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THE NATIONAL RESEARCH COUNCIL OF CANADA

". . . the function of any central organization must be to stimulate and encourage this work in others, to fill the gaps, to conduct generalized researches not apt to the functions of narrower institutions, to create organizations and institutions where these are lacking."

Viscount Hailsham, 1963

In Canada, a great deal of research is conducted by government departments in such clearly defined areas as agriculture, fisheries, mining and defence. Many of the remaining areas of science and technology fall within the scope of the National Research Council, particularly those that aid the secondary industries.

When, in 1916, during the First World War, the Government of Canada established the National Research Council, the purpose was clear -- to strengthen science as an aid to industrial development. From the beginning, the NRC has pursued this objective in two ways: by encouraging and supporting basic science, mainly in the universities, and, as conditions permitted, by strengthening technology as an aid to secondary industries.

Responsibilities

The duties of the Council are outlined in the Research Council Act. Broadly stated, the Council has charge of "all matters affecting scientific and industrial research in Canada that may be assigned to it by the Privy Council Committee on Scientific and Industrial Research" (to which it reports).

The Act also designates a number of specific responsibilities: for discovering processes and methods that may promote the expansion of existing industries or the development of new ones; for maintaining and improving primary standards for Canada and certifying scientific and technical apparatus and instruments used in the government service

and in industries; for investigating industrial products or materials at the request of any of the industries of Canada; and for conducting research on the use of industrial wastes.

Organization

The Council itself -- the governing body of NRC -- is composed of 21 members selected for their scientific attainments, most of whom are scientific administrators in universities, in industry or in government laboratories. Four members are full-time salaried officers of the Council. These are the president and three vice-presidents (two scientific, the other administrative). The rest of the Council undergoes fairly frequent changes; two or three members are retired each year and are replaced by new appointees, who serve for a term of three years.

The Council as a whole is responsible for policy, major decisions and the maintenance of a high professional level within the organization. The salaried officers are responsible, in addition, for the work of the research and administrative divisions operated by the Council.

The NRC reports not to a departmental minister as such but to a member of the Cabinet who acts as chairman of the Privy Council Committee on Scientific and Industrial Research. This Committee is made up of nine ministers whose departments support research programmes and who, as a group, have general responsibility for the scientific policy and activities of the Canadian Government. The NRC is thus a government agency, not a government department. It is largely self-regulating; for instance, it is free to hire, promote or discharge its own professional staff without recourse to the Civil Service Commission, which controls appointees to the Canadian public service in general.

National Research Laboratories

In the late 1920's, the National Research Council began to develop laboratories and research staff; but it did not acquire a building of its own until 1932. By the outbreak of the Second World War, however, the Council's facilities were able to provide the nucleus in Canada for remarkable growth in scientific work, which came during and after the war. Beginning with three research divisions, in chemistry, physics and biology, NRC has expanded to comprise ten research divisions in science and engineering at Ottawa and two regional laboratories at outside locations. The entire staff of NRC numbers some 2,600, about 680 of whom are professionally engaged in scientific research. The yearly budget is now approaching $70 million.(1)

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(1) The scope of scientific investigation carried out by NRC and the degree of specialization within its divisions are indicated by the detailed list of sections in Appendix A.

Most NRC facilities are located at Ottawa. After the last war, however, regional laboratories were established at Saskatoon and Halifax in order to improve the industrial use of the resources of those areas. At the Prairie Regional Laboratory, the emphasis is on agricultural materials and the work is mainly biochemical; at the Atlantic Regional Laboratory, much of the work is on seaweed, fish wastes, peat and special biological problems affecting the pulping of wood. Work is also being done on chemical factors in steel-making, especially as they relate to the coal and iron ores of the Atlantic Provinces.

For reasons of necessity, other smaller laboratories are located outside Ottawa; for example, a meteor laboratory is situated 20 miles south of Springhill, a radio observatory in Algonquin Park, building research units in the Far North and upper-atmosphere research facilities at various points in the Arctic.

