CANADA

NATIONAL ADVISORY COMMITTEE ON RESEARCH IN THE GEOLOGICAL SCIENCES

NINTH ANNUAL REPORT

1958-59

(Including Survey of Current Research in the Geological Sciences in Canada, 1958-59)

Price 50 cents

OTTAWA

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Department of Mines and Technical Surveys

NATIONAL ADVISORY COMMITTEE ON RESEARCH

IN THE

GEOLOGICAL SCIENCES

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601 Booth Street,
Ottawa, October 31, 1959.

The Honourable Paul Comtois,
Minister of Mines and Technical Surveys,
Ottawa, Ontario.

Sir:

I have the honour to submit to you the Ninth Annual Report of the National Advisory Committee on Research in the Geological Sciences covering the period September 1, 1958 to August 31, 1959.

Respectfully submitted,

J.M. Harrison

J. M. Harrison,
Chairman.

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Dr. J.F. Henderson, Secretary . Geological Survey of Canada,
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Meetings:

April 11-12, 1959, Queen Elizabeth Hotel, Montreal, Quebec.

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Ottawa, Ontario.

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Quebec, Quebec.

Dr. J.S. Stevenson ..... McGill University,
Montreal, Quebec.

Meetings:

June 5, 1959, Victoria Memorial Museum, Ottawa, Ontario.

THE YEAR IN REVIEW

The National Advisory Committee on Research in the Geological Sciences has a threefold purpose: to stimulate and coordinate geological research carried on in Canada; to suggest research projects that should receive attention; and to aid in having these projects undertaken. Its function is to stimulate research by the universities, the federal and provincial departments of mines, and by other organizations equipped for the work.

The first part of this report gives a summary of the work of the Committee in the period of September 1, 1958, to August 31, 1959. The second contains the reports of the sub-committees covering the different fields of the geological sciences. These record developments in 1958-59 and suggest some further problems for study.

The report includes the annual survey of current geological research in Canada. This records information on research by the universities, federal and provincial departments of mines, research councils and foundations.

COMPREHENSIVE STUDY OF A CANADIAN ORE DEPOSIT

Progress in initiating such a study has been disappointing. The project, as originally envisaged in 1957, was to be a most comprehensive study which would be carried out by geophysicists, geochemists, geologists and mineralogists. It would be a cooperative project in which the staff of the mine selected, the Geological Survey of Canada, the Department of Mines and Research Council or Foundation of the province concerned, and the universities would participate. The Geological Survey of Canada would sponsor the project and have overall responsibility for carrying it through. A lead-zinc orebody in New Brunswick was selected for study, but the closing of the mine in the spring of 1958 forced abandonment of the project in so far as that mine was concerned. However, the project in modified form under the auspices of the Geological Survey of Canada is proceeding as related to several orebodies in the general area, and with staffs and graduate students from several universities participating.

An attempt was made to initiate study of a deposit in the Sudbury camp and the International Nickel Company of Canada, Limited and Falconbridge Nickel Mines, Limited were approached. A drawback to this camp is that most of the deposits belong to more than one company, thus doubling the difficulties of coordinating a program of study, other disadvantages being the size of the deposits which makes for a long-term project, and their unusual character. A smaller and more representative orebody outside the Sudbury camp might be preferable. Originally it was hoped that the detailed geological mapping of the mine selected might be carried out by the mine geologist. If a small mine is selected for study, this may not be feasible, in which case the mapping must be done by an officer of the Geological Survey of Canada or of the provincial survey concerned.

At the April 1959 meeting, a subcommittee composed of H.D.B. Wilson, C.H. Michener, G.B. Langford and F.R. Joubin was appointed to select a deposit that meets the needs envisaged for the comprehensive study, seek the approval of the company owning the deposit and obtain its cooperation in carrying out the study.

RESEARCH GRANTS TO UNIVERSITIES

The grants were initiated in 1951 to stimulate and support geological research in Canadian universities. Applications are received from members of university staffs and are submitted to the Director, Geological Survey of Canada. They are reviewed by the Projects Subcommittee of the National Advisory Committee and the grants are awarded by the Survey on the basis of the resulting recommendations.

Grants totalling $50,000 were awarded in the year under review to 13 universities in support of 13 new projects and 16 continuing studies. Amounts of the grants and descriptions of the projects being supported are given in Appendix II (p. 85).

Forty-six projects in 14 universities are being (September, 1959) supported; 35 others have been completed. Since 1951, when the grants were initiated, 88 papers have been published in scientific periodicals recording the results of projects supported by the grants. Forty-three of these papers were published in Canada, 32 in the United States, 12 in Great Britain and one in Germany. In addition the results of the research have been incorporated in 24 M.Sc. and 17 Ph.D. theses. Reports of progress on some of the projects are given in Appendix I (p. 71).

In 1951, ten thousand dollars was provided and this was sufficient to finance the worthwhile applications - evidence of the small amount of geological research then in hand. But each year the number of applications has increased and the quality of the projects has improved. In 1959, thirty-seven applications were received and the total of the grants applied for was $94,290. Seventeen of the applications amounting in all to $48,370, were for support of projects supported previously and 20 totalling $45,920 were for support of new projects. Thus, the funds available are little more than sufficient to finance the projects already being supported, much less the twenty applications for new projects. With the limited funds available the Committee in reviewing the grants was faced, again this year, with the problem of how to support worthwhile continuing projects and at the same time provide support for some of the twenty new applications. Only a few of these could be supported and for only part of the amounts needed. The National Advisory Committee again this year, has recommended that the amount provided for grants-in-aid of geological research be increased to $75,000. Unless additional funds are provided, the universities will be unable to work on many highly desirable projects.

It is clearly apparent that the grants are accomplishing their purpose in stimulating and improving the quality of geological research in our universities. Not only have they

helped to provide much-needed equipment, but they have enabled the more brilliant students to pursue their graduate studies in Canada rather than in the United States. By providing a more attractive and stimulating environment for the professorial staffs of our universities, they are encouraging research men to remain in our universities rather than to seek more remunerative occupations in industry or in universities in the United States. At the same time increased opportunities and facilities for research are attracting additional support from other sources. Thus, research in geochemistry and biogeochemistry, originally supported by the grants, has received additional financial help from mining companies interested in its practical application in prospecting.

The role of the universities in research is to pioneer. Effective research of this type results mainly from curiosity, imagination and ingenuity, all of which are attributes of the young mind. It is also desirable that men with different viewpoints work on these problems and that they be given considerable freedom of action. This favourable atmosphere is provided in the graduate schools of our universities. In the geological sciences, such university research, largely neglected in the past, is now being fostered and encouraged by the grants-in-aid.

PROPOSED GEOLOGICAL INSTITUTE FOR RESEARCH

The need for a geological institute supported jointly by industry and government was discussed at some length at the annual meeting (April 1959) of the National Advisory Committee.

Proponents of the Institute pointed out that (provincial and federal) government departments and the universities which were carrying on most of the geological research in Canada are dependent on government for their finances. The mining and petroleum industries need geologists in their search for new deposits and these men in turn need continuing geological research to maintain efficiency in this search. Geological research should not be entirely under the thumb of the government; industry itself should participate. The ideal partnership might be between the government, the universities, and the mining and petroleum industries. Geological research would thus be on a broader base and more money would be available for it. The short-term goal might be to set up an organization with representatives from the universities, the provincial and federal departments of mines and from industry. Its objective in part would be to cooperate with the National Research Council and the National Advisory Committee and to attempt to increase the money available for grants to the universities for geological research. The suggested institute would search for and encourage the submission of research projects of promise; it would raise the money for them from industry and government and allocate the funds. Because of its support from industry such an organization might be preferable and better able to act than the present National Advisory Committee. The long-term goal would be an institute that would possess buildings and laboratories, perhaps somewhat similar to those of the Soviet Union. Such an institute would do advanced geological research with possibly also a school for postgraduate student research.

Other members were not in favour of any attempt to establish such an institute. They felt that both government and industry would have many questions to ask before being willing to support it. Both government and industry would doubtless feel that in the Geological Survey of Canada fulfils, or with necessary expansion could fulfil all the functions envisaged for the suggested institute. A Brief (Appendix III, p. 94) from the Royal Society of Canada and the Geological Association of Canada was submitted to the Prime Minister and Cabinet in Ottawa in October 1958 recommending expansion of the Geological Survey of Canada to make it better able to fulfil these functions. Why should the waters be muddied by stirring up something else at the present time? The proposed Institute would be difficult to fit in with existing organizations. In its research activities it would seem to be in opposition both to the Geological Survey and to the universities. It would be most difficult to obtain money to support such an organization from either the government or from industry because organizations prefer to distribute their own money; they do not want to give it to some other institution over which they have little or not control. This applies to government and especially to industry.

However, the Executive Committee was asked to explore the need for a geological institute further and examine the whole matter of research in the geological sciences in Canada and the function of the National Advisory Committee in fostering such research. For this study the Executive Committee was instructed to add to its numbers with representatives from the universities, industry and the federal and provicial departments of mines.

JOINT BRIEF OF ROYAL SOCIETY OF CANADA AND GEOLOGICAL ASSOCIATION OF CANADA

In October 1958, a special committee of the Royal Society of Canada, Section IV, and the Geological Association of Canada, after consulting many of the scientific personnel of their own and associated groups in Canada, joined in presenting a brief on the Geological Survey of Canada to the Prime Minister and Cabinet. This brief, included in Appendix III of this report (p. 94), presents reasons why the Survey should be expanded and makes recommendations in regard to increasing its establishment, allocation of funds, and cooperation between federal, provincial and industrial agencies in planning geological services.

The National Advisory Committee fully endorsed this Brief at its annual meeting in April 1959 and urged the Government of Canada to implement the recommendations contained therein.

ABSTRACTS OF GRADUATE STUDENT THESES

Since March 1953, the Canadian Mining Journal has been publishing abstracts of geological theses of graduate students in Canadian universities on behalf of the National Advisory Committee. The abstracts are sent by the universities to the

Secretary of the Committee who forwards them to the Journal. In all, 321 abstracts were published in the Journal by the end of 1958. The abstracts are indexed in the Bibliography of North American Geology where they can be found readily by author or subject. In the past they were published four times a year, usually in the March, June, September and December issues of the Canadian Mining Journal. Starting in August 1959 the Journal will publish a page of abstracts each month rather than three pages every three months.

A Bibliography of Theses in Geology[1] was published recently which lists essentially all theses written for advanced degrees in the United States and Canadian institutions up to and including 1957. The theses are arranged by author in alphabetical order. A general index compiled from the titles is included, with primary emphasis on indexing by geographic location and with secondary emphasis on geologic time and subject matter. Formation and group names are indexed separately.

(1) Bibliography of theses in geology; compiled by Chronic, John, and Chronic, Halka, Univ. of Colorado and Petroleum Research Corporation; published 1958 by Pruett Press, Boulder, Colorado.

TRANSLATION OF FOREIGN GEOLOGICAL LITERATURE

The Eighth Annual Report[1] contains a summary account of the translation services available in Canada, Great Britain and the United States. In addition to the facilities outlined in that report, the American Geological Institute now publishes the International Geology Review each month. This journal contains in English, full translations, condensations, and reviews from foreign language publications on significant developments in pure and applied geologic research. Particular attention is given to the literature of the Soviet Union. The basic subscription for 12 issues is $55.00 a year with a special rate of $15.00 to educational institutions and personnel.

(1) National Advisory Committee on Research in the Geological Sciences, Eighth Annual Report, 1957-58, p. 4-6.

GEOLOGICAL LIBRARIES

World geological literature is voluminous and few geological libraries can hope to have complete coverage. However, between them, all the geological libraries in Canada have fairly complete coverage, but to obtain the less well known foreign periodicals, it is necessary to know what libraries have them. This information is available in Union List of Scientific Serials in Canadian Libraries, which is compiled and edited in the library of the National Research Council (N.R.C. 4,200). The list contains 21,000 entries and represents the serial holdings of 140 Canadian libraries, including all our university libraries.

The entries are arranged in alphabetical order, by title if distinctive, or by name of the society or sponsoring body. For example, if it is desired to know what libraries in Canada have the Transactions of the Geological Society of South Africa, that Society is referred to in the List and after it are listed all the libraries in Canada that have these Transactions.

CHANGES IN PERSONNEL OF COMMITTEE

P.E. Auger, D.M. Baird, H.J. Fraser, J.E. Gill H.C. Gunning, G.S. MacKenzie, J.B. Mawdsley and J.C. Sproule retired from the Committee in 1958 and were succeeded by F.F. Osborne, F.H. Edmunds, Wm.C. Gussow, A.L. McAllister, C.E. Michener, V.J. Okulitch and J.S. Stevenson.

All members join in expressing appreciation of the personal contribution of time and effort of the retiring members to the work of the Committee during their terms of office, and look forward to their continued interest and support.

SUBCOMMITTEE REPORTS

(Summary Statements)

Seven subcommittees cover the different fields of the geological sciences and maintain a continuous survey of developments in these fields and of the problems most urgently in need of investigation. Their reports, which were presented at the annual meeting of the National Advisory Committee in April 1959, are given in full later (p. 13) in this report. Summaries of the reports and of the discussions that followed their presentation are given below:

The Subcommittee on Mineral Deposits suggests that the great need in research on ore deposits is the organization and implementation of comprehensive studies; of broad-scale projects that can be done only by some group coordinating the results of many workers. Wall-rocks alteration about ore deposits is cited as a subject for such a large scale, cooperative project and the scope and some of the problems involved in such a study are discussed. Another suggested comprehensive study concerns the metal content of rocks. Research is needed particularly on the distribution of metals in almost all sediments, in metamorphic rocks, and on their redistribution during metamorphism. Knowledge of the metal content of such rocks (igneous, sedimentary and metamorphic) is fundamental to theories of the genesis of ore deposits and to geochemical prospecting. The report suggests, however, that, for the present, efforts should be concentrated on initiation and organization of the comprehensive study of an ore deposit. If this project to which so much thought has been given can be promoted successfully, other large projects such as wall-rock alteration and the metal content of rocks can be handled in the same manner.

The report also discusses the symposium on sulphide deposits held by the Geology Division of the Canadian

Institute of Mining and Metallurgy in April 1959 and the program of the Mineral Deposits Division of the Geological Survey of Canada.

Discussion centred around the comprehensive study of an ore deposit (p. 2). Dr. Wilson suggested that such a study, if successful, might eventually lead the way to the development of a geological institute (p. 3).

The Subcommittee on Mineralogy, Geochemistry and Petrology reviews developments in 1958-59 with emphasis on Western Canada and discusses the changes occurring in geological research across the nation in these fields. The greatly expanded research facilities of the Research Council of Alberta and the University of Alberta are mentioned particularly. Progress is reported in several compilation projects, including the compilation of Canadian rock and mineral analyses, setting up of spectrochemical standards, compilation of a catalogue of X-ray data for minerals and of a list of Canadian mineral occurrences. Some of the current projects in mineralogy and petrology are reviewed. In the final section there is discussion of the inadequacy of funds now available for geological research in our universities and of a suggestion of a member of the subcommittee that closer association of the National Advisory Committee with the National Research Council should be considered. It is concluded that the present set-up in which major items of equipment, usually from the fields of physics and chemistry, are provided to the universities through the National Research Council's non-recurring grants, and funds for strictly geological phases of research are provided through the Geological Survey of Canada on the recommendation of this Committee, is the most realistic one.

In concluding his report Dr. Folinsbee pointed out the change that has taken place in the general attitude toward geological research in Canada. Until about ten years ago no facilities of consequence were available in Canada for laboratory research in geology. Such facilities were becoming available in increasing degree and geologists were anxious to use research equipment to advance the science. It was good to see the trend toward professors doing their own research rather than accepting part-time employment with commercial companies. This was due mainly to increased salary scales.

