentioned the upper atmosphere; we did develop upper atmosphere. I think I should just get in this plug
for a very, very good reason in Saskatchewan: The auroral zone, which is a disturbed region of the atmosphere and the ionosphere, came the farthest south at that time to the university of Saskatchewan. We were closest to it and we had the right geographical position to work on it.

The university was on the north side of the city too, very fortunately, so we did not need to worry about working over the top of the city lights. I think that Dr. Porter and maybe even Dr. MacKenzie mentioned this.

I think I have taken up enough of your time; thank you, sir.

The Chairman: Thank you very much.
As you know, this is the first time we have heard that potash may raise a research problem. It has been known here in Ottawa for several years as a political hot potato, so that if you could solve the political problem through your research it would be welcome.

Now we have Dr. Duckworth, who is Vicepresident, Academic, of the University of Manitoba.

Dr. H. E. Duckworth, (Vice-President (Academic), Universily of Manitoba: Mr. Chairman, Honourable senators, gentlemen: First I give the regrets of our president, Dr. Saunderson, who is at the University of British Columbia today, to quote from the invitation, attending the annual convocation and installation of the new president.

Mr. Chairman, you and other members of the committee have had from the University of Manitoba a brief some time ago which was prepared by the so-called research board. I might say that the members of this board include nine persons elected by the graduate faculty; they include the deans of all the faculties engaged in graduate work in research as well as the president, the dean of graduate studies and the vice-president (academic).

Senator Cameron: Is there no student representation?

\section*{Dr. Duckworth: Not yet, sir, no.}

Now, in this brief, from which I shall quote some portions, we say at the start that we recognize that many points have been made to the Senate Committee. With a large number of these we concur, but they have been made several times to you and it seemed unnecessary to make them another time.
In our brief instead we concentrated on five points which we think had not received much
attention, or perhaps had not been mentioned at all.

The first of these related to the granting policy which would maintain a balance between the federal support for basic and mission-oriented university research. In that connection I would like to read briefly from the brief.

Following a description of the present arrangement, in which by and large the council support basic research and a variety of federal and provincial departments support mission-oriented research, the brief goes on to say:

A possible alternative, that of assigning to a single granting agency the task of supporting both uncommitted and committed research, is a dangerous one. For example, with the present emphasis on mission-oriented research, one might find this consideration beginning to colour all grants. Thus, the nation might lose the high quality of fundamental research which it now possesses, and which is essential to underpin most of applied activity.
If the present arrangement should continue (as this brief urges)...
And, incidentally, as the Macdonald report suggests.
...the ratio of federal support for basic to mission-oriented research in the universities could be rather accurately established by means of the budget. This would avoid the danger of mixing the two considerations-to the unintended, but possible, detriment of one or the other.

The second point relates to collaboration between universities and government agencies. This was a point which Dr. Currie touched on. This is an area in which our university has had long experience, successful experience and we have strong views on the value of such collaboration.
Perhaps I could read a portion of the section from the brief:

There could and should be much more collaboration between universities and government agencies than at present exists, especially in the scientific and technical fields.
Such collaboration virtually requires the location of government laboratories on or near university campuses, as is now the case for many laboratories of the Canada

Department of Agriculture, Fisheries, Forestry, etcetera. This move towards a rational decentralization, in which laboratory sites are selected on the basis of natural regional interests as well as specialized competence in the universities concerned, has a long way to go. Furthermore, it is simply the prerequisite for the subsequent development of cooperative arrangements.
The actual cooperative arrangements may take a variety of forms including:
(a) the inclusion of government scientists in the graduate work of the university with the rights and responsibilities appertaining thereto;
(b) the establishment of integrated laboratories in which specialized equipment and information are either shared or acquired as a result of joint planning;
I should say that Dr. Currie's example of the early soil collaboration of Saskatchewan is a case in point. I could give a couple of examples which we are currently trying to promote.
(c) the participation of government scientists in certain major university studies dealing with problems of national concern.
The third point has to do with the view taken of graduate studies. We say here graduate studies should be regarded as versatile training.

I will quote briefly from the brief in that connection. There is a rather long section in which we develop the point that the training is in fact versatile training, but then go on to say:

If the versatility of graduate study is properly emphasized, and graduating students are encouraged to exercise their competence without restriction to their fields, the graduate training in Canadian universities could contribute more substantially than now to our national aims and aspirations. In addition, the threatened surplus of students in certain areas of study would evaporate.
The fourth point, which I shall simply mention by title and not elaborate upon, because it has been touched on somewhat this morning, is the need for a greatly expanded network for scientific information.
The final point, which again I think I will just mention by title, is the support of univ-
ersity research in the humanities and social sciences.
That, sir, then, is the summary of items in the brief. Perhaps I could take a minute to comment on some matters in the Macdonald report.

These, however, are my own comments; they are my view of the attitude the university would take, but you never can tell in a university.

\section*{The Chairman: Nor in a government.}

Dr. Duckworih: This has not been agreed to by the Senate, say, of the university or by the research board. First, in connection with the proposal to separate the NRC laboratories from the NRC granting function, I personally am reluctant to see the present very satisfactory arrangement discarded unless we are sure we have something that is just as good in its place.
Two, it is suggested in the Macdonald report that graduate students would be supported primarily from the university. Two speakers this morning have already touched on this, perhaps three, with the understanding that the funds will come first through the university and be shared by the province and the federal government.
We can make a strong case, we believe, for federal support of all graduate students, because after graduation these students move through the country where suitable employment offers itself. This would apply as well to Saskatchewan as to some other provinces; there are not opportunities for employment commensurate with the number of graduate students who are receiving training. We are using provincial funds to train students in advanced techniques to the advantage of other parts of the country, the nation as a whole.

Rather than reducing the support of graduate students, one should be urging that it increase because of this very fundamental consideration.

Thirdly, the Macdonald report suggests that something called a research agreement might replace both grants and contracts. I am really not persuaded that this presents any advantage over the present system.

Fourthly, it is suggested that granting agencies should pay the indirect as well as the direct costs. I am sure you will never find a university representative to oppose that, so I heartily endorse that suggestion.

Fifthly, I am getting now to small points. The suggestion is that the general university grant from the National Research Council, colloquially referred to as the president's grant, should be removed. In our case this grant, a small grant which amounts to about \(\$ 100,000.00\) per year, does no end of good things. I am not sure that \(\$ 100,000.00\) from our point of view could be spent in a better way.

The Chairman: Does it involve more security for the dispenser of the funds?

Dr. Duckworth: It means that the president, sir, is able to recognize certain emergency situations in the university which perhaps did not exist at the time applications were made for grants, or in some cases were not recognized by the granting agency. He has this local knowledge and the money serves many useful purposes.

Finally, I would just say in a blanket way that I agree with the other points made by Dean McCalla in connection with the Macdonald report.

Thank you, sir.
The Chairman: Thank you. Finally we will hear Dr. Van Cleave, Dean of Graduate Studies, University of Saskatchewan, Regina Campus.

Dr. Van Cleave: Thank you, Mr. Chairman. Honourable senators, ladies and gentlemen: I would just like to emphasize a few things that really have not been brought up in the president's brief, or that mentioned by Dr. Currie.

There were some submissions from Regina campus which are more or less individual ones. What I have to say is very much an individual point of view.

For many years now I have been quite concerned about the supply of scientists and engineers in Canada. I tend to look at this rather further back than the support of research.

Professor Forward will well remember that I once appeared before him when he was with the Science Secretariat with the suggestion that we were going to have a shortage of scientists and engineers in the future in Canada unless we did something about the training of science teachers at all levels of education.
I think that this is very true; many Canadian universities are now being criticized, of course, for the number of foreign graduate
students that you find. Why do we find them there? Because we are simply not producing enough of our own in Canada. Why are we not doing that? I maintain it is because we do not have the well-qualified science teachers who are interesting these students in science at quite low levels of education, even in the public schools and in the high schools.
Some years ago I became involved in an attempt to introduce new science curricula into the high schools of Saskatchewan. At that time we looked at the programs of the National Science Foundation of the United States. We became extremely envious over the way that they were able to do things there.

I always feel and, Mr. Chairman, you may rule me out of order, but you did not rule my colleague from Nelson out of order on this-

The Chairman: We are having a very broad discussion.
Dr. Van Cleave: I feel that we are hiding behind the British North America Act in respect to education being a provincial matter. When in fact it may have seemed so a hundred years ago, it is a very out-dated point of view to take now when our teachers and professors are so mobile that they move from one province to another.
I just do not feel that we can afford to not say that the federal government should be very interested in education at all levels, not just in the support of research.

I was challenged at that time to prove that there was a severe shortage of well trained science teachers in Canada. I think we did prove that; I can state without any fear of being contradicted now, as a result of a survey that was done, that not more than at the very outside 25 per cent of those people who teach science and mathematics in our high schools are in my estimation anywhere near properly trained in the subjects that they teach.

I feel that we need more support as is given by the National Science Foundation of the United States, to organize teacher institutes within universities. You may not call this research, but I think it is certainly feeding research to update these people, make them more competent so that they will in turn generate interest in the students that come to university.

This I feel, Mr. Chairman, would be a problem that is neglected by all the other briefs. You will find that it will come up in a
brief that is being presented by the Chemical Institute of Canada next week; I had only this opportunity to speak to that.

I certainly agree with some of the other remarks that were made this morning, especially that with regard to the Canada Council. I am in the position of a Dean of Graduate Studies in a new university trying to get research in graduate studies underway. The contrast between the support that the scientist can get and the social scientists and the humanists can get is terrific, of course.

I feel that Canada Council is failing. Even though they are improving, I would agree, they are failing to give the support necessary to develop strong graduate schools in their areas in Canada.
The Chairman: Is it due to a weakness of the Canada Council itself, or to the lack of funds?

Dr. Van Cleave: I think it is both, Mr. Chairman. Their point of view is, they maintain this quite strongly, that they would not support graduate students at the Master's level.

The National Research Council has always supported graduate students at the Master's level. This has certainly been one of the major factors by which they have been able to develop strong science departments in nearly all universities.
I would submit that it is one of the reasons that we are failing to develop strong graduate schools in the humanities and social sciences, because they are not supporting students from the beginning of their graduate careers.

The Chairman: Of course, they can support that kind of activity under their act, but is it not true that they reached that conclusion because of lack of funds, rather than because they did not feel that they should do it?

Dr. Van Cleave: That may well be, but if that is the case they should have more funds.

I would also make a plea, which has been previously made this morning, that when we are having federal support for research and graduate studies and so on in Canadian universities, the support should come more directly to the university and not through the provincial government.

We have a provincial government that does not go for these 50 cent dollars.

The Chairman: Yes, but I understand that there is generally an election campaign going
on in your province, so there may be some changes there.
Thank you very much.
I understand that Dr. Moir does not want to participate in the discussion at this stage.

\section*{Dr. D. R. Moir, (Dean, Faculty of Science, Brandon University): That is true.}

The Chairman: Thank you very much. We have now about three quarters of an hour, because we will have to adjourn at 12.30 . The Senate is sitting at 2.00 o'clock today, so we will be able to meet at our plenary session here this afternoon at 3.00 o'clock and have some time for lunch.

I presume that we will want to adjourn at 12.30, so we have three quarters of an hour for discussion.

Dr. Posima: Mr. Chairman, I would like in connection with the remarks of the last speaker to perhaps correct a misinterpretation.

Let me just state for the record that all my creative constitutional thinking is not limited to factual comparative work. It not only ignores the BNA Act almost in toto, but also all past occurrences of federalism. I want to make sure that I was not misinterpreted there as putting in a plug.

The plea has been made yesterday and the day before yesterday. I thought we should put in a plug today for the many connections that exist between graduate work and undergraduate work, even from the point of view of very specialized research, whether it be scientific in the pure sense, or technological in the applied sense.

I am very concerned, as I am sure all of us in universities today are, about fast occurring developments. I think perhaps it might be worth the committee's while to give some thought to the possibility of federal support for the graduate schools. This is provided that the opportunities will be there for them to stick to what I consider to be their specialty. This in my mind, I think I have got this satisfactorily resolved, should concern itself with what I call educational learning. This is fundamentally interdisciplinary and coherent especially, not only because of its obvious educational values, but also because of its connections with the worthwhileness of any graduate research that will come in its wake at later stages.

I am sure that we all know that research today cannot be channeled into narrow separated disciplinary avenues. It has to be very
broad and discipline problem-oriented. There is no better preparation for that kind of specialized and perhaps even technological scientist than his training at the graduate level. It does not matter whether this training takes place under university, government, or industrial sponsorship in the first place, with assistance from the other quarters.

I think that our scientists, even our applied scientist and our applied research man of the future, even of the present, has to have even in his undergraduate level work that very broad approach along inter-disciplinary lines.

I think it is important to keep in mind the role of the undergraduate level university work. We should also take into consideration the fact that many of the really first class scientific contributions of the past had very little more than a pencil and a note pad to help them. We tend to think necessarily in terms of very technologically advanced gadgetry when it comes to scientific or technological contributions, the really creative work in scientific contributions.

The Chairman: I wonder, Doctor, if you could not wait until this afternoon to expand on these topics for the plenary session, because I know that this morning some of the members of the committee would like to ask some questions to the delegations from the west.

This afternoon we will have a more informal arrangement.

Senator Cameron? Being so closely associated with universities, in Alberta at least.

Senator Cameron: Mr. Chairman, it has been a very heart-warming experience to have the opportunity of associating with former colleagues and even present colleagues so intimately this morning. Obviously in the short time we have we must be concerned with some of the major principles which will assist the committee in formulating a national science policy.

I must say that we are indebted to Dr. Forward and his colleagues in UBC for being the first organization to present a structural possibility in the schematic form. That appears on page 15 of their submission.

The Chairman: I had the impression that it was Ottawa revisited.

Senator Cameron: I was going to say this is probably as a result of his three years in Ottawa that he knows his way around here.

However, I was encouraged to find that my colleague, Dr. McCalla of Alberta, said that this happened to be pretty much along the lines of their own thinking. It is a useful outline, even if the committee does not accept it all in detail. It is beginning to put down in structural form some of the main issues that are exercising the minds of this committee.

Dr. Forward, you referred to the need for providing federal funds for capital purposes for research; I wonder did you have any formula in mind for this? This suggestion has been made before but no one has suggested a formula as to how this might be done, as to what percentage or how the funds might be channeled and who would disburse them.

Dr. Forward: No, I have not any particular formula to suggest. Our feeling has been that if the principle were adopted this might be possible. Then there would be the opportunity to sit down and look at the proportion that might be expected. Obviously the total amount is not going to be very great. The universities and the federal granting agencies between them would have to sit down and work out just what sort of proportion would be going for this capital expenditure on university building.

The Chairman: Would it be a program of itself or connected with assistance to research?

Dr. Forward: I think it has to be connected with assistance to research.

The Chairman: Because, as you know, in the past these capital grants programs set up by the federal government have not been too successful, in the sense that provinces and even universities insist that this money be available more or less on a per capita basis across the country. You do not necessarily have the maximum results from your money in terms of encouraging research.

Dr. Forward: We suggest, Mr. Chairman, in the brief that the formula that was adopted by the Canada Council in its original form might serve.

The Chairman: It was at that time, if you remember, distributed according to population.

Dr. Forward: On a matching basis with the universities.

Senator Carter: Would you include buildings as well as equipment in a capital grant?

Dr. Forward: Yes; equipment is now available, but this is particularly towards what we euphemistically term facilities.

Senator Cameron: Does this suggest that there is need for some new machinery between the universities and the federal government to discover what the needs are and what should be allocated? Some machinery that does not exist now, or do you think that the existing machinery or machinery which may be set up under this proposal would meet the need?

Dr. Forward: Most of us are in favour of this idea, that there would be a national research board or a committee above the councils that would help in this allocation. It is there that the universities would be involved and there would be more advice.

The Chairman: Would it be more or less along the lines of the National Science Foundation in the United States?

Dr. Forward: No, this board that we had conceived was..

The Chairman: Oh, this other one, like PSAC?

Dr. Forward: No, there is still this other one we do not have yet. This board which would be referred to as correlating or coordinating, which would actually distribute among the several councils the amount of money that is going to the universities. It would perhaps take from those councils to the Treasury Board their requirements.

The Chairman: You are going then in that concept of that committee or board much further than the Macdonald study?

Dr. Forward: Probably so, yes. The determination of the percentage that would go to capital and to operating would certainly have to be determined by the council, the board, the university and government officials involved with one another. I do not see that as being the purpose of this PSAC committee; they are concerned with scientific aspects and contents of the programs.

Senator Cameron: Reference has been made several times today to the advantages of the joint federal-provincial or federal-university cooperation in the establishment of laboratories and the use of research personnel. Reference was made by Saskatchewan and Alberta to this.

I know from first hand experience that the soil service personnel, the plant methodology personnel were used in this multi-purpose function. They had a research responsibility while being employed by the federal government but they worked with the university people. They even taught in the university classes.
I have often felt that this was a very valuable approach and I am surprised that more of it is not done.
Would it be your feeling, and I am suggesting this to Dr. McCalla and to you, Dr. Forward, that there is need of a more formal representation, that this kind of program be given more emphasis in terms of getting more effective use for the research dollar we are spending?

Dr. McCalla: Well, I do not know about the formula; there are limitations to this. For example, the University of Alberta located at Edmonton was interested in the possible establishment of federal laboratories, Department of Agriculture laboratories which were related to agriculture in Alberta.

I remember very distinctly the directors of one of the divisions saying the only justification for putting an economic entomological laboratory, for example, in an area was to solve the economic problems of this area. These problems so far as agriculture is concerned are not at Edmonton, but at Lethbridge. So the laboratory was established at Lethbridge. Now we have an informal working arrangement with Lethbridge, particularly in relation to irrigation, whereby we can send our students down there. We use their personnel as assistant directors of research projects.

In our department of mechanical engineering we have the same kind of arrangement with the Suffield station of the Defence Research Board. They have certain facilities that we do not have.

On the other hand, right now there is under construction the forestry laboratory which is located on university land about two miles from the main campus. There will be varying interrelations between the people. Many of these people have been stationed at Calgary.

There has not been an entomology department as such in Calgary. These people will go back and forth between Calgary and Edmonton for a long time and they are going to work in very close cooperation. I do not think we need a really formal relationship; this will
vary. For example, it is a very nice thing for both the university of Saskatchewan and Dalhousie University to have NRC labs on their campuses. We would have been delighted to have had the prairie regional lab at the University of Saskatchewan, but we have not got it.

I think many of the arrangements can be informal or, as at Dalhousie, rather formal arrangements between the Atlantic region and the prairies.

Senator Cameron: Is there not an implication here that if we are to recognize the limitation of the public purse and following that to agree that if we are to make the most effective use of the resources we have, we have got to make the decision on centres of excellence? This has come up time and again but no one has submitted to the committee yet the criteria by which these centres of excellence are determined, where they shall be and what they shall do.

This seems to involve some pretty fundamental thinking as far as a national program is concerned and certainly very fundamental thinking as far as the universities themselves are concerned.

Dr. Forward: In our presentation we did mention centres. We did at one time use the word satellites, but people did not like this. We thought there might be, as in the case of water research, a national laboratory, that at three or four places across the country there would be a university group associated with that national laboratory. Instead of this group getting its money through the National Research Council for the area, or in some other way, they would be supported and really be the responsibility of this national laboratory.

Of course, something of this has happened at Burlington; that is the beginning of this kind of operation, in effect a national laboratory, but there must be not only Burlington but other places across the country where people are going to work in water research. I would think it would be associated with them.

The same thing could be done in communications; the same thing could be done in water pollution; but not every university is going to have a satellite or a centre in every area, as has been said so often. This was the kind of concept that we had in mind, that it would be a relatively formal association with government departments.

Dr. McCalla: Mr. Chairman, as one of the small group which made representations to the National Research Council on negotiated development grants I have been quite disappointed in the way this program has worked out. It was the anticipation of the group that made that recommendation that this is exactly the sort of thing that they would do.

One of the first disillusionments in this was that the first three negotiated development grants were all for materials research. They were all as a result of requests that had been made by universities before the program was ever set up.

Many of us have felt that while the negotiated development grants do involve university commitments later, this is a stimulation under which with today's costs and escalating costs many universities are going to have to stand back and take a look and say, can we afford to extend the negotiated development if that means that we have to take an extra million operating grant on our hands when the support is over?

I think that the discussion of the possible much closer liaison with continuing support in areas of vital interest to the federal research program is a more realistic point of view perhaps at individual standards of excellence than are the negotiated grants in some respects.

Dr. Currie: I think that the use of the word excellence, of course, has to be in parentheses. You can have too much excellence, you see. You might develop an area here so that we would have the most excellent people in the world, but we would not know what to do with them and they would not be of much benefit to Canada. You want excellence, of course, but I think we are concerned with strategic development important to the region.

Of course, many of the government laboratories were established for strategic reasons. I am not at all certain that there must be a broader concept of these. When all is said and done, when the National Research Council puts a laboratory on your campus it is an autonomous organization that works with the National Research Council. The director reports to the president of the \(\mathrm{Na}^{2}\) ional Research Council. You can have situations where there is no particular collaboration between provincial research councils, universities, and so on.

You do get this sort of casual collaboration, it is true. For example, the university may
have no authority whatever, or not even be consulted about the appointment of a director and often the director carries or promotes the nature of the research.

I think we followed a model that you have at Manitoba. This gives here on these laboratories some confidence, the possibility of having a relationship to the graduate faculty which can and in fact does make it possible in Saskatchewan for them to take students into their laboratories and have the benefits of this association of bright young minds.

The university, on the other hand, gets the advantages of equipment and know-how which may not exist within the university.

I am all for this sort of collaboration, but I hesitate to label it always as excellence. I think we have lived too long with excellence here in Canada.