Atomic Energy of Canada Limited

During the wartime scientific boom of 1939-45, large research units developed within NRC, which have since become separate research organizations. For example, the work in atomic energy, which began with the Council in 1942, grew to the point where its size and commercial importance justified its establishment in 1952 under a separate authority. This is Atomic Energy of Canada Limited, the Crown Corporation whose extensive research facilities are centred at Chalk River, Ontario.

Defence Research Board

In 1947, research in support of Canada's military forces was transferred from NRC to the newly organized Defence Research Board. As an active nucleus, the Board took over the defence laboratories that the Council had been operating at Valcartier, Halifax, Ottawa, and elsewhere. With a budget comparable to that of NRC, the Board conducts investigations into materials, armament, special weapons, telecommunications, aeronautics, Arctic problems and operational techniques. Its programme of upper-atmosphere research is carried on in co-operation with NRC and other research groups in government and universities. The Board also makes grants to universities for medical studies related to problems of defence.

Medical Research Council

Aid to basic medical research in universities also developed within NRC, to a yearly volume in 1960 of over $2 million. In that year, the Medical Research Council of Canada was formed to assume responsibility for the medical grants and fellowships and otherwise to prusue its own objectives. By 1965-66, aid to basic medical research had reached $9 million.

Basic Science in Universities

The creditable state of science in Canada today is the result of steady growth over the past 50 years. In 1916, very little scientific research was done in Canadian universities. Only the universities of Toronto and McGill were granting Ph.D. degrees in science and, during the 11 years before the First World War, only three such doctorate degrees were granted.

Looking to the universities for competent scientists, NRC, began in 1917, a programme under which research grants were offered to professors and scholarships were offered to graduate students interested in research. This programme has kept pace with the capacity of the graduate schools in Canada and the demands of government and industry for researchers. Thus, by way of contrast, in 1965-66 more than 8,500 students were enrolled for post-graduate degrees in science and engineering (including medicine, dentistry and psychology) in some 24 Canadian universities. About 3,500 of these expected to obtain their master's or doctorate degrees in 1965. This growth, of course, reflects a general development in Canada. Nevertheless, the NRC programme played a significant role in facilitating this expansion and in developing a system of financial aid to basic research in universities, without interfering with academic freedom.

In 1965-66, NRC administered over 1,200 scholarships for students in post-graduate science, as well as many grants to professors. The grants not only furthered basic investigation but also provided means for hundreds of additional students to continue their post-graduate training. The Council's programme of aid to basic science is to cost nearly $22 million in 1966, compared to $3.6 million in 1957. Included in the programme are grants to individuals in Canadian and international scientific organizations, aid to international congresses held in Canada, and publication of a number of scientific journals.

Scientific Societies and International Affiliations

The Council makes annual grants to such organizations as the Royal Society of Canada and the Canadian Standards Association. It gives financial support to scientific conferences and aids in international exchange of scientists, for example such programmes as the NRC-Nuffield Foundation Visiting Lectures and the exchange between the Soviet Academy of Sciences and NRC. The Council also participates in a space-research programme in collaboration with a number of departments of the Canadian Government and other groups at the universities; and it facilitates Canada's share in the international space programme of COSPAR. It holds membership as the representing body for Canada in various international scientific organizations.

Research Journals

The Research Council also edits and publishes the Canadian Journals of Research, eight periodicals that report basic research in biochemistry, botany, chemistry, earth sciences, microbiology,

physiology and pharmacology, physics, and zoology. Forty per cent of the papers published originate in Canadian universities and, at present, about 15 per cent come from laboratories outside Canada. Distribution of the Journals is world-wide.

Library Services

The NRC Library in Ottawa is designated as the National Library of Science for Canada. It is recognized as the central clearing-house and information centre for science publications, and also as a distributing agency for scientific literature not otherwise available in Canada. It provides lending and photocopy services; it carries out literature searches and compiles bibliographies; its translation services cope with scientific reports in many languages, including Russian; and its index of English translations of foreign scientific publications currently runs to over 100,000 entries.