Members of the Projects Subcommittee pointed out that the suggestion in the report (p. 28) that preference in the allocation of the grants-in-aid goes to the man of proven research ability is true only to a degree. Equally important is the manner in which the projects are presented and how well they are documented. As to the suggestion that the National Research Council handle funds for the grants, it was pointed out that it is the statutory responsibility of the Department of Mines and Technical Surveys to sponsor research in the mineral industry.

The Subcommittee on Physical Methods Applied to Geological Problems notes the growth in geophysical research in Canada in the past year. Particularly noteworthy are developments in submarine research with the inauguration in 1959 of the Polar Continental Shelf Project of the Department of Mines and Technical Surveys, the enlargement of the Institute of Oceanography at the

University of British Columbia and the establishment of an Institute of Oceanography at Dalhousie university. In addition, several universities increased their activities in geophysics during 1958, including the appointment of a number of specialists to their staffs. Each of the following types of geophysical research, including gravity, seismology and seismic exploration, magnetism, terrestrial heat flow and radioactivity, behaviour of geologic materials under pressure and temperature, glaciology, oceanography and limnology, and petroleum and mining geophysics is discussed in turn, with brief reviews of current work of particular interest to geologists.

Replying to a question about the newly developed "AFMAG" method of electromagnetic prospecting, Dr. Blanchard said the device relies on the cumulative effect of thunderstorms all over the world, but that the nearer they are the stronger the effect. Probably the method would not work too well in Canada in winter because storms are too distant.

The Subcommittee on Pleistocene Geology in summarizing current activities notes that increasing attention is being given to the study of Pleistocene geology in Canada. Work in the review year clearly emphasizes the interrelations of the fields of glacial, Pleistocene, engineering and ground-water geology, geomorphology, physical geography, archaeology and biology. Investigations in these varied disciplines have made important specific contributions to the knowledge of one or more of the others. Brief summaries of the work recently completed, in progress, or planned, is given for each of the provinces and territories of Canada. The projects recommended by the Subcommittee in past reports and to what extent they have been implemented are reviewed. Some have been carried out. It is suggested that students interested in Pleistocene geology should read the reports in their search for thesis problems. The report concludes with the listing of a number of problems that have been suggested as being in need of solution.

In the discussion of this report Dr. Okulitch said that, starting in the fall of 1959, the University of British Columbia would offer an option in geological engineering. Dr. Ambrose stated that three students were taking an option in engineering geology at Queen's University and would graduate in 1960.

Dr. Gussow asked why the Pleistocene map of Canada shows no unglaciated area in the Cypress Hills region near the Saskatchewan-Alberta boundary. Dr. Prest thought this was due to the controversy that had once raged over this matter and lack of any new conclusive evidence; the area in question is small. Another small unglaciated area was indicated in southern Alberta.

Mr. Joubin said that the increasing interest in gold-placer deposits in Nova Scotia and the Beauceville area of Quebec, which seem to be related to pre-glacial channels, lends additional emphasis to the need for more Pleistocene studies.

In regard to the need for students to have more training in mathematics and physics (p. 39), Dr. Folinsbee

suggested that so much of the students' time is now taken up on these subjects little time is left for courses in geology. Dr. Gussow suggested that the fault is in the secondary schools; mathematics, physics and other subjects that should be covered in high school are being taught in the universities.

The Subcommittee on Stratigraphy, Palaeontology and Fossil Fuels summarizes by tables present activities in 11 categories of research in this field. These tables indicate the institutions and agencies where projects in each category are being undertaken and their geologic and geographic distribution. Current projects are discussed in the study of plant microfossils, micropalaeontology, subsurface stratigraphy, stratigraphy, invertebrate palaeontology and in the compilation of lexicons of stratigraphic terms. A comprehensive project suggested in the 1957-58 National Advisory Committee report is further amplified. This involves the study and tracing of tectonic features in the Precambrian basement beneath the younger (Palaeozoic) rocks where they may have provided features along which oil-bearing reefs and other structures may have developed in the younger rocks.

A member of the subcommittee points out that, although in 1957-58, 40 per cent of the research projects in Canada were in the fields of Pleistocene geology and stratigraphy and palaeontology, these fields received less than three per cent of the funds available for grants for research. In order to stimulate more research it is suggested that, instead of making grants for definite projects, they be made to individuals, leaving discretion in the choice of project to the research worker. The report concludes by listing and describing a number of research projects in need of investigation that have been suggested to the Subcommittee.

In discussion of the report Dr. Gussow said, in regard to the Precambrian lineaments extending beneath the Palaeozoic and younger rocks of the Alberta syncline (p.55), that there had been no recurrent movement on the faults since the Palaeozoic cover was deposited, or at least none had been detected anywhere to date; the basement topography was the only control. He thought that any migration of petroleum caused by post-glacial uplift as suggested on p.60 of the report would be negligible.

Dr. Gussow said that the Alberta Society of Petroleum Geologists is a very active organization with many affiliated societies in other cities in Western Canada. Now under way is a compilation of the oil and gas fields of Western Canada which it is hoped to have completed for the meeting of the Society in 1960. In January 1960 a symposium was being held on the geology of the Arctic in which the Society was seeking the cooperation and participation of all countries with land areas in the Arctic; so far the cooperation had been excellent. In 1959 the Society hoped to publish a new lexicon of stratigraphic terms used in Western Canada. It had recently published an Annotated Bibliography of Geology of the Sedimentary Basin of Alberta that had received much favourable comment.

Dr. Gussow considered that research in palaeomagnetism holds great promise. It might do much to aid in the search for oil and is of particular importance in the interpretation of aeromagnetic surveys. He suggested as a most worthwhile project the detailed study of a core from a bore-hole that had penetrated a large continuous section of strata and had been cored from top to bottom. Such a study would reveal the changes that have occurred in the magnetism of rocks deposited in one area over long geological periods. The cores from several holes through Palaeozoic rocks in western Ontario and in Western Canada are available for such studies.

Dr. Okulitch said that most fossil study collections in universities in Western Canada are from the eastern part of the continent. Might not the Geological Survey of Canada furnish the universities with duplicate sets of some collections from Western Canada? He considered it regrettable that graduate students on the Survey's field parties are not allowed to bring back palaeontological specimens to their universities. This regulation was a hindrance to to graduate study and discouraged the interest of students in stratigraphy and palaeontology. The Chairman said that the collections made by the Geological Survey field parties are the property of the Survey and the student could hardly expect to take any he had collected back to his university. After the fossils have been catalogued the student is at liberty to borrow them.

Dr. Gussow expressed disagreement with the resolution passed at the last (1958) annual meeting of the National Advisory Committee recommending that the Geological Survey of Canada be the repository for invertebrate palaeontological collections. He suggested that the National Museum of Canada should preserve, store and catalogue all such material with the Geological Survey of Canada keeping only reference specimens. He cited the British Museum as an example of the procedure that should be followed. Dr. Langford said he would hesitate to recommend transfer of valuable collections such as these to an outside organization. Those in charge of museums change and although an administrator might take good care of the collections his successor might not. The Geological Survey has as good or better facilities than the National Museum for storage and is better able to look after the collections. Other members pointed out that dispersion of the material among different organizations in different buildings would handicap stratigraphic-palaeontologic work.

Dr. Gussow stressed the tremendous field for geological mapping in the Canadian Rockies and foothills. Aerial photographs and excellent topographic maps on a scale of one inch to one-half mile are now available. Mapping the structure of these areas in detail is like mapping a large avalanche area; a reasonable interpretation of the structure is possible only by drawing or constructing regional geological cross-sections in which imagination is controlled by geophysical information - both seismic and gravity. In the mountains and foothills excellent stratigraphic sections are exposed where the enclosed fossils, the facies changes, unconformities, etc., can be studied, but little has been done except for the measurement of a few sections. There has been practically no aerial mapping although it is only

by such mapping that the broader unconformable relations can be recognized as, for example, the great pre-Devonian orogeny that Dr. Folinsbee is beginning to recognize by age dating, and which is clearly exposed to view in the Front Ranges of the Rockies as a profound angular unconformity and pre-Devonian deformation, not yet described in the literature. Dr. Gussow suggested that the Rocky Mountains might be divided into small areas to be mapped for Ph.D. theses by students from the Universities of Alberta and British Columbia under the supervision of a senior professor or officer of the Geological Survey of Canada. Several such unit areas could be compiled into a map area for publication. Until this mapping is done the true historical geology of Western Canada and the correct answers to such questions as "the rate of mountain building" (which is probably very rapid) or the "mechanics of mountain building" (which Dr. Gussow believes is due to horizontal crustal shift, which he has named "metastasy") will not be known. Already recognized are (1) a profound pre-Beltion unconformity with unmetamorphosed sediments lying on a crystalline plutonic basement, (2) a strong angular pre-Lipalian unconformity, (3) a major Precambrian unconformity, (4) a great pre-Devonian angular unconformity and dynamic orogeny, (5) pre-Mississippian regional unconformity and (6) a profound pre-Pennsylvanian unconformity - all in pre-Mesozoic time.

Several members considered the use of Ph.D. students for such field mapping an excellent idea. Others considered this type of work is largely areal mapping and not suitable thesis material; more specific problems were needed.

The Report of the Subcommittee on Structural Geology is divided into three parts. The first part discusses structural research in general and concludes that anything approaching complete analysis and comprehension of the structure of an area is impossible unless all structural elements are observed and recorded, interpretation of the several elements are established, hypotheses of mechanics of origin of the elements and of the whole structure developed, and predictions based on the hypotheses are tested by additional observations. The advances and accomplishments of the past thirty years are reviewed and it is suggested that simple descriptions of obvious features, enlarged by uncertain interpolations and extrapolations, can no longer qualify as structural research.

In Part II of the report current structural research in Canada is divided into four ranks ranging at the lower end of the scale, from simple examinations and descriptions of large structures to structural analyses and synthesis, including direct or scale-model experiments, at the higher end. Only six of the 58 structural projects in progress are first rank, nine are second, six are second or third, and remainder are mainly descriptive studies.

Part III of the report suggests several structural problems that should be investigated, including (1) the structural environment favourable to replacement, particularly in relation to ore-deposition, and (2) study of the end products of deformation (deformation that has gone beyond the stage of isoclinal folding). In conclusion, the report urges that all structural studies be carried beyond the descriptive stage. It reiterates the

recommendation of earlier reports that the form, origin, interrelations and mechanics of specific structural elements such as faults, lineations, cleavages, folds, etc., be selected for intensive investigations with a view to ultimate syntheses of mechanical systems.

Dr. Ambrose, after presenting the report, mentioned a joint letter from Dr. J. C. Sproule to him and Dr. Caley calling attention to the persistence of Precambrian lineaments below Palaeozoic and younger rocks of the Alberta syncline. Studies of these lineaments could be most important and useful in the search for oil. This letter is incorporated and discussed in the report of the Subcommittee on Stratigraphy, Palaeontology and Fossil Fuels (p. 55).

Dr. Michener asked what research had been done on the study and interpretation of lineaments from aerial photographs. Such studies could be a useful tool in exploration, but much research is needed to find out how and to what extent lineaments can be used. Mr. Joubin pointed out the growing importance of air photo interpretation in connection with geophysical surveys and the correlation of anomalies with lineaments and other structures visible in the photographs. Mention was made of fracture pattern studies at the University of Saskatchewan. Cornell University, Colorado School of Mines, and University of Oklahoma are among the institutions mentioned that offer courses in air photo interpretation. The University of Toronto plans to offer such a course in the near future.

THE REPORT OF THE SUBCOMMITTEE ON MINERAL DEPOSITS

Presented by H. D. B. Wilson

Members of Subcommittee

H. D. B. Wilson (Chairman)	-	University of Manitoba, Winnipeg, Manitoba.
A. R. Byers	-	University of Saskatchewan, Saskatoon, Saskatchewan.
G. H. Charlewood	-	Heath and Sherwood Drilling Limited, Kirkland Lake, Ontario.
D. R. Derry	-	Rio Canadian Exploration, Limited, Toronto, Ontario.
J. E. Gill	-	McGill University, Montreal, Quebec.
A. H. Lang	-	Geological Survey of Canada, Ottawa, Ontario.
G. B. Langford	-	University of Toronto, Toronto, Ontario.
W. H. White	-	University of British Columbia, Vancouver, British Columbia.

INTRODUCTION

The members of the subcommittee wish to acknowledge the fine service rendered by Dr. H. C. Gunning, who was chairman of the subcommittee from 1954 until the end of 1958. Dr. Gunning is unable to remain a member because of his departure from Canada early in 1959. He suggested that "when he gets settled in Rhodesia he may be able to rejoin as a 'foreign' member and supply a link with thoughts out there."

Four new members have been added to the subcommittee, A. R. Byers, University of Saskatchewan; J. E. Gill, McGill University; W. H. White, University of British Columbia; and H. D. B. Wilson, University of Manitoba.

COMPREHENSIVE STUDY OF AN ORE DEPOSIT

Most members of the Subcommittee believe that this is a very important project. If such a project were organized it might then be possible for the Subcommittee to consider setting up other major projects which would combine the talents of a great

many investigators and perhaps the facilities of several institutions. The Subcommittee and the Chairman of the National Advisory Committee have continued their efforts to arrange for the study of a particular mine, (See also p. 1).

CURRENT RESEARCH IN ORE DEPOSITS

The survey of current geological research on ore deposits is published elsewhere (p. 99) in the Annual Report. The volume of research is considerable and a wide variety of subjects is being examined. The research covers such topics as a) the description and origin of particular orebodies b) structural studies of orebodies c) the distribution of major and minor elements in orebodies and silicate rocks d) geochemical prospecting e) origin and metal distribution in gossans f) the relation of orebodies to regional metamorphism g) geothermometry applied to orebodies h) wall rock alteration i) mineralographic and X-ray studies of ore minerals. Many of these topics include several individual research projects.

The volume of individual research and the breadth of subjects being studied appear to be generally satisfactory. Many problems are available for individual researchers so it seems unnecessary for the subcommittee to suggest further problems for individuals at this time.

COMPREHENSIVE STUDIES

The great need in research on ore deposits appears to be the organization and implementation of comprehensive studies. Almost every subcommittee member suggested this independently.

Dr. Lang reports:

> "It seems to me that the need is not so much for scattered, independent studies as for comprehensive, integrated study that would include: (1) A stock-taking of present information and recommendation of projects that seem required most urgently to round out the picture (2) undertaking of such studies by various individuals or organizations, and (3) integration and summarizing of results. Most of the studies that I envision would require field and laboratory studies by the same investigator or group. It might be possible, however, to allot particular phases here and there as theses studies."

Dr. Charlewood discusses the need for such projects and for some sort of organization to handle them, including the collection of data and the publishing of results. He states:

> "There appears to be an adequate supply of most metals at present. However, the terms of reference of this Committee commit it to a long range view and, by research, to pave the way to discovery

and utilization of ores in the years to come when present known sources will not be adequate to supply the world's needs.

"In looking through the NACRGS reports for the past eight years, one is impressed by the vast amount of geological research that has been done in Canada in that short time to say nothing of that which preceded 1950.

"Much of this material may have been published, but, and one wonders where, since it is obviously not all encoutered in routine reading. A great deal of work listed in these volumes is, of course, recorded in unpublished theses and unless there is some central clearing house or reference point for this material, it may be lost to many who could apply it to practical purpose in the future.

"One approach to this problem may be some sort of data - collecting group suggested last year by the Subcommittee on Physical Methods Applied to Geological Problems."

