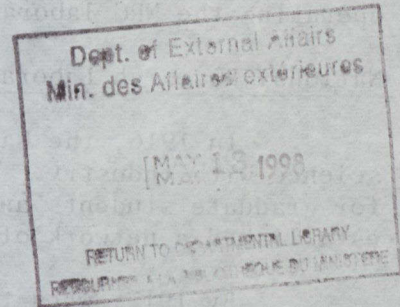


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THE NATIONAL RESEARCH COUNCIL OF CANADA

The Federal Government assumes the major responsibility for financing, stimulating, and carrying out scientific research and development in Canada. In addition to the activities of the National Research Council of Canada, Atomic Energy of Canada Limited, and the Department of Mines, Energy and Resources, federal agencies involved in research include the Departments of Agriculture, Forestry, Fisheries, National Defence, National Health and Welfare, and Northern Affairs and National Resources.

Responsibilities

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The duties of the National Research Council of Canada are outlined in the National 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 Committee of the Privy Council on Scientific and Industrial Research. The Council is responsible to a designated minister who is a member of the Committee of the Privy Council on Scientific and Industrial Research. 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 National Research Council of Canada consists of the President, the Vice-President (Administration), two Vice-Presidents (Scientific), and not more than 17 other members appointed by the Governor in Council. The Council is a body corporate and is required to meet at least three times a year in Ottawa.

Except for the four permanent officers, Council members are appointed for a term of not more than three years and serve without salary. Most of the Council members are drawn from the senior scientific staff of universities; others represent labour and industry. The Council carries direct and final authority on grants and scholarships and is responsible for broad policy in operating the NRC laboratories.

National Research Laboratories

In 1916, the National Research Council of Canada was founded to link science with industry. It began by setting up programmes of scholarships for graduate students and research grants to university professors, and established a network of associate committees.

By 1917, when these activities were running smoothly, the Council became convinced that it was impossible to fulfil its obligations to industry unless it was also provided with its own laboratory facilities. Nine years later, in 1925, the Council began laboratory work of its own, but on a small scale.

From work initiated in NRC's first laboratory a viable magnesite industry emerged, which is still going strong some 40 years later.

Large-scale research began in 1932 when a central laboratory was opened on Sussex Drive in Ottawa. This laboratory housed four divisions, which at that time were called Physics and Engineering, Biology and Agriculture, Chemistry, and Research Information.

During the depression years, a nucleus of highly-trained specialists in all the main fields of science was built up. When the time came, these men became leaders in directing Canada's war research. The wartime demands were enormous and a tenfold expansion had to be, and was, achieved.

War Record

When war broke, the Council had one laboratory in operation. During the war, 21 other laboratories were established from Halifax to Vancouver. By 1940, NRC was engaged in almost every field of war research, and peacetime operations had been reduced to a minimum. There were scores of major achievements: in medicine, in aeronautical engineering, in the chemistry of supplies and substitutes, in biological warfare, in tropicalization of equipment for use in jungles, in protective clothing, in nutrition, in packaging and transportation of foods, in atomic energy -- to say nothing of innumerable devices such as predictors, gun-sights, chronographs, sound-ranging, anti-mine and anti-submarine equipment and radar.

Just as the Canadian Corps during the First World War established the significance of Canada in military affairs, so Canadian scientists during the Second World War won for Canada a recognized place in the field of science.

Post-War Growth

After the Second World War, the anticipated industrial recession failed to materialize. Instead, the country boomed and the reorganization of NRC expanded with the country.