What are the words you had for it, Dr. Katz? Expediency? No.

\section*{Dr. Katz: Irrelevance.}

Dr. Currie: We have got to get relevance tied in with this. We hope that it is excellent, but you must have relevance to your community or local situation across Canada as a whole.

Senator Cameron: That is what the students are saying today. Does this very argument that you are putting forth not suggest that maybe there has been too much autonomy in some of these agencies? If we are to look at this from a national viewpoint maybe we cannot afford to leave it to one of these autonomous agencies at the National Research Council? I would be the last to cast any aspersions on it, because it has done a magnificent job, but in taking a national viewpoint do you not think that the placing of the laboratories, the kind of laboratories and the kind of plants must be considered by this national science organization, whatever it may be?

Dr. Currie: Yes, strategic establishment and so on; I think this is quite correct. I have lived with professors for a long, long time and this question of autonomy and what they work on is a very ticklish business.

Actually to permit students to go into a government laboratory on a campus can be quite a debatable point. I think that somebody has to wield the stick, you see.

The Chairman: I wonder, Dr. Duckworth, if you could not expand a little bit on the internal organization that you have at your
university to consider your research programs?

I was impressed during this week by the representations we have received here from various universities. It seems to me that they tend to come mainly from science, the natural sciences and engineering.

\section*{I wonder why this is so?}

I was also wondering if these groups that you have within your universities to discuss your research programs could perhaps in the future expand a little bit in their scope. Could they also consider occasionally, or perhaps more or less on a continuing basis, the broad issues of science policy, irrespective of the more specific role of universities within this broad concept of science policy?

Dr. Duckworth: Mr. Chairman, the research board which I described does include amongst its membership quite a few representatives of the social sciences and the humanities. So far I have been anonymous today; I should say, to put it in its best light, that I am a natural philosopher, but I am normally called a physicist these days.

In this group, which is fairly new to us, we do have a forum in which we can discuss the overall research aims of the university. We can consider new proposals that have been made, having in mind that they must be given some priority with other proposals.

For example, the university made two applications to the National Research Council for negotiated development grants. One was in the area of cereal chemistry, for which our province is a natural. The other one was in the area of applied mathematics. Now, before our president would sign these applications he requested the research board to consider these.

In a university there is always a suspicion on the part of the professor of classics that physicists have all the money. Here was his chance to say now, if you receive this grant what does this mean five years from now to the university, or ten years from now? I must say that the proposals were subjected to a very searching inquisition. At the end of it we knew what the ramifications were and it was accepted by all that this was a good thing for the university to do.

We are very pleased with this representative forum that we have. We also discuss proposals in the university budget for expansion. Was this what you had in mind?

The Chairman: Yes, I wanted to know more about this. Would this group, perhaps not in the past, but in the future, discuss the broad issues of science policy?

You see, this committee of ours is, of course, a special committee, but we certainly do not feel that we will be able to answer all questions satisfactorily for all time, so we envisage that this exercise by the Senate will be a continuing exercise from now on.

I think it is a very desirable effort, but it seems to me that if the academic community was doing that too and the parliamentarians were in a position to always be able to seek the advice of the academic community on broad issues of science policy, including, of course, the role of universities in that field, that we would be much more together than we have been in the past in this global village of ours.

I wonder if your board could expand its activities to occasionally looking at the global picture as well?

Dr. Duckworth: I think so, Senator; I think the members of our staff who are on this research board would be very pleased to have an opportunity to express themselves on larger matters than university matters. I think if there were a request for expressions of opinion this would be a group that could come forward with opinions.

Senator Cameron: I wonder how many of those there would be?

The Chairman: Yes; is your organization typical of the total Canadian picture, or is it only an experience that you have launched in your university?

Dr. McCalla: At the University of Alberta we have not such a formal group, but perhaps somewhat analogous is our academic development committee to which the applicatons for negotiated development grants are referred. This is considered in the context of all the new developments in the university. So I think it serves a similar function.
On the other hand, the question I wanted to ask you, Mr. Chairman, was that Dr. Hunka and I have been here for the three days. I feel very strongly that it might be worth while, and it might be of some value to your committee, if when we get back home we call together the original committee to review what has gone on here. We would put emphasis on some of the questions that have been asked repeatedly by members of your
committee and submit to you an adendum to our original brief. Would this be useful?

The Chairman: Oh, yes. This has already been suggested by Dr. Burt from New Brunswick. I think this has been the process of gradual collective learning this week. This is, we hope, as far as we are concerned, only a first phase in this process which I believe for the good of Canada should from now on be a continuing process of exchange and consultation.
I think it would be useful for those universities who have such boards and such an integration of their research program and research policy to expand on this. I do not think that all universities in Canada have such an organization which, of course, would be most useful for us and, I think, most useful for individual universities and perhaps regional universities.

Dr. Forward: Mr. Chairman, we do have a committee appointed by the president, the president's committee on research policy, at the university of British Columbia, consisting of approximately 15 senior members drawn from the various sciences, also from law, history, psychology and the arts. One member is in the theatre-It is a committee that has a broad view of research in all its aspects at the university.

\section*{The Chairman: How often do you meet?}

Dr. Forward: Rather infrequently; it was that committee that met to discuss and prepare this brief for this committee. We will be meeting again in July. We meet about two or three times a year; it is not a regular thing. The questions that have been talked about here are matters that should be brought before that committee and will be brought before them. So, as Dr. McCalla has said, we hope that we might think further on them and comment again.

The Chairman: I strongly believe that if we cannot organize participating democracy in the field of science policy we will not get that kind of democracy in other fields.

Dr. Duckworth: Nine of our members are elected; they are not appointed by the president.

Dr. McCalla: I am interested in our academic development committee, which has the responsibility to make recommendations to our general faculty and senate.

This committee meets once a week, Mr. Chairman, the year round.

Senator Cameron: I suspect, Mr. Chairman, that while they may not have this formal, named organization that all universities have some arrangements for, it might be useful if they were made more formal and assumed a more important advisory role in terms of the national structure.

Dr. Currie: Mr. Chairman I think we are breaking ground in Saskatchewan; we do have council committees, one for the natural sciences, one for the social sciences and humanities. These are appointed by council, or course. By this we mean our academic senate in some cases.

Because of the Macdonald report I called both together and served as chairman for a discussion. I think it was generally agreed that a discussion along these lines was a very good thing. A motion was passed that from a strategic point in the campus we should have controlled documentation.

That is, very few of the people had seen this report yet; a lot of them know about the proceedings of this committee here, which has now reached a pile so high, and would like to see them.

There are many other pieces of paper that are coming out, so I think this is a breaking of ground along the lines which you are suggesting here, that once we can get the documentation so that people see what is going on and then call these meetings, we will get a constructive dialogue.

Unless we get this documentation, this sort of information, people come who have not done their homework so that pretty soon they break up and are not too happy.

The Chairman: For us it was, of course, a new experience; it was a new field for us, so we felt that we had to go through the university presidents. Very often it is not the most effective way of direct communication, because they are involved in so many other things.

As a result of this week if we could have for each university the name of someone with whom we could remain in contact and send material to, I think that liaison would perhaps be much more effective than it has been for this particular occasion, but we are only establishing a precedent now.

Also, when we have special requests we could communicate directly with this man.

Dr. Currie: I agree wholeheartedly with you, because I think the first communication for a brief from universities came to the president, at least in our campus it did, and the president was busy with many other things.
About two weeks later it got to my desk and he said, Currie will you please think about this. Pretty soon, you see, it is March 1st and you people want some pieces of paper.
Senator Cameron: Mr. Chairman, I do not want to monopolize the time, but I do not want to switch off this particular aspect.
I want to put a caveat on two areas that we have hardly touched. They have been referred to quite frequently:
One is the role of the computer and its implications for science policy in terms of cost, equipment, and so on.
For example, yesterday Dr. Robinson suggested that a university professor might get a grant from some unknown source, say, \(\$ 10\),000.00 , and it would involve \(\$ 100,000.00\) worth of computer time. I suspect this is happening in other places. There are long range implications in this.
I know that there is one expert here on the computer and maybe more. I am referring to Dr. Hunka.
Secondly, there has been reference time and again to the division of the funding. That is the universities do not want the federal funds to go through the provincial government. Again there are long range policy implications in this.
So, some time this afternoon I would like to see this discussed. I think I had better keep quiet now and leave some time for my colleagues.

The Chairman: I lived for some years under the rule of a provincial government, so I can very well understand the point.
Senator Carter: I have no specific questions and it is getting so late; I do not think it would be worthwhile putting a question right now, but I have some. I would like to express this idea, because I have duty in the House and I might not get here at the beginning, maybe not until 4 o'clock. I was hoping that when we have this plenary session-we have got a lot of ideas and there has been a lot of consensus and a lot of disagreement on points-we could evolve some principles which we could apply which would guide us.

While they might not agree on details, they might agree on principles.

The Chairman: I would be surprised if we could reach even that this afternoon. In any case, it was not the purpose of our meetings this week. The delegations could go back and think about their own re-organization in their respective universities and perhaps in their respective provinces, so as to provide in the future for more liaison, more dialogue. Also in the light of the discussions of this week they could send us back any kind of material that they want to send us. You may be sure that these will be very carefully considered by the committee when we begin to prepare our report.

Senator Carter: Could I give just one example of what I had in mind when I said principles? Somewhere there is a division of responsibility: Research is the responsibility of the university because of its teaching function. It is a part of the teaching function of the university, a part of its function to generate new knowledge, which is a university's function.

Then there is the government's responsibility to at least, as everybody has put it forward here, maintain individual creativity in the field of science. The government is more likely to place, and this is what has happened I think, because everybody has complained about it, undue emphasis on the material sciences and perhaps not enough on the social sciences and the humanities.

So you have these problems of the basic versus the applied, versus innovation, and you have this between the natural sciences and the social sciences and between the social sciences and the humanities. Surely we should be able to develop some principles which would guide us to where the breakdown in responsibility should be?

I do not say we could get it, but it would give us a better idea when we come to assess all this mass of information that we have before us.

The Chairman: We will see what happens. I will ask a final question of Dr. Forward: I would like to know what would happen if a Canadian PSAC were to be established; what happens to the Science Council as it exists now?

Dr. Forward: Mr. Chairman, I am delighted that you asked that question; I was hoping somebody would.

I think the Science Council as it is presently constituted has some wrong concepts. Perhaps I should not say this; I was the one who drafted the form and basis of the present Science Council.
The Chairman: I have drafted a lot of things that I re-drafted afterwards.
Dr. Forward: It is time to re-draft. The problem with the Science Council is that they are neither fish, flesh nor fowl at the moment. They should be able to be free to advise, to warn, to express alarm, to chide, to do all these things quite freely and without any concern for what the people who are in the government are thinking about at the present time. You cannot do that if you have government officials on the Council, because they inherently and basically must influence the thinking. They have access to privileged information; therefore the Council cannot come out and speak its own mind freely. So the Council should be changed and have no government members on it.
The Council then is the counterpart of the Economic Council. It can say anything it likes to anybody and make studies for long term growth in the future, where we should be going and what we should be doing and say so in no uncertain terms. It could develop studies of data, information and so on.
The PSAC committee which I talked of is an internal committee which has access to government classified information.

The Chairman: It would not issue public reports?
Dr. Forward: Not necessarily, but certainly it could make little studies on its own if it wanted to, to acquire information for its own purposes. In general its advice would be internal advice through the Science Secretariat to the Minister for Science, who would be chairman of this Privy Council committee just as there is, as I suggest in the diagram, the committee of deputy ministers.

Of course, they have direct access to the ministers who are on the Privy Council anyhow, but as a committee it can operate, if they wish to do so or find themselves capable of doing so.

The Chairman: If they could find a catalyst that would force them to meet.

Dr. Forward: Yes. There again I look on the Science Secretariat as being not a group that initiates studies, but that assembles from all this and from the Treasury Board, from the Department of Finance, from political sources if they like, the material that they present to the minister so that the decisionmaking body has information from a number of sources, not just one person telling them something, but all sorts of groups of people.

Thus, through the PSAC committee and through the Science Council we would have the opportunity for the scientific community to feel that it has a part in determining policy and what goes on.

I do not think it feels that way at the present time.

The Chairman: If you, Dr. Forward, because of your experience in the Science Secretariat, fell like submitting to us personal views on any of these matters that you have not been able to express here today, or in your memorandum, we would be delighted to have them.

Dr. Forward: Thank you very much, Mr. Chairman.

The Chairman: Thank you very much. The meeting adjourned.

\section*{APPENDIX 82}

Brief submitted by John F. Postma, M.A. (Ottawa), M.A. (Carleton), of the Research and Liaison Office for Academic Development, Notre Dame University of Nelson, British Columbia, on behalf of the University,
to The Special Committee on Science Policy of the Senate of Canada, February 26 , 1969.

\section*{Introductnry Remarks}

The letter, dated December 20,1968 , and sent on behalf of the Senate's Special Committee on Science Policy to the Registrax of Notre Dame University of Nelson in British Columbia, was recently referred to this office.

In view of the nearness of the deadline set by the Committee for ceceiving reports and in view of the fact that, at this time, appropriate and detailed research material related to the Committee's terms of reference is somewhat scarce, I have decided to submit a brief \(r\) port on the limited subject of "the broad principles... of a dynamic and efficient science policy for Canada" (No. d in the Committee's terms of reference).

Put forward for re-emphasis in this brief are those elementary distinctions and general principles which will help to keep our approaches to the problems sorted out and which may thus be indicative of the directions in which we should continue to search for solutions.

I am aware of the difficulties in maintaining the distinctions made below. In a given instance, they may have to be applied, unavoidably, with some degree of arbitrariness. However, I think that allowing them to be obscured or to be set aside entirely will only lead to further chaos and to an ever increasing waste of those financial resources in Canada which are spent on research.

It must be possible to distinguish,however broadiy, between:
- a governmental type of research;
- a university type of research:
- other research, practical, applied or technological; (Cf. business, the professions).
1. Governmental type of research

Engaged in and fully'financed by a government, it relates immediately and directly to the public interest, the common welfare;
-) in the area of federal responsibilities and operations;
b) in the area of provincial rasponsibilities and operations;
c) in the area of municipal responsibilities and operations. (1)

Several observations are in order here:
- The term "responsibilities" is used advisadly. It is not synonymous with "powers". Desponsibilities will necessarily overlap at different levels. Inevitably, there are federal aspects even to areas of immediate provincial concern and the same hold true with regard to municipal concerns in relation to their respective provincial and federal aspects.
- Thus, we must recognize the inadequacy and intrinsic unworkability of an inflexible "division-of-separate-ind-autonomous-powers-approach" to Canadian federalism.
- It is my considered view that, unless we wish to end up with a number of loosely federated but very separated countries, a defensible continuation of Canada as \(a\) one and distinct count... can only be premised (with any degree of safety) upon:
1) a measure of success, or the common will to succeed, in building out of the separately incomplete cultural mainstreams within Western civilization, namely French and English, not just a state of coexistence, however peaceful, but a new and integrated approach to social and public life, wherein these traditions (not to mention others) can be allowed to permeate and supplement one another:

\footnotetext{
(1) For interesting comments on municipal responsibilities, powers and local government generally, see the Ontario Economic Council Report of February, 1969, on the crisis of urbanization. Even their observations and recommendations,however, are valid only within the framework of a traditionally preponderant approach to Canadian federalism which needs to be critically re-examined.
}
2) the ecuivalent of a highly de-centralized and flexible, unitary form of government. I think that we must accept this.
- unless arguments based on a recognition of "the politics of the case" can be allowed to excuse any degree of chaos and cost, and
- unless we are willing to leave the essential issue of Canadian unity wholly to chance, to the vagaries of unpredictable, 'ad hoc' political settlements and economic agreements, or to divine Providence without helping Providence along a Iittle:

With regard to governmental type research, ways must be found to coordinate all such rasearch effectively, as between all participating levels of government and administration. The appearance of the Secretary of the Treasury Board, S.Simon Riesman, befcre your Committee on Thursday, February 6, of this year, has undoubtedly convinced the members of the Committee (if they needed to be convinced !) of the chaos even just within those research areas that are presently considered to be of legitimate and direct federal interest. We suffer from too many "coordinating" bodies operating with an indefensible degree of indepandence from one another. We shall all be surprised if the Cabinet, which is currently engaged in an attempt to draw up a policy of coordination for the benefit of the President of the Treasury Board (the Minister the:retically responsible for the cooperation of the total government scientific program), will wait to take the report of the Senate Committee on Science Policy into account: (2)

It may often be necessary or advisable to use existing university facilities and talent for such governmental type research. Full compensation for such use should then be arranged on a'pro rata' basis between the participating levels of government or administration.

\section*{2. University type research}

Basic research in pure science or the humanities, more proper to the University in the light of what may be considered the original and lasting academic responsibilities of the Universities. (4)
(2) House of Commons Debates, February 13,1969, p. 5465.
(르) In such cases we would have an area of "university work" where the central issues related to the broad and abused concept of "academic freedom" have only limited application. Such issues would only be relevant regardin? those aspects of the work which are directly related to university work and to univeraity responsibilities proper, namely liberal arts and science work and the basic research in these areas.
(4) Dr. J.A.Corry, speaking ot U.B.C. recently, referred to "fundamental research" engaged in by the university as distinct frem "the more practical, short-run type of research conducted by governments and industry." He did not get around to distinguishing, within the latter category, between public and private research, as we have done here.

For academic and cconomic reasons even this type of research cannot be independently and autonomously engaged in to an unlimited legree as a matter of practical principle. Even this work needs to be coordinated in its organizational and financial aspects 1) always and in the first instance by the universities themselves, and 2) if necessery, with discreet "encouragement" from the respective levels of government, acting in concert.

This type of research, like any other activity more proper to the university, is in the first instance normally supported by a combination of student fees as well as private and public funds. We see no clear alternative to this. Perhaps some of the private and public support should be more particularly earmarked for particular research purposes. In any case, all such support should be coordinate to be fully effective and proportionately just. We lack the structures for such coordination, by and large.
3. Other research: practical, professional or business research; applied or technological researchin or research directly oriented towards practical application, in the private sector.

Such research should be financed, wherever it takes place, on a 'prorata' basis, by the sponsors and (or) beneficiaries involved, e.g. a government, a business or a profession, as well as by the University whose talents and facilities may, for practical reasons, happen to be used for this type of work.

It would be simplistic to assume that, just because much of this work happens to take place on a university campus, it therefore is a responsibility proper to the university, to be supported in the same way as e.g. the university's regular liberal arts and science programme.

Professional or business support, if necessary, may have to te "encouraged" by public incentive, the respective levels of government acting in concert. The principles of professional autonomy or of busincss cometition can only be carried so far without chaos and waste becoming indafensible, or, on the other hand, without our losing sight of the fact that a given university may be an essential feature of a natural growth centre in relation to a larger, economically and culturally underdeveloped region.

\footnotetext{
Out of all the conclusions which could be drawn trom this Brief, one may be selected for special emphasis: the glaring lack, especially on a national scale, of effective masterplanning and of appropriate structures for coordination between universities, the various levels of qovernment, business and the professions, with regard to post-secondary education generally and with regard to research in particular.

We are aware of the many obstacles. We see no easy solutions. With reg ard tc the matter of structures, one would hope it to be possible to fashion an effective planning and coordinating body out of some of the membership of such bodies as Treasury Board, the Education Support Eranch in the Secretary of State Department, the National Research Council, The Science Council, The Defense Research Board, The Canada Council, The Iepartments of Regional Development, Manpower and Immigration, Industry, Trade and Commerce, Forestry and Fis.ueries, Mines, Energy and Resources, The A.U.C.C., the professional and business (research) associations at the national level, and so on.

Such a planning, and coordinating body should be capable of setting reneral patterns and guidelines for the development and operation of the appropriate, equally pluralistic structures at the provincial level.

In anycase, we hope that Canada's basic apprcach to these problems will amount to more than ineffectual tinkering. It is hoped, instead, that it will be possible for us to address ourselves to these problems in a forthright, imaginative and creative manner, while not losing sight of the distinctions and principles re-stated in this Brief.
}


This brief, prepared in consultation with committees, faculty groups and individuals in the University of British Columbia, presents brief background statements and specific recommendations concerning:
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- Separate Federal Government support for research and
graduate studies
- Allocation of Federal funds for capital purposes
- Extension of Federal department advisory committees
- Expansion of university research "Centre" concept
- Mutual arrangements for accommodation of research
personnel
_ "Mission-oriented" research
- "Institutional" type research grants
- Uniformity of research contract procedures
- Policy on "out-of-pocket indirect costs" of research
- Establishment of Council for fields not now supported
- Capital requirements for the arts
A structure for providing advice on science policy in
Canada

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\(\qquad\)

1. Every country in every corner of the world is daily made more aware of the urgency, the impact and the inevitability of the surging growth of science and technology. But the advances that result are made only with the consent and support of the hundreds of millions of people whose lives are moulded and affected by them in the social, economic and political sense.
2. It is little wonder then that governments are deeply concerned with the need to assure that the prodigious influence of technologic change has a quality and character that will most benefit their countries. From this concern has arisen the desire and need to develop a "science policy" under the terms of which basic requirements for technologic progress can be identified, their physical and social implications evaluated, and the optimum allocation of human and natural resources in public programmes be effected.
3. The decisions involved in devising and implementing science policy are among the most difficult that governments are called upon to make, for the factors that influence them are embedded deep within the conscience and desires of the people. Above'and beyond the obvious concerns such as physical and economic well-being are those associated with history, with nationalism, racial characteristics, pride, and perhans even climate or geography.