Dr. Charlewood believes that, if large studies were contemplated, individuals in each region could organize the gathering of research specimens or data, if they had the weight of the National Advisory Committee behind them.

Dr. White suggested some of the major problems which need study. These are problems which can only be done with some group coordinating the work of many workers. As an example of such a project he suggests the "metal content of rocks" which is discussed later in this report.

WALL-ROCK ALTERATION

Wall-rock alteration was a major subject for discussion in the 1958 report of the subcommittee and "attention was centred on the need for more data on wall-rock alteration around ore deposits." The National Advisory Committee passed a motion at the 1958 Annual Meeting that this subcommittee be asked to give special thought to the problem of wall-rock alteration.

The general feeling of the subcommittee is that wall-rock alteration would be a good subject for a large cooperative project, because while much has been done in the past, the work has not been very productive of general principles. Each project has been an isolated piece of work and many studies were not complete. Dr. White states:

"Some investigation of wall-rock changes have been done on a few B.C. deposits, but none has been really thorough. Even at Sullivan, the largest base metal deposit in Canada, the wall-rock alteration is known only in a general way."

The prevailing belief has been that each mine is a law unto itself, but, it seems probable that we are missing the underlying principles. For example, the understanding of metamorphic mineral facies has clarified many of our ideas about metamorphism, yet few attempts have been made to apply these principles to wall-rock alteration. Perhaps such facies studies would tell us much. A superficial appraisal shows that the wall-rock of copper-nickel deposits is commonly in the pyroxene hornfels, or pyroxene granulite facies, indicating ore deposition near magmatic temperatures, whereas the wall-rock in many hypothermal deposits is in the green schist facies; that is, a much lower grade facies with perhaps a considerable temperature-pressure gap between the two.

The wall-rock in some replacement deposits such as the Geco copper deposit in the Manitouwadge area in Ontario, appears to be in a high grade metamorphic facies and this deposit may be associated with a high grade metamorphic area. These are suggestions which indicate that comprehensive wall-rock studies may give us answers to the problems of hydrothermal versus magmatic segregation deposits, or igneous versus metamorphic ore deposits. This comprehensive type of work has not been attempted in Canada because we do not have the organization to do it.

Such a problem would require the collection of samples from many specifically chosen mines and the cooperation of many laboratories where petrographic studies and X-ray identifications of minerals could be made so that facies diagrams could be constructed. Cooperation would also be required from laboratories where spectrographic analyses could be made and from others which could analyse the major elements and also elements that are insensitive to spectrographic methods. Perhaps it would even be possible to get some of the new highly accurate radioactivation analyses done at Chalk River.

Although such a project might be rewarding, the subcommittee believes that, for the present, our efforts should be concentrated on initiating and organizing the "Comprehensive Study of an Ore Deposit." If some sort of organization grows out of this project, it is possible that other large projects such as wall-rock alteration studies can be handled in the same manner.

In the meantime, several smaller projects on wall-rock alteration are discussed in the last two reports and these should be re-emphasized.

Dr. White reports on specific projects where wall-rock studies are either started or contemplated:

> "With two associates I have become interested in the geology of disseminated copper deposits at Highland Valley that seem to offer a first class opportunity to study wall-rock alteration in a quantitative way. By this time next year there will be a 5,000-foot crosscut through the mineralized area, with bulk samples every ten feet throughout the workings. This fall I assigned

study of the intense alteration in the first 600 feet of this tunnel to a graduate student. He has discovered some intriguing changes from fresh rock to nearly massive montmorillonite, and these we hope to correlate with changes in composition. The big problem is money for rock analyses.

"Another matter that I intend to investigate is the relation between alteration, copper mineralization, and specific gravity. We discovered more or less by accident that the gravity tends to decrease with increasing alteration, but as several rock types are involved, the reasons for this are obscure. Changes in gravity could be related to (1) rock type (2) mineralogic changes, or (3) changes in porosity. I am designing a portable specific gravity balance with which to facilitate this study. If it seems a likely field of research I will try to get a Ph. D. candidate to make a thorough study."

Petrographic studies of wall-rock specimens from orebodies at Brabant and Hanson Lakes, Saskatchewan, are being made at the University of Saskatchewan and rock alteration at Opemiska Copper Mines, Quebec, is being studied at the University of Toronto. All these wall-rock studies, particularly the large-scale one in British Columbia, are worthy of support by the National Advisory Committee.

A questionnaire to try to determine what has already been done on wall-rock alteration in Canada was contemplated earlier in the year. One was drafted with the intention of circulating it to the various mines, geological surveys, and university laboratories. However, it was not distributed because of the prior distribution by the Geology Division of the Canadian Institute of Mining and Metallurgy, under the chairmanship of Dr. Gill, of a questionnaire on orebodies requesting information on their associated fresh wall-rock, the altered wall-rock and secondary minerals, the chemical changes and the width of the altered zone. This questionnaire does not include queries on precious metal deposits.

Dr. Gill has suggested to the nine participants in the Symposium on Occurrence of Massive Sulphide Deposits in Canada for which the data were collected, that they might direct their attention to wall-rock alteration and if possible, assemble after the symposium to coordinate the data by recording them on punch cards or in some other way.

METAL CONTENT OF ROCKS

Another comprehensive study that should be undertaken concerns the metal content of rocks. Dr. White states:

"Foremost is the matter of the metal content of rocks. I fail to see how we can ever get far in the matter of genesis of mineral deposits unless we can answer the question: 'Are metals cyclical in nature, or unique

contributions to the upper crust?' In British Columbia we have some prospecting on the theory that metals are genetically related to igneous intrusions, and others prospecting what they believe to be ancient granitized shorelines. Not long ago Dr. Sullivan told us at a meeting that if we didn't stop fooling around batholitic margins we would never find any ores!

"If, for every geological unit, both igneous and sedimentary, we knew the metal content, its distribution within the rock unit, and its mode of occurrence, we would be much closer to the answers we seek."

To illustrate how little we know or agree about the source of metals, Dr. Charlewood quotes from the Fourth Sir Julius Wernher Memorial Lecture of the Institute of Mining and Metallurgy (London)[1] delivered by Dr. Anton Gray, September, 1958 in London, as follows:

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[1] Gray, Anton: Future of Mineral Exploration, Bull. Inst. Min. Met. (London), Nov. 1958, p. 23-34.

"..... by the end of the 20th Century presently known mineral fields will not be able to supply all the world's non-ferrous needs ....."

Charlewood continues:

"He goes on to discuss the tools available to the geologist in the quest for future ores. In his opinion there is no agreement among geologists as to the source of metals and of the water that carried them, nor on the method of getting the metals to the places where we now find them. He says further that the problems of ore deposition have not been solved primarily because the need for a solution has not been urgent.

"After developing his case for the Source Bed Concept, he concludes that we cannot expect as sure a guide to ore as the petroleum industry has to oil reservoirs because problems of mineral deposition are too varied and complex. But he suggests a relaxation of what he calls, 'Obsession with the theoretical possibilities of hypothetical magmas' and 'a great effort to solve the structural and chemical problems of metamorphism.'

"We may not agree with all points of this address, and we are not expected to, but the conclusions urge us in the direction already chosen by this subcommittee."

At present, considerable data concerning the metal content of igneous rocks may be obtained from the literature. Data on base metal content of sedimentary rocks are extremely meagre and most of them were obtained so long ago that the standards of accuracy are no longer acceptable. Recently, some data were forthcoming on the content and movement of metals in metamorphic rocks but the amount is still far too small. In economic geology, perhaps the greatest need is for data on the distribution of zinc, because most trace metal studies are done spectroscopically and zinc is not sensitive enough for the spectroscopic method. This lack of data on zinc is most unfortunate because zinc is the metal that links copper and lead in ore deposits and it is one of the most abundant elements in the sedimentary ore deposits.

The trace metal work at Oxford and Cambridge Universities has filled out the picture of the distribution of most metals in basic igneous rocks, but data are needed for the metal distribution in a differentiated series of the more acid igneous rocks. Research is needed on distribution of metals in almost all sediments and on their distribution in metamorphic rocks and redistribution during metamorphism. Problems are not lacking and much of the work could be done by individual investigators. However, the desired goal of determining the metal content of rocks could be reached much sooner if the work were coordinated so that missing data could be noted and duplication of effort avoided.

Dr. White points out that knowledge of the metal content of rocks is also of primary importance in geochemical prospecting. He states:

> "Dr. Warren and Dr. Delevault have been engaged for years on developing methods of detecting traces of heavy metals, and similar work has been going on elsewhere. But I am not aware of any effort in Canada, certainly not in British Columbia, to rigorously and systematically apply such methods to specific rock bodies. Some work of this sort has been done by private companies, but the results are not available. Surveys of this sort, carefully tied to geological observations, would be excellent subjects for Master's theses or could be carried along with detailed mapping by the Geological Survey of Canada. For example, the White Creek batholith in the East Kootenays, so excellently mapped recently by Reesor, would be a fine place for a trace metal survey."

It is difficult to recognize anomalies if we do not know the normal metal content of common rock types. Thus a peridotite commonly contains about 1,000 times as much nickel as a granite and generally weathers much more rapidly, yet a peridotite dyke cutting granite is not an anomaly.

THE SYMPOSIUM ON SULPHIDE DEPOSITS

This symposium took place at the 1959 Annual Meeting of the Canadian Institute of Mining and Metallurgy and was coordinated by Dr. Gill and his committee in the Geology Division of

the Institute. It is an excellent example of a comprehensive project. It included three sessions at which 19 papers were presented. The first session concerned the Occurrences of Massive Sulphides in Canada with speakers to discuss each province; the second was on Exploration for Massive Sulphide Deposits; and the third on the Genesis of Massive Sulphides.

It is hoped that this material can be assembled and published as a unit.[1] The National Advisory Committee should

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[1] Genesis of Massive Sulphide Deposits; Bull. Can. Inst. Min. Metallurgy, October, 1959, p. 610-649.

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support this project because it is of the type "involving the assembly of data from a great variety of sources and the search for patterns therein", that was suggested in the 1958 report of the Subcommittee on Mineralogy, Geochemistry and Petrology.[2]

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[2] National Advisory Committee on Research in the Geological Sciences, Eighth Annual Report, 1957-58, pp. 45 and 9.

MINERAL DEPOSITS DIVISION, GEOLOGICAL SURVEY OF CANADA

Much of the field work of the Division is being devoted to the Economic Geology Series which comprises Canada-wide reports on specific metals. The reports of the series will contain comprehensive, although condensed data on deposits, including generalizations on mode of occurrence and geological considerations regarding prospecting, exploration, and appraisal; descriptions of principal areas and deposits; and tables of geological data on minor occurrences.

These field studies and compilations should be most valuable to economic geologists. The work on niobium and lithium is completed; work on beryllium, iron, molybdenum, and copper, as well as the second edition on uranium and thorium is in progress and it is proposed to start on gypsum in 1959.

The publication of a series of metallogenic maps was begun in 1958. Each map shows the distribution of known deposits of a particular metal or two closely related metals. The maps are on transparent paper so that they can be used as overlays on the geological map of Canada, or for comparison with each other.

They are intended as preliminary steps in research on, and the illustration of, metallogenic provinces. Emphasis was given to this project because additional knowledge of metallogenic provinces would be of great assistance in the selection of a region for prospecting.

ORGANIZATION FOR COMPREHENSIVE STUDIES

The comprehensive review of a particular subject is perhaps the easiest of all comprehensive studies because the main requirement is simply one industrious individual to organize the project. The organization of comprehensive research problems involving the determination of new data is another matter, because it involves the organization and coordination of many individuals and laboratories over a long period of time. The National Advisory Committee might consider how this may be done.

One requirement is that such work be directed by the most experienced men available in the respective fields. Dr. J.T. Wilson's description of the research institutes of Russia and China in his paper presented at the 1959 Prospectors and Developers Convention, suggests that these are suitable organizations for carrying out such comprehensive research. Such institutes are expensive, but a country as rich as Canada can afford at least one such organization, especially when mining is one of its greatest industries.

REPORT OF THE SUBCOMMITTEE ON MINERALOGY, GEOCHEMISTRY AND PETROLOGY

Presented by R.E. Folinsbee

Members of the Subcommittee

R.E. Folinsbee (Chairman)	-	University of Alberta, Edmonton, Alberta.
J.W. Ambrose	-	Queen's University, Kingston, Ontario.
R. Beland	-	Université Laval, Quebec City, Quebec.
L.G. Berry	-	Queen's University, Kingston, Ontario.
R.B. Ferguson	-	University of Manitoba, Winnipeg, Manitoba.
G.S. Mackenzie	-	University of New Brunswick, Fredericton, New Brunswick.
J.A. Maxwell	-	Geological Survey of Canada, Ottawa, Ontario.
W.W. Moorehouse	-	University of Toronto, Toronto, Ontario.
S.C. Robinson	-	Geological Survey of Canada, Ottawa, Ontario.
D.M. Shaw	-	McMaster University, Hamilton, Ontario.
F.G. Smith	-	University of Toronto, Toronto, Ontario.
H.V. Warren	-	University of British Columbia, Vancouver, British Columbia.

The lions in geochemistry, petrology and mineralogy have long been, and continue to be, the Geological Survey of Canada at Ottawa and Queen's, McGill, and Toronto universities. This was pointed out by Dr. Ambrose in the 1957-58 report of this subcommittee and Table III indicates that they continue to dominate today. However, there are signs that the tables may turn towards Western Canada and the Maritimes. This year's report is biased towards western developments with the idea of high-lighting certain fundamental changes that are occurring in geological research across the nation.

Counterbalancing, if you will, the magnificent new facilities for geological research in the new building of the

Geological Survey of Canada in Ottawa, we have in the West such buildings as that available to the Research Council of Alberta, with a million-dollar-a-year budget. The lion's share of the Council's budget goes towards research directly in the field of geology or in related applied fields such as petroleum and coal technology. Much of the work being done by the Council is of a fundamental character and now that the basic equipment, plant and staff, have been run in, as it were, we can anticipate a new surge of research from this group. A recent outstanding paper in geochemistry published by Council members is Geochemical Aspects of Petroleum Migration in Pembina, Redwater, Joffre, and Lloydminster Oil Fields of Alberta and Saskatchewan, Canada, Bull, Am. Assoc. Pet. Geol., vol. 43, No. 2, February 1959.

A new $7,000,000 physical science centre (physics, mathematics, chemistry) is going up on the campus of the University of Alberta - ample proof of provincial government recognition of the growing importance (and cost) of research in the physical sciences. Since research in geology receives impetus and stimulus from the other physical and biological sciences, the West looks forward to the time when it will be able to compete in calibre of graduate work with the older and honored institutions of the east.

TABLE I

Level of Researcher

Subject	Bachelors or Masters Thesis	Doctorate Thesis	Thesis level unknown	Non-Thesis	Total
Mineralogy	7	7	2	30	46
Geochemistry	16	13	4	52	85
Petrology	18	14	3	38	73
					204

(Number of researchers engaged - 167)

TABLE II

Level of Project

Mineralogy	5	4	2	26	37
Geochemistry	16	9	3	41	69
Petrology	14	13	1	24	52
					158

TABLE III

DIVISION OF RESEARCH PROJECTS BY INSTITUTIONS

Institution	Mineralogy	Geochemistry	Petrography & Petrology	Total
British Columbia Dept. of Mines	--	--	1	1
University of British Columbia	--	2	--	2
Research Council of Alberta	2	4	2	8
University of Alberta	--	4	5	9
University of Saskatchewan	3	1	2	6
Sask. Dept. Mineral Resources	--	--	1	1
University of Manitoba	1	2	3	6
Ontario Department of Mines	--	--	1	1
Ontario Research Foundation	1	--	--	1
McMaster University	--	5	1	6
University of Toronto	5	4	9	18
Queen's University	2	4	5	11
University of Western Ontario	--	3	--	3
Carleton University	1	2	1	4
Quebec Department of Mines	1	--	1	2
McGill University	6	16	4	26
Ecole Polytechnique	2	--	1	3
Université Laval	--	--	4	4
Geological Survey of Canada	3	12	5	20
Mines Branch, Dept. Mines and Technical Surveys	13	4	2	19
University of New Brunswick	--	3	2	5
St. Francis-Xavier University	--	--	1	1
Dalhousie University	--	--	1	1
	40	66	52	158

More exact techniques of spectrography, X-ray diffraction and fluorescence, and isotope study now available in properly equipped laboratories offer us the hope of solid advances in the proper understanding of minerals, rocks, and the processes that have gone into their formation. The good, purely descriptive work of the past can be reinterpreted in the light of new data available from these special studies utilizing advanced and rapid techniques.