Post-doctorate Fellowships

Since 1948, the NRC has been developing a programme of post-doctorate fellowships. These provide salaries and travel expenses to enable young scientists who have already attained their doctorates to work for a year or two at NRC or other government or university laboratories in Canada. There are now about 275 of these visiting scientists in Canada, from 29 countries. Of these, 142 are in the NRC, 83 are in Canadian universities, and 50 are in other government departments and agencies. During 1965-66, 1,209 applications were received for post-doctorate fellowships, of which 203 were successful.

Applied Work for Industry

Much of the work of the NRC is of immediate application; for example, investigations requested by industrial groups or carried out under contract for individual companies. The projects range from electronics to building construction, from acoustics to food preservation.

Facilities are maintained by NRC that are too expensive or too specialized for most Canadian industries to support on their own. Examples are: a hydraulics laboratory, where scale-model studies are done on harbours, breakwaters, riverbeds, canal locks, ships and propellers; aeronautical facilities such as wind tunnels, jet-engine test beds, low-temperature installations for icing research on aircraft and helicopters; fire-research apparatus for the destructive testing of floors, walls and building components. Increasing use of these facilities is made by scientists and engineers from industry working along with NRC staff.

The Council's researchers have achieved international recognition in areas of applied research such as corrosion, physical standards, noise research related to construction, snow and ice research and photogrammetry.

Standards

The primary physical standards for Canada are maintained by NRC, which enters into international agreements concerning weights and measures. In addition to regular calibration of industrial standards, considerable research is done on the improvement of the primary standards. NRC made a distinguished contribution towards the adoption of a new standard for the metre, which is now based on wave-lengths of orange light emitted by an isotope of krypton. Advanced developments are being made by NRC physicists in the measurement of time, electrical quantities, heat, light and color.

Technical Information

In 1945, NRC established a Technical Information Service (TIS). The purpose of this office is to bring together the problems of industry and the technological facilities of the Council. TIS receives a large volume of enquiries each year, mainly from companies in the secondary and processing industries. In 1964-65, for example, about 17,000 enquiries were dealt with on a wide variety of problems. Most of the TIS work is with small and medium-sized firms possessing little or no technical staff; but large firms also make frequent use of the service because of the vast amount of material in technical periodicals and other scientific information available through NRC library facilities and the Council's foreign liaison offices. The Information Service itself does not operate research or testing laboratories, but it has at its disposal the technical experience of the NRC laboratories and is well acquainted with the services of other government laboratories and private consultants. Besides its central staff at Ottawa, TIS maintains local representatives across Canada, who work in co-operation with the field staffs of the provincial research councils.

The Technical Information Service issues reports on current developments in technology that have wide application in industry, and each year a number of information notes are prepared to bring industrial firms up to date on new manufacturing facilities, productivity techniques and scientific innovations.

Research in Industry

In 1961 NRC appointed an advisory committee on industrial research, the aim of which was to bring industrial management into closer contact with the work of NRC and to keep NRC informed of the problems of industry. The committee, composed largely of top management representatives of leading Canadian companies, also considers ways of encouraging greater research activity within industry.

In 1962 NRC established a Committee on Industrial Research Assistance (CIRA), whose membership was composed of senior representatives from government agencies having a direct interest in industrial research. The Committee assists NRC in a programme aimed at fostering long-term research in industry. In 1962 an initial fund of $1 million

was provided by the Government to help finance projects undertaken by industrial firms. The cost of projects aided under the plan was shared more or less equally between NRC and industry. Projects are of company choice and results remain the property of the respective firms. In allotting the available funds, preference goes to longer-term projects that appear to have potential for major industrial advances. By 1965-66, this fund had risen to $3.5 million.

Patents and Development

In 1947, NRC established Canadian Patents and Development Limited (CP&D), the Crown Corporation that patents NRC developments and inventions and makes them available under license to industry. CP&D also performs this service for other government laboratories and for Canadian universities.