\section*{4. Although the ultimate basis for decision-making in \\ science policy is necessarily political it is especially \\ important that those who are responsible for the decisions have available to them the advice and opinions of the community of science and technology as well as those of the spokesmen for the social and economic components of society. Thus there must be clearly defined paths for information to reach the decisionmakers and, indeed, not only one but many well-informed and reliable sources of information and advice.}
5. In this realm the universities, because they represent a concentration of advanced thought and because they inevitably influence the ideas and principles of those who now or in later years must be the decision makers, play an exceptionally important role. The universities are destined to produce the professionals, scientists, humanists and others with the quality of scholarship and sense of leadership that will make progress possible: what this quality or this sense will be is certain to be influenced deeply by the graduate research programmes which everyone recognizes provide the chief source of vitality and growth in undergraduate curricula.
6.

It is the purpose of this statement to examine briefly selected topics in what may be considered the administrative area of university graduate studies and research support and to suggest courses of action that would be favoured. Consideration is also given to one form of science policy structure which, it is believed, would be effective in providing channels and agencies for advice to government that would remove some of the confusion that now exists and enhance the opportunity for not only the universities but all groups in the community to bring their views to bear on the complex problems of science policy.
7. In the topics here examined it will be recognized
that the views expressed are not, unanimous, nor do they represent
a consensus. It can be said, however, that they are favourably regarded by many individuals, committees and other groups in the University of British Columbia.

VIEWS ON SELECTED TOPICS

Federal-Provincial "Cost-Sharing".
8. The Federal Government has adopted a policy of \(50-50\)
"cost-sharing" in post-secondary education. However well (or poorly!) this formula may be suited to the support of day-to-day operations in the university it is totally inadequate for supporting research and advanced studies at the post-graduate level as these can only be fruitful if set in a much wider context than is possible on a parochial level. Investigation of new knowledge must be undertaken on at least a national basis, not only to avoid wasteful duplication, but to ensure the fullest development of material and human resources.
9. The Federal Government must accept independently the major responsibility for supporting research and advanced studies at the post-graduate level in Canadian universities. One aspect of support which must be recognized is that the most critical need now, and in the foreseeable future, is for additional space to accommodate faculty and students in post-graduate studies and research. The time will soon come - if indeed it has not already arrived - when effective expenditures of operating funds will be restricted by availability of working space.

IT IS RECOMMENDED:
10. (a) That the Federal Government reaffirm and strengthen its stated intention of supporting research and graduate studies in the sciences, probessions and humanities, independently of the "cost-sharing" programme: on a different basis, by different procedures and at a level consistent with national needs.
(b) That in supporting research and graduate studies the Federal Government policy be such that funds can be allocated directly to the universities for capital purposes - for the construction and fitting of buildings. The principle adopted for capital support under the auspices of the Health Resources Fund or that applied in the early days of the Canada Council could serve as a useful starting point.

The University and Federal Government Laboratories.
11. Government laboratories have been exceptionally well supplied with funds (at a level better than any other country in the world - including the USA) and have taken on a great deal of basic research that the universities quite properly contend could and should be done in the university environment, where relevant teaching stands to benefit. This has been the cause of much controversy and misunderstanding over many years. Government agencies and departments involved in science have buildings, equipment and staff in quantities that far exceed the most optimistic hopes of all the universities combined.
12. It is obvious that government laboratories and civil service establishments, already large, are not going to diminish in size and some means must be provided to staff organizations with well trained and fully qualified professional people. The prime source is the university and if people are to be attracted to the fields of interest of departments and agencies a two-way communication must be established between the universities and the agencies. The agencies must necessarily support work in the universities that is related to their missions and the universities must inform themselves of these national needs.
13. Whatever the liaison may be between government agencies and university departments it must be clearly recognized that the university's objectives are centred primarily on teaching,
training and research: the discovery and dissemination of knowledge. Research required by governments may be undertaken by the university as a public service in those cases where only the university has the variety and depth in the relevant areas of knowledge.
14. One useful way to extend the association between National (Federal Government) Laboratories and the universities is the establishment of additional "Institutes" or "Centres" in the universities. The centres should be an integral part of the university structure engaged in graduate studies and research but supported by funds provided by the National Laboratory. They should be concerned with attracting and training people in the research field of the National Laboratory but their research programmes would not be determined or directed by the National Laboratory. A prime component of the agency budget should be "free funds" for financing the operation of the centres. 15. Another scheme which has already been used to a limited extent is for the Federal Government to station personnel in university laboratories where they work side by side with faculty members on research. A corollary of this is the arrangement whereby the Federal Government builds a building on or near a university campus and university faculty members and graduate students are invited to use the physical facilities thus provided and work beside the Federal Government staff.
16. "Mission-oriented" programmes of the Federal Government are frequently such that some of the work can be very effectively carried out in university laboratories. This has the dual advantage of bringing realism to professional and applied programmes in the university and of introducing graduate students to the field of interest of the government department or agency. It is probable that programmes of this kind, especially those of fairly long term, could be suitably carried out on a contractual basis.

\section*{IT IS RECOMMENDED:}
17. (a) That more National Advisory Committees be established to assist and advise government departments and agencies in formulating research programmes and that, to improve the liaison between government and the universities, a large proportion of the membership of these Committees be drawn from university faculties.
(b) That the concept of "National Laboratories" and related university research "Centres" be recognized and that active steps be taken to expand programmes of this kind.
(c) That the accommodation of government personnel in university buildings and of university personnel in government buildings, with mutual access to facilities, be approved and encouraged whenever this arrangement can be beneficial.
(d) That "mission-oriented" agencies of government be encouraged to have suitable segments of their work carried out in professional and applied units of the university, utilizing research agreement procedures where these appear suitable.

Research Grants Administration.
18. The magnitude of the sums provided by the Federal Government for research in the universities is such that it has outgrown the system that served well when amounts were smaller. A new and more effective form of granting agencies is required for the proper co-ordination and allocation of funds.
19. This topic is complex and its effects are far-
reaching; a detailed assessment of the most important features, with appropriate recommendations, has been submitted to the Macdonald Study Group of the Science Council/Canada Council on behalf of the University of British Columbia. As the results of
this Study are being reported substantially contemporaneously with the submission of this brief it is felt that presentation and discussion of these earlier recommendations would be redundant. There are, however, one or two points that merit some comment.
20. For one thing, increasing attention must be given to the principle of "institutional" grants as distinguished from "project" grants to individuals. Although it has been reasoned that the best way to ensure that research funds are spent to the best advantage is to "support the able man" whose performance can be easily evaluated there is a growing realization that the performance of a group or team is equally susceptible to evaluation. If a larger proportion of available research funds is made available to the President, Deans, Directors or Department Heads there is a better possibility that the objectives of the university will be consistently served. Otherwise if all funds go to individuals there is a strong possibility that a "transfer of allegiance" will take place and that the individual will slant his work and project proposals in a direction that he thinks will gain the favour and approval (and support!) of the granting agency without necessarily having any regard for the broad principles, philosophy or needs of the university.
21. In some cases it has been found useful for government agencies to have specific projects related to their mission carried out in university laboratories. Usually the project is administered under the terms of a contract between the university and the agency, defining terms and conditions relating to payments, patent rights, overhead, publication of results, etc. In some ways the contract has proven to be a cumbersome instrument, as much as anything else, because government departments and agencies all seem to have different policies and practices in arranging contracts. It may well be that a type of "research agreement"
could be worked out, that would be uniform for all agencies, and which would involve less administrative complications in government and university alike.
22. Indirect costs - unquestionably when a research grant is received by an individual, a department or other group the university incurs expenses not specified in the grant but which include purchasing, accounting, stenographic services, library and all the items associated with providing working space. Many people would like to see these items fully covered by a supplementary grant of some kind, in lieu of "overhead". It is very difficult to calculate the true indirect costs arising from a research grant or research agreement. In industrial research a figure of \(100 \%\) to \(150 \%\) of salaries and wages is thought to be realistic. In the humanities, the chief indirect cost of research to the university is that of the substitutes who are paid to do the teaching of faculty members during a leave of absence during which they may be undertaking subsidized research. The cost to the university may be as much as \(60 \%\) of the faculty member's salary.
23. It may perhaps be of interest to record that a careful study by the Federal Audit Services Branch in the University of British Columbia determined the "indirect cost" here to be approximately \(50 \%\) of labour cost in a research project. As the Federal Government already pays \(50 \%\) of university operating costs it is not unreasonable to suggest that \(25 \%\) of labour cost is true "out-of-pocket indirect cost" to the university for a research project. With labour cost representing \(60 \%\) to \(80 \%\) of the cost of a research project it may be said that \(13 \%\) to \(17 \%\) of the overall cost is "out-of-pocket indirect cost". Thus, on the average, the inclusion of a \(15 \%\) supplementary "administrative overhead" payment with grants would fully cover these costs.

\section*{IT IS RECOMMENDED:}
24. (a) That the principle be adopted of increasing modestly the proportion of funds granted for "institutional" purposes and for "team" and "institute" programmes: and that it be recognized that these programmes, like projects carried out by competent individuals, should have continuity of support.
(b) That steps be taken to establish uniform "research agreement" procedures and conditions for all government agencies and departments dealing with universities.
(c) That all grants and research agreements made by the Federal Government carry an amount equivalent to \(15 \%\) of the total sum involved for payment to the university to cover "out-of-pocket indirect costs" incurred in operating the research projects being supported.

Gaps and Needs.
25. In 1967-1968 the total amount provided directly by grants and sponsors for research in the University of British Columbia was almost \(\$ 9,100,000\). In addition unidentified amounts of considerable magnitude were provided indirectly by the university by way of salary payments to professors supervising research, to technicians, and a variety of ancillary services such as secretarial, accounting, purchasing, as well as heat, light, telephone, etc. In the current year the identifiable comparable figure for direct research expenditures will be over \(\$ 12,000,000\). In \(1967-1968\) some \(72 \%\) of the funds were derived from Federal Government sources; 6\% from B.C. Government sources and \(22 \%\) from private sources.
26. That the sums involved are large is self-evident: that they are large enough or allocated to the best advantage is not at all certain. It might be noted, for example, that of the
\$9,100,000 available in 1967-1968 the taculties of law, arts, 81 commerce and education combined spent only about \(\$ 550,000-\mathrm{a}\) sum that was equalled or greatly exceeded by each of two or three departments in science or in engineering. In fact about \(45 \%\) of the graduate enrolment is in the non-science faculties but research funds received are about \(6 \%\) of the total - a patent imbalance. It appears that more money is urgently needed, particularly at the Masters' level, for the support of students in the non-science faculties who are engaged in research as part of their graduate training.
27. It should be pointed out that one of the features of this imbalance consists in the current lack of research funds for library purchases. The Canada Council grant in 1967-1968 for the purchase of books in the field of the humanities and social science is only \(\$ 11 / 2\) million for the whole country. The view is strongly held that, in these fields, the purchase of library resources should be regarded as axiomatic, and be treated as the equivalent of purchase of equipment in other fields. 28.

In the field of the humanities, and especially in the creative and performing arts there is a growing need for equipment and space. Such resources of equipment and space as film studios and equipment, electronic music equipment, space and equipment for inter-media experimentation and the like have become minimum requirements for competent teaching, research and creative work. If the creative and performing arts at the university are to provide leadership in their field comparable to that given by science laboratories, for example, then this technological revolution in the arts must be recognized both administratively and financially.
29. The lack of research funds and facilities in commerce, business administration and the management sciences is especially critical in Canada compared with the United States, Germany, etc., where great strides have been made in recent years. While in
other countries the new discipline of management science has been highly developed and has given great impetus to business administration in general, the financial plight of the faculties of commerce of Canadian universities has impaired the advancement of this discipline. It is important that in those universities where some strength has developed adequate funds should be made available for research.

IT IS RECOMMENDED:
30. (a) That in any reorganization of the Research Granting Administration there be at least one Council or comparable granting body competent to evaluate projects and make awards in the fields that have thus far been neglected but that could be advanced by the injection of research funds.
(b) That the capital requirements for books and equipment in libraries, communications media and the arts be given added consideration.

\section*{ORGANIZATION FOR SCIENCE POLICY DEVELOPMENT}
31. For long years the amount of money provided for
university research by the Federal Government was relatively insignificant in comparison with the large sums voted to government departments and agencies for research and development. As little as six years ago the total amount granted to the universities from all Federal sources was only about \(\$ 20,000,000\) At that time there were at least five government agencies - NRC, DRB, AECL, Mines \& Technical Surveys and Agriculture - that were spending \(\$ 30,000,000\) or more each on research.
32. But the picture has changed - the universities in 1968-1969 received about \(\$ 110,000,000\) for research - much more than any of the five large research groups in government. Thus the universities now appear as major 'competitors" in the quest for funds, yet they are at a considerable disadvantage when
funds are being allocated in that they have no one at the bargaining table to plead their case. Every government department has its "day-in-court" when the Minister and the Deputy Minister present estimates to the Treasury Board. Universities are represented only indirectly by Ministers and Deputies who have included funds for grants in their departmental or agency budgets.
33. The support of university research, however important it may be, is only one of the facets of science policy in Canada. Looking to the broader horizon it can be seen that in the field of science policy there are two distinct areas:first that concerned with allocation and administration of funds and second the mechanisms or structure required to provide the advice upon which the allocation or administration can be based.
34. Matters already mentioned in this brief, such as the position and function of the National Research Council, Medical Research Council, Canada Council, the Research Boards and many other Federal government departments and agencies, lie within the area of administration. Members of the University of British Columbia have already expressed views on these topics in briefs presented to the Macdonald Study Group. These are summarized in Appendix B attached and complete statements are available if required.
35. In dealing with the subject of structure for determining science policy consideration must be given to some basic principles. In the first place the difference between advice and administration must be recognized, the two come together only at the point of decision-making. Secondly, in the advice area, care must be taken to ensure that no group, committee, council or other body is in the position of being both advocate and judge. Causes need strong proponents but the case for the other side
must be presented with equal force. Finally there must be a mechanism for assembling the arguments pro and con and presenting them objectively to the Decision-Making Body together with as much relevant political, financial, social and economic information as may be available.
36. A rather extensive examination of the structure for determining science policy in five major countries - France, Britain, Russia, Japan and the United States - reveals an interesting and perhaps not unexpected parallelism and the presence of five main components in each of the five countries. That the structure for providing advice on science policy is sometimes combined with administration is largely coincidental, possibly a reflection of political philosophy and perhaps, where it exists, a source of confusion and some weakness. The five components are:
- Top-level ministerial decision-making body - a group that, having received advice from all sectors of the community, including those having relatively little to do with science or technology, must make the final decision on the areas to be supported, the emphasis to be given each, and the allocation of funds. (In France, the Committee of Ministers; in Russia, the Council of Ministers; in the U.S., the President and Cabinet, etc.)
- Scientific advisers to government - a group of leading scientists, professionals, social scientists appointed by government and operating in a voluntary capacity to review proposals arising from all sources. They occupy a confidential position, in some countries advise on defence matters, and usually have no administrative responsibility. (In France, the Advisory Committee for Scientific and Technical Research, the "Twelve Wise Men"; in the U.S., President's Science Advisory Committee, PSAC.)
- "In-house" government research advisory group - a council or committee of senior officials of science-based government departments responsible for co-ordination of programmes among government departments and for advising ministers on feasibility and effect of proposals from all sources. (In Japan, the Science and Technology Agency; in the U.S., the Federal Council for Science and Technology, FCST).
- Advice from the community of science - the views and interests of the community of science and technology are brought to the attention of the decision-making group (and the public!) in a variety of ways. Not uncommonly there is a body, financed by government, that conducts studies and presents independent proposals and recommendations that have broad public support. (In Japan, the Science Council of Japan; in the U.S., National Academy of Sciences Committee on Science and Public Policy, \(\quad\), COSPUO; in the U.S., Congressional Committees).
- Secretariat of officials - in every country there is a small body of full-time professionals in government service who assemble information from all the advisory groups and present these views to the decision-making body.

\section*{STRUCTURE FOR CANADA}
37.

It has already been pointed out (paragraph 3) that the decisions on science policy are affected by a variety of complex factors. Because Canada is a unique combination of resources, geography, races, temperaments and needs it is not to be expected that the patterns that have evolved in other countries would be exactly suited for our own. With the thought in mind that the experience of others, expecially where substantially parallel patterns have appeared, might serve as a guide;

IT IS RECOMMENDED:
38.

That in Canada the structure for the advisory segment of science policy depicted in the accompanying chart (figure 1) be formulated comprising:


Staff
38. (a) The Privy Council Committee on Scientific and Industrial Research - comprising Ministers of Departments involved in science and technology, together with the Minister of Finance, Minister of Trade and Commerce, Secretary of State for External Affairs. To this group there should be added a Minister for Science, who would be the Chairman and who would be the spokesman for science policy (and perhaps the universities) in the cabinet. The National Research Council, which now is somewhat anomalously created by the Act establishing the Committee should have a separate Act and should report to a Minister other than the Chairman. There is no reason for the National Research Council having a privileged position vis a vis other government agencies. This Committee is the Decision-Making Body reporting to the cabinet.
(b) Science Advisory Committee - this would be a new committee comprising twelve to fifteen top level scientists, technologists, sociologists, humanists chosen from outside government who would serve in a voluntary, but confidential, capacity. The committee should have access to privileged information, should meet at least monthly, and should be prepared to advise on proposals arising from government departments, Science Council, university granting groups and other sources in the community.
(c) The Interdepartmental Committee on Science and Technology - this now exists as the Interdepartmental Advisory Panel, which rarely meets. The proposed committee should comprise the Deputy Ministers and Chiefs of agencies whose Ministers sit on the Privy Council Committee for Scientific and Industrial Research. The terms of reference should be modified to make the Committee
an active body advising the Government (Privy Council Committeel on internal matters and the effects of implementing proposals submitted by Science Council, universities and other public groups.
(d) Science Council of Canada - the Science Council of Canada should function in much the same way as COSPUP does in the United States or as the Science Council of Japan in its "statement" role. To avoid the advocate-judge conflict of interest the Science Council should have no government officials in its composition. It should be as independent as the Economic Council with much the same structure. There should be a full-time paid Chairman and stafo conducting independent studies. The council should be financed by government but should not be dependent on the Science Secretariat in any way. The Council should not have access to privileged information and would thus be free to speak independently and to inform government and public alike.
(e) Science Secretariat - this is a small group of professionals in the Privy Council Office serving the Privy Council Committee on Scientific and Industrial Research. The Secretariat should be directly responsible to the Minister for science, who would be the Chairman of the Committee. The secretariat would not initiate studies but would record, assemble and condense proposals and opinions from the Science Council, the Science Advisory Committee and the Interdepartmental Committee on Science and Technology, and from any university or public source, for presentation to the Privy Council Committee. The Secretariat would also be responsible for obtaining available political, financial and economic information
for the Minister and Committee. In a number of ways the Science Secretariat should be the counterpart of the Treasury Board Secretariat. There should be the closest liaison and exchange of views and information between the two.
39. The success that has attended the hearings of Select Committees of the House of Representatives and of Special Committees of the Congress and of the Senate in the United States in bringing out volumes of information and opinions provided by the community of science and those whom it affects has proven most useful in helping to form public policy. In Britain the "Parliamentary and Scientific Committee" comprising about 200 Members of Parliament and of the House of Lords in all parties together with some 300 members appointed by scientific and professional societies offers an interesting forum for broadly based discussion of topics in science and technology. In Canada, until recently, there has been no such forum: in our view the Special Committee of the Senate on Science Policy provides precisely the kind of opportunity, that has long been lacking, for open and objective examination of matters that are of the gravest importance to Canada now and in the years that lie ahead. It is our hope that the activities of the Special Committee can be continued indefinitely, in a permanent form, thus providing yet another source of information for those who are faced with making decisions on science policy.

\section*{APPENDIX A}
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DATA RELATING TO
THE UNIVERSITY OF BRITISH COLUMBIA

The University of British Columbia was established by Provincial legislation in 1908, first opened its doors to students in 1915 and moved to the present 1000 -acre campus on Point Grey, adjacent to Vancouver, in 1925. It was the sole public university in British Columbia until 1963 when a new Universities Act was passed by the Legislature making provision for sister institutions all of which, like the University of British Columbia, are non-sectarian in character.