Internationally, there were noteworthy steps forward during the review year in making available in translated form the great mass of data collected and being collected by the geologists of the Soviet Union particularly in the field of geochemistry.

CURRENT RESEARCH

The rate of accumulation of data and the difficulties of incorporating these data into general review papers were discussed by Dr. Ambrose in last year's report. This remains a stumbling block and wider application of compilations such as those now being prepared by the Geological Survey of Canada should prove most helpful.

Though these compilation projects cannot properly be regarded as research, they provide much-needed tools for the researcher. A few of them follow:

Compilation of Canadian Rock and Mineral Analyses

Dr. Shaw of McMaster makes a special point of commending the work being done by Dr. Dawson and Dr. Maxwell of the Geological Survey of Canada on this project. He expressed the hope that it should be carried forward to publication as soon as possible, but that it should be a continuing project. Dr. Robinson reports that the work was continued by two seasonal employees under supervision of J. A. Maxwell during 1958-59. The importance of this project cannot be overemphasized. It is allied with other cataloguing projects in the field of geochemistry, mineralogy and petrology.

Spectrochemical Standards

The Canadian Association of Applied Spectroscopy has a committee on standards, whose task is to set up samples of different kinds of material for the purpose of interlaboratory comparisons. Dr. Shaw suggests the committee is in need of catalysis, and that it should be asked to produce the necessary standards in quantity and arrange for calibration of the samples by precise and accurate analytical methods. In this regard, Dr. Baadsgaard of the University of Alberta prepared a number of rock standards last fall and has arranged for their analysis as part of his graduate course in geochemistry. These samples are available for interlaboratory calibration purposes. The analyses available are not spectrographic, but chemical trace element technique applied from current advanced analytical techniques of the chemical field.

X-ray Data for Minerals

Miss A.P. Sabina is compiling a catalogue of X-ray data for minerals for which X-ray diffractions patterns are available in the Geological Survey of Canada.

Professor R.M. Thompson, University of British Columbia, is in charge of assembling X-ray powder data for rarer minerals for the A.S.T.M. card index.

List of Canadian Mineral Occurrences

Preliminary work has been started on revision of Geological Survey of Canada Memoir 74, "A List of Canadian Mineral Occurrences under supervision of R.J. Traill". The Mineralogical Association of Canada has agreed to assist in this compilation.

Clays

The Mines Branch, Department of Mines and Technical Surveys, has undertaken a study of the mineralogical constitution and physical and chemical properties of Canadian clays.

Mineralogy

Feldspars

A concerted world-wide attack on the genesis and crystal structure of these most common of the rock-forming minerals is going forward. Dr. Ferguson at the University of Manitoba, in association with Dr. Traill of the Geological Survey of Canada and Dr. Taylor of Cambridge University, has investigated albite and is attempting to apply crystal structure data for the alkali feldspars to petrologic situations, particularly to establish the reason for the occurrence of orthoclase in one rock, microcline in another.

Greenwood and McTaggart at the University of British Columbia have completed and published an interesting paper on correlation of zones in plagioclase.

Petrology

Meteorites

A description of the mineralogy and geochemistry of the Abee meteorite by K.R. Dawson has been prepared for publication. This meteorite weighs 236 pounds and is of the brecciated stony type. It fell into a wheat field north of Edmonton in June 1952.

Basic Igneous Rocks

C.H. Smith of the Geological Survey of Canada has made field and laboratory studies of Cordilleran basic and ultrabasic intrusives as part of a larger study of these rock types throughout Canada.

G.S. Mackenzie reports that Dr. Hale at the University of New Brunswick has been carrying on a trace element study and petrographic study of the St. Stephen, New Brunswick gabbroic and ultrabasic rocks.

John Patterson at the University of Manitoba is studying metamorphism in relation to the Cu-Ni deposits of the Moak Lake area.

Dr. Delevault and Dr. Warren have been investigating the Cu-Zn content of coarse grained eruptive rocks. C.J. Sullivan's eloquent pleas for reconsideration of the lateral secretion hypothesis apparently have not all fallen on deaf ears.

E.R. Rose of the Geological Survey of Canada commenced work on iron-titanium deposits related to anorthosite bodies in the Grenville sub-province of the Canadian Shield.

J.A. McDonald, graduate student, University of Manitoba, has undertaken a petrological study of the basic and ultrabasic dyke rocks of the Cuthbert Lake region, Manitoba.

Granitic Rocks

J.E. Reesor of the Geological Survey of Canada is continuing his study of Canadian granites. His recently published memoir on the White Creek batholith, a masterly study of the mode of emplacement of a pluton, should lend encouragement to the magmatists in our midst.

G.S. Mackenzie has been conducting a similar study of the New Brunswick granites, of Taconic, Acadian or Caledonian age.

Dr. Hawley and his students at Queen's University have been studying the Grenville granites.

Pegmatites

J.W. Ambrose has been investigating eucryptite in the spodumene-bearing pegmatites of southeastern Manitoba.

Metamorphic Rocks

At Laval, Rene Beland is studying the gneisses and granulites of the Rawdon-St. Gabriel area, Quebec; and Pierre St. Julien, an M.Sc. student, is studying the petrography of the albite-chlorite schists of Abitibi County.

Sedimentary Petrology

Dr. Mellon of the Research Council of Alberta has been studying the petrology of the Blairmore Group since 1956. This outstanding work is shortly to be published by the Council.

This brief classified review of the projects in the field of petrology, suggests that the work now in progress covers the whole rock spectrum.

GENERAL REMARKS AND SUGGESTIONS

Much of the research in geochemistry, petrology, and mineralogy now going forward requires specialized equipment of great cost. Commenting on this, Dr. Shaw has this to say:

> " ... The last point I want to mention concerns finances. The National Advisory Committee has altogether too little money available to it for disbursement in the form of research grants. In recent years the applications for such grants have very much increased in number and the competition is therefore becoming very keen. The sum of $50,000 awarded in 1957-58 is completely unrealistic if Canada is to be considered as a country in which valuable geological research is being carried out. If it is not possible to obtain additional funds, I think the National Committee should very seriously consider the possibility of asking for its activities to be associated with the National Research Council, which is already supporting geological research on a very considerable scale ..."

Dr. Shaw is particularly concerned with the difficulty faced by those of our colleagues who are initiating applications for grants for research which might be in every way as valuable as the projects that the National Advisory Committee has supported, and that have been underway for some time.

Most geologists would be loath to see the National Advisory Committee, a small group who understand geological problems, delegate their responsibilities for the support of geological research to the National Research Council. But it is clear that National Research Council and Defence Research Board funds are larger than those available for distribution by this committee. This is especially noticeable at universities like McMaster which have had deservedly generous support from National Research Council.

Dr. Smith of Toronto, in the suggestions of this subcommittee report last year, indicated this dilemma - the fact that even though costly major research equipment is obtainable, the researcher often has a problem in obtaining funds for running expenses.

Certainly the universities have begun, at least, to recognize and shoulder the enormous burden of providing adequate facilities and equipment for research in science. The capital equipment budget of the University of Alberta has increased from less than $100,000 in 1955-56 to $175,000 in 1957-58, $425,000 in 1958-59 and $600,000 in 1959-60. It is assigned almost entirely to the science departments and threatens to be a line of cleavage between the Arts and the Science departments of this, as of many, universities.

Nevertheless, a man stands behind any substantial advance in science. All the research equipment in the world is not

going to produce one significant paper. There must be in the geological survey organizations, research councils, and universities a climate and incentive leading to productive research. Perhaps this is what can best be provided by the funds available to this committee.

Dr. Langford[1] touches on several significant points:

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[1] Langford, G. B., Teaching the Geological Sciences, Trans. Royal Soc. Canada, Vol. LII, Series III, pp. 39-43, June, 1958.

> " ... In recent years we have seen another development that has given scientific development a setback. The shortage of field men has led exploration companies to employ university staffs for summer work. Seldom have these men been called upon to use their highly specialized knowledge. In fact, it is unsual for men in this type of work to be able to find time or encouragement for any scientific investigations. Consequently we find that the teachers also are neglecting their science ..."

It should be noted that the Geological Survey of Canada, through the activities of the director and chief geologist, has done much to foster a climate favourable to research. Dr. Harrison's talks on the work of the Geological Survey of Canada given in 1958 to Queen's University and this year to Alberta and other universities, contributes awareness of our geological heritage and future.

A small publication that has come to our attention is Miller Memoirs, published by the students at Queen's University. The editor gives an eloquent plea for understanding, on the part of geologists, of new developments in physics, chemistry and other sciences related to geology. This view is endorsed by the Subcommittee on Geochemistry, Petrology, and Mineralogy.

Perhaps the present situation in which major equipment items, usually from the field of physics or chemistry, are provided through National Research Council non-recurring capital grants, and funds for the strictly geological phases of research are provided by this committee, is the most realistic one. It at least affrds a very necessary and inspiring liaison with scientists in fields other than geology. In general, the physicists and chemists are far more research minded than the geologist who has been steeped in a long tradition of field work, with a tea pail his principal laboratory equipment.

REPORT OF THE SUBCOMMITTEE ON PHYSICAL METHODS APPLIED TO GEOLOGICAL PROBLEMS

Presented by J.E. Blanchard

Members of Subcommittee

J.E. Blanchard (Chairman) - Dalhousie University, Halifax, Nova Scotia.

G.D. Garland - University of Alberta, Edmonton, Alberta.

M.J.S. Innes - Dominion Observatory, Ottawa, Ontario.

G.P. Mitchell - Falconbridge Nickel Mines Limited, Toronto, Ontario.

L.W. Morley - Geological Survey of Canada, Ottawa, Ontario.

N.R. Patterson - Hunting Technical and Exploration Services, Limited, Toronto, Ontario.

R.J. Uffen - University of Western Ontario, London, Ontario.

P.L. Willmore - Dominion Observatory, Ottawa, Ontario.

H.D.B. Wilson - University of Manitoba, Winnipeg, Manitoba.

J.T. Wilson - University of Toronto, Toronto, Ontario.

INTRODUCTION

The disciplines of geophysics concerned with earth science are showing a continued growth in numbers of people engaged in research and the facilities available for research.

The National Research Council has recognized the growing importance of geophysics and presumably the branches of geophysics related to earth science by appointment of Dr. J. Tuzo Wilson to the Council.

GROWTH OF GEOPHYSICAL RESEARCH

The Polar Continental Shelf Project of the Department of Mines and Technical Surveys, on which field work was commenced in 1959, the enlarging of the Institute of Oceanography

at British Columbia, and the establishment of an Institute of Oceanography at Dalhousie University will make available facilities for research and training in marine geology among other disciplines.

In addition to the above projects several universities increased their activities in geophysics during 1958 and a number of appointments of specialists in this field were made. At the University of British Columbia there are now three geophysicists in the Physics Department and research activities include geomagnetism, glaciology, isotope geology and magnetic methods of exploration. The Physics Department at the University of Alberta has added a number of geophysicists to its staff and research is continuing in gravity, earth currents, terrestrial heat flow and isotope geology. A Department of Geophysics has been created at the University of Western Ontario and two academic appointments have been made. Active research projects there include seismology, electromagnetic exploration, rock magnetism, terrestrial heat flow, radioactivity and operational methods applied to prospecting. Research in isotope geology will also be undertaken at St. Francis Xavier University where a mass spectrometer is under construction.

Geophysical research in problems related to geology is being conducted at all major Canadian universities, at a number of provincial research institutions and on a much larger scale in various branches of the Department of Mines and Technical Surveys.

GRAVITY

The Dominion Observatory is continuing its regional gravity program. In northern Quebec 80,000 square miles have been covered in the areas bounded by latitudes 52°N. and 58°N. and longitude 72°W. and Hudson Bay. In Western Canada, through the efforts of the Canadian Society of Exploration Geophysicists, the oil industry has made available to the Dominion Observatory data from gravity surveys in Alberta and Saskatchewan south of latitude 52°N. Data from commercial gravity surveys in southern Ontario have also been released to the Dominion Observatory for publication.

The Nova Scotia Research Foundation is continuing gravity observations at 1,000 foot intervals along roads (elevations established to 0.5 foot). In 1958 surveys of sedimentary areas in Cumberland, Northern Colchester and Pictou counties were completed.

In addition to regional gravity surveys with gravity meters, absolute determinations of gravity are being made with pendulums by the Dominion Observatory. A vibration gravity meter, suitable for submarine observations, developed at the Observatory, was given its first underwater test in cooperation with the Netherlands Geodetic Commission. A number of adjustments have still to be made to this apparatus.

Earth tide measurements were made for 1958-59 at Resolute and Meanook, Alberta with recording gravity meters. These records should provide valuable information about the strength of the crust, etc., and the Canadian Shield. The establishment of tide gauges at Resolute Bay, Cornwallis Island and

Frobisher Bay, Baffin Island, together with two more stations to be established on the mainland at Coppermine and Taktoyaktuk, will show the effects of recent removal of the Pleistocene ice-sheets.

Gravity meter surveys have been an accepted part of petroleum exploration for many years and for the past few years have been used by mining companies. With the publication of regional gravity maps by the Dominion Observatory a new source of information to aid in geological studies has been made available. The quantitative interpretation of gravity fields in terms of possible geological features can be a lengthy process. Wide use of commercial computing centres is being made by petroleum and mining geophysicists in the interpretation of gravity observations.

SEISMOLOGY AND SEISMIC EXPLORATION

Two seismic studies of crustal structure were made in Western Canada as part of the International Geophysical Year. The first was the Ripple Rock blast in April 1958 at which time 1,300 tons of explosives were set off. Permanent and temporary stations operated by the Dominion Observatory, universities and commercial geophysical parties recorded the explosion at distances up to 600 miles. Preliminary interpretations of the results indicate there is a thickening of the crust under the Cordillera in agreement with gravity observations and accepted theories. In addition, near Calgary, a refraction profile 81 miles long parallel to the mountains was made by commercial seismic companies cooperating through the Canadian Society of Exploration Geophysicists. A depth of 43 kilometers was obtained for the Mohorovicic discontinuity.

A novel use of seismology has been made at Springhill, Nova Scotia, by the Mines Branch, Department of Mines and Technical Surveys, and the Nova Scotia Research Foundation, in the study of stress in strata resulting from mining operations. A Willmore seismograph has been used to record the rock failures and this seems to be a promising field of investigation for the study of local stressing of strata.

In the field of seismic exploration two new techniques have been introduced to Canada. An underwater seismic profiler called the Sparker provides a very rapid method of obtaining reflections to depths of 1,200 feet in water-covered sediments. This apparatus will be useful in engineering geology problems and geologic structural studies in the Great Lakes and the coastal areas of Canada. The Sparker operates much as an echo sounder except a much larger energy source is obtained by discharging an electric condenser under water. Two new devices for the seismic velocity logging of bore-holes are now available. This equipment provides information from oil or gas wells that is useful for porosity calculations and interpretation of seismic reflection records.

