The National Research Council of Canada

Forty-sixth Annual Report 1962-1963

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Forty-sixth Annual Report for 1962/1963

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THE HON. C. M. DRURY,
Chairman, Committee of the Privy Council on
Scientific and Industrial Research,
Ottawa, Ontario

SIR:

I have the honour to present to you herewith the Forty-sixth Annual Report of the National Research Council, for the fiscal year 1962–63.

In accordance with the requirements of the Research Council Act, this report contains the report of the President and a statement of the receipts and expenditures of the Council during the year under review.

Your obedient servant,

B. G. BALLARD,
President, National Research Council

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National Research Council 1962-63

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Honours and Distinctions 1962-63

MR. C. H. BAYLEY, head, textile chemistry section, Division of Applied Chemistry, was elected President of the Institute of Textile Science.

DR. S. A. BROWN, plant biochemistry section, Prairie Regional Laboratory, was elected Vice-President of the Plant Phenolics Group of North America.

DR. J. R. COLVIN, head, biophysics section, Division of Applied Biology, was elected a Fellow of the Chemical Institute of Canada.

DR. W. H. COOK, Director, Division of Applied Biology, was elected President of the Royal Society of Canada.

DR. R. J. CVETANOVIĆ, head, applied catalysis section, Division of Applied Chemistry, was elected a Fellow of the Royal Society of Canada.

DR. N. E. GIBBONS, Assistant Director, Division of Applied Biology, was elected Secretary-General of the International Association of Microbiological Societies.

DR. J. W. HOPKINS, head, biometrics section, Division of Applied Biology, was elected Honorary Treasurer of the Royal Society of Canada.

DR. K. O. KUTSCHKE, head, photochemistry section, Division of Pure Chemistry, was elected a Fellow of the Chemical Institute of Canada.

DR. D. K. C. MACDONALD, head, low temperature and solid state physics section, Division of Pure Physics, was awarded the 1963 Gold Medal of the Professional Institute of the Public Service of Canada for contributions to national or world well-being in a field of pure or applied science.

DR. LÉO MARION, Vice-President (Scientific) was awarded the honorary degrees of LL.D. by the University of Toronto and D. de l'U. by the Sorbonne, France.

DR. P. M. MILLMAN, head, upper atmosphere research section, Radio and Electrical Engineering Division, was elected President of the Meteoritical Society for 1962–66.

DR. G. L. OSBERG, head, chemical engineering section, Division of Applied Chemistry, was named Editor of the *Canadian Journal of Chemical Engineering*.

MR. E. PENNER, soil mechanics section, Division of Building Research, was named recipient of the 1962 C. A. Hogentogler Award of the American Society for Testing Materials for his paper "The Importance of Freezing Rate in Frost Action in Soils".

DR. F. T. ROSSER, Vice-President (Administration), was awarded the honorary degree of LL.D. by the University of Western Ontario.

Changes in Council Membership

The Research Council Act provides that: (i) The Council shall consist of a President, a Vice-President (Administration), two Vice-Presidents (Scientific) and not more than seventeen other members, to be appointed by the Governor in Council; (ii) The members of the Council, with the exception of the President, the Vice-President (Administration) and the Vice-Presidents (Scientific) shall hold office for a period of three years; (iii) A retiring member shall be eligible for reappointment; (iv) There shall be an Executive Committee of the Council consisting of the President, the Vice-President (Administration), the Vice-Presidents (Scientific), and at least three other members selected by the Council.

During the year ending March, 1962, five members of the National Research Council completed their terms of office. Those retiring were: Dr. I. McTaggart Cowan, Head of the Department of Zoology, University of British Columbia; Dr. F. R. Hayes, Head of the Department of Biology and Director of the Oceanographic Institute, Dalhousie University; Dr. A. D. Misener, Director of the Ontario Research Foundation; Dr. B. W. Sargent, Head of the Department of Physics, Queen's University; and Dr. D. L. Thomson, Vice-Principal and Dean of Graduate Studies, McGill University.

One of these, Dr. F. R. Hayes, was reappointed for a further term of three years, ending March 31, 1965.

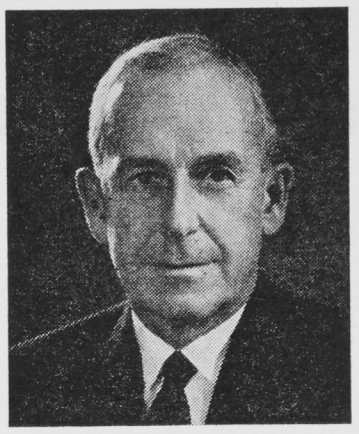
Four new members, also appointed to March 31, 1965, were Professor F. A. Forward, Head of the Department of Mining and Metallurgy, University of British Columbia; Dr. F. K. Hare, Dean of the Faculty of Arts and Science, McGill University; Dr. G. A. Krotkov, R. Samuel McLaughlin Research Professor of Biology and Head of the Department of Biology, Queen's University; and Mr. W. F. McLean, President of Canada Packers Limited.

On August 28, 1963, the National Research Council lost one member through the death of Dr. E. W. R. Steacie, President of the Council since 1952.

Following Dr. Steacie's death, Dr. B. G. Ballard, Vice-President (Scientific) and Director of the Radio and Electrical Engineering Division, was appointed Acting President. On February 4, 1963, Dr. Ballard was named President of the Council.

At the same time Dr. Léo Marion, Senior Director of the National Research Council and Director of the Division of Pure Chemistry, was named Vice-President (Scientific) succeeding Dr. Ballard.

With these changes the National Research Council in 1962–63 consisted of the President, two Vice-Presidents (Scientific), a Vice-President (Administration), and seventeen other members.



Edgar William Richard Steacie

1900–1962

Officer of the Order of the British Empire
Bachelor of Science
Master of Science
Doctor of Philosophy

Doctor of Science
Doctor of Laws
Doctorat de l'Université
Honorary Member of the Polish Chemical Society
Honorary Fellow of the Chemical Society of London
Foreign Associate of the National Academy of Sciences of the U.S.A.
Foreign Member of the Academy of Sciences of the U.S.S.R.
Honorary Member of the Belgian Chemical Society
Honorary Member of the Canadian Physiological Society
Honorary Member of the Engineering Institute of Canada
Honorary Member of the Agricultural Institute of Canada
Fellow of the Royal Society of Canada
Fellow of the Royal Society of London

President, National Research Council of Canada, 1952–1962

Forty-sixth Annual Report of the

National Research Council of Canada 1962-63

In the past year, the National Research Council:

- began providing direct financial support for research performed by Canadian industry (62 projects involving 44 companies);
- provided $10.4 million to support pure research in the universities (including 1200 grants; 735 scholarships and fellowships); an additional $4.3 million was provided through the Medical Research Council;
- answered 19,000 technical enquiries from Canadian industries;
- operated five laboratory Divisions in the sciences: Applied Biology, Applied Chemistry, Pure Chemistry, Applied Physics, and Pure Physics; operated four engineering Divisions: Building Research, Mechanical Engineering, the National Aeronautical Establishment, and Radio and Electrical Engineering; operated two regional laboratories, one at Halifax and the other in Saskatoon;
- employed 719 scientific research staff (including 144 postdoctorate fellows), 952 technical personnel, and 845 general service and administrative staff;
- sponsored 40 Associate Committees, operating in such diverse fields of science as Aeronautical Structures and Materials, Dental Research, Forest Fire Protection, Geodesy and Geophysics, Oceanography, Plant Diseases, Radiation Biology, and Space Research.

Remarks of the President

Through its university support program, through its industrial research assistance plan, and through the work of its own laboratories, the National Research Council will continue to promote both pure and applied science, to cooperate fully and wholeheartedly with Canadian industry, and to contribute as richly as possible to the economic well-being of the nation.

Canadian science suffered a grievous loss in the death of Dr. E. W. R. Steacie in August 1962. He had won wide recognition—for himself, for his country, and for the laboratories he headed. He had been made a Fellow of the Royal Society of Canada and of the Royal Society of London, a Foreign Associate of the National Academy of Sciences of the United States, a Foreign Member of the Academy of Sciences of the U.S.S.R., and an Honorary Member or Fellow of several distinguished Societies. He had been awarded 18 honorary degrees, and at the time of his death was President of the International Council of Scientific Unions.

While his personal scientific interest was mainly in fundamental science, his general interest was very broad and he promoted both pure and applied science with equal vigour. Nor was his interest confined to the National Research Council. He played an important part in fostering the growth of science in the nation's universities and throughout the government service. For the National Research Council, his passing was a special misfortune. Under his leadership as President, the laboratories provided a continually expanding service, and their reputation grew accordingly.