Associate Committees

Over the years the Council has formed groups of specialists as needed, to study the use of certain resources and to investigate other problems science might help to solve. Today, some 36 associate committees, as these groups are called, are co-ordinating research effort and technical knowledge in as many fields(1). The committees, which are national in scope, combine the interests of industrialists, government experts, and university scientists. They have precise objectives and are disbanded as soon as their tasks are accomplished. Typical areas of interest at present are aerodynamics, automatic control, computers, crystallography, forest-fire protection, a national building code, oceanography, radiation biology, and space research.

Scientific Liaison

During the Second World War, NRC found it necessary to establish scientific liaison officers in London and Washington working through a Scientific Liaison Office in Ottawa to create an expeditious and secure channel for the exchange of information on classified research and to organize the exchange of visits by scientists.

After the war, with the advent of the Defence Research Board, these liaison officers were no longer concerned with classified research and were able to devote their attention to non-defence research. In the post-war years, as national and international activity in the field of science expanded greatly, it became desirable to accredit the scientific liaison officers as scientific attachés, to enable them to work in those areas where science and foreign relations intermingled.

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(1) See Appendix B.

Thus the present science attachés perform a dual function. On the one hand, as liaison officers they function as a direct link between the National Research Council and the scientific community of the country to which they are accredited. On the other hand, as attachés they function as an inter-governmental link to facilitate the development of national policy and action in the international field of science.

In addition to the scientific attachés in London and Washington, a similar post was created in the Canadian Embassy in Paris. The Paris attaché is also accredited to the Canadian delegations to NATO and OECD and assists these delegations in their scientific and technological activities.

APPENDIX A

Laboratory Divisions
National Research Council of Canada

DIVISION OF BIOSCIENCES

- Animal Physiology
- Biological Macromolecules
- Biometrics
- Biophysics
- Carbonhydrate and Fat Chemistry
- Fermentations and Exzymology
- Food Chemistry
- Food Technology
- Microbiology
- Plant Physiology

ATLANTIC REGIONAL LABORATORY--Halifax, Nova Scotia

- Biochemistry and Microbiology
- Chemistry of Natural Products
- Plant Physiology
- Reactions at High Temperatures

PRAIRIE REGIONAL LABORATORY--Saskatoon, Saskatchewan

- Physiology and Biochemistry of Fungi
- Physiology and Biochemistry of Bacteria
- Plant Biochemistry
- Chemistry of Natural Products
- Engineering and Process Development

DIVISION OF APPLIED CHEMISTRY

- Analytical Chemistry
- Kinetics and Catalysis
- Chemical Engineering
- Colloid Chemistry
- Metallic Corrosion and Oxidation
- Metallurgical Chemistry
- Applied Physical Chemistry
- Physical Organic Chemistry
- High Polymer Chemistry
- Rubber
- Textile Chemistry
- High Pressure

DIVISION OF PURE CHEMISTRY

- Organic Chemistry
- Physical-Organic Chemistry
- Organic Spectrochemistry
- Organic Synthesis
- Chemical Kinetics and Photochemistry
- Mass Spectrometry
- Molecular Spectroscopy
- General Physical Chemistry
- Surface Chemistry and Low Temperature Calorimetry
- Thermochemistry
- Thermodynamics of Surface Regions
- Structure of Carbons
- Inorganic Chemistry
- Chemistry of Fats and Oils

DIVISION OF APPLIED PHYSICS

- Acoustics
- Electricity
- Mechanics
- Heat and Solid State Physics
- Instrumental Optics
- Interferometry
- Photogrammetric Research
- Radiation Optics
- X-Rays and Nuclear Radiations
- Diffraction Optics

DIVISION OF PURE PHYSICS

- Cosmic Rays and High Energy Particle Physics
- Low Temperature and Solid State Physics
- Spectroscopy
- Theoretical Physics
- X-Ray Diffraction
- Plasma Physics