MAGNETISM

The Geological Survey of Canada flew about 90,000 line miles of aeromagnetic surveys during 1958. For the first time

on this continent the Decca navigation system was used for flight control over water when the Bay of Fundy and Gulf of St. Lawrence areas were surveyed. A number of research projects reported by the universities are concerned with the interpretation of aeromagnetics. The Geological Survey is using the computing centre at the University of Alberta for some interpretation operations.

Continued interest is being shown in palaeomagnetism. Measurements of the natural remanent magnetism of rocks are being made at the Dominion Observatory, the Geological Survey and various universities, with the aim of more accurately determining the position of the magnetic poles in the past. Studies of the Curie point of various rock types are being made at the Geological Survey of Canada. At the University of Western Ontario the magnetic properties of ilmenite samples are being correlated with their petrological characteristics.

At the University of Alberta short-period variations of the earth's magnetic field and their relation to earth currents are being studied. These studies may have a geological application by providing a method of determining basement depth. They are also of interest to the petroleum industry because of the contribution these currents make to electric fields measured in the "SP" logging of bore-holes. A most interesting application of variations of the earth's magnetic field to mining geophysical exploration has been the development of "AFMAG", a device which uses these variations as the excitation field in a method of electromagnetic prospecting.

TERRESTRIAL HEAT FLOW AND RADIOACTIVITY

Heat flow measurements are being made by staff members of the University of Alberta in oil wells in Alberta and the work of the Physics and Geophysics Departments at the University of Western Ontario is well known. McGill University workers have also obtained data for the St. Lawrence valley. The high value of 2.9×10^{-6} cal/cm^2 sec. found at Resolute Bay suggests that many more measurements are necessary. These studies, in addition to providing knowledge about the interior of the earth, should provide more information about the disposition of radioactive materials in the earth's crust.

In addition to isotope geology and radioactive age determinations, which are covered by the Subcommittee on Mineralogy, Geochemistry and Petrography, other measurements of radioactivity of interest to geologists are being made. The University of Western Ontario group is measuring the scattering and absorption of gamma rays in geologic materials. The Geological Survey of Canada is measuring the energy spectrum of natural radio-activity in rocks. At the University of Manitoba a radioactive method of prospecting for beryllium has been perfected.

BEHAVIOUR OF GEOLOGIC MATERIALS UNDER PRESSURE AND TEMPERATURE

The Mines Branch, Department of Mines and Technical Surveys, is investigating the strength of various types of rocks in

order to determine their behaviour under stress. McGill University is also studying the behaviour of rocks under high temperatures and pressures. Professor Uffen reports that facilities for experimental studies in metals are available at CARDE of the Defence Research Board. Here the technique of investigating the propagation of shock waves and interpreting the data in terms of pressures and temperature is used. Experiments such as these are most necessary for the better quantitative understanding of the behaviour of materials at high temperatures and pressures.

GLACIOLOGY

The stimulus of the International Geophysical Year has aroused interest in glaciology in Canada. The University of British Columbia is investigating a number of western glaciers. The Defence Research Board, in cooperation with McGill University and University of Toronto, has undertaken glaciological research on Gilman Glacier, Northern Ellesmere Island.

OCEANOGRAPHY AND LIMNOLOGY

The activities of the Institute of Oceanography at British Columbia, the Great Lakes Research Group, the new Oceanographic Institute at Dalhousie University and the Polar Continental Shelf Project of the Department of Mines and Technical Surveys should add greatly to our knowledge of submarine geology in Canada. The overwater aeromagnetic surveys of the Geological Survey of Canada, the underwater gravity meter of the Dominion Observatory, the establishment of tide gauges in the Arctic, seismic exploration and other geophysical prospecting techniques should all play their part in the geological programs of these organizations.

PETROLEUM AND MINING GEOPHYSICS

Petroleum and mining exploration decreased during 1958. However, the use of electronic computers in the reduction of seismic, gravity and magnetic data has increased markedly. Two commercial services are available in Calgary and services are also available in Toronto and Ottawa.

A number of new instruments have been developed for petroleum and mining exploration. The new velocity logging devices and the "Sparker" seismic reflection system were mentioned under Seismology. The AFMAG, mentioned under Magnetism, uses the natural variations (short period) in the earth's magnetic field caused by thunderstorms to determine electric conductivities and magnetic permeabilities from measurements similar to those made in electromagnetic prospecting. The developers claim that conductors may be detected at greater depths than is possible with conventional electromagnetic equipment. One man can carry the detector and make measurements at will. Another geophysical method - induced polarization - which has been developed during the past ten years to a useful exploration technique is now available in Canada. Induced polarization refers to the

polarization of electronic conductors (metals) in a medium of ionic (solution) conductors. Very low percentage sulphide bodies of large extent such as porphyry copper deposits make ideal targets for this method. It can be used to distinguish between metallic and non-metallic conductors which have been detected by other methods. The berylometer used to locate beryllium, described in last year's report, is now available for prospectors.

Mining geophysics has made remarkable advances during the past ten years. The divining rod and the black box which was never opened in public have largely disappeared in Canada. The physical principles that are the bases for the various prospecting techniques are completely understood by the properly trained. Theoretical calculations can be made to determine the resolving power of all these methods under any assigned physical condition. Usually in order to make the calculations less time consuming, certain simplifications of the known geologic conditions are made. A knowledge of the sensitivity of a particular measuring apparatus is all that is required to know which method or methods is best suited for a particular problem. At present this information is not readily available to the mining industry in a form that the average exploration engineer can use. With the claims and counter-claims that are made for various geophysical exploration methods and equipment it should be a matter of vital importance to the mining industry to have this information.

REPORT OF THE SUBCOMMITTEE ON PLEISTOCENE GEOLOGY

Presented by V. K. Prest

Members of Subcommittee

V. K. Prest (Chairman)	-	Geological Survey of Canada, Ottawa, Ontario.
Roland De Blois	-	Quebec Department of Mines, Quebec, Quebec.
R. E. Deane	-	University of Toronto, Toronto, Ontario.
Alexis Dreimanis	-	University of Western Ontario, London, Ontario.
J. A. Elson	-	McGill University, Montreal, Quebec.
C. P. Gravenor	-	Research Council of Alberta, Edmonton, Alberta.
P. F. Karrow	-	Ontario Department of Mines, Toronto, Ontario.
W. O. Kupsch	-	University of Saskatchewan, Saskatoon, Saskatchewan.
R. H. MacNeill	-	Acadia University, Wolfville, Nova Scotia.
W. H. Mathews	-	University of British Columbia, Vancouver, British Columbia.
A. K. Watt	-	Ontario Water Resources Commission, Toronto, Ontario.

GENERAL INFORMATION

The Subcommittee on Pleistocene Geology notes with pleasure the increasing attention being given the many phases of scientific endeavour that involve the study of Pleistocene geology. The study and areal mapping of surficial deposits has been continued by the Geological Survey of Canada, Alberta Research Council, Saskatchewan Research Council and Nova Scotia Research Foundation. Specific surficial geology projects have been carried out by Alberta Research Council, Ontario Research Foundation and the Universities of British Columbia, Alberta, Saksatchewan, Western Ontario, and Toronto, and by McGill University. Geomorphological aspects of the Pleistocene epoch have been receiving special attention at McGill and McMaster. Geological engineering and engineering geology studies have been carried out by the National

Research Council and Geological Survey of Canada. Ground-water studies have been stepped up by Alberta Research Council, Saskatchewan Research Council, Ontario Water Resources Commission, and Geological Survey of Canada. The work of the Hydrology Division of the Quebec Department of Mines has continued at about the same pace as last year. In Nova Scotia the Well Drillers Association has begun to supply records on overburden and ground-water conditions to the Nova Scotia Research Foundation. Research projects involving the chemistry, physics, or fabric of soils have been in progress at many centres.

Of particular interest over the review year are reports by Gravenor and Meneley on till fabrics, by Odynsky on dunes, by McKay on an organic layer associated with permafrost, and by Dreimanis on the Nipissing phase of the Great Lakes.

The Pleistocene Map of Canada released early in 1958 by the Geological Association of Canada[1] has received widespread attention and general acclaim. A lengthy review by Charles Swithinbank was published in the British periodical Geographical Review and shorter reviews appeared in both American and Canadian publications. Only one of the reviews might be considered derogatory and this was based on false premises. Knowledge of the map's shortcomings, indicated by the sum of the reviews, will be useful in any further Canada-wide or regional glacial map project. A second but smaller scale Glacial Map of Canada compiled in 1954 and 1955 by a committee organized by the Geological Survey of Canada also became available in 1958-59 with the publication of the Atlas of Canada by the Geographical Branch, Department of Mines and Technical Surveys, Ottawa. Although the areal coverage of glacial features shown is not as close to completion as the more recent larger scale map, it provides a general picture of the trend of glacial movements, of existing glaciers and the extent of glacial lakes and marine overlap. This map did, in fact, provide the first accurate map of Canada's existing glaciers. Both glacial maps suffer for want of accompanying explanatory notes.

[1] Copies may be obtained from the Secretary, Geological Association of Canada, 111 St. Clair Ave., W., Toronto, Ontario at $2.00 a copy.

The radiocarbon laboratory at the University of Saskatchewan continued to operate during the year, though a move to a new building caused some delays in the output. Work by the Mines Branch on the radiocarbon unit for the Geological Survey of Canada was continued, but at a slower pace than expected a year ago. It is hoped that the unit will be set up and in operation in the new Geological Survey building early in 1960.

In addition to the C-14 analyses made at the University of Saskatchewan over the past year, numerous datings of Canadian geological and archaeological samples were obtained from American laboratories and some from Europe. The Geological Survey of Canada obtained about 24 'datings', partly by

purchase and partly on a research basis from Isotopes Incorporated, Lamont Geophysical Laboratory and Groningen Geochronological Laboratory. Other geologists and archaeologists obtained datings of samples from Lamont, Yale, Pennsylvania and Groningen. The continuing flow of C-14 datings of Canadian samples is adding greatly to our knowledge of the Pleistocene history of Canada, a matter of surprisngly great concern to soil scientists, botanists, zoologists, archaeologists, forestry research workers and others.

The radiocarbon datings already obtained, coupled with detailed palynological and microfaunal studies, are providing basic data on the age and interrelations of the surficial deposits. A more reliable picture of the deglacial events that have shaped and fashioned Canada's surface is thus being obtained. Of particular interest are the ages of the various glacial lakes and spillways that led to the present Great Lakes system. Recent datings are supporting field data that indicate discrepancies with the earlier accepted Great Lakes deglacial chronology, the age of Lake Barlow-Ojibway and the Cochrane stage ice-advance.

Work throughout Canada over the past year has clearly pointed out the interrelations of the fields of glacial, Pleistocene, engineering, and ground-water geology, geomorphology, physical geography, archaeology and biology. Investigators in these varied disciplines have made important specific contributions to the knowledge of one or more of the others. Detailed investigations of muskegs and forest cover by botanists have provided valuable data for Canadian and American palynologists endeavouring to work out the ecological and climatological conditions of Pleistocene non-glacial intervals and of post-glacial time. This information, in turn, is of great interest to other scientists concerned with many aspects of the Pleistocene epoch and especially of deglacial events.

Engineering projects of many kinds in Canada commonly involve the Pleistocene or surficial deposits and hence practical problems in the one field may have a direct bearing on basic research investigations in the other. The listed projects in the National Advisory Committee reports clearly indicate this overlap. There remains, however, a great need for geologists to take a more active part in soil studies as applied to engineering projects and principles. They should also become more active in the study of permafrost phenomena as applied to practical or engineering projects. Currently engineers and geographers are doing most of the work in this field.

The Tabulation of Some Research Needs in Engineering Geology, presented at the 1958 annual meeting of the Geological Society of America in St, Louis, by George A. Kiersch reveals the great diversity of research underway in the United States and the active role being played by geologists. For the widely diversified subjects listed, the proportion of work by professional geologists to engineers is roughly 55 to 45. Though no comparable figures are available for Canada it is safe to say that the relative proportion of geologists to engineers would be very low. In the main, Canadian geologists have been concerned with the exploration for minerals and fuels and with actual mine development. In Canada in the future, the geological fraternity may

well look forward to increasing interest in the construction industry and to basic research in the many disciplines involving geological knowledge. As this swing or changeover comes about, and it is already evident, students in geology will require better backgrounds in mathematics, physics and engineering principles.

The Kiersch compilation considers both the geological and interdisciplinary areas or fields under the following headings.

1. Geologic Processes - Phenomena
2. Materials - Geologic
3. " - Manufactured
4. Engineering Seismology
5. Geophysics
6. Soil Science and Mechanics
7. Rock Mechanics
8. Exploration Techniques
9. Instrumentation Technique
10. Remedial Techniques
11. Interpretation - Presentation of Data
12. Engineering Operation
13. Engineering Works.

Though it is not fair to compare the Kiersch tabulation with the compilation of current research of our National Advisory Committee, the comparison is worthy of passing attention. In Canada, of 18 projects listed, only three may be considered the work of geologists, the others being by engineers. If we broaden the scope to include the interdisciplinary fields, the proportion might be raised to seven geologists to 16 engineers. If a survey similar to that by Kiersch in United States were made in Canada, however, probably the results would show less rather than more geologists in these fields of research and application. In passing, a recent paper[1] is an excellent example of what research-minded

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[1] Hubbert, M. King and Rubey, William W., Role of Fluid Pressure in Mechanics of Overthrust Faulting, Bull. Geol. Soc. Amer., Vol. 70, pp. 115-166 (1959).

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geologists may do when well-grounded in mathematics and mechanics.

RECENT AND CONTINUING WORK

Brief summaries of work recently completed, in progress, or planned, is given below for various parts of the country.

Northwest Territories

Soils engineers from Division of Building Research, National Research Council, carried out several investigations of soil characteristics, ground temperatures and permafrost conditions. The Geographical Branch, Department of Mines and Technical Surveys, also made special studies involving surficial

deposits. In particular, a paper[1] on a subsurface organic layer

[1] MacKay, J.R., A Subsurface Organic Layer Associated with Permafrost in the Western Arctic, Geographical paper No. 18, Department of Mines and Technical Surveys, 1958.

associated with the permafrost surface is a most informative piece of research work. Also, studies in the Mackenzie River delta are providing much new information on the sequence of glacial and deglacial events in this region.

The 1959 season should provide a wealth of information on surficial features and Pleistocene history and geomorphology in north-western Canada; the Geological Survey of Canada sponsored two airborne operations - Coppermine and Banks Island - to each of which a Pleistocene specialist was attached. Very little is at present known about the Pleistocene history of these regions. The local changes of ice-movement directions in the Coppermine area are exceedingly complex. On Banks Island, attention is being directed toward the determination of the outer limit of glaciation and to the stratigraphy of the west coast deposits with their buried organic horizons; they may be very early Pleistocene or Tertiary in age.

Yukon Territory

An interesting map of the Pleistocene features in the Whitehorse area has been compiled as an adjunct to a bedrock mapping program by the Geological Survey of Canada. Placer deposits in this area are receiving renewed attention in the light of Pleistocene history and geomorphology. These deposits offer a verdant field for Pleistocene research. It is expected that much general information on the Pleistocene geology of the eastern part of Yukon will be forthcoming from Operation Pelly, an air-supported project of the Geological Survey of Canada, that will cover over 20,000 square miles in southeastern Yukon in the field seasons 1958 to 1960 inclusive.