Perhaps because of the very wide dissemination of literature in the fundamental sciences, the Council's achievements in that area have been more widely recognized than have its contributions in applied science. However, the Council's achievements in applied science have been no less significant. Indeed the National Research Council's laboratory activity has been, and still is, considerably more extensive in applied science than in fundamental investigations. Of the nine operating Divisions of the Council, only two devote their efforts exclusively to fundamental work: the primary concern of the remaining seven is applied research.

Over the years, the Council's laboratories have made important contributions in both pure and applied research. Many of these have resulted in significant commercial developments successfully marketed at home and abroad. Nevertheless, although such developments do occasionally occur, it is not the role of the National Research Council to develop marketable products.

The Council's main purpose is to promote the science and technology that make possible the development and improvement of products.

This purpose is achieved firstly through the Council's university support program, under which the supply of trained scientists has been substantially increased by scholarships and by grants to university staff, secondly through its Industrial Research Assistance Program, and thirdly, through the work of its own laboratories.

The Council's efforts have been strengthened by the mutually beneficial and stimulating interaction that exists between government, university and industrial laboratories. Industry is now participating actively in the development of the nation's research capacity, and there has been a healthy increase in the Canadian industrial research effort.

Government tax concessions for industrial research and the NRC Industrial Research Assistance Program announced last year have considerably encouraged Canadian firms to carry out their own research. Industry has been quick to take advantage of the NRC scheme, and almost all of the firms that sought assistance last year have renewed their applications for the current year. Many new applications have also been received. This industrial activity has significantly increased the employment opportunities available to trained Canadian scientists. Indeed, in some areas shortages of trained personnel have developed.

The Industrial Research Assistance Program has also provided an opportunity for closer liaison between the laboratories of government and industry, and this cannot be other than beneficial to our general scientific advancement. This liaison has not been confined to the laboratories of the National Research Council; it extends to virtually all other government agencies and departments engaged in research.

While much has been accomplished, much remains to be done, and even closer liaison between the laboratories of government, industry, and the universities would be fruitful. The National Research Council is endeavouring to obtain a truly comprehensive understanding of industry's problems and to arrive at the most effective means of providing the scientific support that industry requires.

Lately it has been pointed out by several observers that Canadian research, considered on a per capita basis or on the basis of gross national product, lags behind that of other highly industrialized countries. It is both important and gratifying to note, however, that Canada's research effort is growing at a faster rate than that of either Great Britain or the United States. The experience of these and of other countries is being carefully examined, and every effort will be made to profit from it.

Industrial problems and technology are changing rapidly. It is therefore important that the whole scientific area be carefully and continually reviewed to ensure that Canada makes the most effective use of her scientific potential. NRC Associate Committees, of which there are now forty with representatives from government, industry and the universities, are exploring these problems, and very significant results are emerging. The investigations undertaken by these committees are wide-ranging and cover such fields as aeronautics, automatic control, railway problems, grain research, heat transfer, radio science, and space research. Another committee of the Council has begun a study to determine how applied research can best be fostered and how the industrial and economic life of Canada can best be advanced by research. Science is becoming increasingly complex, and the Council is devoting extensive thought to its planning and to its most effective application.

Science is only one facet of the promotion of a healthy Canadian economy, but it is a very important one.

The creation of new and improved products requires research in both pure and applied science, and this need becomes more imperative as world technology advances.

Through its university support program, through its industrial research assistance plan, and through the work of its own laboratories, the National Research Council will continue to promote both pure and applied science, to cooperate fully and wholeheartedly with Canadian industry, and to contribute as richly as possible to the economic well-being of the nation.

Industrial Research Assistance

During the year under review the National Research Council began to provide direct financial support for research performed by Canadian industry.

The purpose of this new and timely activity is to encourage Canadian concerns to carry out much more of their own research than they had previously done. For by developing strong and independent research facilities and skills, they strengthen both their positions in the markets of the world and the economy in general.

I am pleased to report that in 1962–63 the NRC Industrial Research Assistance Program gave rise to 62 new projects involving 44 Canadian companies. To carry out this work new laboratories have been established and existing groups have been enlarged. In addition to its economic worth, the work has created desirable professional careers for both graduating and senior research workers. In the first few months of operation, in fact, the program called into being more than 260 new positions.

Most significant of all, the program has succeeded in inducing foreign parent firms to expand the research efforts of their Canadian subsidiaries. This will increase the ability of Canadian concerns to develop unique products based on their own research, rather than on work done in other countries.

To encourage a solid build-up of Canada's industrial research facilities, the program concentrates on supporting new, long-term projects expected to last from three to five years. The types of work supported include applied research in the sciences, applied research in engineering, and applied research aimed at producing prototypes and processes. Firms of all sizes may apply for assistance, but these firms must be incorporated, and the research must be performed, in Canada.

The program is in fact a cost-sharing scheme in which NRC attempts to meet 50% of a project's cost. Industry chooses the project and retains all rights arising from the work. Requests for support are assessed by an impartial committee of senior government representatives who recommend appropriate action to NRC. For simplicity of operation grants, rather than contracts, are used. NRC remits its share by paying monthly invoices from industry covering the salaries of scientists, technicians and engineers employed on assisted projects. Reports from the companies and visits by NRC project liaison officers ensure that progress is being made and that a project merits continued support.

In money terms, the NRC scheme, together with the tax exemptions now allowed on increased research expenditures, enables industry to perform its research at costs as low as $12\frac{1}{2}$ cents on the dollar.

Present indications are that the program provides industry with a definite incentive to expand or to initiate its research plans. In the first year, however, industry was unable to absorb all the funds that the government made available. For the coming year the government has more than tripled its initial cash commitment, and will consider providing more money if it is needed. It is hoped, therefore, that requests from industry will match this rate of increase. In this way the development of Canada's industrial research facilities, and the resulting economic benefits, will not be delayed.

NRC Support for University Research

In 1962–63, NRC expenditures supporting science and engineering in Canadian universities reached a new high of $10.4 million—up 20% from 1961–62. Allocation of this aid was as follows: $2.1 million for 575 graduate scholarships and 160 postdoctorate fellowships; $6.6 million for 1200 grants to university staff members; $1.2 million for major equipment required by the grantees; and $0.5 million for items such as publication of the Canadian Journals of Research, and contributions to scientific organizations and activities at both national and international levels.

The 20% increase registered this year represents the latest attempt by the Council to keep pace with the growth of science in the universities. In his Report to Parliament last year Dr. Steacie outlined the impressive build-up of science and engineering that our universities have achieved. He also described how, in response to this growth, the Council's support budget had increased four-fold in the last five years. His Report warned, however, that to avoid stifling the development of science in the universities far more support is needed.

At present, in our universities, undergraduate enrolments are rising by 15% per year. The number of full-time graduate students in science and engineering, and the number of staff members directing them, are increasing by 20% per year. But the problem is not simply that there are more people doing research. It is that each of these people, because of the complexity of modern research, becomes more and more expensive to support.

Years ago it was possible to do research with the help of one or two graduate students and relatively simple equipment. Today's research team often involves many students, each requiring equipment and supplies, and the advanced nature of the work demands elaborate and costly apparatus.

The provision of research equipment and supplies is the largest and most important part of NRC's aid to the universities. And it is here that a major increase in the level of NRC support is most urgently required. This aid is supplied in two forms: operating and major equipment grants. Operating grants are used for purchasing small equipment and supplies, and for hiring assistants who are usually graduate students. Major equipment grants are for large apparatus costing $5000 or more.

At its present level of spending, the Council is only able to provide about 30% of the major equipment grants requested. In addition, there is a growing need in the universities for the major installations, such as particle accelerators, that front-line research now demands. In this area the Council is able to make only one or two grants annually, with payments spread over a period of years.

The universities bear the costs of buildings, salaries of professors, general laboratory facilities, and services such as libraries and work-shops. NRC funds assist the research activities of staff members and graduate students, and provide the special and increasingly expensive equipment needed for their work.

On this basis it is easily seen that the support provided by the Council plays a truly vital role in the conduct of university research. It is equally obvious that the level of this support must be sharply raised so that it more closely approaches current needs.

Division of Applied Biology

The Division's ten sections do mainly fundamental or long-term research. Most of the investigations have possible applications and influence in a number of widely differing fields, including medical research, food processing, dairying, refrigerated transport of foodstuffs, chemotherapy, pulp and paper manufacturing and fibre production. Some of these studies are described briefly below.

Changes in the normal lipoprotein pattern of blood serum may be an important factor in heart disease, but comparatively little is known about the structure of the several types of lipoprotein present. The lipoproteins of egg yolk, being readily prepared, were studied by the Division as experimental macromolecular models and the results were correlated with data obtained by others on the serum lipoproteins. It was found that all lipoproteins evidently fall into two types, distinguished by a transition in composition when the protein, phospholipids and neutral lipids are present in 1:1.1 proportions. The interconversion of these two types cannot occur by a simple loss or gain of lipid.