Radio research, which had grown from a small group in 1939 to a large branch, was associated with the electrical engineering laboratories in 1947 to establish the Radio and Electrical Engineering Division. The same year, the Division of Building Research was formed to study problems of construction, to act as the research wing of the Central Mortgage and Housing Corporation, and to provide technical and secretarial support to the Associate Committee on the National Building Code. In 1948, the Prairie Regional Laboratory -- largely an outgrowth of the work of the Division of Biosciences -- was set up on the campus of the University of Saskatchewan in Saskatoon. The Atlantic Regional Laboratory was opened on the campus of Dalhousie University in Halifax in 1952, and the Division of Chemistry was divided into the Division of Pure Chemistry and the Division of Applied Chemistry. In 1955, the Division of Physics was divided into the Division of Pure Physics and the Division of Applied Physics. The National Aeronautical Establishment, comprising the aerodynamics, flight and structural activities of the Division of Mechanical Engineering, was formed at the beginning of 1959 to meet the aeronautical research needs of military and civil aviation. The effect of radiation on living things is the subject of research in the newest NRC division, the Division of Radiation Biology.

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

In 1966 NRC took over the Churchill Research Range, placing it under its newly-formed Space Research Facilities Branch. This Branch also supports experiments from universities and government laboratories by providing rockets, components, and launch support services for the Canadian space-research programme.

NRC's ten laboratory divisions in Ottawa and two regional institutions, one in Halifax and one in Saskatoon, now comprise Canada's largest and most diversified laboratory complex. Both pure and long-term applied research are carried out in these laboratories, as well as contract research on specific projects, standardization work, and testing for which no private or commercial facilities are available.

The staff of NRC numbers 2,900, about 820 of whom are professionally engaged in scientific research. The estimated laboratory budget for 1967-68 now runs over \$40 million.

Defence Research Board

In 1947, research in support of Canada's military forces was transferred from the National Research Council of Canada 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.

Atomic Energy of Canada Limited

The largest wartime undertaking was the Atomic Energy Project. It began in 1942 as a secret laboratory in a wing of the University of Montreal, and was transferred to the new site at Chalk River by 1946. In the first ten years of its existence the project grew so extensively that size and commercial importance justified the establishment in 1952 of a separate Crown Corporation, Atomic Energy of Canada Limited.

Medical Research Council

The Medical Research Council, an autonomous unit responsible for policy in the field of medical research but functioning initially within the administrative framework of the National Research Council, was established in 1960. At the same time, the National Research Council disbanded its Division of Medical Research, and its Advisory Committee on Medical Research, which had previously administered Council grants in this important field. The primary aim of the Medical Research Council is the development of medical research and the support of medical research workers in the university centres of Canada.

Support for University Research

When the National Research Council was established in 1916, the nation's primary need was, as it still is, for qualified scientists and for facilities to train them. The first action of the Council, therefore, was to support research in the natural sciences in Canadian universities by awarding scholarships to graduate students and grants-in-aid to professors.

This programme has continued without interruption for 50 years. During the last decade, the number of universities and colleges holding operating grants has doubled, and annual expenditures have increased at an accelerating rate, rising from \$2.7 million in 1957-58 to a new high of \$34.4 million for 1966-67. Of this sum, an increase of \$12.5 million over 1965-66, \$28 million was used for grants in aid of research to university staff members, \$5.5 million for graduate scholarships and post-doctorate fellowships, and \$0.9 million to assist the special activities of scientific organizations at national and international levels.

Thus, during 1966-67, the Council supported the research work of more than 4,900 graduate students and over 2,741 professors, in the biological sciences, engineering, pure and applied mathematics, experimental psychology, dental research and space research.

Research activities in Canadian universities have advanced enormously during the last ten years and the National Research Council has contributed substantially to this progress.

The types of university support provided are: direct, consisting of support to individuals in the form of scholarships, fellowships and grants in aid of research; and indirect, consisting of support related to the promotion and encouragement of research at the universities, such as contributions to scientific organizations and functions, publication of research journals and the administrative expenses of the programme.

The Council also conducts and administers the North Atlantic Treaty Organization's Science Committee's scholarship and fellowship programme for Canadians. In addition, the Council administers the Atomic Energy Control Board's grants-in-aid programme; decisions regarding its grants are made by a Committee of the Board.

Funds are provided in annual Parliamentary appropriations to the Council, and the Atomic Energy Control Board, and by NATO's Science Committee, which receives Canada's annual contribution to its activities from the Department of External Affairs.