British Columbia

The Geological Survey of Canada completed its reconnaissance of the sub-till Pleistocene deposits of the eastern lowland of Vancouver Island and of islands in Georgia Straits. The work has confirmed the existence of at least two successions of non-glacial deposits, of which the uppermost succession is by far the most extensive. The British Columbia Department of Mines made some studies of surficial deposits in the Big Bend part of the Rocky Mountain Trench and is directing considerable attention toward a study of the physiography of the Province. The Geological Survey of Canada made examinations of many dam sites on the Columbia River and thereby obtained also considerable regional information on the Pleistocene history of the Rocky Mountain Trench.

As an adjunct of bedrock mapping by the Geological Survey along the Fraser River near Quesnel, some attention was given to the Pleistocene deposits. Two till sheets separated by 10

to 20 feet of gravels were noted in the valley bottom and a third, less consolidated till, on the plateau. Two opposing directions of ice movement are indicated by the distribution of erratics. Detailed studies of the Pleistocene geology are warranted in this region. Similarly, in the McDame area in northern British Columbia, a bedrock mapping program has led to an informative map of glacial features.

Alberta

Pleistocene studies, largely sponsored by the Research Council of Alberta, are being given more attention in Alberta than anywhere else in Canada. In co-operation with the Alberta Soil Survey, a Pleistocene geologists from the Research Council participated in a helicopter survey operation in northern Alberta. Map areas designated in the National Topographic Series as 84E, F and G were mapped in 1958 on a scale of one inch to eight miles, and 84J, K, and L are being done in 1959. Later work is planned to cover the remainder of northern Alberta except for Wood Buffalo National Park. Extensive glacial lake deposits were outlined during the course of the first helicopter program. Mapping of the Pleistocene deposits, in part in connection with ground-water surveys and including two Ph.D. thesis projects was carried out in the Edmonton, Wainwright, St. Paul - Vermilion, Beaverlodge, Calgary and Medicine Hat districts. Some of these were continued in 1959. Projects to work out the bedrock topography and pre-glacial drainage of Alberta and to determine depths to bedrock by geophysical means are being actively pursued. A Master's thesis has been written on glacial Lake Edmonton. Work is in progress on the micro and macro fabrics of varved clays and on the micro fabrics of tills. Studies are being continued on the origin and significance of dead-ice features. Special Pleistocene research work includes that on soil potentials and the rate of dissolution of silicates.

Ground-water surveys and projects include work in the Beaverlodge, Edmonton, Lamont, Calgary and Medicine Hat area, on the Bulwork sandstone and on the Milk River artesian basin. Both Pleistocene soil studies and ground-water surveys are supported by test drilling, the Research Council maintaining its own equipment and crew. Pump tests are also carried out to give quantitative data on the specific yields of wells. All test holes are electro-logged and a radioactive logger has also been acquired. Seismic and resistivity surveys are made where useful as an adjunct to the ground-water investigations. About 20 automatic water level recorders were in operation in 1958-59.

Pleistocene research work is also in progress at the Geology Department, University of Alberta, with emphasis on periglacial phenomena. The Geological Survey of Canada did no Pleistocene work in Alberta in 1958, but resumed its work in southwestern Alberta in 1959 with special attention to the Cordilleran-Laurentide contact relations.

Saskatchewan

Activity increased during the review year. In 1958 the Saskatchewan Research Council initiated a program of systematic mapping of the surficial deposits south of the Precambrian Shield on a scale of one inch to four miles. The first party worked in the Qu'Appelle Valley area (62L). A ten-year program has been established to provide the basic information pertinent to study of the ground-water resources of southern Saskatchewan. A Pleistocene geologist also undertook several minor projects for the Council such as the study of loess deposits near Swift Current. The detailed mapping of ice-thrust structures in the Dirt Hills and of till fabrics of glacial flutings near North Battleford were undertaken through the Department of Geology, University of Saskatchewan. The Geological Survey of Canada undertook detailed studies of the Pleistocene geology in the area embracing the proposed South Saskatchewan River dam site. The physical properties of soils and rocks in the immediate vicinity of the dam site are being given particular attention. The Geological Survey of Canada initiated a study of the ground-water resources of the Souris River Valley in 1958 which is continuing in 1959. Test drilling to determine the character of the 'soils' in the buried Missouri River valley north of Estevan will be made in 1959. The Saskatchewan Research Council will support the Geological Survey's program and sponsor several test holes to determine the water-bearing potential of any aquifers indicated.

Manitoba

Aside from a study of dyke construction in an area of sporadic permafrost at Grand Rapid on the Nelson River, carried out by the National Research Council, no studies of direct concern to the Pleistocene subcommittee were made in 1958. Study of the ground-water resources of the Red River Valley were initiated in 1959. This survey will complement the earlier work of the Geological Survey in southern Manitoba.

Ontario

Studies and projects bearing on the various disciplines of Pleistocene geology were carried out in many parts of Ontario. The Ontario Department of Mines, as its part of the study of the geology and limnology of the Great Lakes, sponsored a 4-man field party in the Hamilton map-area to study the Pleistocene deposits. Attention was given also to the location of wells of which logs are on file with the Ontario Water Resources Commission and it is hoped that bedrock isopach maps will be prepared. Mechanical, heavy mineral, X-ray and chemical analyses will be made on specific samples collected in the area. The work is being continued westward into the Galt area in 1959. The Department is also compiling soils data from new excavations and borings in the Toronto area and this is bringing new information to light on the areal extent of the buried Toronto Interglacial Formation.

The Great Lakes Research Group, largely supported by the Ontario Department of Lands and Forests, Ontario Hydro Electric Commission, Metropolitan Toronto and oil companies, commenced field operations in June 1958, when a small vessel on

loan from the Royal Canadian Navy entered Lake Ontario. By the end of the sailing season almost 5,800 miles had been logged and over 900 stations occupied for scientific observations. That part of the program of particular interest to Pleistocene geologists included a study of mass water movements in the lake, and bottom sampling around the mouth of the Niagara River and in the region of Humber Bay. The work is continuing in 1959. A more limited program of water and bottom sampling has been carried out by a smaller boat, the R.V. Plainsville, in Lake Simcoe.

The Department of Geological Sciences, University of Toronto, contributed towards the Great Lakes research program by employing a launch to carry out sounding and bottom sampling operations off Scarborough Bluffs, and in the Cobourg, Presqu'ile and Bay of Quinte areas. The limited amount of work done in 1958 has already indicated the inaccuracy of existing scant data on the lake-bottom contours. A preliminary examination of Scarborough Bluffs was made to study shoreline erosion, and in 1959 the Bluffs will be examined in detail. The Department also sponsored precise levelling of the Iroquois shoreline from Rochester, N.Y. to Oshawa, Ontario and it is hoped to continue the levelling eastward in 1959.

The Geological Survey of Canada is contributing toward the study of the Lake Ontario basin by mapping the surficial deposits in the Trenton map-area. This, together with detailed study of the Pleistocene deposits and the geomorphology of the area, will constitute a Ph.D. thesis assignment at the University of Toronto. In this area particular attention is being given to the dividing Lake Iroquois shorelines and the Trent Valley outlet in an effort to integrate the late glacial history of this part of the Great Lakes System with that of the upper Great Lakes. The Geological Survey of Canada is also making detailed examinations of microfauna from borings made in Hamilton Bay by the Ontario Hydro Electric Commission. Organic layers in sediments from depths more than 200 feet below the bottom of the bay indicate a low-water stage during the Two Creeks non-glacial interval. This is the first conclusive evidence of the postulated low-water stage in the Ontario basin.

The Geological Survey also commenced a study of the Pleistocene deposits in the Cornwall area along the St. Lawrence Seaway and will continue the work in 1959. Advantage is being taken of the heavy construction in this area with consequent new exposures and bore-hole data to gain a better knowledge of Pleistocene deposits and hence of glacial and post-glacial events. Mapping of the surficial deposits of the Chalk River area was also undertaken by the Survey to obtain information about the ground-water systems and their possible bearing on radioactive waste disposal. In the Ottawa area, the Geological Survey has been collecting and collating soil-boring records with a view to publishing maps of the city showing the depth of overburden. A preliminary map[1] of part of the city was published in 1958. Maps

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[1] Drift Thickness Contours, City of Ottawa (West Part), Geological Survey of Canada, Map No. 13, 1958.

showing the character of the overburden will be produced at a later date. The Geological Survey has also made palynological studies of many non-glacial and post-glacial deposits in Ontario and is obtaining an excellent picture of the climatological changes that have taken place in Ontario in Wisconsin time.

At the University of Western Ontario work has continued on the stratigraphic correlation of glacial deposits in the region between Lake Huron and the St. Lawrence Lowland with emphasis on lithologic studies of till, depth of leaching, techniques of till fabric analysis and carbonate content of till matrix. A palynologic study of the sediments of the Tupperville mastodon site was completed. In May 1958 the annual field conference of Friends of the Pleistocene met in the London, Ontario area under the leadership of Prof. Alexis Dreimanis, to study the Wisconsin and pre-classical Wisconsin stratigraphy.

The Ontario Water Resources Commission made approximately 40 surveys of ground-water conditions for municipalities desiring such information. The Commission looked after the tendering for drilling and supervised the work until the water supply was assured when plans were formulated to develop the groundwater. In addition, the Ground-water Branch of the Commission made water resource surveys of six counties; reports on some of which are now available. Further counties were surveyed in 1959. Special prblems of ground-water supply and quality also received some attention. Ground-water investigations in Canada are still in their infancy and this field offers considerable scope for research along engineering and more purely scientific lines.

Quebec

The Hydrology Division of the Quebec Department of Mines studied the surficial deposits to locate adequate water-bearing formations near those municipalities or institutions seeking new or additional ground-water supplies. The second phase of the work of the three specially trained geological engineers of the Division is to conduct the tests necessary to assess the potentialities of the indicated aquifers. Thirty-four such surveys were carried out in 1958 in 19 electoral districts.

The performance of various soil formations along the Quebec North Shore and Labrador Railway are under study by soils engineers of the Building Research Division of the National Research Council. Three papers[1] of interest to both geologists and soils

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[1] Pryer, R.W. and Woods K.B.: Investigation of Banded Sediments Along St. Lawrence North Shore in Quebec; presented to 61st Annual Meeting of A.S.T.M., June, 1958.

Pryer, R.W.: Frost Action and Railroad Maintenance in the Labrador Peninsula; presented to 37th Annual Meeting, Highway Research Board, January, 1958.

Woods, K.B., Pryer, R.W., and Eden, W.J.: Soil Engineering Problems on the Quebec North Shore and Labrador Railway; Bull. Amer. Railway Eng. Assoc., February, 1959.

engineers have been presented regarding the sediments along this railroad. Soil engineers are also studying the characteristics of the Champlain Sea clays and of tills with the aid of National Research Council grants.

A series of coordinated projects concerning the late glacial history of northeastern Quebec and Labrador is being carried out from the McGill Subarctic Research Laboratory at Knob Lake. This work is being sponsored in part by the Geographical Branch, Department of Mines and Technical Surveys and in part with the aid of Arctic Institute grants. A study of permafrost in the Knob Lake area may also be made from the Knob Lake station under a National Research Council grant. Also in 1959 the Geological Survey of Canada will have a Pleistocene geologist in the Kaniapiskau - Knob Lake region.

Graduate students in geology at McGill University are giving more than passing attention to the Pleistocene geology of their thesis areas and information is thereby coming to light on glacial, periglacial and aeolian features in some of the mining areas. Investigations are also being made in the fields of geomorphology, palynology and photo-geology. The molluscan fauna of various levels of the Champlain Sea is being studied in detail and compared with modern Atlantic coast fauna.

New Brunswick

The Geological Survey of Canada continued its study of the Pleistocene geology of the St. John River Valley in 1958 and expects to complete the work in 1960. The work is largely concerned with mapping the deposits and working out the history of cyclic retreat of the last ice in the St. John and Madawaska River valleys which cross the Appalachian Mountain structures, but parallel the direction of ice retreat. A cycle consists of the events that took place while the ice-front was retreating from one position of temporary halt, or minor advance, to another such position. Mapping has been completed within seven one-mile map areas and two remain to be done.

Nova Scotia

The Nova Scotia Research Foundation continued its Pleistocene mapping program and completed four more preliminary map sheets. The work will continue in 1959. As already noted, the Well Drillers Association began to supply records to the Foundation over the past year and it is hoped that the records of many wells drilled in former years will be assembled and filed with the Foundation. Such data on the depth and character of the overburden will be of value to construction and soils engineers and to drillers and geologists.

Prince Edward Island

The Geological Survey of Canada had a field party in the eastern end of the Island in 1958 and 1959. The project is concerned with the bedrock and the surficial deposits. Emphasis has been directed toward the origin of the surficial deposits and the glacial and post-glacial history of the Island. Much has been

learned of the interrelations of New Brunswick and Cape Breton glaciers on Prince Edward Island and of sea levels relative to this land mass. Such information is essential to the study of present-day coastal erosion and to planning for the construction and maintenance of a causeway between Prince Edward Island and the mainland.

Newfoundland

The Geological Survey of Canada continued its study of the Pleistocene geology of Avalon peninsula and hoped to complete the program in 1959. The work to date has indicated that the peninsula was glaciated by a local ice-cap; no evidence has been found indicating that the main Newfoundland ice-cap extended over the Avalon peninsula. The Survey gave considerable attention to relative land and sea levels on the peninsula, but this study will require further work. It is already clear, however, that formerly accepted data on changes of sea level along the Newfoundland coast are misleading.

ACCOMPLISHMENTS AND RECOMMENDATIONS

Some of the Pleistocene projects recommended in earlier National Advisory Committee reports have been initiated. Direct attention has been given, in part at least, to the compilation and publication of a glacial map of Canada, analyses of till fabrics, Cordilleran-Laurentide drift relations, study of preglacial and interglacial buried valleys, the palynology of buried organic horizons and of post-glacial peat deposits, the stratigraphy and chronology of the Great Lakes, heavy mineral suites in tills, study of boulder trains, study of aeolian deposits, sedimentation in glacial lakes and the chronology of varves. Core sampling and study of Lake Ontario bottom sediments including aqualung operations, as recommended by P.F. Karrow in the 1957-58 report will be undertaken in the summer of 1959 as part of the Great Lakes Research Group activity. More indirect attention has been given to flow type landslides in the St. Lawrence valley, the study of permafrost relative to soil types and geological history, the detailed engineering geology of dam sites, the porosity and permeability of rocks and surficial materials relative to ground-water supplies, and many other problems. Some good thesis problems are among the suggested projects in the 7th and 8th National Advisory Committee reports that have not been undertaken. Students interested in Pleistocene geology would do well to consider them.

More institutions and organizations are becoming involved in pure and applied aspects of the study of surficial materials and Pleistocene history, with a corresponding increase in the numbers of workers and projects in these fields. This increase appears greater in the allied disciplines than in the geological fraternity proper. Although cutting deeply into the geological field these disciplines look to the Pleistocene geologist for reliable information. Radiocarbon datings of well-documented samples are needed from late-glacial and post-glacial deposits. Detailed studies of good sections of Pleistocene deposits in coastal areas, the St. Lawrence Lowlands, the Great Lakes region and major glacial lake basins should be encouraged as thesis problems at many of our universities.

Professor Dreimanis recommends more studies of fabrics and lithologies of tills as specific Pleistocene projects, as well as in connection with all field mapping. Work on the depth of leaching of soils and the carbonate content of tills, as carried out in southern Ontario by Dreimanis and reported by him in the literature, should be more widely applied in connection with all field investigations.

P.F. Karrow stresses the need for detailed mineralogical and size analyses of the marine deposits in the St. Lawrence Lowland. Such a study might be undertaken as a thesis project at an adequately equipped university to settle apparent discrepancies in high quartz and feldspar to illite and chlorite ratios of the clay-size materials.