The effects of different immersion cooling methods on the rate and amount of water absorbed by poultry during processing have been studied. It has been found that the amount of water absorbed may be as high as 15% of eviscerated weight. About half of this is lost during packaging and other handling before cooking, and most of the remainder is lost during cooking. Appreciable loss of mineral content also occurs. Methods for reducing moisture absorption during cooling have been tested.

Studies of some of the combined immersion and air-blast procedures used for freezing poultry show that large birds may not be completely frozen for 10 days or more. Since other phases of the poultry work have shown that such slow freezing causes a substantial loss of quality, methods for improving these procedures have been studied.

Waterblooms or scums of blue-green algae that develop in ponds, reservoirs, and lakes in many parts of Canada during the summer months are sometimes toxic to farm livestock and other animals. By isolating, growing, and testing cultures of the principal algae involved it has been found that strains of at least two species are poisonous. The toxin from one of these strains has been identified. Factors that influence the growth of bloom-forming algae are being investigated in the hope of finding useful control measures.

The structure and composition of the very small acorn-shaped particles, ribosomes, which form the raw materials in living cells for muscle, hair, wool, bone and connective tissue, are being studied. The Division's investigations have shown that the ribosome itself contains several different kinds of structural proteins which comprise part of the assembly line for synthesizing the above materials. Eventually, deviations from the normal mechanism for producing these substances may be related to hereditary defects in humans, or to diseases of aging or abnormal tissue growth.

Atlantic Regional Laboratory / Halifax, N.S.

Long-range studies of a fundamental nature form the bulk of this Division's program. The work relates in general to developing the Canadian economy, and in particular to the resources of the Atlantic region. Projects under way include high temperature chemistry, structures and reactions of naturally-occurring organic compounds, and the biochemistry and physiology of fungi, marine algae, mosses, lichens, ferns and higher plants. The program on high temperature reactions was reviewed in last year's Report.

Much of the Canadian economy, especially in the Atlantic Provinces, is based on plant life. This is obvious for the pulp and paper industry, for lumbering and for agriculture. The fishing industry depends on the growth of marine plants. Studies on higher plants and soil micro-organisms have been quite extensive but not much is known about lower plants such as seaweeds and other marine algae, mosses, lichens and ferns. Small industries have been based on peat moss and seaweeds but it is desirable to find out more about the plants of bog, sea and forest. Investigations now in progress in the Division include studies on the unusual chemical compounds found in fungi, mosses, lichens, marine algae, and the leaves of coniferous trees. It is expected that antibiotics or other compounds of interest to industry may be found. Studies are also being conducted on the biosynthesis of lignin, ergot alkaloids and other substances of economic importance. In general the work is aimed at finding out more about non-agricultural plants (which cover most of Canada) with the expectation that information of industrial value will emerge.

Probably the most significant development during the past year has been the establishment of a closer working relationship with Dalhousie University. By means of a new arrangement between the Laboratory and the University's Faculty of Graduate Studies, students acceptable to the Faculty may now do their research in the Laboratory under the direction of any one of five staff members holding unpaid appointments in the Faculty. This provides a stimulus to the Laboratory's staff and also helps the University to extend its graduate studies program in certain branches of chemistry and biology.

The establishment of a strong graduate school in this region would undoubtedly be quite useful to the local economy. Traditionally, students have left the Atlantic area to study in larger centres, but there is no sound reason why students should not come here from other regions of Canada for advanced studies in certain fields. Of the five graduate students now in the Laboratory, one is a graduate of the University of Alberta, one is from Sir George Williams University and three are from McGill. Graduates of Alberta, McGill and Carleton Universities have applied to come next year.

The Division is currently hampered in its work by its small size, but plans for expanding to double the present size have been approved in principle. Once this expansion has been carried out, the Division will be in a much better position to play its role in fundamental research, in training scientists, and in strengthening the local scientific community—an essential prerequisite for any large-scale development of local industry.

Prairie Regional Laboratory / Saskatoon, Sask.

This Division is concerned with studies in chemistry, microbiology and physiology related to producing and utilizing the plant crops of the prairie region. A relatively large part of the work is devoted to investigating the fundamental properties of biological materials, the methods by which plants and micro-organisms produce these components, and the chemical and biological mechanisms involved in their interconversion. When well chosen, such studies provide information that is essential for solving more practical, applied research problems. Two projects illustrating the relevance of fundamental work concern the ergot fungus, and sulphur compounds found in rapeseed.

A one per cent infection of grain by the ergot fungus renders the material unfit for use as food by humans and animals. However, this organism is also a source of lysergic acid, the basic unit involved in preparing hallucinogenic chemicals used in psychiatric research. Fundamental studies in the Laboratory have shown that the fungus can be induced to produce active materials in culture medium. By combining these findings with information on how the fungus produces the active materials, it has been possible to devise culture media and growing conditions that will give maximum product yields. The same basic information should also provide useful leads for attacking ergot as a cereals disease.

Studies made on rapseseed in the Laboratory showed that the seed contains sulphur compounds which affect the ease of hardening of the oil, and which also produce growth depressant effects when rapeseed meal is fed to livestock. Methods were devised for isolating and identifying these compounds, and further work revealed how they are built up in the plant and how they can be broken down by enzymes. From this work the following information has been obtained: (1) The sulphur in these compounds comes from inorganic sulphate in the soils. By controlling this factor, the content of sulphur components in the seed can be increased or decreased. (2) If conditions in processing the seed are designed to minimize enzymatic degradation of the sulphur components, the oil can readily be hardened for use in margarines and shortenings. (3) The adverse physiological properties of the sulphur components only occur after the components have been partially broken down by enzymic action. This knowledge provides a method of dealing with the nutritional problems associated with feeding rapeseed meal.

In carrying out the program, considerable emphasis is placed on collaboration between the Laboratory and other agencies and between different sections within the Division. Current examples include cooperation with the federal Department of Agriculture and with industry in developing oil seed crops and uses for them; studies with animal science groups in the University of Saskatchewan and the Food and Drug Directorate, Ottawa, to promote the use of oil seed products in human and animal nutrition; and a collaboration between the chemistry and fermentations sections of the Laboratory that has resulted in a new method of producing hydroxy fatty acids.

Division of Applied Chemistry

This Division concerns itself mainly with long-term programs in areas of wide general interest to the chemical industry. These programs include experimental studies of high pressure, catalysis, textiles, high polymers, metallurgical chemistry and related subjects. The investigations of a group primarily interested in metallic corrosion provide a typical example of Divisional activity.

The importance of corrosion processes has become well established over the years. While in general these processes are wasteful—corrosion has been estimated to cost Canadians about 500 million dollars annually—chemical reactions associated with them can also be put to use. Thus the procedures used to produce pigments, metal salts and some magnetic materials are frequently based on corrosion reactions. Obviously a greater degree of knowledge than is now possessed, particularly about the primary processes of corrosion, is highly desirable. As well as providing new scientific information, such knowledge would give us greater control over the rate at which these reactions occur—a matter of considerable economic importance.

Corrosion research is among the older activities at the National Research Council, having been in progress for more than twenty years. Initially considerable attention was given to aqueous systems, such as those found in domestic, civic or industrial water supplies, cooling systems for internal combustion engines and the like. The object of such studies, of course, is to reduce the speed of the corrosion process; this may involve protective coatings, electrochemical methods or chemical inhibitors. In general the latter materials are useful because they favour the rapid formation of a thin, adherent, conversion coating on the surface requiring protection, thus reducing the rate of further attack to acceptable limits. While the work of the laboratory has stimulated interest in chemical inhibitors now in common use, the major contribution has been in establishing the initial chemical reactions involved and the conditions required to give improved performance from these chemicals.

During the past several years NRC's corrosion research has broadened considerably, and the formation of metal oxide films at elevated temperatures has also been studied. In this work it has been possible to investigate the rates of formation and the physics and chemistry of films less than 40 billionths of an inch in thickness in atmospheres where both the temperatures and concentrations of reacting gases are closely controlled. The techniques used in these investigations also make possible the study of the behaviour of metal surfaces in unreactive atmospheres where the protective, contaminating coating usually found in ordinary air has been removed. These oxidation studies at elevated temperatures have revealed the highly significant fact that some alloys of high chemical purity are several times more stable—or less reactive—than their present commercial counterparts.

Studies such as these that lead to a better understanding of elementary phenomena should inevitably lead, also, to improved industrial products and processes. It is this principle that governs most of the Division's work.

Division of Pure Chemistry

The Division of Pure Chemistry is concerned with fundamental research in the fields of physical and organic chemistry. There are thirteen sections in the Division, twelve of which are concerned with problems of long-range nature, while the remaining one has for its function the preparation of substances needed by the other sections. The research staff is relatively small, but it is increased by a number of postdoctorate fellows who stay for a maximum of two years.