\section*{The Faculties}

In the University there are thirteen faculties and a number of schools. Training in most of the learned professions in British Columbia is provided exclusively by the University of British Columbia. Also, most of the postgraduate students enrolled in British Columbia universities are to be found in the University of British Columbia. The enrolment of full-time students at lst December, 1968, was:

Number Enrolled
Arts 5,887

Science 3,387
Agricultural Sciences 217
Applied Science \(\quad 1,490\)
Commerce \& Business Administration \(\quad 1,021\)
Dentistry 90

Education 3,581
Forestry 218
Law 488
Pharmaceutical Sciences 141
Medicine 354
Graduate Studies \(\quad 2,457\)
Unclassified and qualifying \(\quad 406\)
TOTAL
19,722
\begin{tabular}{l} 
Part-time credit courses \\
1968 summer session credit courses
\end{tabular}\(\sqrt{ }\) 2,438
The total number of graduates from the University

\section*{The Staff}
\begin{tabular}{rr} 
Full-time teachers (12 months) & 1,325 \\
Lecturers (8 months) and lab. assts. & 2,532 \\
Administrative, technicians, etc. & \(\underline{2,073}\) \\
& TOTAL \\
& \(\underline{\underline{5,930}}\)
\end{tabular}

The Plant
\begin{tabular}{lr} 
Area of campus & 1,000 acres \\
Total gross area of floor space & \(5,822,426\) sq. ft. \\
Academic and administrative floor space & \\
(In 52 permanent buildings; \\
47 semi-permanent buildings; & \\
120 former army huts) & \(4,058,580 \mathrm{sq} . \mathrm{ft}\). \\
Total value about: & \(\$ 100,000,000\) \\
Student residences: \\
Beds \\
Units for married students & \\
Student Union Building (financed by & 2,854 \\
Students) and opened October 1968 & \(\$ 5,000,000\)
\end{tabular}

Finances (1968-1969)
\begin{tabular}{l|r} 
Income Source & \begin{tabular}{c} 
Amount \\
(\$ million)
\end{tabular} \\
\hline Student fees & 9.3 \\
Province of BC & 31.2 \\
Sundry & 1.9 \\
Research grants & 11.4 \\
Gifts and grants for special purposes & \(\underline{2.0}\)
\end{tabular}

TOTAL \$ 5
Amount (\$ million)

Direct Academic
Academic Services
Administration, Physical Plant
Research
Special projects
28.4
7.4
6.0
12.0
2.0

TOTAL
55.8

APPENDIX B

I. University Committee Submission - November 1967
II. Faculty of Arts Submission - April 1968

\section*{APPENDIX B}

No. I

Summary of Statements in University Committee Submission on "Support of Research in Universities"
to the Macdonald Study Group - November 1967

In this statement research is defined as being:
"work carried out by students and faculty at the post-graduate level in any area of scholarly endeavour, including the natural and social sciences, the arts and humanities and professional studies".
1. University Research - a National Asset
"The conduct of post-graduate studies increases the level of awareness (of foreign science) and hence the ability to appreciate, adapt, and apply ideas and discoveries made elsewhere in the world. The universities, as centres of basic research producing material that is freely published throughout the world, assist materially in discharging this country's international obligations in many fields of thought and discovery."
2. University Research in the Community
"Universities provide direct benefits and service to the community by clinical, or consulting, or research activities. A serious effort must be made to improve lines of communication and mutual understanding that will enhance these benefits."
3. Size of Graduate School
"There is as yet no indication of the upper limit in number of graduate students or of the proportion of first degree students who will (or can) continue to graduate studies."
4. Federal Government Commitment to Research Expenditures

Federal Government must assume major responsibility for support of graduate research independent of "costsharing" and must be prepared to allocate funds for capital expenditures on buildings and facilities.
5. Universities and Federal Government Laboratories

Closer association between government and universities urged, also extension of "National Laboratory" and university "Centre" concepts and the inclusion of larger
numbers of university personnel on Federal department and agency advisory committees.
6. Research Grants Administration

Suggest the creation of a "University Research Grants Board" having the responsibility of channelling funds to some six "Research Councils". The Board would not itself make grants and would exercise no control over individual government department extramural programmes.

The Research Councils proposed are:
- Science Research Council - natural sciences
- Health Science Research Council - medicine, etc.
- Engineering Research Council - applied physical
sciences
Renewable Resources Research Council - forestry, fisheries, agriculture, water, etc.
- Advanced Studies - humanities and social sciences
- New Projects Council - nucleating areas of research

None of the above (nor the Grants Board) to have their own laboratories.
7. Techniques of Grant Administration
- Project grants
- Institutional grants
- Negotiated Development grants
- Contract policy
- Award procedures
- Review of Proposals
- Student support (scholarships)
- Indirect cost policy
8. Salary Policy

Proposed that it be permitted to pay faculty salaries from research grants.
9. Gaps and Needs

Law - no source of research funds
Fine Arts - Canada Council should extend
Education - no source of research funds
- Business Administration - research funds most inadequate
Medicine - lack of support in clinical research and in studying quality of health care
Architecture - source of funds uncertain
Nursing - recognition of character of programme and independent support sources needed
Engineering - gaps noted in some areas
Forestry - need for working space and more emphasis on certain applied aspects

\section*{APPENDIX B}

No. II

Summary of Statements in Faculty of Arts Submission on
"Support of Research in Universities"
to the Macdonald Study Group - April 1968

The term research should be defined throughout to
mean:
"legitimate scholarly and/or creative activity within a recognized discipline".
1. Organization of Research Súpport

Monies given in support of research within universities must be distributed by the Federal Government to two separate but equal grant-giving agencies, one for Arts and one for Science. The Canada Council seems at the moment to be an admirably suitable body to act as distributor of funds to the Arts, Social Sciences and the Humanities.
2. Arts versus Sciences

Division of monies by the Federal Government must be reassessed. The disparity between the support of those working in the technological areas and those working in the area of the Arts is extreme, and reflects a radical imbalance in the intellectual life of the community. If the Arts are going to play their part in illuminating and even transforming society, and are not going to simply reflect society as it is, they must have much greater resources at their command. We, therefore, ask for a rapid expansion of support for the Arts until the disparity with what is spent on science disappears.
3. The Objects of Support

The dimensions of the support asked for should be seen to include not only operating grants, but also capital grants for adequate provision of such needs as research institutes, museums, art galleries, film studios and libraries, and laboratory equipment. Clearly a capital grants programme of great magnitude is needed.

With respect to operating grants, the two examples that follow will help summarize the kind of needs the Arts now have.
(a) Library Support: This year the Faculty of Arts at the University of British Columbia asked for \(\$ 500,000\) in response to Canada Council's invitation to apply for funds to extend research collections. The Canada Council's grant
to 40 universities and colleges amounted to \(11 / 4\) million dollars. The UBC request suggests the magnitude of support necessary to service adequately library needs across the country.
(b) Faculty Support: There is general agreement that the programme of the Canada Council for senior fellowships, together with the university's sabbatical leave programme, have supported most of those faculty who have proved their ability to undertake research projects. Nevertheless, the problem arises with regard to predictability of such support, and there is still a lack of awareness of the flexibility in support programmes offered by the Canada Council. We recommend that the same provision should be made by the Canada Council as is made by the National Research Council for an added percentage to be given to the university authorities from which grants will be made for special projects, to assist new faculty and to take care of emergency or unseen factors.

The Faculty of Arts at UBC was granted last year approximately \(\$ 100,000\). Such an amount does not in any way satisfy the legitimate claims of scholars needing to study in libraries, museums, etc., in order to pursue their studies. It would not be difficult to justify an amount of approximately \(\$ 500,000\) under this heading alone.

\section*{4. The Support of Graduate Students}

Graduate students must be supported at all years and levels in the Arts. Given the 1967 enrolment of 600 graduate students in the Arts Faculty of this University, and using \(\$ 3,000\) per student as the norm, the cost would be \(\$ 1,800,000\). Whereas the shortfall in the support of Ph.D. students is approximately \(10 \%-15 \%\), we know that it is alarmingly disproportionate among M.A. candidates, especially at the first year level.

ADDED - FEBRUARY 1969

Those members of the university who have experience of dealing with the Canada Council are in general gratified by its performance, and would be disturbed by any suggestion of a change in its status or function that had not been very carefully considered and thoroughly debated. We, therefore, urge that the problem of support for research in the humanities - which is in some ways a different problem from that of support for science and technology - be given independent and careful consideration before any change is made in the present status of the Canada Council.

\section*{APPENDIX 84}

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from
RESEARCH BOARD*
of the
UNIVERSITY OF MANITOBA

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The Research Board includes nine members elected by the Graduate Faculty, the Director of Libraries, and the Deans of the Faculties engaged in research. Its Chairman and Vice-Chairman are the Vice-President (Academic) and the Dean of Graduate Studies, respectively.

\section*{1. Introduction}

The Research Board of the University of Manitoba is aware that the Special Committee on Science Policy of the Senate of Canada has considered a number of topics relating to science policy in quite sufficient detail for its purpose. Hence, the present Brief is restricted to five subjects which may have received insufficient emphasis, notwithstanding the fact that they represent important factors in the development of Canadian science.
2. Granting Policy to Maintain Balance between Federal Support for Basic and Mission-Oriented University Research

The three federal councils - the Canada Council, the
National Research Council and the Medical Research Council make research grants without much concern for the direct relevance to Canada of the results of the proposed research. Instead, by supporting good work per se, they seek to ensure that the whole spectrum of Canadian scholarly activity is at a high level. Thus, if and when Council-supported work is concerned with the solution of problems of economic, social or cultural
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\section*{Brief to Special Committee on Science Policy}
concern to Canada, it is almost by coincidence. On the other hand, a variety of Federal and Provincial Departments exist for the very purpose of ensuring that our human and natural resources are developed and utilized for the common good. Examples are the Federal Departments of Agriculture, Fisheries, Transport, Industry, Energy Mines and Resources, Indian Affairs and Northern Development, and their provincial counterparts. In recent years these agencies have initiated or expanded their university grants programs in order to guarantee that more of the research and graduate training that is done in our universities is relevant to the Canadian scene. This is an eminently sensible policy, as it provides a desirable complement to the grant programs of the three Councils.

A possible alternative, that of assigning to a single granting agency the task of supporting both uncommitted and committed research, is a dangerous one. For example, with the present emphasis on mission-oriented research, one might find this consideration beginning to colour all grants. Thus, the nation might lose the high quality of fundamental research which it now possesses, and which is essential to underpin most of the applied activity.

If the present arrangement should continue (as this Brief urges) the ratio of federal support for basic to mission-oriented research in the universities could be rather accurately

Brief to Special Committee on Science Policy
established by means of the budget. This would avoid the danger of mixing the two considerations -- to the unintended, but possible, detriment of one or the other.
3. Collaboration between Universities and Government Agencies

There could and should be much more collaboration between universities and government agencies than at present exists, especially in the scientific and technical fields.

Such collaboration virtually requires the location of government laboratories on or near university campuses, as is now the case for many laboratories of the Canada Department of Agriculture, Fisheries, Forestry, et cetera. This move towards a rational decentralization, in which laboratory sites are selected on the basis of natural regional interests as well as specialized competence in the universities concerned, has a long way to go. Furthermore, it is simply the prerequisite for the subsequent development of co-operative arrangements.

The actual co-operative arrangements may take a variety of forms including:
a) the inclusion of government scientists in the graduate work of the university with the rights and responsibilities appertaining thereto

Brief to Special Committee on Science Policy
b) the establishment of integrated laboratories in which specialized equipment and information are either shared or acquired as a result of joint planning
c) the participation of government scientists in certain major university studies dealing with problems of national concern.

Amongst the fruits of such collaboration would be:
i. the development of major research centers dedicated to specific subjects and of a quality that neither partner could achieve separately. Such a center would often be a natural point of stimulation for the corresponding technology-based industry
ii. the recognition of the necessity for both long-term ("academic") and short-term ("action-oriented") research, and that each must take cognizance of the other
iii. an increasing awareness amongst students of the problems faced by governments, with consequent willingness on their part to contribute towards their solution
iv. an improvement in the training of graduate students
v. a significant saving in the costs of replicating specialized equipment and services.

Brief to Special Committee on Science Policy
4. Graduate Studies should be regarded as Versatile Training

This section relates to recent predictions that Canadian universities are training too many graduate students in certain specific areãs of speciality. These predictions draw attention to a serious flaw in our method of training graduate students.

Although the point is always made in seeking support for nuclear physics (for example) that this subject provides an excellent setting in which to acquire a sound knowledge of the concepts and techniques of physics, the general usefulness of their training is seldom emphasized to the graduate students themselves. Instead they are apt to gain the impression that they are especially trained for the noble calling of nuclear physics and to settle for less would be unworthy of them. The rest of the scientific world might find this attitude tolerable if unlimited positions existed for nuclear physicists -- but this is no longer the case. On the other hand, certain branches of applied physics and many areas of cellular and molecular biology could utilize immediately the knowledge of electronics, of particle detection, of vacuum technique, of computer programming and of data analysis which nuclear physicists acquire as an integral part of their training. A period of acclimatization would be needed before a transplanted nuclear physicist could make a productive contribution in the new setting, but that period would not be long. Although
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Brief to Special Committee
on Science Policy

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nuclear physics has been chosen as the example, these comments apply equally to many other fields of specialization.

If the versatility of graduate study is properly emphasized, and graduating students are encouraged to exercise their competence without restriction to their fields, the graduate training in Canadian universities could contribute more substantially than now to our national aims and aspirations. In addition, the threatened surplus of students in certain areas of study would evaporate.
5. Need for Greatly Expanded Network for Scientific Information

This section is concerned with the need of scientists and engineers for selective access to the research information that is relevant to their work.

A solution to this problem would appear to be the establishment of regional scientific information centers, as suggested by George Bonn in the 1966 report entitled Science-Technology Literature Resources in Canada. Each such center would be tied in with the National Science Library and would utilize modern information retrieval techniques to provide information to the scientific community of its region. The National Science Library is to be commended for its leadership in this field and is to be encouraged to develop an effective information system of the

Brief to Special Committee
on Science Policy
sort described. Canadian science and Canadian technology will be increasingly dependent upon it.
6. Support of University Research in the Humanities and Social Sciences

The Canada Council, the main funding agency for university research in the Humanities and Social Sciences, does a commendable job in the light of its present rather vague terms of reference and the limited funds available. However, the lack of precision in definition of the nature, areas, and approaches for acceptable research applications is frustrating for many university scholars. It would be helpful if the general types of grants available from the Council were to conform more to the general pattern of those available from the National Research Council and the Medical Research Council. For example, the merit of an application should be judged on the demonstrated competence of the applicant rather than on the details of his proposed research. Also, negotiated development grants could contribute greatly to the growth of centers of specialization.

For many reasons it is difficult to make quantitative statements concerning the effective level of university support in the Humanities and Social Sciences as compared to the Natural Sciences. Notwithstanding, the level of support appears to be significantly lower. The provision of sufficient funds to the Canada Council to remove this imbalance should not be overlooked in any consideration of Science Policy.


This brief note is intended to convey our ideas concerning the desired nature of governmental support for research in the University of Lethbridge and possibly other new or small universities. Here it should be pointed out that the University of Lethbridge has no graduate programs in existence nor planned for the near future.

In a general way we believe that there should be support for a considerable number of small and medium sized research projects, rather than support for a much smaller number of very large projects. This preference means that research in such areas as high energy nuclear physics will not be carried out at the University of Lethbridge.

Support for small and medium sized (It should be emphasized that small or medium sized projects need not be small or medium in terms of intellectual quality or potential value) should cover several areas as follows:
1. Capital equipment.
2. Supplies and services. Supplies includes such items as electrical circuit components, chemicals, biological specimens. Services might include computer costs, commercial chemical analyses, salary for a typist to prepare a long manuscript that cannot be handled in various departmental offices.
3. Salaries for scientific personnel. Most numerous people in this category will be undergraduate students. It is anticipated that most of the undergraduates so employed would work on a fuil time basis during the summer, but some students might well be employed on a part time basis during the academic year or even
3. Continued.
in the summer. Although it is important to us that this employment makes a useful contribution to the scientific education of our students, it is likely that potential supporters of our research will be more concerned with the accomplishments of these people on whom research money is being spent. Fortunately, there is already considerable evidence from first hand experience of some of our faculty (and many others elsewhere) that relatively inexperienced (but well-trained and well-motivated) undergraduate students can carry out significant research in some areas if they are given appropriate guidance.

It is also important that funds be available for postdoctoral research fellows. In addition to the direct and useful contribution these people make to specific research projects, they can also help us build a general atmosphere of scholarly activity in the entire university.
4. Some funds should also be available for support of travel to meetings, travel to collect specimens, or to use special facilities available elsewhere.

We hope there will also be support for some kinds of: "semi-applied" research that are not entirely traditional or currently fashionable in universities. More specifically, we would like to foster research in areas of contemporary significance to this part of the world and also to foster basic, fundamental research in certain fields of technology. An example of the former is an investigation of chinooks being carried out here by a physicist. An example of the latter is an investigation of kinetics of reactions involving calcium silicate. This research is a fundamental investigation of a particular system that is of great practical importance in cement chemistry.

\section*{APPENDIX 86}

\section*{SCIENCE POLICY FOR CANADA}

A BRIEF SUBMITTED BY

THE UNIVERSITY OF ALBERTA
to

THE SPECIAL COMMITTEE ON SCIENCE POLICY
OF THE SENATE OF CANADA


March 1, 1969.

\section*{Introduction}

The University of Alberta, acting on a letter from Senator M. Lamontagne, has prepared this brief for submission to the Special Committee on Science Policy established by the Senate of Canada. The procedure followed in preparing the brief was as follows.

A committee of senior faculty members was convened by Dean A. G. McCalla of the Faculty of Graduate Studies with the approval of President W. H. Johns and Academic Vice-President M. Wyman. Members of the Committee solicited suggestions and material from all departments in the university. The submissions from each major academic area - physical sciences, biological sciences, medical sciences, social sciences, education, engineering - were summarized by the appropriate member of the committee and a consensus of ideas submitted to the chairman, who then drafted the report. The draft was considered by the committee and this report, as submitted, is the result of the final consideration by the committee.

The Problem
A large proportion of the total funds available for research and development in Canada has been provided by the federal Government. It is clear from evidence already presented to the Senate Committee and from the discussions resulting from these presentations that it is generally accepted that Canada is not carrying on an adequate amount of applied research and development work, and that therefore the federally-provided funds are not being used to the best advantage. It has been concluded that expenditures on research have not resulted in the degree of innovation that should be expected from the investment. These conclusions are, in general, supported by the Report No. 4, "Towards a National Science Policy for Canada" prepared by the Science Council of Canada.

While most bodies and individuals who have appeared before the Senate

Committee have stated that basic research should continue to receive support, the statement is frequently accompanied by the comment that a much larger proportion of research funds must be directed to applied research and development. It is an easy step from this to the conclusion that too much money is now being spent on basic research.

Universities have traditionally been the source of a large proportion of very important discoveries as a result of curiosity-directed, or basic, research. Since the universities of Canada have been very dependent on the federal Government for research funds, any science policy on a national scale must provide adequate funds for university research which is basic in character. The advance of Canada to the level of a scientific nation of some international stature is largely the result of the early decision by senior officials of the National Research Council that research support for any academic scientist would be determined by his scientific stature and nothing else. Canada's best scientists responded to this challenge and have raised the quality of university research to a high level. Many distinguished scientists have been attracted to Canadian universities and these universities can now offer advanced graduate education as good as that offered by any other country.

The writers of this brief wish to make their position very clear. We agree that much more money must be provided for applied research and development but we also agree with Dr. Bladen(1) and with Dr. Bachynski(2) that more, not less, money is needed for basic research. It is our definite opinion that Canada must increase its funds for research and must attempt to get more research ideas carried forward through the applied research and development stages and on to the stage of innovation. This will require a larger proportion of research funds for these stages, but the actual dollars required should not, and could not, be obtained by reducing expenditures on basic research.

Obviously, we are most concerned with research carried on at Canadian universities. Much of this research is directly associated with the education programs of graduate students and therefore the funds available to support basic research directly affect these programs. The calendar of the University of Alberta states:
"The essential requirement for the doctorate is the planning and carrying out of research of high quality leading to an advance in knowledge in the candidate's field of study."

The candidate's chances of meeting this requirement are greatest if the research project on which he is engaged is fundamental in nature or has fundamental aspects. This does not mean that it cannot be directly related to problems to be solved or even be a part of a large mission-oriented program. But it cannot be a fully directed part of that program or the candidate becomes a glorified technician.

Universities must therefore develop their research programs as part of their educational programs. It will frequently be possible to make parts of thesis research programs fit into larger applied projects. An excellent example is the work done at the Universities of Manitoba, Saskatchewan and Alberta on the studies of the effects of rust, frost and excessive moisture on the production and quality of wheat grown in western Canada. Many graduate students carried on research for thesis purposes while working on the generally mission-oriented projects coordinated by the National Research Council and the Canada Department of Agriculture. It must be recognized, however, that most of the specifid thesis topics were concerned with basic research required as part of the major projects, and not with the specific development of new varieties of wheat or new processes of drying damp grain.

As we see it, then, the problem concerns the adequate provision, in Canada, of research support for all phases of research programs. The funds for such support must continue to be provided largely by the federal Government. If the funds for applied and mission-oriented research are to be directed to a limited number of Government-specified missions, then there must be adequate funds for complementary individual research and much of this will be carried on at universities.

Comments on earlier submissions to, and discussions with, the Special Committee.
Our committee considers it essential to comment on some of the discussions carried on at the Senate Committee hearings.

Dr. Schneider of the National Research Council presented figures on the number of Ph.D.'s in science and engineering each year for the period 1959 to 1968 and projected to 1973. (3) These figures for 1966 and 1967 are decidedly higher than those supplied to the Canadian Association of Graduate Schools (CAGS) by Canadian universities for degrees actually awarded. It seems certain, therefore that the NRC figures are too high and are probably based on the
forecast made by students and departments each fall.


The National Research Council projections of employment opportunities are based on existing programs. No account is taken of the staffing needs of technical institutes or community colleges. No account is taken of foreign students who return home.

Dr; Schneider recognized these factors and concluded (p.41) that the numbers of Ph.D.'s expected to be graduated are "not an embarrassment." Nonetheless, the figures shown on \(p .36\) have certainly been used to infer that Canadian universities are, in fact, overdoing advanced graduate work in the sciences. We wish to go on record, most emphatically, that we do not accept this. Certainly in most disciplines, we are still considerably below a desirable level if we are to staff the research effort that nearly everyone who has appeared before the Senate Committee agrees that Canada must mount.

Senator Lang, in the same report, p.41, referred to an article by Dr. Ernest Rudd (4) when he said, "it is strongly suggested that expenditures on pure science are not in the best interests of at least the economic development of any country --." Senator Lang said further that "--if there is any merit whatsoever in these observations -- perhaps the course the N.R.C. has been following in connection with the expenditure of public funds on pure science --- may very well have been a misapplication of funds."