J. Terasmae suggests a study of dunes in the St. Lawrence Lowlands to establish palaeo-wind directions and the history of dune formation. He points out that dunes near Prescott, Ontario indicate winds from the east whereas raised beaches on the west sides of till ridges were formed by prevailing westerly winds in Champlain Sea time. The present prevailing winds are from the west. The distribution of the dunes built by easterly winds should be established, the dunes studied in some detail and deductions made as to their origin. Dunes built by easterly winds are known also in other parts of the Lowland. Photoanalysis of the region supported by field observations should constitute an excellent thesis problem and fill a gap in our knowledge of post-glacial events.

N.R. Gadd suggests that a study be made of the physical and chemical properties of the "upper clay" and "lower clay" in the Ottawa region. Such factual information would do much toward establishing the environment of deposition of these clays, about which there is considerable controversy. The red banding of some Champlain Sea clays might be similarly studied.

J.G. Fyles suggests a study of bore-hole data from the Strait of Georgia as a possible thesis problem. He comments as follows:

> "In the Georgia depression of coastal British Columbia, the following features are suggestive of late post-glacial marine levels a few feet or tens of feet below present sea-level: (1) wave-cut (?) platforms down to 50 feet or more below present sea-level, border exposed, readily eroded promontories in the Strait of Georgia. (2) Some stream gullies along the shore of Vancouver Island between Ladysmith and Sooke, and extending a few feet or tens of feet below present sea-level, are cut in Vashon drift and younger marine deposits. A regional study should be made of logs and bore-holes that have penetrated the many alluvial and deltaic deposits that are graded to the present sea shore, in hope of finding more concrete information pertaining to these low sea-levels."

Two laboratory research problems have been suggested by Geological Survey of Canada staff involved in mechanical analyses procedures:

1. The study of variability of specific gravity of till aggregate from various regions. The specific gravity is necessary in applying Stokes Law to hydrometer and pipette analyses. The specific gravity of till aggregate should vary with the content of the montmorillonite group minerals as opposed to the kaolin group or to quartz; hence the calculated grain size diameters based on the hydrometer or pipette readings may be in appreciable error. Overall specific gravity values might be established for broad regions where the montmorillonite forms appreciable amounts of the sediment. The Geological Survey of Canada could supply samples of till from several areas on request.

2. Investigation of the problem of variation in initial and recovery "dry" weights of clayey sediments. These weights seldom correspond and adjustments must be made in the log graph curves of the size distribution. Some laboratories avoid such adjustments by utilizing only the recovery dry weights. The difference in initial and recovery "dry" weights appears to be due to the escape of water from clay minerals and clayey aggregates as a result of the use of dispersing agents. This phenomenon needs to be fully investigated. A series of controlled tests on samples of varying clay content would be the first step in attacking the problem.

REPORT OF THE SUBCOMMITTEE ON STRATIGRAPHY, PALAEONTOLOGY AND FOSSIL FUELS

Presented by John F. Caley

Members of the Subcommittee

John F. Caley (Chairman)	-	Geological Survey of Canada.
F.W. Beales	-	University of Toronto, Toronto, Ontario.
W.C. Gussow	-	Union Oil Company of California, Calgary, Alberta.
E.I. Leith	-	University of Manitoba, Winnipeg, Manitoba.
D.J. MacNeil	-	St. Francis Xavier University, Antigonish, Nova Scotia.
H.W. McGerrigle	-	Department of Mines, Quebec.
V.J. Okulitch	-	University of British Columbia, Vancouver, British Columbia.
C.R. Stelck	-	University of Alberta, Edmonton, Alberta.
C.G. Winder	-	University of Western Ontario, London, Ontario.

INTRODUCTION

The review of current research projects being carried on in Canada (p. 99) indicates that about 100 deal with problems falling more or less within the fields of stratigraphy, palaeontology and fossil fuels. These projects are exclusive of geological mapping, although it is fully realized that mapping in areas of sedimentary rocks involves establishing both the lithologic and faunal succession and, therefore, includes problems of stratigraphic palaeontology, sedimentation, and correlation.

CURRENT RESEARCH

Many of the problems within the general field of this subcommittee are of such a nature as to intimately combine stratigraphy, palaeontology, sedimentation, sedimentary petrology, etc. Classification of these presents difficulties. However, in order to show the type of work being done most of the current research projects have been divided into 11 categories.

Table 1, summarized from available information shows 11 categories of research and indicates the institutions and agencies where projects in each category are being undertaken. The table is doubtless incomplete, both as to the institutions and projects, but is an essentially correct portrayal of the known data.

TABLE I

Distribution of Current Stratigraphic and Palaeontologic Research in Canada

	University of British Columbia	B.C. Dept. of Mines	University of Alberta	Alberta Research Council	University of Saskatchewan	Sask. Dept. of Mineral Resources	University of Manitoba	Manitoba Mines Branch	University of Toronto	McMaster University	University of Western Ontario	Carleton University	Queen's University	Laval University	Quebec Department of Mines	Acadia University	University of New Brunswick	Geological Survey of Canada	National Museum of Canada	McGill University
Vertebrate Palaeontology									X										X	
Invertebrate Palaeontology	X		X		X	X	X	X	X	X					X			X		X
Micropalaeontology			X	X					X				X					X		
Spores	X									X								X		
Palaeobotany				X														X		
Stratigraphy	X	X	X	X		X	-	X	X	X							X	X		X
Subsurface Stratigraphy					X	X			X		X							X		
Sedimentary Petrology			X	X								X		X		X	X	X		
Fossil Insects																		X		
Sedimentation				X					X											
Lexicon											X							X		

TABLE II

Geologic and Geographic Distribution of Current Research Projects

	N.W.T.	Arctic Islands	B.C.	Alta.	Sask.	Man.	Ont.	Que.	N.S.	N.B.	P.E.I.	Nfld.
Tertiary				X	X							
Cretaceous	X	X	X	X	X							
Jurassic		X	X	X	X							
Triassic	X	X	X									
Permian	X	X	X									
Carboniferous			X	X	X	X	X?		X	X	X	
Devonian	X		X	X	X	X	X			X		
Silurian				X			X	X	X	X		
Ordovician			X		X	X	X	X				
Cambrian			X	X			X	X				

Table II indicates that all geological systems from Cambrian to Tertiary are represented in current research and that the geographic distribution of research effort covers practically all of Canada.

In the subcommittee report for 1957-58 reference was made to the Research Committee of the American Association of Petroleum Geologists and to its report on Research Needs in Petroleum Geology. The Association is currently engaged in a Basement Rocks Project designed ultimately to geologically map the basement rocks of North America. Considerable progress has been made and in eastern Canada the following has been done:

1. All wells reaching basement have been plotted.

2. Precambrian surface beneath the Palaeozoic rocks in southwestern Ontario has been contoured.

3. Outcrop areas of basement rocks in the Maritime provinces have been tentatively outlined.

The Lower Palaeozoic Names and Correlations Committee of the Saskatchewan Geological Society published a brief report in December 1958 on the Ordovician and Silurian strata revealed by deep wells in the general Williston Basin area of Saskatchewan. Correlation is made with exposed formations in southern Manitoba. This is an important contribution in view of recent indications of potentially oil-bearing reservoirs in these rocks in Saskatchewan.

Plant Microfossils

A continuing project designed to establish a reference collection of plant microfossils (spores) has been initiated by the Geological Survey of Canada. This project is combined with research into the stratigraphic value of these fossils. An entirely new spore assemblage has now been obtained from the Melville Island formation (Upper Devonian) of the Canadian Arctic.

Spores in coal seams have already proved useful in correlation and in solving stratigraphic problems in the Pennsylvanian of both Nova Scotia and New Brunswick. A spore assemblage from coal from the South Nahanni River area, N.W.T. dated the coal as Carboniferous and thus has provided the evidence for the first recognition of coal of this age in Western Canada.

Micropalaeontology

The Alberta Research Council in collaboration with the University of Alberta is investigating the microfaunal succession in the Cretaceous of Western Canada as a continuing project. This program includes a study of the Wapiabi, Kaskapau and Bad Heart formations in northwestern Alberta and of the Blackstone, Cardium and Wapiabi formations in Nordegg and Sheep River areas of the foothills belt.

Jurassic microfaunas from Saskatchewan are the subject of a Ph.D. thesis by Mr. J.H. Wall and the Geological

Survey of Canada is making a similar detailed study of the Jurassic ostracods from Saskatchewan, Manitoba, and part of Alberta. Ostracods from the Silurian Stonehouse formation of Nova Scotia are also to be studied by the Survey.

The stratigraphic distribution of the microfauna of the Kettle Point formation of southwestern Ontario is being investigated by the University of Western Ontario. It is thought that the Devonian-Mississippian boundary may be within this general succession of shales and it is hoped that this study may contribute toward solution of this problem.

Subsurface Stratigraphy

Continuing projects in regional subsurface geology are being pursued by the Geological Survey of Canada in Ontario, Saskatchewan, Alberta and British Columbia. These involve the Cambrian, Ordovician, Silurian and Devonian systems in Ontario; the Cretaceous in Saskatchewan; the Devonian in Alberta; and the Jurassic and Cretaceous in British Columbia. These projects are designed to provide information on the distribution, thickness, lithology, facies, etc., of subsurface formations as an aid in unravelling geological history and assessing the economic potentialities of the rocks concerned.

Similar projects, though generally more restricted, are being carried out at the University of Saskatchewan, the Saskatchewan Department of Mineral Resources, and the University of Western Ontario. A detailed study of the succession as revealed by the core of a boring near Simcoe, Ontario is the subject of an M. A. thesis being prepared at the University of Toronto. This core penetrates the entire (Devonian to basement) Palaeozoic succession and has, therefore, great value in correlating the subsurface with the exposed formations.

Stratigraphy

Projects in stratigraphy as separate from those combined with geological mapping are being conducted by most provincial surveys, by several universities, and by the Geological Survey of Canada. These are not enumerated here. However, the value of this work is recognized by industry and by all who are engaged in geological mapping and palaeogeologic studies.

Invertebrate Palaeontology

Much of the current palaeontological work is in connection with determining the succession, age, correlation, environment of deposition, etc., of the sedimentary formations, that is, stratigraphic palaeontology. As indicated in Table I, this type of work is carried on at many universities and by most of the provincial surveys and it constitutes a large part of the work of the Geological Survey's Section of Stratigraphic Palaeontology. In addition, projects involving detailed studies of individual genera, families, groups, and faunas are being pursued.

The combined results of this work are gradually adding to existing knowledge of the geological history of much of

Canada and, thereby, furnishing data necessary to exploration for and development of our natural resources.

Lexicon of Stratigraphic Names

The necessaity for a lexicon of stratigraphic names is widely felt and several subcommittee members have referred to this in recent years. Attention is once more directed to this problem by Dr. Jacques Beland of the Quebec Department of Mines who suggests preparation of a lexicon of the names for the Province of Quebec.

For the past year, the Geological Survey has been working on preparation of a lexicon for Canada to include Precambrian as well as all younger rocks. Considerable progress has been made and completion is expected by about 1961.

The Alberta Society of Petroleum Geologists has published a lexicon of names used in that province. In addition, Dr. C. Gordon Winder recently completed a lexicon of names used for the Palaeozoic formations in southwestern Ontario. It is hoped that its publication will follow.

EFFECT OF BASEMENT STRUCTURES ON FORMATION AND ACCUMULATION OF OIL AND GAS

At the 1958 Annual Meeting of the National Advisory Committee, Dr. J. C. Sproule suggested that the tectonic features in the Precambrian basement that extend beneath younger (Palaeozoic) rocks may have been responsible for features in the overlying rocks leading to the formation and accumulation of oil. He considers that the tracing of such features from the Shield through the overlying Palaeozoic and younger rocks and the study of the physical and organic facies changes in the sedimentary rocks overlying them, would be a most fruitful field of research. Such a project, which must be broad in scope, would require the coordinated efforts of Precambrian specialists, stratigraphers, geochemists, geophysicists, palaeontologists, and experts in air photo interpretation. Dr. Sproule was asked to submit a fairly detailed account of what would be entailed in such a comprehensive project. In a letter to the Chairmen of the subcommittees on Stratigraphy, Palaeontology and Fossil Fuels and on Structural Geology, Dr. Sproule has amplified his suggestion as follows:

> "My research suggestion is based on two fundamental concepts, which together go far toward explaining the origin and reservoiring of oil and gas, as well as other minerals, metallic as well as non-metallic. This suggestion, however, is directed only toward the matter of improving methods of exploration for oil and gas.
>
> "The first concept referred to has to do with the close relationship between the occurrence of the organic life that later becomes oil and gas, and submarine topography. That relationship is known, inasmuch as water depth, temperature, supply of mineral salts and other foods, ocean currents, etc.,

are known to be related to submarine topography, and to the propagation of organic life that later becomes liquid and gaseous hydrocarbon.

"The second concept has to do with the effect of basement structure and tectonics, and paleotopography and structure at any horizon, on the overlying structure, and the reflection of such features at the surface, where they may be recognized by photo-interpretation or by other means.

"The research I have in mind, therefore, combines studies of oil-forming and oil reservoir facies with the regional as well as local tectonic features. Photogeology, as for example, the study of a number of strong tectonic trends that pass from the Pre-cambrian shield across the adjoining sedimentary basin area, is one of the best known tools available for such studies. One of the best known examples of these reflections of deep-seated trends is the Great Slave Lake tectonic trend, of which the Pine Point fault system is one element. We also know that there are (Pre-Laramide) regional trends that pass from the Rocky Mountain area across the adjoining sedimentary basin. One of the best examples of this is the Peace River Basement Arch and its equivalent in the Rocky Mountains. Another one that will soon be much better known than it is now is the roughly east-west trend passing through the northern portion of the Liard Basin close to the Northwest Territories-British Columbia-Alberta boundary. Along this trend we find a very strong, probably ancient feature similar to the Peace River Uplift along which several high ridges have already been recognized. Two of these locally high areas are the Bovie Lake Uplift and the East Petitot Uplift, the latter of which is represented by Mississippian at the surface over a fairly large area along the Northwest Territories-British Columbia boundary at approximately longitude 122°18'.

"A reef trend that is probably of basement origin is the Leduc-Woodbend-Bonnie Glen-Rimbey, etc., reef series. It could not be proven at this time, but research work on wells now drilled and to be drilled will quite likely lead to that conclusion.

"Several large tectonic features referred to above, particularly the Peace River Arch and the south-westward extension of the Pine Point Fault zone, are known to have controlled oil-forming environments as well as the development of reservoirs, from the early Palaeozoic on. As indicated above, there are undoubtedly many others that are as yet unknown. Much remains to be learned about all of them by research.

"Many of the above features, as well as related features and patterns, are recognizable from air photographs on the Precambrian, in the mountains and in the basin areas adjoining them, despite the mantle of glacial drift that covers the greater part of the sedimentary basin areas. A study of photogeology and its relation to tectonics and the effect of tectonic trends on oil formation and accumulation is a most fruitful study. In my opinion, there is no study that could be carried out at this time that would mean as much to the future of the petroleum and natural gas industry, not only in Western and northwestern Canada but even in the more restricted sedimentary basins of Eastern Canada.

"With respect to the method of approach to this type of research, I realize that it is a very large "order". It may take a fair sized staff to accomplish recognizable results.

"If it is agreed that such research is worthy of attention the question of what is a reasonable approach still remains. In this connection I suggest tentatively that the research in its early phase be assigned to several groups somewhat as follows:-

"1. Study of facies at all horizons from well borings along and adjacent to well known deep-seated tectonic trends, such as the Peace River Arch and the Pine Point Trend (over 2,000 holes by American Metal Co. and Consolidated Mining and Smelting Co.).