Although the research projects investigated have all produced some results, some of these are more immediately applicable than others. As illustrations of the work done, two typical examples have been selected.

(a) The program of the organic chemistry group is related to the constituents of plants with reputed medicinal action. *Fabiana imbricata*, a plant used by the ancient Incas for various diseases, was shown to contain an alkaloid of a new structural type, the structure of which was deduced with extensive aid of nuclear magnetic resonance spectroscopy. The yellow pigment of the root of *Inula royleana*, a medicinal plant from India, was shown to have a mixture of quinones of a new type belonging to the diterpene class, and one of these was synthesized. The structure of two resin acids from the North African sandarac tree was determined, and a contribution made to the determination of the structure of the alkaloid tuberostemonine.

A new photochemical reaction of acid azides was developed, by which nitrogen could be attached to saturated carbon. This was used to effect synthesis of the heterocyclic system of diterpenoid alkaloids, and by the resultant correlation with known diterpenes, to prove rigorously the structure and absolute stereochemistry of this class of alkaloids.

(b) The thermodynamic properties of some simple molecular crystals such as of methane are being measured at very low temperatures. In order to account for the experimental results it seems necessary to conclude that some of the energy levels of the crystals are very similar to the rotational energy levels of the free molecules. This gives some rather direct information about the intermolecular forces in the crystals. It also suggests that caution is necessary in the use of the third law of thermodynamics to estimate the thermodynamic properties of symmetrical molecules at high temperatures.

A method has been worked out for computing the temperature dependence of the intensities of X-ray reflections of crystals from their thermodynamic properties. For cubic crystals, the computed values are considerably more accurate than those obtainable by direct X-ray experiments. It is hoped that the method will be of value in the detailed analysis of the scattering of radiation by crystals.

Division of Applied Physics

This year saw the completion of the Division's new building at the Montreal Road property. The move from the Sussex Drive Building to the new quarters was carried out during July and August of 1962. The new building is in effect a complex of four buildings—a main one housing most of the Division and three special purpose ones: a nuclear physics building, an underground beta-ray spectrometer building, and an anechoic chamber with laboratory area attached. Brief outlines of the Division's research activities are given below.

The acoustics section has continued its interest in audiometry; studies of noise in the broadest sense with a view to its control; vibration in discs; the application of ultrasonic measurements to the study of molecules; and the interaction of sound fields with spherical bodies.

One of the main functions of the heat and solid state physics section is the development of the temperature scale at very high and very low temperatures. The group concerned with high temperature physics is making excellent progress in thermal conductivity studies, and sponsored a successful symposium in this field in October, 1962.

The instrumental optics section has dealt mainly with optical problems associated with photogrammetry. It has also made an interesting proposal for a special type of lighting unit that may prove useful at airports.

The photogrammetric research section has extended its exploitation of the basic ideas involved in the analytic plotting machine invented in the section. Mathematical methods of triangulation and photogrammetric methods for problems arising in fields other than mapping have also been studied.

The radiation optics section has been engaged in three important projects: problems associated with heterochromatic photometry; the development of better standard light sources for industrial colorimetry; and the study of colour tolerances in the production of coloured materials—a problem which has for long been of great concern to industry.

The X-rays and nuclear radiations section has completed an extremely successful beta-ray spectrometer which, for its size, compares favourably with any other instrument of this type. This section has also taken a very active part in the establishment of an international standard neutron source through the International Bureau of Weights and Measures.

The interferometry section has continued to apply itself to the problem of length measurement by wavelengths of radiation. During the year the section entered the field of laser techniques and constructed a continuously operating helium-neon gas laser.

The demands made on the electricity section for high quality electrical measurements for industrial purposes have increased markedly. The other important work of this laboratory is the investigation of atomic frequencies that may be suitable as substitutes for the astronomical unit of time.

Division of Pure Physics

The Division of Pure Physics conducts basic research in six specialized branches of physics: cosmic rays and high energy particle physics, low temperature and solid state physics, plasma physics, spectroscopy, theoretical physics, and X-ray diffraction. The objective of the program is to provide new fundamental knowledge in these fields.

The outstanding event in the Division during the past year was the establishment of the plasma physics group. Although the staff and equipment needed to give this group a full start have not yet been obtained, a beginning has been made. It is hoped that within a short time the group will be able to make fundamental contributions to a subject which, in the long run, may prove to be important for the problem of controlled nuclear fusion.

A second notable event is connected with the launching of the Canadian earth satellite "Alouette", which contains an instrument package designed by the cosmic rays group to detect energetic particles in the satellite orbit. This package has been particularly successful, and is sending back new information on the nature and time variations of the Van Allen radiation belts and on the persistent artificial belts created by atomic explosions. Few problems are of more immediate interest for the whole of space research than this one.

In the low temperature group, considerable effort has recently been concentrated on a study of the so-called de Haas-van Alphen effect. This effect consists in oscillations of the magnetic susceptibility of various substances as a function of the magnetic field. From this study it is possible to learn a great deal about the characteristics of the conduction electrons in metals and compounds. At the same time, electron microscopic studies of so-called dislocations are proceeding, and are proving to be a powerful tool for understanding the mechanical properties of metals. Promising progress has also been made in statistical theory which may help to understand the liquid state.

The spectroscopy group has continued its investigations of the absorption spectra of simple and somewhat more complicated molecules. These studies are carried out from the radio frequency region far into the vacuum ultraviolet. A great deal of work has also been done on the so-called optical maser, which during the past two years has developed into a tool of extraordinary importance with all sorts of applications. A maser beam is an exceptionally narrow beam of light in which, unlike ordinary light, the waves are all in phase, having, in fact, the same frequency to an accuracy of 1 in a billion. At the same time, the light energy per unit volume in such a beam is extremely large, and this allows the observation of entirely new phenomena connected with light.

The theoretical physics group is at present mainly concerned with a theoretical study of irreversible processes in ionized gases, that is, with theoretical problems basic to the field of plasma physics.

In the X-ray diffraction laboratory, in addition to the normal studies of molecular crystal structures, the nature of certain key narcotics is being investigated in terms of their molecular structure.

Division of Building Research

In continuing to provide a research service to the construction industry of Canada, with special services to Central Mortgage and Housing Corporation and for the National Building Code of Canada, the Division of Building Research pursued its stated policy of concentrating upon those areas of experimental research that have special significance for Canada. Close liaison with building research organizations throughout the world, especially with those of the English speaking world and Scandinavia, ensures that the best world-wide knowledge in all areas of building research is available for Canadian use through the Division.

Amongst the branches of special work to which the Division has given close attention is the problem of building in Canada's North. More than ten years ago, before such developments as the DEW-line and the current northern road construction program were even under consideration, the Division undertook careful reconnaissance of northern building problems, especially in the valley of the Mackenzie River, the site of almost all early northern development. With the cooperation of Imperial Oil Limited, a small summer field station for permafrost research was established at Norman Wells, N.W.T., in 1952. Permanent buildings there were officially dedicated in 1956.

From this small station much useful field research was undertaken. The major project was to assist in exploring the site of what is now Inuvik, a development which resulted from earlier permafrost research studies at Aklavik. Successful performance of piled foundations in permafrost at Inuvik and other northern settlements relates directly to the application of the results of these early studies. Field observation of a number of similar new installations is under way. To date the Division's northern field studies have been concentrated along the southern boundary of the permafrost region and at specific engineering developments such as the town of Thomson and the Kelsey power plant in northern Manitoba, at both of which intensive programs are in progress. With the prospective opening of the federal research laboratory at Inuvik, however, the place of the Norman Wells station is being reassessed. The Division looks forward to continuing actively its information service concerning northern building, but the extent of its field operations in the north must necessarily be limited and kept in balance with other responsibilities.

Research in housing continues to be preeminent in the Division's program. Cooperation with the Central Mortgage and Housing Corporation and with the National House Builders' Association in many joint enterprises continues profitably. The Division has begun publication of a new series of leaflets—*Housing Notes*—designed to communicate to the small house-builder practical research results that he can apply to his own jobs. Assistance has also been given with a complete review and revision of the new *Housing Standards*, republished by the Associate Committee on the National Building Code. The Division took the first steps, jointly with the Central Mortgage and Housing Corporation, towards integrating the Corporation's *Apartment Standards* into the National Building Code. Behind all such regulatory Documents, prepared by nationally recognized committees, must stand the results of sound research work. These and similar major research tasks constitute the continuing work of the Division.

Division of Mechanical Engineering

The past year has seen a variety of the Division's work put into industrial production. For example, a Canadian firm has evolved and manufactured for space vehicles an extensible antenna devised in the Division. This antenna has been installed in the Canadian earth satellite "Alouette", and in various United States satellites, with conspicuous success.