First, we reject the "strong suggestion" in Rudd's paper, as stated by Senator Lang. Dr. Rudd is a sociologist at the University of Essex and his approach to the relative importance of basic science and engineering ignores completely the importance of basic research in providing the initial research results on which engineers act. We suggest that conclusions exactly the opposite to those reached by Rudd are fully documented in the report entitled, "Technology
in Retrospect and Critical Events in Science" (5). The conclusions of this study are listed in the next section of this brief. It is sufficient to quote here that:
"Ten years prior to innovation; i.e., shortly before conception, approximately 90 percent of the nonmission research had been accomplished." And "In all cases studied, nonmission research provided the origins from which science and technology could advance toward the innovations which lay ahead."

We think that Rudd's conclusions are quite erroneous on these points.
Main Argument
The principal thesis of this brief is that individual scientific creativity in Canada must be encouraged as an essential element of the total Canadian research effort. The development of a national science policy is essentially an attempt by government to channelize the creativity of its scientists towards the realization of preconceived national goals. A major factor in the successful growth of any nation is the maintenance of the collective creative vitality of its citizens at the highest possible level. Since true creativity does not easily conform to the transient political goals of a nation, excessive emphasis on channelizing this creativity may destroy it. As already indicated we support completely the demand that adequate resources be directed to research and development leading to innovations. All too often in the past, ideas which originated in Canada have been exploited elsewhere. You have had some of these drawn to your attention already. Let us cite just one more.

The discovery and isolation of insulin were done in Canada by Banting, Best, Collip and Macleod. Large-scale preparations of insulin were required for clinical testing and Banting initially applied to Canadian governmental and industrial resources for support but to no avail. Banting was invited to the Eli Lilly \& Co., Indianapolis, and the director of research offered to set up a pilot plant and to effect rapid industrial application of the insulin purification process worked out by the Canadians. Banting had no alternative but to accept, with the result that insulin became one of the biggest money-maker items for an American pharmaceutical firm.

Earlier, we referred to the document entitled "Technology in Retrospect and Critical Events in Science", (TRACES)(5). The summary includes 11 statements of fact and is as follows:

\section*{SUMMARY}

This investigation is based on the historical tracing of key scientific events which led towards five major technological innovations. The data collected were carefully analyzed. This study produced findings which not only substantiated some intuitively accepted beliefs but which also yielded some interesting points that shed new light on the very involved process which leads from research to innovation.
1. In all cases studied, nonmission research provided the origins from which science and technology could advance toward the innovations which lay ahead.
2. Of the key events documented, approximately 70 percent were nonmission research, 20 percent mission-oriented research, and 10 percent development and application.
3. The distribution by performers of key events was as follows:
\begin{tabular}{c} 
University \\
College \\
\hline
\end{tabular}

\section*{Nonmission research}

Mission-oriented research
Development and Application
\(76 \%\)
31
7

Res. Inst.
Gov't Labs. Industry \(14 \%\) \(10 \%\)

15
105483
4. The number of nonmission events peaks significantly between the 20 th and 30 th year prior to an innovation, while mission-oriented research events and those in the development and application area peak during the decade preceding innovation.
5. For the cases studied the average time from the conception to demonstration of an innovation was nine years.
6. Ten years prior to an innovition; i.e., shortly before conception, approximately 90 percent of the nonmission research has been accomplished; in so far as one can generalize from the results of this study, most nonmission research is completed prior to the conception of the innovation to which it will ultimately contribute.
7. Although nonmission and mission-oriented activities regress during the several years just preceding innovation, it is apparent that the interplay between these types of research activities is important and some-
times even crucial during this terminal period.
8. The presence of interdisciplinary communication is very evident in, and important to, the achievement of innovation.
9. The role of U.S. research has continued to increase relative to foreign contributions. However, foreign research continues to be important to innovation.
10. The study points out the need for a better understanding concerning the two-way interaction between science and technology. The tracings revealed cases in which mission-oriented research or development efforts elicited later nonmission research which often was found to be crucial to the ultimate innovation.
11. Innovations for the next generations depend on today's nonmission research.

These studies clearly indicate that university research played a very important role not only in the "origins" (basic research) leading to innovations but also in the mission-oriented research involved. Industry, on the other hand, played a minor role in basic research but a major role in mission-oriented research and a clearly dominant role in development and application. This, we believe, is exactly as it should be. Canada is now producing effectively in the fields of basic research but obviously very poorly in development and application leading to innovation. It is in industry that these aspects of research must be made much more effective.

We suggest that the Senate Committee might well study the capabilities of Canadian industry to act upon the results of basic and applied research. No science policy will be really effective unless Canada has the industrial capability and risk capital to carry research results through to innovation when this is justified.

Many of the submissions made to our university committee stressed the undesirability of drawing a sharp line between basic and applied research. Many university departments, particularly in the fields of agriculture, engineering and medicine are engaged in research aimed at solving specific problems. This is certainly also true in the social sciences and we shall return to some of the consequences and problems which result from this. Basic research may often have an obvious and immediate application while mission-oriented research must often,
of necessity, be very basic in character. Members of our Faculty supplied the committee with many examples, only a few of which can be referred to.
1. The basic research of Cohn and Edsall and their associates at Harvard led to the successful fractionation of the blood plasma proteins. The fractionation schemes developed from fundamental studies on the solubility and structure of the amino acids, peptides and proteins, and the application of purely fundamental methods for separation and purification. In retrospect, this work looks almost like applied research, so quickly were the results translated into practical application. Out of this basic research came vast quantities of serum albumin for the treatment of patients in shock; of \(\gamma\)-globulins for patients requiring immunization against certain diseases; of fibrin foam and film for use in neurosurgery; of isoagglutinins for blood typing; and of knowledge of the detailed nature of the \(\alpha\) and \(\beta\) lipoproteins and their roles in diseased states such as atherosclerosis.
2. The basic research of Enders at Harvard showed that monkey kidney cells, grown in culture, are capable of supporting the replication of poliomyelitis virus. Provided with this crucial information - and the system in which to produce vast quantities of virus - Dr. Salk and the Polio Foundation were able, in a very short time, to produce the first effective vaccine against this dread disease.
3. The present generation of computers must certainly be classified as an example of technology utilizing the results of curiosity-based research into the properties of the solid state. It is the use of the transistor which is one of the major advances in computer technology.

Earlier it was stated that the more applied faculties at the university carry on considerable applied research and scientists in these faculties all caution against drawing a sharp distinction among types of research.

The Faculty of Agriculture is directly concerned with the production and distribution of food at the international level as well as with the very important contribution of food and other farm products to national prosperity. Certainly these concerns fit into the goals cited by the Science Council of Canada as a framework for future policy. The departments in this Faculty believe that their major contribution is, and will continue to be, in the form of basic research into the fundamental laws which govern the production of foodstuffs for human consumption. Nevertheless, the capacity of the individual or small groups
of individuals to solve the problems facing agriculture will diminish. They therefore believe that individual research should be complemented by the development of multi-discipline projects. The university researchers should work together with government and industry on such projects. To some extent this is already being done, but continuous financing is not definitely and adequately provided. Agricultural scientists believe that graduate students can be effectively and efficiently educated in such a research environment.

The position taken by the academic staff in our Faculty of Engineering is somewhat different. The concluding statements of their submission are as follows:

22 "I trust these comments will leave no doubt in the minds of the committee that we give our wholehearted support to the essential philosophy expressed in the E.I.C. report and the Science Council Report No. 4. We favor an increased percentage of the Gross National Product in Canada being spent on research and development and we believe that a far greater percentage of this money should be directed toward applied research and development. We agree with the general principle that the research effort in Canada must be concentrated on certain priority areas or missionoriented projects which are of prime importance to the country, and we favor a relocation of much of the research activity currently undertaken by Government laboratories.

The final point I would like to make concerns semantics. We should be very clear what we mean when we are discussing the merits of basic research versus applied research, Basic research as used in this report is that it is a generalized search for new knowledge without application in mind whereas 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. Much of the work required for applied research or development is very "basic" and very "fundamental"."

They also state:
"Greater funding and greater emphasis should be placed on applied research and development in graduate schools and in particular in the Professional Faculties at Canadian Universities."

While part of the differences presented by various groups is due to differences in the use of terms, it is clear that the engineers wish to see more drastic shifts in the use of research funds than do many other groups. It is probably natural that the scientists in basic physical science fields do not entirely agree with the emphasis that the engineers put on the need to direct the research funds available in Canada to support a limited number of massive projects which, if successful, appear to the Science Council to have the best chance of bringing about improvement in our socio-economic position. The physical
scientist must protest that no one can say what basic research projects will be most important to the innovations of tomorrow, and therefore creative scientists must be allowed to carry out research in their own fields. (See Douglas, Science Forum (6).)

The medical scientists stress the need for major increases in research funds for the health sciences. Canada's position in medical research has recently been reviewed by 16 assessment groups under the auspices of the Medical Research Council (M.R.C.). The findings were published in two volumes in 1968(7). The major recommendations call for enormous increases in financial support, in the numbers of competent research workers, and in research space. Again, there can be no clear classification of research projects into basic and applied and the rapid utilization of basic research results in medical applications has already been stressed.

The biological sciences are intimately associated with developments in such areas as agriculture and medicine. A particular project might be called basic or applied simply on the basis of the description. Thus, one investigator said that his own basic research could be described either as, "The study of the morphology and physiology of chloroplasts and photosynthesis", or alternatively as, "The study of biochemical processes which use the sun's energy to produce the world's food." What more important potential application could there be?

Biologists are also very much concerned with fisheries, wildlife and the management of renewable resources. University biologists, in carrying out their responsibilities for training professional scientists are in a position to supply and direct the manpower required for mission-oriented research in ecology and resource management. Expenditures for research in such situations also become expenditures for education.

Canada has lost many of its most outstanding biological scientists to the United States because there was no adequate source of support to meet the offers made to these high quality scientists by American institutions. Our biologists are convinced that biological research has a most important role to play in improving our socio-economic position and that science policy must make adequate provision for its support.

There is a general feeling that specialists in the social sciences are working by themselves too much and that departmental organization must be modi-
fied if fruitful interdisciplinary research is to be done. It is also agreed that more funds are needed for all types of social science research.

Mission-oriented research projects in the social sciences will utilize the abilities of many specialists in different disciplines. Such projects, however, are almost certain to disturb different groups and individuals in society and very quickly run into resistence. Any recommendation to change our society draws fire from some quarter and the chances are that the more the recommendations aim at fundamental change, the greater the opposition from traditional or conventional social and political forces. For example the Hall Commision on health services used the services of many people in the social sciences, who carried out massive research studies. One of the recommendations, the provision of universal medical care for all Canadians, has met bitter opposition.

Industrialism (i.e. science and technology) has provided mankind with means undreamed of one or two generations ago. The process of material economic growth will go on so long as we make sure that a rising proportion of scientists, technologists and administrators is produced by our society. It remains for the social sciences to work hard on modifying social institutions to adapt them to the ever-changing environment and shifting power structures. The world of today is a better place in which to live than it was 60 years ago, and there is tremendous potential for a much better world in the future.

Education has a very important role to play in bringing about changes in our social structures. It is, in fact, a social science of greatest importance. Policies in Canada have resulted in very little support for research into elementary and secondary education. Research in these areas is just as important as in any other and a science policy that neglects this area will neglect one of the most important channels for educating people to accept and contribute to the social changes that will be required.

Many successful commercial companies have developed research organizations that recognize the importance of all levels of research and provide adequately for each. Such a company as I.B.M, has such a research organization and no one can question its success as a profitable company. We suggest that the senate Committee might well study some of the models of research and development used by companies now operating and competing most successfully in highly competitive technical markets.

Rudd (4) was quoted by Senator Lang as stating: "The purchase of know-how by a firm or a country can play a more important part in technological advance than the firm's or country's own research and development." This is certainly true if there is no really first-rate research going on in a country but this is not the case with Canada. Carried to its logical extreme, this policy would result in no one carrying on research or development and innovation and new production would quickly grind to a standstill. We therefore reject this idea as applied to Canada. On the contrary, we believe that to a considerable extent, innovation will be directly related to Canadian research results if our science policy provides adequately for the carrying of our best research results through from basic ideas to conception and application in production. We will, of course, use imported ideas, but to depend exclusively on them is to settle for mediocrity, and economic domination by other countries.

There are two further very important reasons why Canada cannot rely on imported know-how and technology. They have been mentioned by scientists in nearly all disciplines.

First, a nation cannot even use imported know-how unless it has a sufficient number of highly trained specialists. This is particularly true in some disciplines; e.g., Medicine. One example will illustrate this. The benefits of the artificial kidney cannot be made available in every hospital simply by buying the necessary machines. The application of this highly advanced form of treatment requires the presence of a specialized team and, at present, such teams are found only in those centers doing research in the field.

Second, our universities simply cannot recruit staff to discharge our teaching responsibilities if, as the Medical Research Council Report (7) says, "they are to be merely purveyors of knowledge rather than contributors to knowledge." Universities cannot provide the facilities necessary for education beyond the first degree unless they have access to large amounts of money for research. But they cannot be permitted to fail in the education of highly qualified scientists and scholars because continued advance in Canada depends to a great extent on these people. If, as we stated earlier, a steadily rising proportion of scientists, technologists and administrators is required to assure Canada's future, then our universities have a most important role to play in the successful application of any science policy that may be developed for Canada.

The University of Alberta has established and developed extensive research facilities in many disciplines, This development has been greatly helped by the provision of federal funds, but it must be recognized that the Province of Alberta has contributed large sums to provide buildings and to staff the departments with highly competent scientists. These resources must be effectively used and we believe that our university can continue to make substantial contributions to the scientific development of Canada.

We conclude by repeating that, in the best interests of Canada, individual scientific creativity should be used to its fullest and this means that there must be adequate support for curiosity-based research by our creative scientists. A science policy for Canada that would concentrate the research resources exclusively on a limited number of mission-oriented projects selected by government or government councils could easily discourage or destroy much of the scientific creativity - or else drive it from the country. Universities can contribute much to mission-oriented research but our research responsibilities demand that we have the resources to discharge the unique responsibility we have for the education of those who will carry on research in the future.

\section*{Respectfully submitted,}
J. S. Colter - Professor and Chairman, Department of Biochemistry
H. E. Gunning - Killam Professor and Chairman, Department of Chemistry
E. J. Hanson, Professor of Economics
S. M. Hunka, Professor of Educational Psychology and Director of Educational Research
A. G. McCalla, Professor of Plant Biochemistry and Dean, Faculty of Graduate Studies
F. V. MacHardy, Professor of Agricultural Engineering and Dean, Faculty of Agriculture
D. M. Ross, Professor of Zoology and Dean, Faculty of Science

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5. National Science Foundation. "Technology in retrospect and critical events in Science." Vol. 1, Dec. 15, 1968.
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7. Medical Research Council Report No. 8, "Canadian Medical Research, Survey and Outlook", September, 1968.

\section*{APPENDIX 87}

\author{
BRIEF \\ SUBMITTED TO \\ THE SENATE SPECIAL COMMITTEE \\ ON \\ SCIENCE POLIGY \\ BY \\ DEPARTMENT OF GEOLOGICAL SCIENCES \\ UNIVERSITY OF SASKATCHEWAN \\ REGINA CAMPUS
}

24 February,1969.
1. Rapid Communication of Information

A deficiency in the structure of science in Canada is the poor means of communication of information whose significance may be short-lived. In this respect, Canadian science tends to be an appendage of U.S.science which has available to it a variety of means of rapid dispersal of scientific ephemers.

General scientific journals such as "Science", disciplineoriented journals such as "Geotimes", a variety of newsletters, and the many regional meetings of national scientific societies in the United States provide the means for rapid spread of information. Such things as personnel appointments, grants in aid of research, new publications, reviews of growth points in science, comments on science by government and political leaders, job vacancies, and announcements of conferences are quickly made known to scientists across the United States and in other countries. It is, therefore, considerably easier for Canadian scientists to know of the needs and pressures of science in the United States than of the same things in their own country. Canadian institutions to some extent communicate to each other and to the world via American media.

On the one hand, the open-ness of science in the United States and the availability of its communications systems to Canada is an undoubted benefit. But, on the other hand, it does seem that a national science policy for Canada should include a better and more rapid means of information
dispersal than exists at present.
2. Research Emphasis

Without going into specifics of particular disciplines of science, it seems possible only to re-state certain truisms which the development of science in Canada already is taking into account.

Canada should maintain a broad spectrum of scientific research and development while at the same time emphasizing areas which are of peculiar interest to the Canadian situation. The northern geographical position, climate,size, available wealth, and degree of development of Canada indicate what those areas of particular interest should be. Canada has developed, and should continue to develop, points of excellence in fields for which this country either has unique opportunities or unique needs. These include northern hemisphere upper atmosphere studies, long distance data transmission, long distance transportation (including arctic transportation), natural resource development and its relationship to environmental spoilage, and arctic studies of all kinds.

\section*{3. Science Education}

Because of the Federal-Provincial constitutional relationship, science education presents a difficult problem. Nevertheless, a national science policy should take into account all levels of schooling.
a) Public Attitude Towards Science

The attitude of even the intelligent layman towards science is all too of ten one of disinterest,if not of aptipathy. Science and its technlogy have been fundamental in the creation of Canadian and world society. It seems most fortunate that what have been, on the whole, benign influences should not have attracted a better feeling from the ordinary man who is usually more conversant with history or literature than with any aspect of sciences. Presumably, grade school and high school education is not being effective in transmitting to students a proper understanding of science as a great formative influence in the world in which they live. Certainly, many young people arrive at university with an open hostility to science.
b) Sub-university Education

In light of the foregoing, it seems that greater national or regional efforts should be made to expand and improve science teaching in school from kindergarten upwards. Although the constitutional position is different in the United States, it is worth noting the success which the American National Science

Foundation has had in upgrading science teaching below the university level. A national science policy must surely lose much of its effectiveness if it is directed only at the highest levels of education and at research and development.
c) Universities

Federal, provincial, other governmental, and nongovernment support for university education and research is an accepted commonplace. It needs little comment except perhaps to note that more consideration might be given to support of undergraduate science in the earlier university years. Here again, the National Science Foundation in the United States has worked most effectively to finance a variety of projects including teaching aids, refresher courses for university teachers, re-equipping out-dated teaching laboratores, and high school teacher training courses. Canada could, perhaps, learn from this experience.

\author{
W.A. Gordon \\ Associate Professor of Geology
}

WAG:de

\section*{APPENDIX 88}

\section*{BRIEF}

SUBMITTED TO
THE SENATE SPECIAL COMMITTEE
ON

\section*{SCIENCE POLICY}

\section*{BY}

FACULTY OF ADMINISTRATION
UNIVERSITY OF SASKATCHEWAN
REGINA CAMPUS

February 25,1969

FROM: Robert E. C. Wagner
February 25, 1969 Faculty of Administration

TO: Dr. A. B. Van Cleave
RE: Faculty of Administration Submission to the Special Committee on Science Policy of the Senate of Canada

In this discussion, the general framework indicated by Senator Lamontagne in his letter of December 20, 1968 to Principal Riddell will be followed:
A. Recent trends in research and development expenditures in Canada as compared with those in other industrialized countries.

The simple but startling facts are that whereas the United States spends approximately \(\$ 112\) per capital on research and development, Canada's outlay is only \(\$ 37\) per capita. These figures are for the latest year available (1967) with total expenditures amounting to \(\$ 22.3\) billion for the U.S. and \(\$ 770\) million for Canada.
"A recent study shows Canada ninth of nine leading western industrial nations in percentage of \(R\) \& \(D\) performed by industry about \(45 \%\) compared with \(70 \%\) in the U.S. Moreover, Canada ranks eighth in percentage of GNP alloted to R \& D ....t2 Canada allocątes \(1.19 \%\) of GNP to \(R\) \& D whereas in the U.S. it is \(3 \%{ }^{3}\)

This gap,unless Canada makes a remarkable turnabout, is likely to get worse instead of better. All indications are that the new Nixon Administration is going to increase emphasis on R \& D.4, 5. Lee DuBridge, Nixon's science advisor, says that every possible measure

1
"Canada asks Industry into the lab", Business Week, December 28,1968. pp. 84-86.
2.

Ibid., p. 85.
3.

Ibid
4."Plugging the gap in R \& D grants to universities", Business Week February 15,1969, p. 63.
5. "Science agency gets more funds", The New York Times, Febryary 6,1969
is being taken to restore the cuts made by President John last year \({ }^{6}\).

It is instructive to note that many in the Canadian science community feel that the situation with, \(\begin{gathered}\text { egard } \\ \text { to } \\ \text { federal } \\ \text { funding }\end{gathered}\) of \(R \& D\) is getting worse not better., 8
B. Research and development activities carried out by the Federal government in the fields of physical,life, and human sciences.

The Canadian government supports R \& D in the amount of \(\$ 255\) million whereas the U.S.government spends \(\$ 14.93\) billion once again the U.S.is proportionately ahead of Canada on this account by a ratio of almost \(6: 1.9\)

It is worthy of note that the Canadian government does approximately \(35 \%\) of the R \& D whereas the U.S.government does only about \(14 \%\) of the total R \& D engaged in. Questions as to policy and organizational efficiency are obviously involved - the U.S.thinks that industry and the universifjes are better suited for the actual R \& D than the government.
"The support given to research in the social sciences in Canada has been totally inadequate. It represents only a small fraction of the support for natural sciences; it is smaller in relation to population and total income in Canada than in the United States.

6
"DuBridge to Seek Closer Ties of Government with Scientists", The New York Times, December 17, 1968, p. 30.
7
"The gloomy picture painted by Canada's scientists", The Globe and Mail, September 28, 1968.
8 "Canada has no science policy", The Leader Post (Regina), February 7, 1969, p. 18.
\({ }^{9}\) Business Week, December 28,1968 , op cit. This proportionate ratio, like all others in this paper, is determined by using a \(10: 1\) adjustment for the population difference between the two countries; i.e., with regard to this example, the absolute ratio is close to \(60: 1\) whereas the ratio adjusted for the population difference is \(6: 1\).
10
ibid.
and various other modern societies. \({ }^{111,12}\) Since Clark Kerr says that only about \(10 \%\) of government support to academic institutions for research goes to the social sciences \({ }^{13}\) (and the government supports academic research with about \(\$ 1.5\) billion) by extrapolation this means that less than \(\$ 15\) million must be available for such research in Canada.
C. Federal assistance to research and development activities carried out by individuals, universities, industry and other groups.