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 laboratories in Canada. There are now about 300 of these visiting scientists in Canada, from 30 countries.

International Scientific Affiliations

The National Research Council is the representative body in Canada for the International Council of Scientific Unions and most of its constituent unions, and also holds membership, on behalf of Canada, in many other international scientific associations and organizations. In addition, the Council, in conjunction with the Department of External Affairs, has responsibility for Canadian participation in the NATO Science Committee and in some of the scientific activities of the Organization for Economic Co-operation and Development. The National Research Council supports travel of Canadian scientists to attend meetings of various international scientific organizations.

NRC maintains liaison offices in London, Paris and Washington, where liaison officers are accredited to the respective embassies as scientific attachés. In addition, an NRC representative is attached to the Permanent Delegation of Canada to OECD as First Secretary (Scientific).

The National Research Council has a scientific exchange agreement with the Soviet Academy of Sciences, which provides for visits of scientists ranging from three weeks to nine months. In addition, NRC has accepted responsibility for exchange of Canadian scientists with France under the cultural agreement between the Governments of Canada and France.

Canadian Journals of Research

The National Research Council of Canada publishes eight scientific journals in basic physical and biological sciences: biochemistry, botany, chemistry, earth sciences, microbiology, physics, physiology and pharmacology, and zoology. These provide an international distribution for scientific information originating in Canadian laboratories and institutes. Any article submitted for publication is first examined by anonymous referees who are expert in the subject of the article.

During 1966, 2,289 articles were submitted to the Canadian Journals of Research and 1,572 were published. Of those published, 44 per cent came from Canadian universities, 27 per cent from outside Canada, 9 per cent from laboratories of the National Research Council of Canada and 20 per cent from all other sources (federal and provincial government laboratories, industry, etc.). Over the past few years, the Canadian Journals of Research have grown at an average rate of 15 per cent a year. This is roughly consistent with the current total rate of growth of investment in fundamental research in Canada.

National Science Library of Canada

NRC maintains the National Science Library of Canada, which is responsible for ensuring that literature resources and information services are available to meet the needs of the scientific and industrial community of Canada. This is accomplished through a service that answers requests for scientific and technical information, provides loans and photocopies, performs literature searches, compiles bibliographies, and locates translations and obscure publications and references. The Library's collection of more than 600,000 volumes is growing at the rate of 40,000 volumes a year.

Science Film Library

The National Science Film Library was made possible by NRC and is administered by the Canadian Film Institute at Ottawa. The Library has available more than 2,000 films on scientific developments.

Links with Industry

The National Research Council is a link between the scientific interests of the Government, industry and the universities of Canada and a patron of basic and applied science.

Much of the work of 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.

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.

NRC's Industrial Research Assistance Programme grew to an estimated \$4.5 million in 1966-67. Since the Programme began in 1962, total industrial research effort has been initiated in industry amounting to more than \$50 million, shared between company and government funding. Industrial research positions created by the Programme now total more than 800.

Technical Information

NRC's Technical Information Service, established in 1945, provides, without cost, information and advice on technological matters to Canadian firms. Its industrial engineers give direct assistance and advice especially to small firms on improvement of their plant layout, efficiency of operating and good plant management. This service answers about 14,000 enquiries a year from Canadian industries.

Physical Standards

NRC maintains, and improves by research, the primary physical standards for Canada (for precise measurements of length, mass, heat, electricity, time, etc.) and enters into international agreements concerning weights and measures.

Associate Committees

NRC maintains 45 associate committees to deal with special problems of national concern. Members serve without salary other than travelling and living expenses. Each committee has defined objectives; when these are accomplished, the committee is disbanded. Typical areas of interest are geotechnical research, computers, forest-fire protection, aerodynamics, automatic control, radiation biology and space research.

Scientific Attachés

NRC provides scientific attachés for the Canadian embassies in Paris, London and Washington. These offices also assist in the exchange of technical information.