For aircraft and for general commercial use two factories are now producing flameless combustion heaters developed jointly by the Division and a provincial organization. The device ensures the starting of vehicle and aircraft engines in the coldest weather, and a substantial market for it is foreseen. Another cold weather development involves the improved winter operation of railway brakes. A self-draining air brake aftercooler, evolved jointly with the Canadian Pacific Railway Company, has been the subject of a copper extrusion development with a Canadian manufacturer. In spite of substantial problems, the manufacturer has made spectacular progress which seems likely to produce new techniques, developments, and products.

The above examples are in many ways typical of the 225 projects executed for 85 firms by the Division during the year. A roughly equal body of "internal" work, at earlier stages of development, is in progress. Examples of this other work are a group of theoretical and experimental examinations of the centrifugal compressor, for which a new type of cryogenic test bed was built and put into use; observation of the ice formations and water flows in large rivers; and observations of the wave motion in Northumberland Strait.

Probably the largest manifestation of Divisional research this year was the construction at Baie Comeau of a reinforced concrete breakwater. This type of installation was designed to allow minimum reflection of waves, and is, according to preliminary wave measurements, a success.

In addition to the above-mentioned practical activities there are under way a number of studies devoted primarily to scientific ends. One of these is an investigation into the interrelation of man's nervous and muscular system with the operation of high speed servo mechanisms. A stationary simulator which has been in use for some time is being followed by a more advanced one which will be capable of subjecting the operator to accelerations and other inputs, appropriately controlled through a high speed computing system.

Another long-term research concerns the production and behaviour of very hot ionized gases. Though the temperatures under consideration are too high to permit containment by material boundaries, the ionized gases exhibit electrical properties permitting control, and to some extent containment, by magnetic fields. Experimental work connected with this study involves methods such as seeding the gases with easily ionized materials, measuring the interactions between flow fields and magnetic fields and examining the radiation emitted, and has required the development of many new observational techniques. Although essentially a purely scientific research, this study promises to have many useful applications and by-products. One of these by-products (a high speed camera) is already in production in Canada, and a second (a plasma cutting torch) is far enough advanced to permit commercial exploitation.

National Aeronautical Establishment

Construction of the Division's 5-foot supersonic wind tunnel at Uplands Airport was completed in the summer of 1962. The development and refinement of this equipment will continue for some time to come, but there now exists for the first time in Canada a supersonic wind tunnel of adequate size and capability to support most of the industrial or military high speed aircraft developments of the foreseeable future. The new tunnel is designed to provide wind speeds with a maximum velocity of about $4\frac{1}{2}$ times the speed of sound, but its utility is not wholly or even primarily dependent on this high speed capability. It is provided also, with useable speed regimes down to about one fifth of the speed of sound, and in the vicinity of the speed of sound—which in an aerodynamic sense is a critical speed regime.

One particular advantage to be derived from the new wind tunnel is that it will relieve the excessive industrial work load now being placed on the Division's low speed tunnel—the only other fully developed large wind tunnel in Canada. This work load, which is approximately 2000 hours of actual operating time per year, has almost entirely preempted the time of the low speed tunnel: industrial work currently scheduled, in fact, occupies it fully for eighteen months into the future.

The work program for the new tunnel includes aerodynamic investigations on a series of Canadian-designed and built sounding rockets, a number of research projects supporting the development of a Canadian transport aircraft, and some basic research studies.

To aid industry's attempts to capture some of the world's market for short- or vertical-take-off and landing aircraft, considerable effort has been put into developing a flying simulator for studying the complex stability and control problems that the transition performance of such aircraft involves. This flying simulator is in fact a small helicopter equipped in such a way as to permit controlled variation of the aircraft's apparent response characteristics, and realistic reactions of pilots to a real flying environment can be fully taken into account. In this way, it is believed, conclusions drawn as to the limits of acceptability of flying qualities will have greatest validity.

The applied mechanics research program has continued to be highly diversified and oriented towards specific industrial development problems. Studies of aircraft material and structural fatigue make up a large part of the effort, and some progress has been made toward a better understanding of the mechanisms of cumulative fatigue damage. Measurement of the response of aircraft to low altitude turbulence and to runway roughness was undertaken in collaboration with the Royal Canadian Air Force and one of the airlines. Work on the development of a crash position beacon has progressed to the point of experiments on the supersonic use of the device; the subsonic version is now in the hands of an industrial company working with the assistance of the Department of Defence Production.

The basic research work of the Division is not discussed in this Report, but includes studies of boundary layer stability, hypersonic aerodynamics, thrust augmentation, pressure vessel and tower analysis, and fatigue at ultrasonic frequencies.

Radio and Electrical Engineering Division

This Division undertakes fundamental research in electrical science, and engineering problems of interest to the Canadian electrical industry and the Armed Services. A few examples of the work are outlined below.

The interaction of low energy particles, both charged and neutral, with solid surfaces at very low pressures, is known as "ultra-high vacuum". Studies in this field have been under way in the Division for some time now and various instruments for measurements at ultra-high vacuum have been developed. The results of these experiments are useful in obtaining a better understanding of the forces involved in interactions at surfaces. The data can also be used to calculate the interaction between a satellite and its environment; in particular, they are useful in designing space simulation systems.

A group previously engaged in defence research has been reorganized to provide engineering support for Canada's rocket sounding program and to do electronic space research.

In the field of electrical engineering, corona loss and radio interference are being studied because of increased interest in Canada in high voltage d.c. transmission. In addition, a special voltage divider has been developed for accurately measuring high-speed electrical surges, such as occur on transmission lines subjected to direct lightning strokes.

A new electrocardiograph has been developed and built in cooperation with Queen's University. Whereas the conventional electrocardiograph displays a graph of the time variation of heart voltage between two points on the body, the new instrument is connected to 70 points on the body and displays these voltages on a cathode-ray tube screen, so as to form a map of the voltage distribution.

The application of digital computers in scientific research, industry, and commerce is one of the most significant developments of recent years, and the pace of this development has quickened immeasurably with the introduction of the transistor. A compact, medium-speed, transistorized digital computer, using modular transistor-resistor logic throughout, has been designed and built by the Division. All computer operations are asynchronous, permitting the use of core and drum stores and a variety of input-output equipment. The computer operates on batteries for flexibility in field applications. Magnetic thin film memories for computers are also being developed.

As the speed of aircraft increases, it becomes more important to maintain radar contact with all flights from take-off to landing. A compact radar-data transmission system has been developed which provides air traffic controllers with a continuous radar display of activity at two or more adjacent airports. The system is currently being assessed by the Department of Transport.

A simple marine distress beacon has been developed which operates in the frequency band used by RCAF Search and Rescue craft. The beacon weighs only 3 pounds, is buoyant, and is sufficiently inexpensive as to be suitable for fishing vessels, pleasure boats and aircraft.

Division of Administration and Awards

This Division provides supporting services for the National Research Council Laboratories and for Canadian science generally.

To aid the NRC Laboratories the Division carries out administrative functions such as purchasing, personnel, accounting, transport, duplication and stenographic services. There is a separate branch of the Division that handles legal matters relating to the Council's operation, and another that maintains laboratory utilities and supervises minor construction. Although the Division works within the general operating procedures of the government service, these are always interpreted and applied in such a way as to support and sustain a creative research environment.

Divisional activities that benefit Canadian science in general are administration of the Council's foundation program supporting science and engineering in Canadian universities; maintenance of the National Science Library; the provision of free scientific and technical information to Canadian industry; operation of scientific liaison offices in Ottawa, London, Washington and Paris; public relations for the Canadian scientific community; administrative services for NRC Associate Committees; and representation of Canada in international scientific organizations.

A truly outstanding service that NRC provides for Canadian science is the publication of six scientific periodicals communicating the results of original research. Known as the Canadian Journals of Research, these appear under the subject headings of Biochemistry and Physiology, Botany, Chemistry, Microbiology, Physics, and Zoology. In addition to providing international distribution for the work of Canadian scientists, the Journals are widely used in library exchange agreements to bring foreign publications to Canada. The National Research Council bears the editorial, administrative and publication costs of the Journals, recovering a small portion of these costs through sales.

The growth of the Journals since their inception illustrates the remarkable growth of Canadian science during the same period. In 1929, when the Journals were begun as four sections of a single title, the total number of pages issued was 558. In 1962, and representing six separate titles, this total was 10,123. A significant and highly gratifying aspect of this increase is that 40% of the papers published in the Journals now originate in Canadian universities. Nine-to-ten per cent come from the laboratories of the National Research Council, and the remainder from other sources.