The following figure should prove enlightening. In 1965, the Canadian government supppfted research in the universities in the amount of \(\$ 57\) million \({ }^{4}\). In the United States, the federal government for the current fiscal year has allocated \(\$ 1.519\) billion to academic research. 15 Taking into account the population differences, this still results in a ratio of federal support to academic research favoring the U.S. condition by almost \(3: 1\). In this connection it is worthy of note that the total amount spent on academic research (in the United States) from all sources for the year ending December 31, 1967 exceeded \(\$ 3.0\) billion dollars".
\(11_{\text {Fifth }}\) Annual Review of the EconomicCouncil of Canada: The Challenge of Growth and Change. September, 1968, Queen's Printer, Ottawa, p. 53
\({ }^{12}\) See also The Social Sciences in Canada by the Social Science Research Council, May 1968,0ttawa.
\({ }^{13}\) Clark Kerr, "New Challenge to the College and University" in Kermit Gordon (ed.) Agenda for the Nation. The Brookings Institution, Washington,D.C.,1968, pp.237-276.
14 Fifth Annual Review, op cit.
\({ }^{15}{ }^{\text {"FFederal }}\) Budget", The New York Times, January 16, 1969, p. 24.
\({ }^{16}\) Business Week, December 28,1968 , op cit.

Federal supportfor university research in the United States has been growing at a \(15 \%\) rate compounded since 195317 Although it is unrealistic to think that this rate can be maintained indefinitely, such scholars as Clark Kerr, 18 Donald Horning \({ }^{19}\) (Johnson's science advisor), and Harvey Brooks \({ }^{20}\) (Dean, Division of Engineering and Applied Physics, Harvard University), think it should be the goal of the government for the foreseeable future. Dr. DuBridge is not sure whether the \(15 \%\) rate of increase can be maintained but is certain that the increase will not fall below \(10 \%\). 21 A 15\% rate of increase would double current \(R\) \& D in less than five years.

What is Canada doing to match this level of increase?
D. The broad principles, the long-term financial requirements, and the structural organization of a dynamic and efficient science policy for Canada.

The import of the parts A, B and C appears quite obvious to the Faculty of Administration. More money must be generated in the area of \(R\) \& D in general and in academic research in particular. To quote again from the Fifth Annual Review of the Economic Council of Canada,"in our view, no task may be more important to improving Canada's innovative performance than to strengthen the capabilities of Canadian management to understand and manage technological change and its innovative process. There are many routes to this end. One of the most rewarding is likely to be improvement in management education and training . . Along with this there should be an expansion of university based business research, as well as attention to improved systems of management development in Canadian corporations, governments and institutions."22,23

IT"Scientists on campus flunk in federal aid",Business Week January 4,1969,pp.86-89
18
Clark Kerr, op cit.
19
Business Week, January 4,1969, op cit. 20

Harvey Brooks, "The Future Growth of Academic Research: Criteria and Needs" in Harold Orians (ed.) Science Policy and the University. The Brookings Institution,Washington,D.G.,1968,pp.53-87.
\({ }^{21}\) The New York Times, December 17,1968 , op cit.
\({ }^{22}\) Fifth Annual Review, op cit., pp. 54.
23
See also The Professional School and World Affairs. The University of New Mexico Press,1968. This study emphasizes the need for education in the professions and indicates that we have been woefully neglectful in this area--particularly as it relates to world affairs.

Several of our faculty have been thwarted and frustrated in their attempts to secure funds for study in the areas of public, business, and health administration. The sparse amounts of money available from either internal or private research funds limits these as truly meaningful sources of assistance for long-range research projects. 24

It is meaningful to note that the one institution in Canada which has gained a national reputation for innovative research in the area of administration and the development of graduate programs in fields other than business is York University whose main financing has come through a grant of \(\$ 500,000\) from the Ford Foundation in New York City \(111^{25_{" 1}}\) interesting . . .

As far as management education is concerned, the latest figures available (for 1967-68 academic year) indicate that there were 16,354 MBA (or equivalent) degrees and 490 Ph.D. degrees granted from universities in the United States as compared to 341 MBA degrees and only one Ph .D. degree in Canada. \({ }^{26}\) The ratio again favors the U.S.by 5:1 for MBA's with the Ph.D comparison meaningless.

\footnotetext{
\({ }^{24}\) The Principal's Research Fund on the University of Saskatchewan Regina Campus amounts to \(\$ 10,000\) per year; the Banff School of Advanced Management Research Fund amounts to only \$10,000 in total; The Bronfman Research Fund also only had \(\$ 10,000\) available and The Institute of Public Administration of Canada's Research Fund amounts to \(\$ 20,000\).

25 "The closed loop", The MBA, January, 1969, p. 25.
26
The MBA January, op cit.
}

\begin{abstract}
One of our faculty members whose area of research is in manpower, labor and industrial relations indicates that he feels that Canada is at least two decades behind the U.S. in both the quantity and quality of research undertaken.
\end{abstract}

The goals of a science policy have been discussed and deliberated at great length on both sides of the border. Some excellent books are available summarizing these discussions. \({ }^{2 \gamma}\) As both the Economic Council Report and the Social Science Report indicate, one of the major problems of Canadian effort in this area is lack of coordination and communication as to what has, is, or might happen. As a result of this, it is highly recommended that the conclusions and recommendations of both these reports be studied carefully. \(28,29,30\) The rediscovery of the same problems and potential solutions by various sectors in our society, due to inefficient or nonexistent communication, is one of the most deplorable wastes of manpower immaginable.

Those who fear the advance of science and technology because of its effect on the human quality of mankind should be reassured by the preliminary results just released of a study by a group of Harvard University scholars. According to this group, modern technology, rather than dehumanizing the populace, has made western civilized man the most genuinely individual in all history. 31

\footnotetext{
\({ }^{27}\) See Agenda for the Nation; Science Policy and the University referred to above. The following books are also useful in this regard: Applied Science and Technological Progress: A report to the Committee on Science and Astronautics by the National Academy of Sciences, Government Printing Office, Washington,D.C., 1967; William R.Nelson: The Politics of Science, Oxford University Press, 1968; L.V.Bernner, The Scientific Age, Yale University Press,1964; Van Tessel and Hall (eds.): Science and Society in the U.S., The Dorsey Press,1966; Frederick Seitz: Science, Government and the Universities, University of Washington Press,1966; Boyd R.Keenan (ed.) Science and the University, Columbia University Press, 1966.
\({ }^{28}\) Fifth Annual Review, op cit. pp.29-61.
\({ }^{29}\) The Social Sciences in Canada, op cit.
\({ }^{30}\) Also see Applied Science and Technological Progress above
\(31_{\text {"Study }}\) terms technology a boon to individualism", The New York Times, January 18, 1969, p. 1 F.
}

\section*{APPENDIX 89}

\author{
BRIEF SUBMITTED BY \\ J.W.T.SPINKS, \\ PRESIDENT, UNIVERSITY OF SABKATCHEWAN TO THE
}

SENATE SPECIAL COMMITTEE ON SCIENCE POLICY

February,1969.

\section*{Introduction}

About a hundred years ago Newman expressed the ideal of the university as that of being a repository of knowledge and ancient wisdom and stated that the university fulfilled its duty if it kept this wisdom alive and handed it on from generation to generation. He thought that research was better done in academies and institutions and that, in fact, a good teacher was unlikely to have time to do research. However, universities, like other institutions, are subject to change, and nowadays the universities have as one of their major aims the extension of the boundaries of knowledge. It has even been said that for a modern university to stop doing research is to commit academic suicide. Similarly, in choosing senior staff one usually looks for the productive person, on the grounds that if, say, the head of a department is well known for his research he will be able to attract to him lively young men, and between them, the burden of teaching can be very well taken care of. One of the main objectives in teaching at the university level is to inspire the student to work and think for himself. Who can do this better than the man who is still actively contributing to the production of new knowledge? The nightmare of a president is to have unproductive heads of departments, for it soon becomes evident that, with an unproductive head, the whole department loses its interest in furthering knowledge, too. Universities have proved, for their part, to be ideal places for doing fundamental research; they provide time to think, an opportunity to work and talk with keen minds in other disciplines, the stimulus of contact with bright students, the lack of being prodded to some close and fiked goal.

An important development in the last decade has been the demonstrated capacity of the modern university to tackle problems in 'big science' as well as \({ }^{\text {'little science'. A much to be hoped for development would be a greater involve- }}\)
ment in 'big social science' experiments as well as 'little social science' experiments.

\section*{Graduate Studies and Research in a Modern University}

One of the dominant features of the modern university is the graduate school and the conscious search for excellence. Graduate studies are now so well accepted in the modern university that the writers of a recent report on graduate studies felt that they could start one chapter with the following sentence: "The Committee began its work on the assumption that graduate studies need no justification," and it is likely that no one would care to challenge this assumption. However, between agreeing generally with this assumption and agreeing to provide the rather staggering sums required for present-day graduate work and research at the universities, there may still be a rather large gap. Closing the gap by the provision of adequate funds is, in a sense, a political decision, since funds used for this purpose are not available for roads, social welfare and other desirable public ends. It is to help justify the closing of this gap that some further comment is presented on the paramount importance of graduate work and research to the provincial and national economy.

The first point to make is that not only is good research done by the universities, but a number of autonomous or semi-autonomous research groups have also found it profitable to establish themselves on university campuses.

There is now at the university an increased emphasis on graduate work and research; an increased emphasis on training people to take their place in research organizations, not only in the basic sciences, such as physics and chemistry, but also in medicine, economics, engineering and education; an increased emphasis on research for its own sake; an increased emphasis on excellence. All this is in keeping with the spirit of the new age -- an age characterized by change, an age characterized by towering intellectual achievement. Our young people must be brought up to be aware of the fact that we have much yet to learn and that, in
science at least, the only place from which to begin probing into the unknown is in the borderland of knowledge. In words attributed to Ashby:
> "Universities are traditionally places where research is to be found ...but...this is a very minor reason for requiring university teachers to advance knowledge. The main and compelling reason is that they cannot do the sort of teaching which is required of them unless they are advancing knowledge. Advanced work has to be done in the front line of schclarship. A student has to be led up to the 'no-man's land' between what is known and what is unknown. Now, the only kind of teacher who can be trusted to lead students to the frontier between the known and the unknown is a man who himself spends many of his thinking hours at that frontier. Only at the frontiers can man discern the anatomy of scholarship."

These same students must also be made aware that the world belongs to those who achieve -- not only in the launching of satellites, where a superior thrust due to a superior chemical puts the heavier satellite into orbit, but also in business, where the corporation with the best research group comes up with the most revolutionary ideas, whether it be in artificial fibres, such as arnel, or in the latest type of jet aircraft.

\section*{The Knowledge Industry}

Earlier, many of our best young men and women went elsewhere for graduate work, and no one was very happy about this. Obviously, some of the best graduates should be encouraged to go abroad to enrich their educational experience, but to allow this to become a general practice with ever-growing numbers, would mean that Canada was neglecting its responsibilities in the field of higher education. Progressively the country would lose many of its best brains and in the process lose its creativeness and independence.

Acceptance of this point of view has resulted in the growth of graduate studies and a much greater emphasis on research, both for its own sake and as an essential concomitant to teaching, in Canadian universities.

Kerr has summarized the matter very neatly:
"The basic reality for the university is the widespread recognition
that new knowledge is the most important factor in economic and social
growth. We are just now perceiving that the universities' invisible product, knowledge, may be the most powerful single element in our culture, affecting the rise and fall of professions, and even of social classes, of regions and even of nations... it has been estimated that over the last thirty years, nearly half of the national growth (of the USA) can be explained by the greater education of our people and by better technology, which is also largely a product of the educational system.

What railroads did for the second half of the last century and the automobile did for the first half of this century, may be done for the second half of this century by the knowledge industry; that is, to serve as the focal point for national growth. And the University is at the centre of the knowledge process.

The new connection of the university with the rise and fall of industrial areas has brought about an inter-university and inter-regional competition unmatched in history except by the universities and their Lander in 19th century Germany. Texas and Pittsburgh seek to imitate what California and Boston have known; so do also lowa, Seattle and nearly all the rest. A vast campaign is on to see that the university center of each industrial complex shall not be 'second best'."

Similar points are made by the Economic Council of Canada, in Towards
Sustained and Balanced Economic Growth and in the report put out by the Organization
for Economic Co-operation and Development, The Residual Factor and Economic Growth.
The importance of research in stimulating economic growth now seems so well accepted that in the United States at least, the doctrine is being advanced that for the well-being of the nation, centres of excellence should be somewhat more widely dispersed.

Quoting from a White House document, Strengthening the Academic Capability
for Science Throughout the Nation:
"Lyndon Johnson and his scientific and educational advisors have decided that basic research has too much impact on the university environment and surrounding geographic regions to permit it to be governed mainly in terms of the desires of its most successful practitioners.

Heretofore, money for university researchers was allocated with fairly strict adherence to the concept that science could be treated as an island in the academic setting. For the first 15 or so years of the postwar period, this concept was scientifically and politically useful, since a Congress that was skittish about supporting education. could be told that, in the interest of defence, public health, and other nationally accepted goals, the money was being used to buy nothing but science and that only the best science was being bought. Eventually, however, it became painfully clear that science could not enjoy unique prosper ity without affecting other parts of the academic setting, and further, that the
concentration of scientific capability at a relatively few universities was somehow related to regional economic prosperity."

In summary, then, graduate studies and research play a vital role in the proper development of this country and each province. Every effort must be made to ensure that they develop rationally and receive adequate support.

\section*{Research - National and Provincial}

The national aspects of research have been dealt with at length in numerous other briefs. Only matters relating to universities and the provinces will be dealt with here.

\section*{Coordination of Federal-University Research Interests}

The interest of the Federal Government in fostering research in graduate studies in the universities during the last half century is too well known and too well accepted to require further elaboration at this time. The universities are most grateful for the assistance given by the NRC, MRC and many government departments and agencies. They would not wish this assistance to be in any way diminished ...- in fact, they would like it to be very much increased. However, it should be pointed out that every dollar of research support received from outside the university usually implies the commitment of at least one dollar, in one way or another, from inside the university. The support is given to a large number of individuals, largely as a result of a policy of supporting excellence in individuals. This policy was all right when the numbers of people and amounts of money were small, but once the numbers of people become large and the amounts of money an appreciable proportion of the university budget a more conscious attempt to coordinate this method of support with the long range plans of the institution becomes imperative.

Thus greatly increased federal research support, both operational and capital, is required. In addition, the method of giving this support to ensure
that it is used in the best interests of the recipient institution and the province in which the institution is established, needs a thorough re-examination.

\section*{Federal-Provincial Liaison}

While the Federal Government has exhibited a lively concern for science and technology for the last century it is only within the last two or three decades that the provinces have started to show a corresponding interest. Most of the provinces now have a Provincial Research Council and there are the first stirrings of interprovincial coordination through informal meetings of Directors of Research Councils and through the setting up of such bodies as the Canadian Council of Resource Ministers. The Federal Government is gradually developing a policy with respect to science, as is evidenced by the recent establishment of the Science Council. However, even here the Federal Government has a long way to go before it has a reasonably well defined science policy. Here again we lag behind the USA which has long since recognized the powerful centralizing effects that modern science policy can exert. The President has well established mechanisms for receiving top level scientific advice and there are well established methods for raising the level of scientific competence of less developed parts of the country. A number of the provinces are now defining provincial policies with respect to science but it would probably be fair to say that provincial policies with respect to science are still in the formative stage. The role of the provincial research effort in the overall national research effort is still far from clear and to date no very obvious steps have been taken to integrate or coordinate provincial research plans with the Federal Government's grand design for science and technology. In a country the size of Canada more and not less coordination of effort is clearly indicated if Canada is to find its proper place in a world dominated by highly sophisticated technologies. Collective autonomy should be the slogan. Quite apart from the obvious economies to be achieved in areas such as library services and
scientific information retrieval it is only by making an optimum use of all its resources that Canada will be able to develop its full potential. It is strongly recommended that the Federal Government take immediate steps to strengthen its science policy making machinery and at the same time assume a leadership role in promoting a more effective courdination of the scientific efforts of the Provinces.

\section*{Health Sciences Research}

Much of what has been said about science generally could be applied equally to the Health Sciences. The advent of medicare is rapidly forcing the provinces into a systems approach to their health-care systems and makes them more easily able to adapt themselves to long-range federal plans.

Planning with respect to research and the execution of those plans would be helped by the early establishment of a Medical Research Council or a Health Science Research Council, reporting directly to a Minister of the Crown. The MRC might be expected to assume the responsibility for meeting national needs in health science research by supporting research in universities, other institutes and government laboratories. The importance of systems analysis or 'operations research' with respect to the optimum development of health care systems cannot be overemphasized.

\section*{Social Sciences and the Humanities}

Needless to say, all that has been said about science needs to be said still more strongly for the Social Sciences, the Arts and the Humanities, where even the bare resources are often pitifully inadequate, e.g. with respect to libraries, art galleries, concert halls, theatres, museums, etc., etc., and so forth! The start made in the 100th anniversary year to rectify some of these inadequacies needs to be strongly reinforced, and, here again, the Federal Government has a strong leadership role to play. It is strongly recommended that the Federal Government take immediate steps to strengthen its policy making
machinery with respect \(u\) the Arts, Social Sciences and the Humanities and at the same time assume a leadership role in promoting a more effective coordination of activities in the humanistic and cultural activities of the Provinces.

Regional Disparities.
There exist many examples of regional disparities in Canada. The northern half of the Province of Saskatchewan shows an accentuated regional disparity with respect to other parts of the country. An especial all out effort should be made to remove this disparity. The Federal Government, as establisher of the original boundary lines, has a clear responsibility in thisarea. It has been suggested that in line with the concept of organization for development, one or more regional Research and Development Institutes, charged with the specific task of accelerating the economic development of the region, might be set up. As they developed new industries or gainful occupations, the institutes might take on a teaching and training role,

What all this boils down to is this -- deeds not words are required -deeds of a federalistic kind where the whole assumes some degree of responsibility for the wholesome development of its parts. The deeds take place as a result of well developed long range plans respecting the future of our country -their implementation requires men and materials -- in other words -- a proper apportionment of resources, not a series of handouts to suppliant or clamorous beggars.

\section*{Coordination of Research Efforts - Intraprovincial}

\section*{(a) General}

Each of the provinces now does a considerable amount of research - partly within the universities, partly in industrial laboratories and research institutes, partly in provincial government laboratories. There does not seem,
however, to be any conscious effort on the part of anyone to ascertain what the total research effort of a given province is, or the degree to which the totai research effort meets the particular needs of the province. What is needed in most cases is a provincial policy with respect to research. It is of interest that the N.S.F. has recently provided a substantial grant for a pilot State Science Policy Study for the State of Tennessee. A similar study for one of the provinces in Canada would be well worth while.

\section*{(b) Interuniversity}

The coordination of research efforts in the sense of fitting in with the provincial needs and also of avoiding wasteful duplication of effort requires some form of interuniverșity coordination.

\section*{Coordination of Provincial Multiple University Systems}

The problem posed by the support of several institutions from the same public fund is certainly not a new one. Most of the Provinces of Canada have more than one institution of higher education receiving state support. All but two states in the United States have several, and some have literally dozens of institutions supported from the common purse. In Great Britain all the universities derive the major portion of their funds through the University Grants Committee.

Various patterns of governance have been developed for the coordination of such multiple university systems, each involving a certain minimal loss of autonomy. In return the constituent universities receive assurance that their basic programmes will be supported and that their more specialized or esoteric fields of study will be protected from competition; that capital grants will be made on the basis of inter-institutional agreements and that operating funds will be justly allocated.

The coordination of university research efforts within a province will be greatly influenced by the pattern of overall governance of the multiple university system. Broadly speaking, there are two main patterns; in the one, the universities coordinate their efforts in a voluntary system under a University Affairs Committee or Commission; in the other, there is a Provincial University to which all the university campuses in the province belong. This subject is pursued further in Appendix A。

\section*{Coordination of Graduate Studies and Research}

\section*{(a) Intraprovincial}

Coordination of graduate studies and research is in principle particularly simple using the one-university approach. Each campus has a College of Graduate Studies to foster and supervise graduate work at the campus level. There is, in addition, a University College of Graduate Studies which supervises work at the Ph.D. level for the whole University. The Dean of the University College is also Vice-President (Research) for the University and advises the Board on large research contracts. By comparison, promoting the advancement of graduate studies and research in the Ontario universities is undertaken by the Ontario Council on Graduate Studies, an affiliate of the Committee of Presidents of Universities of Ontario. The Committee of Presidents was formed in 1962 and relates to the Committee on University Affairs but does not, as far as can be ascertained, have any statutory status or authority. It is placing its faith quite firmly in a voluntary university system but is becoming increasingly aware of the necessity of 'collective autonomy'.
(b) Interprovincial

Coordination of higher educational activities has only just started at the interprovincial level through agencies such as the Association of Universities of the Atlantic Provinces and IPCUR for the Prairies. University

Iiaison at the national level, but not-coordination, takes place through the AUCC. In this respect Canada lags far behind such countries as the United States of America, where there has been, for a long time now, a very powerful Federal Agency for the support of Higher Education. Educational liaison at a rather more general level takes place in Canada through the recently formed Council of Ministers of Education.