DIVISION OF RADIATION BIOLOGY

Now being organized

ENGINEERING

DIVISION OF BUILDING RESEARCH

- Inorganic Materials
- Organic Materials
- Building Services
- Building Structures
- Building Physics
- Fire Research
- Soil Mechanics
- Snow and Ice
- Northern Building
- Construction
- Housing
- Building Standards
- Prairie Regional Station
- Atlantic Regional Station
- British Columbia Regional Station

DIVISION OF MECHANICAL ENGINEERING

- Mechanics
  - Analysis Section
  - Instrument Laboratory
  - Control Systems Laboratory
  - Engineering Laboratory
- Hydrodynamics
  - Hydraulics Laboratory
  - Ship Section
- Thermodynamics
  - Gas Dynamics Laboratory
- Engine Laboratory
- Low Temperature Laboratory
- Fuels and Lubricants Laboratory

NATIONAL AERONAUTICAL ESTABLISHMENT

- Aerodynamics
- Unsteady Aerodynamics Laboratory
- Structure Laboratory
- Flight Research

RADIO AND ELECTRICAL ENGINEERING DIVISION

- Navigational Aids
- Electrical Engineering
- Upper Atmosphere Research
- Instrument Section
- Defence Section
- Engineering Design
- Space Electronics
- Radio Astronomy
- Antenna Engineering
- Electron Physics

APPENDIX B

Associate Committees
National Research Council of Canada

Aerodynamics, Associate Committee on

Aeronautical Structures and Materials, Associate Committee on

Aircraft Noise, Associate Committee on

Animal Nutrition, Associate Committee on

Automatic Control, Associate Committee on

Biochemistry, Canadian National Committee of

Biological Programme, National Committee for the International

Biological Sciences, Canadian National Committee for the International Union of

Biophysics, Associate Committee on

Biophysics, Pure and Applied, National Committee for the International Organization for

Bird Hazards to Aircraft, Associate Committee on

Chemistry, Pure and Applied, Canadian National Committee for

Computers, Associate Committee on

Co-ordination and Policy, Associate Committee on (Medical Research Council)

Crystallography, Associate Committee on

Culture Collections of Microorganisms, Canadian Committee on

Dental Research, Associate Committee on

Experimental Psychology, Associate Committee on

Fats and Oil, Canadian Committee on

Food, Associate Committee on

Forest Fire Protection, Associate Committee on

Gearing Research, Associate Committee on

Geodesy and Geophysics, Associate Committee on

Grain Research, Associate Committee on

Heat Transfer, Associate Committee on

High Polymer Research, Associate Committee on

History and Philosophy of Science, National Committee for International Union for the

Hospital Infections, Associate Committee on Control of (Medical Research Council)

Illumination, National Committee for the International Commission on

Industrial Research, NRC Advisory Committee on

Industrial Research Assistance, NRC Committee on

International Council of Scientific Unions (ICSU), Canadian National Committee for the

Mathematics, Pure and Applied, Associate Committee on

Meteorites, Associate Committee on

National Aviation Museum, Associate Committee on a

National Building Code of Canada, Associate Committee on the

National Fire Codes, Associate Committee on

Natural Sciences Programme of UNESCO, Associate Committee on the

Nutritional Sciences, National Committee for the International Union of

Oceanography, Canadian Committee on

Paint Research, Associate Committee on

Physics, Pure and Applied, National Committee for the International Union of

Physiological Sciences, National Committee for the International Union of

Plant Breeding, Associate Committee on

Plant Diseases, Associate Committee on

Propulsion, Associate Committee on

Radiation Biology, Associate Committee on

Radio Science, Associate Committee on

Railway Problems, Associate Committee on

Refrigeration, National Committee for the International Institute of

Scientific Information, Associate Committee on

Soil and Snow Mechanics, Associate Committee on

Space Research, Associate Committee on

Special Western Agricultural Committee -- This includes the following four Committees -- Grain Research
Plant Diseases
Plant Breeding
Animal Nutrition

Water Pollutiom, Associate Committee on

Waves and Littoral Drift, Associate Committee on

RP/A