Financial Statement for the year 1962-63

NATIONAL RESEARCH COUNCIL, INCLUDING THE MEDICAL RESEARCH COUNCIL

RECEIPTS

Parliamentary Appropriations		
Vote 1 (Operations of Laboratories)	$36,458,606.02	
Vote 70 (General Salaries—Dept. of Finance)	1,034,950.80	
Vote 5 (Capital)	2,565,852.06	
Vote 10 (Assistance Towards Research in Industry)	537,318.02	
		$40,596,726.90
Special Funds: On hand 1 April 1962		
Cash unallotted	$1,843,280.61	
Central Warehouse Account and Other Accounts	333,655.81	
		$2,176,936.42
Laboratory Services	$582,062.34	
Sales of Publications	144,919.21	
Rental of Housing	2,479.30	
	$ 729,460.85	
Plus: Adjustment re Central Warehouse Inventory	154.85	
		729,615.70
Contributions from Government Departments	3,474,341.00	
		6,380,893.12
Total Receipts		$46,977,620.02

EXPENDITURES

Salaries	$19,143,446.25	
*Less Salaries of Service Staff	540,606.45	
		$18,602,839.80
Allowances		71,507.40
Professional and Special Services		685,503.90
Travelling and Removal Expenses		396,743.05
Freight, Express and Cartage		50,336.72
Postage		32,435.99
Telephones and Telegrams		47,605.51

Printing of Annual Report, Scientific Journals and Other Material		571,343.21
Exhibits, Advertising, Films, Broadcasting and Displays		63,617.86
Office Stationery, Supplies and Equipment		530,681.86
Library Books and Periodicals		204,519.43
Materials and Supplies		2,136,528.83
Expendable Research Equipment		2,242,407.43
Repairs and Upkeep of Buildings and Works		298,686.02
Repairs and Upkeep of Equipment		330,056.06
Municipal or Public Utility Services		514,469.75
Scholarships and Grants in Aid of Research—Science and Engineering		10,452,649.60
Scholarships and Grants in Aid of Research—Medical		4,296,760.99
Grant to the Royal Society of Canada		17,000.00
Sundries and Contingencies		114,670.54
Fire Research Building		1,136.85
Communications Building and Equipment		6,862.42
National Aeronautical Establishment High Speed Wind Tunnel and Equipment		33,697.48
Improvements to Aerodynamics Laboratory and Equipment		147,158.75
Algonquin Radio Laboratory and Equipment		710,625.43
Administration Building and Equipment		292,895.93
Applied Physics Building and Equipment		246,781.41
Alterations and Extensions		488,327.45
Acquisition of Equipment		638,366.34
Assistance Towards Research in Industry		537,318.02
Total Expenditures		$44,763,534.03
Balances on Hand, March 31, 1963: Special Fund		
Cash Unallotted	$1,880,430.18	
Central Warehouse Account and Other Accounts	333,655.81	
		2,214,085.99
Reconciliation to Receipts		$46,977,620.02

**This is the amount of salaries of staff of Plant Engineering Services and Mechanical Engineering (Workshops) paid from charges made for services rendered which are included in other items of expenditure.*

In addition to the above the Council spent $985,082.08 on scholarships and grants administered on behalf of other organizations who provided the funds.

The Medical Research Council

Canadian Patents and Development Limited

Medical Research Council 1962-63

R. F. FARQUHARSON, M.B.E., M.B., F.R.C.P.(C), F.R.C.P., M.D.(HON.), D.SC.(HON.), LL.D., F.A.C.P., F.R.S.C. Vice-President (Medical), National Research Council of Canada; Chairman, Medical Research Council.

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R. GINGRAS, M.D. Dean of Medicine, Laval University, Quebec, Quebec.

R. C. HARRISON, M.D., M.S., F.R.C.S.(C). Professor of Surgery and Director of Surgical Research, Department of Surgery, University of Alberta, Edmonton, Alberta.

F. C. MACINTOSH, M.A., PH.D., F.R.S. Professor and Chairman of the Department of Physiology, McGill University, Montreal, Quebec.

J. A. MCCARTER, M.A., PH.D. Professor and Head of the Department of Biochemistry, Dalhousie University, Halifax, Nova Scotia.

Continued overleaf

R. W. REED, M.A., M.D., C.M. Professor and Chairman of the Department of Bacteriology, McGill University, Montreal, Quebec.

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H. E. TAYLOR, M.D., C.M., F.R.C.P. Professor and Head of the Department of Pathology, University of British Columbia, Vancouver, British Columbia.

Medical Research Council 1962-63

Report of the Chairman

In the past year the Medical Research Council has provided approximately $4,300,000 for the support of medical research in Canadian universities and associated institutions and hospitals. Some 395 grants totalling $3,069,448 were made to scientists in preclinical departments such as anatomy, biochemistry, physiology and histology, in various clinical departments and in pathology and microbiology. A further 49 grants totalling $335,143 for the purchase of major items of research equipment were also provided. Eighty-two Fellowships were awarded for the training of promising research workers and 29 established scientists were supported as Medical Research Associates in universities; expenditures for these two categories were $353,408 and $305,307 respectively.

The volume and quality of the work done in all fields has increased in recent years, and gratifying progress is being made in all medical schools.

Particularly encouraging is the increase in the number of highly qualified young scientists interested in doing research. In 1957–58, eighteen Fellowships were awarded for training research workers. In each subsequent year the number has risen, reaching 60 in 1961–62, and 82 in 1962–63. Although the interest of talented graduates in research definitely is increasing, this is not in itself sufficient: it is important to find the funds with which to pay them and to provide space in which they would work.

Two great shortages currently exist in Canada's medical research program. One of these is the small number of full-time appointments in Canadian medical schools, particularly in clinical departments. Because of its heavy teaching load, the small full-time staff has inadequate time for research. To help meet this need the National Research Council, through its medical division, established in 1956 a new category of award known as Medical Research Associates. These Associates are highly trained medical research scientists who will devote most of their time to active investigation, with only a small portion given to teaching. Funds for paying their salaries are granted to the universities. The total number appointed has gradually increased to the point where there were, in 1962–63, twenty-nine Medical Research Associates in different Canadian medical schools.

Even this small number is helping to build up in the universities a larger pool of full-time medical scientists comparable to (but very much smaller in number than) the scientists of the National Research Council. The training of larger numbers of young researchers is already providing a good source of competent scientists from which excellent Medical Research Associates may be selected.

The other great shortage is of research laboratories. In all our universities there is a serious lack of space for the work that must be done. This shortage is becoming a critical factor actively interfering with further progress. It also aggravates the tendency for good people to seek positions outside the country.

The serious drain of our competent scientists to the United States is not due to the higher scale of American salaries. It is due, rather, to the shortage of research laboratory space in Canada, and to the lack of funds for salaries with which to pay an adequate number of medical scientists and to support their research.

In the last few years the Medical Research Council has modified and improved its method of examining applications for research grants by establishing four strong subcommittees in the following areas: biochemistry; physiology, pharmacology and anatomy; bacteriology and pathology; and clinical investigation. Each subcommittee consists of a few members of the Medical Research Council and a number of carefully chosen scientists. In addition, each application for support is referred to two special reviewers competent in the applicant's field. The grants subcommittees examine the applications and the reports of the special referees and make recommendations to the Council about them. Since the funds available are usually much less than the funds applied for (in 1962–63 it was not possible to award even two-thirds of the total amount requested), the initial recommendations must often be reduced; this is done by consultation between the subcommittees and, finally, by the Council.

It is of course important to examine carefully and in detail the projects submitted by younger and new applicants and to encourage them. The Council's great responsibility, however, is to seek out those with imagination, talent, keen insight and industry who are proving themselves highly competent research scientists, and to give them the fullest support possible.

Canadian Patents and Development Limited

Annual Report for the Year 1962-63

Officers:

President: F. T. ROSSER
Vice-President: MARC BOYER[1]
Secretary-Treasurer: F. R. CHARLES
Manager: J. R. JOHNSON

Directors:

DR. B. G. BALLARD
DR. E. R. BIRCHARD[2]
DR. MARC BOYER[1]
PROFESSOR R. E. JAMIESON
DR. C. J. MACKENZIE
MR. F. L. W. MCKIM
DR. F. T. ROSSER
DR. E. W. R. STEACIE[3]
DR. W. E. VAN STEENBURGH
BRIGADIER F. C. WALLACE
DR. A. H. ZIMMERMAN

Auditor: The Auditor General

Bankers: The Canadian Imperial Bank of Commerce

Head Office: National Research Building, Sussex Drive, Ottawa, Canada

[1]Deceased November 8, 1962
[2]Deceased January 6, 1963
[3]Deceased August 28, 1962

Canadian Patents and Development Limited

THE HON. C. M. DRURY,
Chairman of the Committee of the Privy Council on Scientific and Industrial Research, Ottawa

SIR:

In accordance with Section 85(3) of the Financial Administration Act, I have the honour to present to you on behalf of the Board of Directors, the Fifteenth Annual Report of Canadian Patents and Development Limited for the year ended March 31st, 1963, together with the financial statements and the Report of the Auditor General, following his examination of the Company's accounts.