These varied methods of coordination of university activities on the provincial and national scale are the first stirrings of what might be called a systems approach to Higher Education. We shall hear more and more of this as time goes on. Strong Federal leadership is imperative.

To date, Federal action with respect to Universities has been somewhat sporadic, not particularly effective and always too late and too little. The BNA Act is often named as the villain of the piece but this Act gives the provinces exclusive educational jurisdiction only "in and for each province". It leaves interprovincial and national education unmentioned and this gives the federal government plenty of leeway if it wishes to become more active in this area. In view of the overriding importance nowadays of a first-class system of university education, it seems hard to believe that some way out of the present impasse will not be found. A start has been made in the education office attached to the department of the Secretary of State.

\section*{Centres of Excellence}

There are, of course, a number of centres of excellence in Canadian Universities. The University of Saskatchewan has developed a number of areas of excellence - agricultural research, including soils research, nuclear research, upper atmosphere research, certain aspects of medical research and so on - each with a very large budget, mostly coming from sources outside the Province. These areas of excellence or centres of excellence require cooperative action among a
group of professors and support of them by the University and others outside the University providing much needed funds. It says a good deal for the adaptability of the University that it has accommodated itself to this aspect of the modern world and has, in fact, shown that the free atmosphere of the University is particularly conducive to the conduct of imaginative scholarly work not only by individual scholars but also by teams of researchers.

A long-range progran for the orderly development of centres of excellence in Canadian Universities is long overdue.

Federal Fiscal Transfers in Relation to Higher Education
The effects of the recent change in Federal policy with respect to University support by way of fiscal transfers are still being worked out. There is no doubt that they are having a major effect on University-Government relations. Discussion of the problem is made almost impossible by the almost complete absence of any discernible long-range policy and the absence of a group to develop such a policy or policies and give them some stability. The paucity of the Canadian effort in comparison with that of our neighbors to the south does not bear thinking about. The establishment of a powerful Federal office of Higher Education which might be expected to assume a leadership role is long overdue.

\section*{Summary. Towards a National Research Policy}

The development of an overall national research policy is particularly difficult for a country such as Canada, consisting as it does of a number of relatively powerful provinces held together constitutionally by the B.N.A. Act which was enacted at a time when research was completely unknown in Canada and higher education about equally so. Subsequent minor amendments to the Act have not recognized the fantastic twentieth century growth of research and higher education and the climate at the second Constitutional Conference held in February,

1969 was such that neither subject was even mentioned publicly let alone debated. However, this does not alter the fact that it is imperative that Canada develop an overall national research policy. About ten years ago, the U.S.A. adopted the device of having a 'Scientific Advisor' to the President -- Great Britain has had a Minister for Science, now a Minister for Education and Science. Just recently in Canada, we have seen the establishment of a Science Secretariat and a Science Council, the latter to advise on high level Science policy. What has become painfully obvious has been the absence of what one might call scientific statesmen, or better 'statesmen scientists', to give leadership in this area of national life. A recent study of the O.E.C.D., 'Towards a National Science Policy', emphasizes the same lack.

From what has been said about the important role of the Universities in the total research picture, it becomes equally urgent to develop policy with respect to research in the Universities. Here coordination is required (a) at the Provincial level to see that there is no unnecessary or wasteful duplication of effort and that major Provincial needs are met and (b) at the national or interprovincial level to see that again there is no overall unnecessary or wasteful duplication of effort and that major national needs are met. All of which is equivalent to saying that there should be a systems approach to research in the universities. As senior partner in the operation, it would seem advisable that the Federal government take the lead in fostering such a systems approach. If this is politically quite impossible, the committee of Provincial Premiers should be urged to undertake this important task

The Role of the Universities in Research - Towards a Systems Approach

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Coordination of provincial multiple-university systems
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\section*{APPENDIX A: COORDINATION OF MULTIPLE UNIVERSITY SYSTEMS}

In the United States two forms of governance have emerged as the most satisfactory and successful. The first and simpler of these provides a State Board of Regents (in some states called Board of Higher Education), which receives and coordinates the budgets of the individual institutions and submits the combined budget to the Governor of the State for inclusion in his budget message to the Legislature. The Board receives and acts upon the proposals of the individual institutions for the initiation of new graduate programmes, new departments, new degrees, professional schools, institutes, study centres, and so forth. It is to be noted that the authority of this Board covers only those areas that are of importance to the State and the educational community as a whole. It does not concern itself with the internal operation of the various units; faculty appointments and promotions, curricula and courses of study, and so forth. This form of coordination is now well established in Michigar, lllinois, Ohio, Kansas, Texas, and Florida, and is in the process of establishment in Pennsylvania, Georgia, and several other states.

The second pattern is more complex, much more sophisticated and much to be preferred because it provides for the active participation of the university faculties in the governing process and maintains an open line of communication from the institutions to the state government. It consists of the establishment of a State University of which all existing and all future publicly-supported institu:ions in the state are constituent members. It has well-defined fiscal and academic powers established by statute or by constitutional amendment but preserves a maximum degree of autonomy for each of the constituent universities. At least two of these state systems have operated successfully for very many years. The State University of New York was chartered in 1781; its Board of Regents was established in 1897, and it became a multi-campus university by Act of Legislature in 1948. It now consists of seven universities and 22 colleges. The University of California was chartered in 1868; its Board of Regents was
established by the State Constitution of 1879, and it became a multi-campus university in 1919. Today it includes nine universities and three affiliated colleges. Among the more recently established state systems is the one in Missouri, which now operates four universities with several more about to be added.

During the last ten years the University of Saskatchewan has changed from being one campus to two essentially autonomous campuses whose operations are coordinated by a modified California - SUNY type of organizational structure. The University hopes in this way to achieve the 'Collective Autonomy' spoken about by the Presidents of Ontario committee in their second Annual Review.

\section*{University of Saskatchewan}

The University of Saskatchewan is governed by the University Act, 1968. Its affairs are managed by a board of management called the Board of Governors of the University of Saskatchewan. The University of Saskatchewan has at present two campuses, one located in Saskatoon, with approximately 10,000 students, the other in Regina, with approximately 4,000 students. Each campus is presided over by a Principal who is the academic and administrative head of his campus. Each campus has an academic Council, to determine academic programmes, and a Finance and Personnel Committee to determine fiscal programmes. Academic programmes are coordinated by the Board of Governors of the University of Saskatchewan which is, effectively, the Board of Management for the whole University. Interposed between the General University Council and the Board is the Senate, a mixed academic-lay body, which acts as our 'window on the world'.

\section*{Coordination of Effort}

Coordination of business from the two campuses and discussion of matters common to both takes place in the first instance in a University Executive Committee. The two Principals are members of this committee together with the Vice-President (Planning), the Vice-President (Research), the Controller and Treasurer, the

President, and the University Secretary aided by the Director of Planning. The present structure allows for the largest possible degree of decentralization of authority and in line with this, each campus will have its own institutional research group, to keep its operations and procedures under constant review, rather than having a gargantuan overall review group. It is realized that this method of coordinating a multi-campus operation differs from that practised in a province such as Ontario, where there is a University Affairs Commissior, but we feel that our method keeps matters in University hands while at the same time striving towards optimum use of scarce resources and funds. Where a number of universities have existed for some years side by side in a province, in the complete absence of any coordinating mechanism, there has been an understandable reluctance to give up any previously held freedom of action or independence. Under such circurnstances any form of coordination appears intolerable and only to be submitted to as a last resort. We were perhaps fortunate that we started our dual campus existence in \({ }^{\mathbf{t}}\) double harness' \({ }^{\text {' }}\) and so did not have to be bludgeoned reluctantly into it.

A good deal of time has been spent on the governance and administration of the University since there is much misunderstanding about it. It bears repetition that while faculty and students determine in large measure the academic excellence and reputation of a University, there is no doubt that the smooth running of the University and the establishment of the desired reputation is greatly helped by a suitable 'mix' of academic knowledge and administrative skill. The operation of a large university is nowadays such a complex affair that in the absence of good administrative practices it would quickly become a shambles. It is to be remarked that the continuous monitoring and upgrading of administrative practices is helped by discussions initiated by C.A.U.B.O., the Canadian Association of University Business Officers.

\section*{University-Government Relations}

Relationship with the Government becomes increasingly important day by day. The University was originally established by act of the legislature and the University is responsible in the first instance to a Minister of the Government. It is also almost entirely dependent on the Government for its revenues and must each year justify its requested budget to the Government which subsequently approves, by legislative vote, a grant to the University (actually two grants; one operational, one capital). The University grant now forms an appreciable fraction of the Provincial budget and thus comes into competition with other public needs. The situation is aggravated by a rapidly rising budget resulting from rapidly increasing numbers and a certain inevitable escalation due to increase in cost of living. The situation is not, however, hopeless, since governments depend to an increasing degree on the universities. The well-being of the public depends to an ever increasing degree on an adequate supply of doctors, lawyers, dentists, teachers, agriculturalists, etc. etc., and so forth, and to an increasing degree on the researchers, the producers of knowledge. In the Western World the producers of knowledge cone mostly from the universities who thus play a key role in our modern society. At the University of Saskatchewan we meet this public obligation by having practically all the customary faculties, except architecture, and a reasonably large graduate school.

While the Provincial Government does not interfere in the internal affairs of the University, it is not unlikely that the maintenance of this state of affairs is dependent in large measure on the degree of responsibility shown by the University in responding to the larger needs of society.

\section*{Division of Available Provincial Funds}

In a number of provinces, the division of available provincial funds
is made by a conmittee or a commission, based on the pattern of the British U.G.C., e.g. in Ontario, the University Affairs Committee. In Saskatchewan the division of available funds is made by the Board of Governors on the recommendation of the University Executive Committee. This aspect of our operations is still in the developmental stage. The success of a multi-campus operation is probably very largely dependent on the wisdom with which available funds are distributed.

\section*{APPENDIX 90}

Brief to the Special Committee on Science Policy of the Senate of Canada

\section*{Presented by}

The University of Calgary
A.W.R. Carrothers President and Vice-Chancellor
\[
\begin{aligned}
& \text { "You cannot have a clear, dictated science policy un- } \\
& \text { less it is dictated by God . . What with the naivete } \\
& \text { of the natural scientist, the arrogance of the econo- } \\
& \text { mist, the ignorance of the politician, and the super- } \\
& \text { iority and complacency of the general bureaucrat, there } \\
& \text { isn't a hope in hell of getting an integration (of } \\
& \text { science policy with economic, social, defense, and } \\
& \text { other policies), and this is the situation we're in." } \\
& \text { - Alexander King, Director } \\
& \text { Scientific Affairs } \\
& \text { Organization for Economic } \\
& \text { Cooperation \& Development }
\end{aligned}
\]

\begin{abstract}
It is perhaps appropriate to quote such a pessimistic viewpoint in introducing a Brief purporting to address itself to the vexed and complex question of establishing a National Science Policy. There can then be no feeling of "let down" if the conclusions reached and the recommendations advanced lack definitiveness or practical detail. The consequences to the Nation, however, of pursuing a policy of scientific endeavor which is, in essence a non-policy are almost as dangerous as those of overstructuring our scientific endeavors and trying to play the role of God in second guessing the future creativity of our fellow men. We must therefore seek the compromise. Not necessarily, in this case, because a compromise is the only solution that could be imposed but rather because, by virtue of our ignorance, such a middle road is the only one that we dare follow. We must keep our options open lest we be damned by future generations for our short sightendness.

This Brief directs its attention to a number of the general terms of reference of The Special Committee on Science Policy but more specifically voices the concerns and the views of a University which, although relatively new, is well established in research. Many of our problems are those also of older and larger universities but some are peculiar to our particular stage of development.
\end{abstract}

\section*{Research Support and How it Should be Provided}

Research in universities is not only an essential feature of the established educational and intellectual activities of such institutions but is, equally, essential to the national well being and the economic and cultural development of the country. If this national role is recognized then there can be no question of the propriety of federal assistance to research. It is at this point that we must consider the relative roles of Federal and Provincial governments for this has a direct bearing on how the federal assistance should be provided. Provincial governments have, by their very mandate, primary responsibility for the development of provincial interests. They cannot, therefore, be faulted if in their enthusiasm to achieve these ends they tend to favour provincial needs over national ones. If federal assistance to research is provided in recognition of the national role played by university research then it is clear that such federal assistance must be provided directly
to universities and not through the intermediacy of regional government. Effective research support involves the overlay of federal grants to individual researchers on the institutional grants of the regional governments.

If such assistance is to be provided directly to universities how best may the Federal Government assess the relative need and administer the program? We believe that Canada is already well provided with appropriate mechanisms to achieve this task although improvements are needed. The National Research Council, the Canada Council, the Medical Research Council and numerous more "mission oriented" federal granting agencies are already playing an important role in assessing and administering research aid to universities. They should not be replaced or relegated to a subordinate role by the establishment of some super ministry. Rather should their role and their means to support be strengthened. It is for their future guidance that any Science Policy statement should be prepared. The National Research Council and the Canada Council, in particular, have laboured long and hard to establish viable relationships with the Canadian university system and these hard won benefits should not be swept aside by the stroke of the policy pen. Admirable though these present institutions may be, what are their faults?
a) We recognize that each in its own sphere serves a different research interest and consequently differences in administration policy are necessary. Overlap in the operating fields of federal granting agencies is essential to guarantee a fair hearing for all research proposals, to eliminate or at least minimize personal prejudice and to ensure that research in interdisciplinary areas is supported. The universities, however, each have within their structure academic research units which are supported by the different agencies. Accordingly, it is at the university receiving end that the differences in agency policy are most troublesome and noticeable. We urge that such major policy differences in both assessment and administrative procedures be reviewed.
b) One of the best examples of the impossibility of producing a definitive Science Policy at the national level is our inability to foresee the development of new interdisciplinary areas of research endeavor. A number of these developments, particularly those which straddle the imaginary boundary between the human and the physical and life sciences, tend to fall in the no man's land between the existing granting agencies. Much has been done in recent times to improve the communication between the various federal agencies, particularly between NRC and MRC and between NRC and Canada Council. Even among these major agencies, however, much still remains to be done. They should be encouraged rather than discouraged to provide overlapping research support to ensure that all areas of research endeavor are encompassed. In the area of the "mission oriented agencies" (DRB, Forestry, Agriculture, Fisheries, Geological Survey, AECL, Manpower, Health and Welfare, Industry, etc., etc.) however, the extent to which proposals for research assistance are exchanged is minimal. Much effort and money is wasted in the process by virtue of duplication and eventual frustration on the part of both the university and the agency. We urge that a
more efficient means of communication and interchange of research ideas between federal agencies be established.
c) The concept of annual research grants to researchers is still prevalent among most major federal granting agencies. This policy, while administratively more convenient in view of the annual nature of government appropriations, fails to recognize the increasing complexity and long term nature of fundamental research. We urge that some method be devised to permit longer term commitments for research assistance with appropriate safeguards to allow termination of non-productive projects and to cover inflationary trends during the lifetime of the commitment.
d) Researchers of the immediate future are the graduate students of today. If a national Science Policy is to stand us in good stead for the future it must include generous provision for the support of these "researchers in training". There is a particular need for much improved student support either in the form of direct scholarships or assistance through research grants to established workers. The present level of support is barely adequate in the physical and life sciences and completely inadequate for beginning students in the human sciences. We urge that in any Science Policy statement there be adequate and flexible provision for the support of these "researchers in training" and their research. Specifically, we suggest that there be greater flexibility in the administering of awards to students assisting the research of faculty members with particular reference to the Humanities and Social Sciences. In these areas some of the existing rules governing Canada Council awards are overly restrictive, requiring differential salary scales as between summer and regular employment and not giving the individual faculty member the right to waive such rules. The lower rates prescribed for regular employment periods, in effect require that the full-time graduate students be supported from other sources, and this generally requires a reallocation of internal university funds which, for a variety of reasons, is not infrequently academically and administratively undesirable.
e) The Bladen Commission recommended that serious consideration be given to some modest form of "overhead" to universities associated with research grants from federal agencies. While it may never be specified in any formal accounting every time a university accepts a research grant from any source, it is committing a sizeable sum from its own resources in the form of hidden "overhead costs" associated with the project. It may be argued that in most public institutions these so called "university resources" are also public funds but they are provided primarily for educational purposes and not research. While it would be unrealistic and potentially dangerous to assume that real costing of overhead on research grants could be provided with the grant, as is common in the United States, some form of modest assistance seems little enough to ask. This situation becomes extreme in the case of research contracts with certain federal agencies where, even here, overhead allowances are not permitted. We urge that in the case of all federal contract research with universities real
overhead costs be provided for within the contract and that in the case of research grants-in-aid some modest overhead assistance be provided.
f) Research today in all fields means data-processing costs. These can be staggering and are not likely to diminish with time. While the major federal granting agencies have long recognized the real extent of these costs, they have not been in a position to do much more than give token assistance. Many universities carry an inordinately large share of the real cost of research data-processing. We urge that a national Science Policy address itself directly to the problem of coordination and consolidation of computer facilities in the nation with a view to providing every qualified university researcher and educator with access to required computational facilities.
g) Today's productive research is in large part based on the preliminary findings of the workers of yesteryear. Access to their data is therefore essential; this requires libraries and improved data retrieval systems. The automation of libraries is imminent. The integration of libraries into data retrieval centres will alter traditional concepts. None of the federal granting agencies have done more than offer token support in this area despite the essential nature of this element in the research projects which they support. Interest in this problem is currently high across Canada (vide Downs' Report on University Libraries 1968) and the time is ripe to set the policy which will determine the development of these essential Canadian resources in the 70 's. We believe that the federal government must recognize its national role in providing major assistance through its agencies for the development of this invaluable national resource. We urge that any Science Policy clearly define the federal government's role in providing the future libraries necessary for effective and efficient research in Canada.

The Broad Principles of Science Policy
Science Policy presumably covers scientific research. A policy presumes the existence of goals. Achievement of these goals constitutes a mission. Mission-oriented research?

Report No. 4 of the Science Council of Canada, "Towards a National Science Policy for Canada", made much of "mission-oriented research" but, alas, nowhere did the Report define the term. "Basic or Fundamental Research" and "Applied Research" were appropriately defined and we can only assume that "mission-oriented research" is something else again. Assumption, however, is no substitute for assurance in a matter so vital to university
research. Universities have traditionally guarded their right to the unencumbered pursuit of knowledge for knowledge sake with such fervant jealousy that even the hint that Canada's National Science Policy will swing heavily in favour of mission oriented research raises every academic hackle in sight. In our understandable enthusiasm to direct our national research effort to the solution of current social and economic problems let us, however, not
forget that the reason why we can even contemplate such a move is that there currently exists a modest cadre of trained researchers to be turned to the task. What set of circumstances led to the existence of this cadre? Are they the result of a couple of decades of a mission-oriented Science Policy in Canada? The answer is clearly negative. Since the end of the Second World War and with increasing impetus Canada has engaged in a rapid build-up of training facilities for researchers based on the concept of free enquiry and broad, generalized higher education. We do not suggest that at this stage in our development there is no place for mission-oriented research or that this is not the time to place increased emphasis on this presumably hybrid activity midway between basic and applied research. As members of the university community, however, we must caution against over-emphasis lest it be interpreted by those charged with executing the Science Policy as a downgrading of the importance of fundamental research. We may appear oversensitive in this regard, but enthusiasm for fundamental enquiry is a frail flower difficult to nurture but easy to destroy. We urge that any statement of Science Policy define clearly the meaning of missionoriented research and establish beyond any doubt that no form of research can thrive without the continued healthy growth of unencumbered fundamental enquiry in both universities and selected federal and corporate institutions.

Recently the government in the United Kingdom has attempted to impose a "mission-oriented" scientific research policy on the universities and technical colleges of that nation. The object of this policy was to encourage industry to modernize its technology and to design and manufacture sophisticated products so that it could compete more effectively in the world's markets. This policy has been a dismal failure and has accelerated the rate at which the "brain-drain" from the U.K. has been occurring. Canada has been one of the beneficiaries of this drain with the favourable effect of completely counteracting our own "braindrain" to the United States. It is easy to conclude that Canadian science policy, which places a similar emphasis on "mission-oriented" research, would be disastrous, since it would accelerate the "brain-drain" outflow to the United States while decelerating the inflow from the U.K. and elsewhere.

There is no inherent reason why universities should not engage in missionoriented research. Indeed, many now do. The promotion of mission-oriented research is essential to the future development of Canada. Furthermore, missionoriented research programs, if properly selected, can fulfill a vital role in the training of graduate students in professional faculties such as Education, Engineering and Business. Research projects suitable for the training of graduate students should be chosen so as to emphasize and encourage the intellectual development of the student. There is a danger that graduate students are employed as cheap technicians when they become involved in mission-oriented research. Mission-oriented research does not necessarily contravene the academic credo provided it does not become the master in the house. Care must therefore be exercised in the relative proportions of federal funding provided for the support of fundamental as opposed to mission-oriented and applied research in universities.

We urge that those federal agencies currently engaged primarily in the support of fundamental research continue to be generously funded while those missionoriented federal agencies receive additional funds specifically to support mission-oriented research in their specific areas of interest, both in house and through their university support programs.

Like all other seekers after coin from the public purse, we have been seeking more! As this nation develops there can be little question that her endeavors in physical, life and human science research will continue to represent a larger and larger drain on the public purse. The federal contribution will not be exempt from this escalation and the projections may well appear frightening to those who have grown accustomed to our dependence upon importation of innovation and invention. Nonetheless, it is not unreasonable for those who foot the bill to expect at least a modicum of efficiency in the manner in which their dollars are spent on this apparently insatiable yet unplanable activity called research.