Scientific attachés perform a dual function: as liaison officers they function as a direct link between the National Research Council of Canada and the scientific community of the country to which they are accredited; as attachés they function as an intergovernmental link to facilitate the development of national policy and action in the international field of science.

Patents

NRC has established Canadian Patents and Development Limited, a Crown Corporation which patents NRC inventions and then licences them to industry. CPD also performs this service for other government laboratories and by agreement with a number of Canadian universities.

Appendix A

NRC Laboratory Divisions

Division of Biosciences

Animal Physiology
Biological Macromolecules
Biometrics
Biophysics
Carbohydrate and Lipid Chemistry
Fermentations and Enzymology
Food Chemistry
Food Technology
Microbiology
Plant Physiology

Atlantic Regional Laboratory

Reactions at High Temperatures
Chemistry of Natural Products
Biophysics
Physiological Chemistry
Chemical Biology
Microbiology
Instrumentation
Marine Botany
Phytochemistry

Prairie Regional Laboratory

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

Division of Radiation Biology

Division of Pure Chemistry

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

Division of Applied Chemistry

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

Division of Pure Physics

- Cosmic Rays and High Energy Particle Physics
- Solid State Physics
- Lasers and Plasma Physics
- Spectroscopy
- Theoretical Physics
- X-ray Diffraction

Division of Mechanical Engineering

Mechanics

- Analysis Laboratory
- Instrument Laboratory
- Control Systems Laboratory
- Engineering Laboratory

Hydrodynamics

Thermodynamics

- Gas Dynamics Laboratory
- Engine Laboratory
- Low Temperature Laboratory
- Fuels and Lubricants Laboratory

National Aeronautical Establishment

- Flight Research Section
- Low Speed Aerodynamics Section
- High Speed Aerodynamics Section
- Unsteady Aerodynamics Laboratory
- Structures and Materials Laboratory

Division of Building Research

- Inorganic Materials Section
- Organic Materials Section
- Building Services Section
- Building Structures Section
- Building Physics Section
- Fire Research Section
- Soil Mechanics Section
- Northern Research Group
- Snow and Ice Section
- Construction Section

Division of Building Research (cont'd)

- Housing Section
- Building Standards Section (Codes Secretariat)
- Prairie Regional Station
- Atlantic Regional Station
- British Columbia Regional Station

Radio and Electrical Engineering Division

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

Division of Applied Physics

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

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Appendix B

NRC Associate Committees

Aerodynamics, Associate Committee on
Aeronautical Structures and Materials, Associate Committee on
Agricultural and Forestry Aviation, Associate Committee on
Aircraft Noise, Associate Committee on
Aircraft Systems, Associate Committee on
Animal Nutrition, Associate Committee on
Automatic Control, Associate Committee on
Avionics, Associate Committee on
Biochemistry, Canadian National Committee of
Biological Programme, National Committee for the International
Biological Sciences, 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 the
International Union of
Composite Materials, Associate Committee on
Computers, Associate Committee on
Crystallography, Associate Committee on
Culture Collections and Taxonomy of Microorganisms, Canadian Committee on
Dental Research, Associate Committee on
Experimental Psychology, Associate Committee on
Fats and Oils, Canadian Committee on
Forest Fire Protection, Associate Committee on
Gearing Research, Associate Committee on
Geodesy and Geophysics, Associate Committee on
Geotechnical Research, 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 the International
Union for the
Hydrologic Decade, Canadian National Committee for the International
Illumination, National Committee for the International Commission 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
Mechanics, Canadian National Committee for the International Union of
Theoretical and Applied
Meteorites, Associate Committee on
National Museums of Science and Engineering, Associate Committee on
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
Plant Breeding, Associate Committee on
Plant Diseases, Associate Committee on
Plasma Physics, Associate Committee on
Propulsion, Associate Committee on
Quaternary Research, 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
Space Research, Associate Committee on
Special Western Agricultural Committee
Water Pollution Research, Associate Committee on
Waves and Littoral Drift, Associate Committee on

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