Canadian Patents and Development Limited is a subsidiary company of the National Research Council of Canada responsible for patenting and exploiting commercial inventions originating in the laboratories of the Council. The Company also handles inventions referred to it from the research establishments of Federal Government departments, twelve Canadian universities and five provincial research councils.

The Company's business has continued to grow steadily. The number of active inventions now held by the Company exceeds 750. Some 164 of these are licensed to industrial organizations throughout the world, with Canadian industry holding 72.5% of them.

The invention windfalls that bring in large revenues are very rare indeed and often short lived. The profit which is shown for this year may be attributed to the revenue from one license alone. However, the diversity of the inventions recently licensed by the Company tends to stabilize the financial position since many of the new licenses contain provisions for minimum annual payments. Even without a windfall, the Company would be able to meet its obligations and, with one, development work is made possible. The results of recent exploitation and promotion have been encouraging; approximately 96% of the Company's royalty income this year was derived from licenses which were completed since 1955.

This year the Company resumed its assistance to industry in establishing new industrial processes in Canada. This development program got under way more slowly than had been expected but the Company is now studying the possibility of doing development work on such projects as ore treatment and design of surgical instruments and office machinery.

The operating budget for the ensuing year has been approved by the Chairman of the Privy Council Committee on Scientific and Industrial Research and the Minister of Finance in accordance with the Financial Administration Act.

It is with regret that we record the deaths of Dr. Marc Boyer, Vice-President of the Company, and of two of the Company's Directors, Dr. E. W. R. Steacie, President of the National Research Council, and Dr. E. R. Birchard, the Company's first President, who contributed so greatly to its organization and growth.
Yours sincerely,

F. T. ROSSER, *President*

July 18, 1963

AUDITOR GENERAL OF CANADA
Ottawa

THE HON. C. M. DRURY,
Chairman of the Committee of the Privy Council on Scientific and Industrial Research, Ottawa

SIR,

I have examined the accounts and financial statements of Canadian Patents and Development Limited for the year ended March 31, 1963. In compliance with the requirements of section 87 of the Financial Administration Act, I report that, in my opinion:

(*a*) proper books of account have been kept by the Company;

(*b*) the financial statements of the Company

(i) were prepared on a basis consistent with that of the preceding year and are in agreement with the books of account,

(ii) in the case of the balance sheet, give a true and fair view of the state of the Company's affairs as at the end of the financial year, and

(iii) in the case of the statement of income and expense, give a true and fair view of the income and expense of the Company for the financial year, and

(*c*) the transactions of the Company that have come under my notice have been within the powers of the Company under the Financial Administration Act and any other Act applicable to the Company.

Yours faithfully,

A. M. HENDERSON
Auditor General of Canada

May 13, 1963

CANADIAN PATENTS AND DEVELOPMENT LIMITED (*Incorporated under the Companies Act*)

BALANCE SHEET AS AT MARCH 31 1963 (with comparative figures as at March 31 1962)

ASSETS

		1963	*1962*
Cash		$ 36,270	$ 18,209
Accounts receivable	$169,837		108,131
Less: Provision for doubtful accounts	6,600		6,600
		163,237	101,531
Investments in bonds of, or guaranteed by, the Government of Canada, at cost (market value, March 31, 1963, $639,880; March 31, 1962, $386,013)	651,073		394,198
Add: Accrued interest	8,816		3,818
		659,889	398,016
		$859,396	$517,756

Note

The Company had outstanding commitments amounting to approximately $32,000 as at March 31, 1963, in respect of a development program.

LIABILITIES

		1963	*1962*
Accounts payable		$ 39,636	$ 59,459
Royalties paid in advance		—	4,815
Capital:			
Capital stock:			
Authorized —10,000 shares of no par value			
Issued—5,000 shares, fully paid		296,199	296,199
Surplus			
Balance as at April 1, 1962	$157,283		
Add: Net profit for the year, per Statement of Income and Expense	366,278		
		523,561	157,283
Balance as at March 31, 1963		819,760	453,482
		$859,396	$517,756

Approved on behalf of the Board

F. T. ROSSER
Director

F. L. W. MCKIM
Director

I have examined the above Balance Sheet and the related Statement of Income and Expense and have reported thereon under date of May 13, 1963, to the Chairman of the Committee of the Privy Council on Scientific and Industrial Research.

A. M. HENDERSON
Auditor General of Canada

CANADIAN PATENTS AND DEVELOPMENT LIMITED

STATEMENT OF INCOME AND EXPENSE FOR THE YEAR ENDED MARCH 31 1963
(with comparative figures for the year ended March 31 1962)

		1963	*1962*
Income			
Royalties, licensing fees, etc.	$553,972		$277,329
Less: costs of licensing rights and related technical assistance, etc.	62,782		12,168
		$491,190	$265,161
Income from agency agreements		2,915	3,457
Interest earned		20,773	10,081
Miscellaneous income		186	948
		515,064	279,647
Expense			
Services provided by National Research Council	36,000		30,000
Salaries	28,801		26,879
Patent attorneys' fees and other patent expense	55,058		33,473
Awards to inventors	18,640		13,810
Provision for doubtful accounts	—		100
Promotion and development	6,790		28,903
Travel	2,108		2,846
Miscellaneous	1,389		1,315
		148,786	137,326
Net Profit		$366,278	$142,321

Note: Salaries for the year 1963 include directors' fees, $200 ($150)

The Research Council Act/R.S.C. 1952 c. 239

As amended by 1953-54, c. 40 and 42

SHORT TITLE

1. This Act may be cited as the *Research Council Act*, R.S., c. 177, s. 1. Short title.

INTERPRETATION

2. In this Act, Definitions.

(*a*) "Chairman" means the Chairman of the Committee of the Privy Council on Scientific and Industrial Research; "Chairman."

(*b*) "Committee" means the Committee of the Privy Council on Scientific and Industrial Research; "Committee."

(*c*) "company" means a company incorporated pursuant to paragraph (*a*) of subsection (1) of section 17 and any company the direction and control of which is assumed by the Council pursuant to paragraph (*b*) of subsection (1) of section 17; "Company."

(*d*) "Council" means The Honorary Advisory Council for Scientific and Industrial Research; "Council."

(*e*) "President" means the President of The Honorary Advisory Council for Scientific and Industrial Research; "President."

(*f*) "Vice-President (Administration)" means the Vice-President (Administration) of The Honorary Advisory Council for Scientific and Industrial Research; and "Vice-President (Administration)."

(*g*) "Vice-President (Scientific)" means a Vice-President (Scientific) of The Honorary Advisory Council for Scientific and Industrial Research. R.S., c. 177, s. 2; 1946, c. 31, s. 1; 1950, c. 21, s. 1. "Vice-President (Scientific)."

3. There shall be a Council to be called "The Honorary Advisory Council for Scientific and Industrial Research." R.S., c. 177, s. 3. Advisory Council.

4. There shall be a committee to be called the Committee of the Privy Council on Scientific and Industrial Research consisting of such number of ministers belonging to the Queen's Privy Council for Canada as the Governor in Council may determine, to be nominated by the Governor in Council. 1946, c. 31, s. 2. Committee of the P.C. on Scientific and Industrial Research.

5. (1) The Council consists of a President, a Vice-President (Administration) and two Vice-Presidents (Scientific) and not more than seventeen other members, to be appointed by the Governor in Council. Appointment of Council.

(2) The members of the Council, with the exception of the President, the Vice-President (Administration), and the Vice-Presidents (Scientific) hold office for a period of three years. Tenure of office.

(3) A retiring member is eligible for re-appointment. Re-appointment.

(4) There shall be an Executive Committee of the Council consisting of the President, the Vice-President (Administration), the Vice-Presidents (Scientific), and at least three other members selected by the Council. 1950, c. 21, s. 2. Executive Committee.

President of the Council.

6. (1) The President is the chief executive officer of the Council and has supervision over, and direction of, the work of the Council and of the officers, technical and otherwise, appointed for the purpose of carrying on the work of the Council.

Vice-President (Administration).

(2) Subject to the direction and control of the President, the Vice-President (Administration) has charge of all matters relating to administration and shall perform such other duties as the President may from time to time assign to him.

Vice-Presidents (Scientific).

(3) Subject to the direction and control of the President, each of the Vice-Presidents (Scientific) has supervision over such scientific matters and shall perform such other duties as the President may from time to time assign to him.

Salaries as prescribed by Governor in Council.

(4) The President, the Vice-President (Administration) and the Vice-Presidents (Scientific) shall receive such salaries and be employed for such terms of office as the Governor in Council may prescribe, and such salaries shall be paid out of moneys provided for the work of the Council. 1946, c. 31, s. 4; 1950, c. 21, s. 3.