The freedom to engage in fundamental enquiry, so precious to the academic, frequently finds itself extended to mean freedom to research on anything at any time by anybody anywhere. It goes without saying that adoption of this policy quickly produces astronomical projections of future costs. Our point is simple and not a new concept - - the intriguing but politically hazardous concept of Centres of Regional Excellence. We are particularly sensitive to the implied limitations imposed by such a concept being as we are a relatively new university. We are only too conscious of the argument (often fallacious) that it is cheaper and safer to build new excellence on existing excellence than to break new ground (1iterally). Unqualified acceptance of this argument would generate a vicious circle of non-success. Only flourishing research centres attract the greatest degree of support; generally researchers of repute are attracted primarily to those institutions offering the greatest degree of research support; and in general, it is only those institutions which already have researchers of repute that are considered to be flourishing. This leads, almost invariably, to the consequence that embryonic institutions or departments never attain maturity. Nonetheless, it requires something less than a realistic outlook to argue that proliferation and multiplication of complex and expensive research installations can be permitted without a resulting unacceptable level of inefficiency. We have previously cited examples of such complex and expensive installations - libraries, computer facilities and it requires little imagination to expand this list to include many modern nuclear research machines, space research facilities, and an ever growing array of modern scientific research equipment with unit costs in excess of \(\$ 100,000\). There appears to be no truly compelling reason why such major facilities should not be located at appropriate centres across the nation provided that they are operated on a service basis and available, without preference, to all those researchers qualified to use them. A further argument in favour of their maximum utilization is the rapid rate of obsolescence
of such installations. They should not be duplicated unless a sound rationale exists or develops.

Centres of Regional Excellence do not necessarily have as their focal point some particularly sophisticated instrumental facility or collection of data. The geographical regions of the nation provide us with a wide diversity of environments and resources upon which Centres of Excellence may be based. These predominant regional characteristics should also provide a guide to the location of appropriate research centres and should be identified as having special priority in a particular field for federal research support, irrespective of the fact that there may be older, well established research centres. That is, our concept of Centres of Regional Excellence envisages not only, nor necessarily, building upon existing strengths but includes recognition of the need for the creation of new research centres, where, for a variety of reasons, it is predictable that such new centres should eventually surpass in excellence, presently existing centres.

The concept of Centres of Regional Excellence should not be allowed to encroach upon the need for financial support of basic levels of research endeavor at any institution. Universities are, by definition, concerned with all aspects of knowledge and they must be free to follow any direction that their enquiries may suggest. This requires a basic minimal level of support but does not necessarily imply that the more complex and sophisticated paraphenalia of research be provided on each and every campus. Such advanced facilities need only be freely available to the researcher at some central location.

We urge that the concept of Centres of Regional Excellence be incorporated into any statement of Science Policy together with adequate definition of the factors which should be considered in arriving at a decision regarding location and with due regard for the limitations that must be observed in applying concept.
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\section*{APPENDIX 91}

BRIEF TO THE SPECIAL SENATE COMMITTEE
ON
SCIENCE POLICY

\section*{Submitted By:}

\section*{Stephen Watson}

Randy Cormack
Michael Marr
Marty Rosove

Grade VIII Students of
1720 Fleet Ave.,
Winnipeg 9, Man.
1. We propose that the committee must become aware of the necessity for changing the concept of "Text-Books" at the Junior High Level of Science Teaching.
2. We further propose that the committee should recommend in its findings that science be taught in an up to date context through the use of pamphlets or science papers.

We also propose that Science text-books in Canada be issued through a central Federal Government Agency.

Sirs:
We would thank you for the opportunity of presenting this brief before such an august body of lawnakers. We present this brief in the belief that we as students are missing out on some of the most exciting developments in science in perhaps one of the most productive scientificeras of all time simply because our present science text-books are inadequate. We would go further and say that the present standards of science education in the school today are almost stagnant at the junior high level.

We are sure that the gentlemen of this committee realize that this is the time of our lives thai our curiosity is the greatest, that our thirst for knowledge is unsatiable, that our desire to know what's going on, and why, is excessive. But what are we faced with? Right now; at this very moment our science text book is over 30 years old.

We realize of course that text books and education are "Provincial matters". But then, gentlemen, we also realize that you are representatives of the Provinces, and perhaps, in the long run the senate will be the central agency of. 'affaires provincial'. Perhaps it is already.

Our inquiries among teachers, students, and parents, our research in educational journals and teacher magazines etc reveal, without a doubt, that the science text does not fulfill our needs in this rapidly changing world.

We are told that scientific knowledge has doubled since 1960. Te are told that we only learn such a small part of the knowledge that is available. We are also told that our lack of current basic scientific knowledge will in a year or two be the despair of our high school science teachers.

Obviously then, we need more preparation for the intensive science courses we will encounter in high school.

We know that fortunately, our text book will change. We do not wish to deal with the contents of any text book as such, knowing that any contemplated text-book takes at least five years to reach the student. What we are concerned with though, is keeping the content of science courses more up-to-date.

Our research leads us to conclude that there is a current belief in education that keeping science texts "up-to-date" is too costly for the taxpayer s of our country. This belief is erroneous.

In our preparations for, and discussions of, this brief, we asked ourselves the question "How can a science text book be kept up to date economically?" We concluded, it cannot. le even wondered why the present hard covered books could not be replaced by paper-backed editions. It was suggested that this would not find too much favor with the text-book makers.

To keep a text book up to date would need the expenditure of much money and require considerable 'instant' research. Ye investigated many alternatives, and our main proposal concerns the use of what to us appears very feasible, and entirely economical. We refer to the use of science papers (multi-paged pamphlets) in place of science text books. These science papers, or pamphlets, or however they may be titled, would be published monthly by an organization such as the National Research Council and the distribution financed by the Federal Government in cooperation with the Provincial Governments.

At the beginning of each year, every student would be issued a hard covered pressure binder in which to keep the science papers, notes, newspaper clippings etc. Each pamphlet could contain self-testing tests, suggested references; and basic scientific knowledge. It is strongly suggested here, that this basic scientific knowledge be facts and not the "history" of science that seems to be in vogue in present day text books. The format of these papers would basically be the same each year, but would be revised to include current facts.

What we have in mind, is perhaps best illustrated by using the attached sample of an American publication, "Current Science". There are eight pages of up to date material, including pictures, articles, and tests. It is published weekly. The price is \(\$ 1.35\) a school year or 40 (forty) issues. The price undoubtedly could be lowered with country-wide distribution.

We are suggesting that a similar type of format be issued on a monthly basis and would encompass twenty-four to thirty pages. This would seem to be a reasonable amount to study each month. It is of course forsecable, that sentire issues of the American publication could be included in the above proposed Canadian publication.

What the actual cost of producing the suggested pamphlet would be, could not be determined with too great an accuracy. Each pupil would of course retain his "text book" at the end of the year; but although this might seem expensive, it really only adds to the attractiveness of our proposal. All students need reference books; and what better one could you have than the above.

At the same time we know that our present text book costs \(\$ 3.62\). It has a life expectancy of approximately three years. Three years of "Current Science" would cost only \(\$ 4.05\). It contains up-to-date material.

To sum up we would like to present our personal thoughts on our proposal. We feel the Science Papers would
(1) provide more interesting information;
(2) allow a more imaginative approach to science teaching.
(3) give the teacher and pupil more scope and flexibility
(4) encourage more self discovery and delving by pupils
(5) better prepare us for the future

As an after thought, and in order to obtain some adult concensus, we discussed our proposal with our science teachers. Most of them felt the pamphlets should be used with the text book. One teacher, however, offered the suggestion of printing a paper backed text of about 100 pages every three years. This text would contain the basic facts. The pamphlets would enlarge and expand on the facts in an up-to-date context. This is an interesting suggestion and we are including it in our brief.

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\section*{APPENDIX 92}

BRIEF SUBMITTED TO
THE SENATE SPECIAL COMMITTEE ON SCIENCE POLICY
BY
B.W.CURRIE

VICE -PRESIDENT (RESEARCH)
UNIVERSITY OF SASKATCHEWAN, SASKATOON,
SASKA TCHEWAN

\begin{abstract}
The current discussions on a science policy for Canada are failing to recognize the responsibilities and the potential capabilities of our universities for research and consultative services related to the needs of the community or the Province in which each is located. They are limited generally to broad aspects of an overall policy designed to meet the economic and cultural needs of Canada as a whole. The need for adequate support for advanced training and research in universities is recognized, but largely on the premise that the principal function of a university is to supply the trained people required by governmental establishments, industry and business, and the universities themselves.

The universities located in many parts of Canada are the most immediate sources of the "know-how" to investigate problems peculiar to their respective locations, and to provide consultative services to "small" industry. It is true that some departments of the Dominion Government have regional laboratories and establishments, and that many of the provinces have Research Councils with Laboratories; but these are usually limited in their activities. Any integration that exists between their activities and those of their neighbouring
\end{abstract}
universities depends largely on casual arrangements rather than on well-recognized policies for Canada as a whole. The cumulative effects of a policy which would promote advanced training and research related to local problems within universities located within the less populous and well-developed parts of Canada could contribute much to the economic welfare of the country.

Historically, many of the colleges and universities in the United States and Canada were established to provide groups of trained people to investigate problems related to the economy of the regions in which they were located. Throughout the interior of North America, a college or a school of agriculture was often the first component of a university, --recognizing the need for research to realize the agricultural potential of the regions in which they were located. The first major building on the campus of the University of Saskatchewan was one for the use of the College of Agriculture. Barns for animal studies and plots for crop studies were among the first facilities provided.

Several examples taken from our experiences at the University of Saskatchewan emphasize the merit of professors applying their research skills to local problems. A great need existed ón our Provinces during the early decades of this century for varieties of grains better suited to the prevailing climatic conditions and resistant to plant diseases (rusts in particular); another was the rapid deterioration
and failure of concrete structures in Western Canada.
Professor W.P. Thompson, Biology Department, turned his attention to a genetical approach to rust controls in wheat. In collaboration with his colleagues in the Biology and Crop Science Departments and their students rust resistant varieties of wheat were developed. Many of the students progressed to senior positions in governmental establishments and universities where they, in turn, were instrumental in producing improved varieties of plants of great economic value to Canada. Several members of the original group and their students concerned with improved cereal varieties for Western Canada served as consultants to the World Food Organization, organizing groups and training people for crop breeding programmes in the developing countries. The results of these programmes are now being realized by steadily increasing yields of cereals in these countries. No estimate of the value in dollars of these operations which started in a small way from university personnel devoting their time to a local, mission-oriented problem can be made. It has been said that the return to Saskatchewan alone has far exceeded capital and operating costs of the University up to the present time.

Dean C.J. Mackenzie of the College of Engineering undertook to investigate the concrete problem. He was joined by Professor T. Thorvaldson of the Chemistry Department. The first stage showed that the trouble was with the quality of cement and its lack of resistance to alkaline compounds in the
soil. Dr. Thorvaldson and his students investigated the physical and chemical changes occurring in concrete because of the alkaline materials, and experimented with additions to the cement which would increase their resistance to the disintegrating effects of alkaline water. The results were applied to the manufacture of cement, increasing the durability of a structure from ten to a hundred times, and thereby saving millions of dollars. Dr. Thorvaldson's fundamental studies in this area were recognized nationally and internationally by awards from many learned and professional societies.

Another example demonstrates the benefits which can result by close collaboration between a university group and Dominion and Provincial Departments. Little was known up to 1921 about the soil resources of Saskatchewan or of the other Prairie Provinces, and how they could be utilized for crop productions. From a Royal Commission of Inquiry into Farming Conditions (1921) came the Saskatchewan Soils Survey, which has functioned almost from the beginning as a co-operative research group of University, Saskatchewan Department of Agriculture and Canada Department of Agriculture employees, co-ordinated and directed by the Head of the Department of Soil Science. In 1965 the group was given a formal structure by the establishment of the Saskatchewan Institute of Pedology, supported jointly by the University and the two Departments of Agriculture. More than seventy million acres have been examined and classified. About two million acres have been
examined in detail, --particularly their suitability for
irrigation by waters from the South Saskatchewan River. A system of comparative soil ratings for grain production was developed. This is now the basis for assessment of agricultural land in Saskatchewan for taxation purposes. A recent, important addition was a Soils Testing Laboratory, operated by the University. A farmer, for a very modest fee, can get tests of the soils on his farm and advice on suitable combinations and quantities of fertilizers required. This service is now used by the majority of the farmers in the Province. Wheat yields for 1967 and 1968 when drought conditions prevailed during critical parts of the growing season were generally much larger than anticipated,--largely from the use of suitable fertilizers. The widespread use of fertilizers is now being reflected in increases in the processing facilities of a number of companies and of their distributing agencies for agricultural fertilizers.

A number of other examples where the University staff alone, or in collaboration with scientists in governmental establishments on the Campus, have been instrumental in initiating investigations and enterprizes of value to the Province and eventually to Canada could be mentioned. These include the production of rape seed and the utilization of oil and meal from it, the testing of farm machinery, and hydrologic and biological productivity studies. For many of these there is a well-defined series of steps. These are:
(a) recognition of a local problem with some economic implications;
(b) initiation of research both fundamental and missionoriented with respect to it; and
(c) the application of the results of (b) by industry. Step (a) is usually obvious to researchers in universities located in the region. Step (b) is often difficult to realize because of current policies on the financing of university research. The university researcher often undertakes some fundamental aspect of the problem which can be completed in 2 or 3 years with modest annual grants-in-aid. Sometimes significant progress on the applied aspects is made by collaboration with his colleagues in the applied faculties, -again with modest annual grants-in-aid. Generally, further progress depends on collaborative efforts by a number of scientists with adequate facilities and technical support.

Assured financial support on the required scale for a period of years is usually difficult to get. Step (c) is often the most difficult to achieve. It requires collaborative efforts between the innovators and the developers of a finished product for manufacture and sale to users. Occasionally, step (a) and step (b) in part has been reached by a small industry and the proprietor comes to a university for consultative advice or help needed to overcome basic or applied problems related to his product. Universities and governmental establishments by tradition do not enter actively into step (c). The notable exception is agriculture where
small and large-scale testing of crops, feeding of livestock, etc., are undertakon by agricultural colleges; where extension services are regularly provided; and where the users expect and receive consultative services. With respect to the last, it is interesting to note that numerous farmers on our Prairies have an investment in land and in machinery, or livestock and related facilities, or a combination of these valued at several hundred of thousands of dollars. Each can get the best available adviee without charge. The owner of a small plant, or even a large plant, in need of help to improve his product finds it almost impossible to get this service. He is expected to employ the expert help required, or to enter into a contract with research council or university laboratories, --both requiring risk funds which he is unable or hesitant to provide.

Numerous examples can be found of university researchers, abtracted by the economic possibilities of ideas developed both inside and outside of universities, who have left their universities to start small firms of their own or to become partners in existing firms in order to participate in step (c). The number who do so to their personal financial gain and to the success of their firms is suprisingly large.

It should be possible for universities in particular to collaborate actively in step (c) when they have the "know-how" and when the projects are ones related to the communities which they serve. Such collaboration requires money for its support--money which universities don \({ }^{\mathrm{t}} \mathrm{t}\) have and
and which it is unlikely that they can get through Provincial votes for their support. The money is needed for a wide variety of purposes,--sometimes for a pilot plant operation, or for development of an idea into a manufactured product; invariably for additional stafl to free university personnel from some teaching duties, for space and for technical assistants. A spin-off from such activities within a university is the training which students would get. A common complaint of industry about university graduates is their lack of experience or even appreciation of the conomics of the industrial world. Unless process or a device can be utilized in a way to make a profit to a company, there is no merit in spending time or money on it.

One may argue that all the problems peculiar to particular parts of Canada have been recognized and are receiving adequate attention from universities and various governmental organizations. There is little support for such an argument. Numerous problems exist, and many more are becoming evident as Canada grows in population, in industrial sophistication and in the utilization of its resources.

Crop scientists in Western Canada are becoming increasingly alarmed at the decrease in number of people engraged in projects designed to improve the yields of existing varieties of agricultural crops, and to breed new and better varieties with higher yiclds and more resistance to plant diseases. An Institutc of Crop Science attached to a university, has been
recommended on a number of occasions. The annual costs would not be great, but they are ones which a university in Western Canada could not readily provide.

A vast industry has developed in Saskatchewan with the discovery of potash. The general practice of mining the potash by conveyance of the material through tunnels and shafts anabab leaves large amounts of potash to support the over-burden, -potash which may never be recovered. A pollution problem exists with the dust from the mines and the accumulations of sodium chloride on the surface. A more economic method of transport of the potash is desirable,--possibly by pipe-1ine. A limited amount of research on these problems is in progress at the University of Saskatchewan and the Saskatchewan Research Council; but an Institute of Potash Technology involving university, government departments and industry is needed.

Other examples include the lignite deposits in the southern part of the Province and the uranium deposits in the northern part of the Province. A substantial amount of research, largely basic in nature, has been done by the members of the University Chemistry Department and by the Saskatchewan Research Council. The ultimate utilization of these awaits a policy which would provide long-range support for more fundamental research and subsequent mission-oriented research related to the recovery and utilization of the coal and the uranium. A pilot plant project is needed that would improve the extraction of oil from rape seed and the processing
of the oil so as to make it more palatable. An almost unlimited number of smaller projects become evident to a person who tours the Province and talks with the agriculturalists, with persons concerned with the economic utilization and conservation of the natural resources of the Province, and with the managers of many small plants manufacturing articles and materials required locally.

A policy which defines broad, national objectives is desirable, but it can fail to realize the purposes for which it is established. It can provide for national laboratories, for incentives to promote research by "big" industry, for training at the post-secondary level of professional people and highly-skilled technicians, for the rapid dissemination of technical information, and so on. All this is a costly superstructure based on the assumption that it will provide not only the means bu the incentives for solving the almost infinite number of small problems that are delaying the economic development of the country.

A policy should recognize the incentives and support for the investigation of the local problems (often national problems when explored in depth) are also necessary. Universities are the orgnizations best-fitted to recognize them and to initiate the investigations. But they need support to carry them to their loeical conclusion,--discovery development and utilization. It would mean close co-operation between fundamental and applied departments in universities,
government establishments in close proximity to them, industry
and business. It should result in a bigger return for the
dollars spent on research and development, since it could
eliminate costly duplication of facilities and research per-
sonnel. Following the common terminology, a policy should
include specific grass-roots components, --encouragement of
research and development directed toward the local and immediate
problems by the institutions (universities mostly) closest
to them, organization and support of Institutes and Regional
Laboratories closcly integrated into the activities of
particular universities when an activity has reached major
economic importance to a region, and support from time to time
to universities for enterprizes which would initiate or give
impetus to "small" industry.

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[^0]:    * Subject to a few minor revisions. |
    ** Of which some $\$ 740,000$ was spent to cover the cost of 437 research assistants.
    *** Of which about \$1 million was spent to cover the cost of 597 research assistants.

[^1]:    See nol:es on next page.

[^2]:    See notes on next page.

[^3]:    

[^4]:    "The Board is established to initiate and promote the production and distribution of films in the national interest and in particular -

[^5]:    Farm Credit Corporation,
    P.O: Box 4209,

    Postal Station "E",
    Ottawa 1, Ontario.
    November 13, 1968.

[^6]:    $20404=7$

[^7]:    Douglas, Hugh Charles, Deputy Industrial Research Adviser, Department of Industry, Trade \& Commerce Ottawa, Canada: Mr. Douglas is a native of Ottawa, Ontario, where he received his elementary and secondary school education. In 1946, he graduated from Queen's University, Kingston, Ontario, with a Bachelor of Science Degree in Mechanical Engineering. Subsequently, in 1953, he undertook post graduate studies in Business Administration at the University of Western Ontario. Following university graduation Mr. Douglas worked for a short time at Fairchild Aircraft of Canada Limited, Longueuil, P.Q. From 1946 to 1953 he was employed as an Aeronautical Engineer by AVRO Aircraft of Canada Limited at Malton, Ontario, where he was in charge of the Aircraft Performance and Flight-test Divisions during the design and development of the C-102 jet transport aircraft and the CF-100

[^8]:    \#The percentages above equal more than $100 \%$ because of the fact that some individuals have been employed by more than one sector.

[^9]:    2. Title to Results and Pronerty
    9.1 Under the PAIT Prcaram, the title to all results and property (e.p, desirns, inventions, patents, prototypes, equipment, etc.) vests in and remains with the comnany.
    3. Obligations of Annlicant
    10.1 The PAIT applicant comnany undertakes that the product or process resulting from the project will be produced or used by the comnany in Canada and that the company will, within a reasonable period of time, exploit the results in accordance with sound industrial practice. In the event of non-exploitation, the Minister has the right of exercising remedies as specified in Clauses $5(2)$ and 10 of the 5004 General Terms of the PAIT Assistance Agreement.
    10.2 The maior condition imposed on the PAIT applicant company is the requirement not to transfer technical data or inventions, whether or not patented, methods and processes resulting from the proiect to any other covernment or to any person, company, partnership or firm outside of Canada for the purposes of production, without the nrior consent of the Minister; and nlace the same restriction on any transfer it may make to another Canadian company, firm, partnership or person.

    ## 11. Administrative Procedures

    11.1 Companies applications for PAIT assistance are generally hatan received in the PAIT Program Office where they are allocated to the apnropriate line branch. Line branch officers examine the applications within the context of their knowledge of the industry. The PAIT Office also forwards a cony of the company's application to the Director (scientific) of the Office of Science and Technology who assigns the annlication to a Scientific Consultant for an appraisal of the technical content of the pronosed project. The PAIT Office is instmmental in bringine tomether the line officer and the Scientific Consultant for a commrehensive evaluation of the applicant's eligibility for assistance. Anplications are in narrative form and are expected to set out in detail the technical aspects of the project, the market prospects and marketing plan, the cost estimate, the financial resources of the comnany, and its R\&D capability. The Scientific

[^10]:    