Duties of Council.

7. The Council has charge of all matters affecting scientific and industrial research in Canada that may be assigned to it by the Committee, and also has the duty of advising the Committee on questions of scientific and technological methods affecting the expansion of Canadian Industries or the utilization of the natural resources of Canada. R.S., c. 177, s. 6.

Council incorporated Rep. and New. 1953–54, c. 42, s. 1, National Research Council.

8. (1) The Council is a body corporate, capable of suing and being sued and having power to acquire and hold real and personal property for the purposes of and subject to this Act.

(2) The Council may be called the National Research Council. R.S., c. 177, s. 7; 1950, c. 21, s. 4.

Agent of Her Majesty.

9. (1) The Council is for all purposes of this Act an agent of Her Majesty and its powers under this Act may be exercised only as an agent of Her Majesty.

Proceedings by and against the Council.

(2) Actions, suits or other legal proceedings in respect of any right or obligation acquired or incurred by the Council on behalf of Her Majesty, whether in its name or in the name of Her Majesty, may be brought or taken by or against the Council in the name of the Council in any court that would have jurisdiction if the Council were not an agent of Her Majesty. 1950, c. 51, s. 3.

Meetings Rep. and New. 1953–54, c. 42, s. 2.

10. The Council shall meet at least three times a year in the City of Ottawa on such days as are fixed by the Council and at such other times and places as the Council deems necessary.

Powers of Executive Committee.

11. The Executive Committee of the Council may exercise the powers of the Council and shall submit at each meeting of the Council minutes of its proceedings since the last preceding meeting of the Council. 1946, c. 31, s. 5.

Travelling and other expenses.

12. No member of the Council, with the exception of the President, the Vice-President (Administration) and the Vice-Presidents (Scientific) shall receive any payment or emolument for his

services, but each member shall receive such travelling and other expenses in connection with the work of the Council as may be approved by the Governor in Council. 1950, c. 21, s. 5.

13. Without thereby limiting the general powers of the Council conferred upon or vested in it by this Act, it is hereby declared that the Council may exercise the following powers, namely:— Powers of Council.

(*a*) to make by-laws for the conduct of its business;

(*b*) to control and direct the work of the Council through the President, and, in case of the illness, absence or suspension of the President, or in the case of vacancy in the office of President, through an Acting President temporarily appointed by the Council;

(*c*) to undertake, assist or promote scientific and industrial research, including, without restricting the generality of the foregoing, Am. 1953–54, c. 42, s. 3 (1).

(i) the utilization of the natural resources of Canada, Rep. and New. 1953–54, c. 42, s. 3 (1).

(ii) researches with the object of improving the technical processes and methods used in the industries of Canada, and of discovering processes and methods that may promote the expansion of existing or the development of new industries,

(iii) researches with the view of utilizing the waste products of the said industries,

(iv) the investigation and determination of standards and methods of measurements, including length, volume, weight, mass, capacity, time, heat, light, electricity, magnetism and other forms of energy, and the determination of physical constants and the fundamental properties of matter,

(v) the standardization and certification of the scientific and technical apparatus and instruments for the Government service and for use in the industries of Canada, and the determination of the standards of quality of the materials used in the construction of public works and of the supplies used in the various branches of the Government service,

(vi) the investigation and standardization, at the request of any of the industries of Canada, of the materials which are or may be used in, or of the products of, the industries making such a request, and

(vii) researches, the object of which is to improve conditions in agriculture;

(*d*) to have charge of, and direction or supervision over, the researches which may be undertaken, under conditions to be determined in each case, by or for single industrial firms, or by such organizations or persons, as may desire to avail themselves of the facilities offered for this purpose;

(*e*) to expend, for the purposes of this Act, any money appropriated by Parliament for the work of the Council or received by the Council through the conduct of its operations, be- Rep. and New. 1953–54, c. 42, s. (2).

quest, donation or otherwise;

Rep. and New. 1953–54, c. 42, s. 3 (2).

(*f*) with the approval of the Chairman, to appoint such scientific, technical and other officers as are nominated by the President, and to fix the tenure of such appointments, to prescribe the several duties of such officers, and, subject to the approval of the Governor in Council, to fix their remuneration;

Rep. and New. 1953–54, c. 42, s. 3 (2).

(*g*) subject to the approval of the Chairman, to publish and sell or otherwise distribute such scientific and technical information as the Council deems necessary;

(*h*) to carry on work and manufacturing of an experimental and development nature with respect to the matters referred to in paragraphs (*c*) and (*d*) so as to render the processes, methods or products to which the said matters relate more available and effective in useful arts and manufacturing and for scientific purposes and otherwise; and

(*i*) to license, sell or otherwise grant or make available to others, Canadian or other patent rights or any other rights, vested in or owned or controlled by the Council, to or in respect of any discovery, invention or improvement in any art, process, apparatus, machine, manufacture or composition of matter, and to receive royalties, fees and payments therefor. R.S., c. 177, s. 10; 1946, c. 31, s. 7; 1950, c. 21, s. 6.

14. Repealed. 1953–54, c. 40, s. 15.

Audit of expenditures.

15. All the receipts and expenditures of the Council are subject to examination and audit by the Auditor General. R.S., c. 177, s. 12.

President's report.

16. (1) The President shall report annually to the Council upon the progress and efficiency of the work of the Council and as to its requirements, and shall make such recommendations therein as he may deem necessary.

Council's report.

(2) The Council shall, after the conclusion of the fiscal year, make a report to the Committee containing the report of the President to the Council and also containing a statement of the receipts and expenditures of the Council during the preceding fiscal year.

(3) Such reports shall be printed and laid before Parliament within fifteen days of the making thereof, or, if Parliament is not then in session, within fifteen days after the commencement of the next session of Parliament. R.S., c. 177, s. 13.

*NOTE: "14. (1) Every discovery, invention or improvement in any art, process, apparatus, machine, manufacture or composition of matter made by a member or any number of members of the scientific and technical staff of the Council or a company and all rights with respect thereto are vested in the Council.

(2) The Council, with the approval of the Governor in Council, may pay to its scientific and technical officers and to others working under its auspices who have made any valuable discovery, invention or improvement in any art, process, apparatus, machine, manufacture or composition of matter, such bonuses or royalties as in its opinion may be warranted. 1950, c. 21, s.7."

The Public Servants Inventions Act, chapter 40 of the Statutes of 1953–54, which was proclaimed in force as of the 1st day of June, 1955, repeals section 14. The Act, however, applies only to inventions that were made, or for which an application for a patent was made, after June 1st, 1954. Section 14, therefore, remains in force for all prior inventions.

17. (1) The Council may, with the approval of the Governor in Council,

Council may procure incorporation of companies.

(*a*) procure the incorporation of any one or more companies under the provisions of Part I of the *Companies Act*, for the objects and purposes of exercising and performing on behalf of the Council such of the power conferred upon the Council by paragraphs (*c*), (*d*), (*h*) and (*i*) of section 13 of this Act as the Council may from time to time direct and all the issued shares of the capital stock of each such company shall be owned or held in trust by the Council for Her Majesty in right of Canada except shares necessary to qualify other persons as directors; or

Assume control of existing companies.

(*b*) assume, by transfer to the Council in trust for Her Majesty in right of Canada of all the issued share capital thereof except shares necessary to qualify other persons as directors, the direction and control of any one or more existing companies incorporated under the provisions of Part I of the *Companies Act* all the issued share capital of which is owned by or held in trust for Her Majesty in right of Canada except shares necessary to qualify other persons as directors and may delegate to any such company any of the powers conferred on the Council by paragraphs (*c*), (*d*), (*h*) and (*i*) of section 13 of this Act.

Books and records.

(2) Every company shall keep and maintain such books and records, in addition to those required by the *Companies Act* as the Council may prescribe and shall make such reports and returns to the Council as the Council may require.

Accounts.

(3) The accounts of a company shall be audited by the Auditor General. 1946, c. 31, s. 9.

NRC Reports

ANNUAL REPORT

The Annual Report of the National Research Council, as required under the Research Council Act, contains the President's report and the financial statement of the Council for the fiscal year. It also outlines the main projects of the laboratory divisions.

NRC REVIEW

The "NRC Review" contains reports of the directors of divisions and heads of sections and accounts of the work of the Council's committees. A directory of scientific staff is included at the end of the book. It is distributed to scientists, research institutions and other persons or organizations who require such information.

REPORT ON UNIVERSITY SUPPORT

The Report on University Support provides detailed information about the Council's program of university support for science and engineering, and the research awards of the Medical Research Council. Published annually.

NRC RESEARCH NEWS

The "NRC Research News" is a bulletin intended to provide the scientific reader with a continuous record of activities of the National Research Council.

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