"2. Library research on some of the better known of the world's oil fields with particular reference to published facies and lithofacies studies and the structural and tectonic histories of the same fields.

"3. Photogeological studies of the Western Canadian Sedimentary Basin areas. Studies of known Precambrian basement features and their extensions in to the basins should supplement basin photogeological studies for correlation purposes."

NOTES AND SUGGESTIONS

Dr. F.W. Beales makes the following comments regarding the present system of awarding grants:

"Applications for research grants to support stratigraphical and palaeontological research are presumably not reaching the Awards Committee (of the National Advisory Committee) in appreciable number. The 1957-58 report (National Advisory Committee Eighth Annual Report) indicates:

Pleistocene and Surficial	Stratigraphy and Palaeontology	All other Research
% of total research in Canada by projects		
15	25	60
Grants made by Geological Survey of Canada on recommendation of N.A.C.		
$760	$700	$48,540

"This table presumably reflects the fact that the main call for stratigraphical and palaeontological research is for field work. Field work generally involves considerably larger outlays than most grants-in-aid awarded to date and in consequence the sponsorship of such research has tended to be restricted to federal and provincial surveys and companies. The object of the grants system is to aid and stimulate research in Canadian institutions. There is no doubt that the aid given is considerable but is the Committee stimulating new research? Apparently it is not so doing in all fields of geology.

"The present system of making research grants depends as a rule on the submitting of very definite projects long in advance of requirements. Is this sytem adequate?

"Is it possible to make grants to persons rather than to projects on a basis of proof of previous research ability? If this were implemented, researchers could draw plans with the definite knowledge that at least some support would be available. All unused balances should automatically be renewable for one year. Renewal of expended personal grants should be contingent on definite results obtained since the issuance of a previous grant. This system would leave much more discretion to the research worker in the use of his grant than is the case at present, but it might stimulate more research.

"At a time when research is rapidly becoming the backbone of academic, economic and even national survival, anything which might stimulate more research at reasonable cost is worth trying."

Dr. H.W. McGerrigle submits the following suggestions made by Dr. Jacques Beland of the Quebec Department of Mines:

"1. Preparation of a lexicon of stratigraphic names for the province of Quebec. This would involve studying historical background of several names now loosely used and clarification of many poorly defined stratigraphic names.

"2. A study of the mineralogy of the Cambro-Ordovician greywacke or subgreywacke found on either flank of the Sutton axis in the Appalachian belt from northern Vermont to Kamouraska County, Quebec, in an attempt to determine the source areas of these sediments.

"3. A study of the anticlinal structures of Siluro-Devonian rocks in western Gaspe (southwest of the Matapedia River Valley) as potential sources of oil or natural gas."

Dr. C. Gordon Winder makes the following comments and suggestions:

"1. The Mississippian-Devonian boundary presents a problem in most of central and western North America. Palaeontological research on this problem in western Canada has utilized macrofossils. The Bibliography of Alberta Geology recently published by the Alberta Society of Petroleum Geologists includes about one paper on Palaeozoic microfossils. A combined systematic and stratigraphic study on a regional basis of upper Palaeozoic microfossils should add materially to our knowledge of these rocks.

"2. The Bibliography referred to above would seem to be the most noteworthy publication on that area. Although such publications soon become dated, and occasionally omissions place important works in greater obscurity, reference manuals are an essential tool in research. Comprehensive biobiographies for other provinces or "geological areas" would substantially advance geological research in Canada.

"3. Research in modern marine sediments has been concentrated in the warm seas. What is known about marine deposition in temperate and arctic seas? Canada is unique in that it encloses one of the largest epeiric seas in the world -- Hudson Bay. Sedimentation in this body of water has never been studied except possibly on a very local basis. The results might show that our ideas on Palaeozoic, Mesozoic and Cenozoic epeiric deposition are not correct. A research institute supported by government agencies was recently initiated for the Lake Ontario basin. A similar program for Hudson Bay should be initiated by a Canadian agency before geologists from some other area do so.

"4. Last year a series of palaeogeographic maps for pre-Jurassic time was published for Western Canada. A similar set of maps for eastern Canada and the Arctic Islands would be a noteworthy contribution."

Dr. V. J. Okulitch has, on previous occasions, stressed the need for much more work on the Lower Palaeozoic stratigraphy of the Rocky Mountains. He again directs attention to this need and reports that Mr. Robert Greggs who is preparing a Ph. D. thesis has found very vexing and important problems in the Upper Cambrian and Lower Ordovician; certainly much more work is indicated. Dr. Okulitch makes the further comment that possibly more, and more easily available adequate scholarships would enable advanced graduate students to do such field and laboratory research and is the most pressing need.

Dr. W. C. Gussow feels that one of the most serious problems facing the petroleum industry is that of by-products and in this regard, finding new uses for sulphur appears to head the list. The natural gas in several major fields in Western Canada contains hydrogen sulphide in such amounts that its removal is necessary before the gas can be marketed and this is resulting in an accumulation of considerable quantities of sulphur. Dr. Gussow, therefore, recommends a concerted research effort on this problem.

"Our greatest need", continues Gussow "is factual information obtained by field mapping. We should, therefore, support field mapping at every opportunity. In my opinion, no student in geology should be out of work as long as the Geological Survey of Canada has unmapped regions on hand. This effort should not be limited by funds but rather by shortage of trained personnel".

Dr. B. A. Liberty stresses the need for both fundamental and applied research in Palaeozoic and younger strata in shelf areas. He suggests the following projects:

1. Compilation and study of occurrences in which faulting has occurred in and subsequent to Palaeozoic time.

2. Study of occurrences in which igneous intrusions have occurred in and since Palaeozoic time.

3. Evaluation of the effect of 'post glacial uplift' on migration of pre-existing petroleum accumulations in south-western Ontario. This would involve study of the original depositional dip. Present regional dip is about 25 feet a mile; present 'lift' of the Pleistocene beaches is about the same value but in the opposite direction. What are the criteria for determining the original depositional conditions? Where were original conditions most favourable to petroleum accumulation? Post-glacial uplift must have caused some migration, so where are the new locations of accumulation?

4. A detailed subsurface study of 'consistent clay seams' (bentonites) in an effort to establish their lithologic equivalence ('correlative') value. This study should be undertaken with the closest horizontal control possible and preferably in southwestern Ontario where the well density is sufficient.

On the subject of structural geology and particularly thrust mechanics, Dr. D.K. Norris comments as follows:

"Very incompetent rocks such as coal play an important part in thrust mechanics and hence in the interpretation of closures at depth in rocks favourable to the accumulation and retention of oil and gas. In southwestern Alberta, for example, a major glide plane for thrust faults is known to occur near the Jura-Cretaceous boundary and its presence at that stratigraphic level is considered due to the coal of the Kootenay formation.

"Of prime importance in this mechanics is a thorough understanding of the reactions of media in a confined state to directed stress. Thus far mathematics and laboratory experiments have dealt with simple deformation of homogeneous solids. The next step is a consideration of more complex layered media. Coal mines are an ideal source of information because one or more stratigraphic levels are freshly exposed over wide areas in contrast to the outcrop. Detailed studies should be made of deformation of the coal seams and adjacent rocks exposed in mines in varying degrees of structurally disturbed ground e.g. the mines of the Drumheller area in relatively undeformed strata of the Alberta syncline, those in the flanks of the Crowsnest coal field or at Coal Creek, and in the extreme, those of the Coleman, Canmore and Nordegg areas."

Dr. B.R. Pelletier feels that the following lines of research could be very fuitful:

1. Description, classification, measurement, and mapping of current structures in sedimentary rocks should be made in order to deduce direction of sedimentary transport and to reconstruct the palaeogeography of that time. Emphasis must be placed on cartographic representation. Statistical studies may be undertaken in order to accelerate the methods of study and to represent the data with facility and in a suitable, easily comprehensible form.

2. Description, classification, measurement, and mapping of textural features in sedimentary detrital deposits should be attempted. Facies maps should be prepared from outcrop and well data and should be used in conjunction with the information obtained by paleocurrent studies. Geographic variation in scalar properties such as sizes and percentage composition may be amenable to mathematical treatment and these data may be plotted on suitable curves (e.g. size vs. distance). In this form, predictions can be made into areas where information is not available.

3. Description, classification, measurement, and mapping of the carbonate rocks should be attempted in order to understand the change in carbonate facies and carbonate sedimentation with the aid of petrographic methods. Facies maps based on physical and organic factors can be drawn from such observations. Staining and etching techniques should be encouraged as they are useful in distinguishing the dolomites and limestones and a rapid point count for the purpose of obtaining percentage composition can be made. Minerals, organic content, voids, secondary fillings and other solutional phenomena such as stylolites, veins, replacement and disrupted bedding must all be studied and the percentage of occurrence for various samples, or beds, must be noted and assigned to a particular facies. Such information must be well illustrated by photographs and sketches in thin section, and specimen and stratigraphic section in order to set up type-facies that can be easily recognized.

4. Sedimentary trends and belts should be delineated from the above studies in order to predict unknown occurrences of producing horizons especially in cases where a field has just been discovered.

5. Statistical studies should be made on fossil species in order to evaluate variations of morphological detail. This would give a better understanding from a standpoint of evolution and taxonomy and thus sharpen the chronology which is basic to all stratigraphic work associated with petroleum exploration. There is a fundamental need of this work for the advancement of the science notwithstanding the economic importance that generally accompanies it.

Regarding these projects, Pelletier strongly recommends that the researcher commence his investigations in an area that has been geologically mapped or on stratigraphic sections that have already been measured in order to provide himself with a framework for the problem. It is also desirable to outline the basin of deposition within which the study is to be made.

REPORT OF THE SUBCOMMITTEE ON STRUCTURAL GEOLOGY

Presented by J. W. Ambrose

Members of the Subcommittee

J. W. Ambrose (Chairman)	-	Queen's University, Kingston, Ontario.
A. R. Byers	-	University of Saskatchewan, Saskatoon, Saskatchewan.
J. E. Gilbert	-	Quebec Department of Mines, Quebec, Quebec.
M. S. Hedley	-	British Columbia Department of Mines, Victoria, British Columbia.
J. C. Sproule	-	Consulting Geologist, Calgary, Alberta.
C. H. Stockwell	-	Geological Survey of Canada, Ottawa, Ontario.

INTRODUCTION

This report, concerning structural research in Canada, is based on information and suggestions kindly supplied by the Secretary and by members of the Subcommittee. It was written by the Chairman, and since time did not permit its circulation for comment by Subcommittee members, he must accept full responsibility for opinions expressed in Part I. Part II is a compilation of information at hand, and Part III contains recommendations and conclusions.

PART I

What is structural research, and is it necessary?

The amount and character of research in structural geology currently underway in Canada is extremely difficult to determine, mainly because structural research is difficult to define. Few, if any geological investigations can be undertaken without devoting some attention to structure. Studies of structure are, of course, fundamental in the search for and exploitation of petroleum and mineral deposits. Areal geological maps, except the most general reconnaissance, depict the structure and relate it to adjoining areas; and in non-fossiliferous strata correct interpretation of stratigraphy, the geological history of the area and of its economic possibilities depend to a very considerable extent on correct interpretation of the structure. From this point of view one might say that structural studies and geological studies

are virtually synonymous and that structural research is thus being pressed on a wide front in all parts of the country.

However, it is legitimate to ask if such examinations and descriptions constitute structural research.

Research in any scientific field can be divided into three phases: observation and description; analysis, deduction and generalization; and prediction. Thus, although most geological investigations involve structural studies, many such studies are limited, for a variety of reasons, to descriptions of the structural features as observed or inferred. Moreover, depending partly on the scale of mapping and partly on the geologist's interest, descriptions of structural features too often consist of a few generalizations concerning obvious folds and faults, sometimes accompanied by bland statements about the forces which formed them. Other equally significant structural elements, as joints, cleavages, lineations, minor folds, even attitudes of faults or directions of movement, are neglected or overlooked. No attempt is made - commonly cannot be made because of lack of data - to determine interrelations of structural elements or the processes that led to their development. Interpretations, interpolations and extrapolations are correspondingly weak. All might be greatly strengthened with some additional observations and effort. If research consists of observations, induction, deduction and prediction much, although by no means all, of the structural research on record in this country seems to stop at an elementary level, somewhere in the observation and description stage.

Anything approaching complete analysis and comprehension of the structure of an area is impossible unless:

1. All structural elements are observed and recorded.

2. Interrelations of the several elements are established.

3. Hypotheses of mechanics of origin of the elements and of the whole structure are developed.

4. Predictions based on the hypotheses are tested by additional observations.

At risk of being considered unduly optimistic, I suggest that structural research can now be carried forward through the four stages on a progressively broadening front.

Some people have felt that rock mechanics defy sensible analysis and explanation, that study of rock mechanics is foredoomed to failure and frustration. Although attempts to understand and explain rock mechanics date back at least to Sir James Hall, for one reason or another the explanations and generalizations offered by such men as Daubree, George Becker, Bailey Willis and many others, including notable contributions by C.K. Leith and W.J. Mead, proved incomplete or otherwise unsatisfactory, or perhaps were overlooked and forgotten.

However, in 1936 M. King-Hubert made two major contributions to structural theory. First he drew to geologist's attention the Mohr-Coulomb theory of rock fracture which, although not completely unassailable, has proved to be a master key for unlocking many of the mysteries of rock fracture; and secondly, he introduced geologists to the theories governing scale models and so put experimental structural geology on a firm footing for the first time. In the same period, i.e., during the last three decades, Hans Cloos, Ernst Cloos and Robert Balk were demonstrating the significance and usefulness in structural interpretations of the so-called minor features such as joints, lineations, small faults, and so forth, features by no means limited to igneous rocks. Simultaneously Bruno Sander and his associates were pursuing structural data on both megascopic and microscopic scales. In 1951, C. H. Stockwell and Hoover Mackin made a major contribution to structural theory as understood in this continent when they rediscovered, independently, ideas concerning the geometry of folds, ideas which were subsequently expanded by C. D. A. Dahlstrom and Dahlstrom and A. R. Byers. It is interesting to note that essentially the same ideas were presented twenty years earlier by C. E. Wegman, but his paper, written in German and published in Finland made no visible impact on geological thought in this continent, and apparently neither Stockwell nor Mackin were aware of its existence when their papers were written. Council members may call to mind other recent noteworthy contributions to structural geology, such as those of David J. Griggs to experimental geology, of H. S. McKinstry and M. King-Hubert to theories of faulting, and of Walter Bucher and S. Warren Carey to theories of folding.

When one views the advances and accomplishments in structural theory during the past thirty years it seems reasonable to hope that structural research in general can be advanced beyond the descriptive phase into examinations of processes and of rock mechanics. The crux of this report is, that to achieve correct interpretation of structure all structural elements must be taken into account, each must be fitted into its proper place and each must lend its support to interpretation of the geometry and of the dynamics of the structure. The goal of complete understanding is not to be reached easily or quickly, if at all, but it will never be reached unless the attempt is made.

PART II

Current Structural Research in Canada

With the considerations set out in Part I of this report in mind, it is perhaps useful to subdivide current structural research into four ranks, defined as follows:

Rank IV — Examination and description limited to large scale structures. Study incidental to routine areal mapping, and structural observations largely or wholly restricted to attitudes of obvious planar features as bedding planes or gneissosities; surface traces of larger faults recorded. Compilations, any scale, of gross structural data presented without examination of processes. No cross-sections.

Rank III Examination and description extended to include observations and notes concerning origins of several structural elements, e.g., lineations, cleavages, small folds; investigation of attitudes of, and directions of separations on both large and small faults. Compilations to include all pertinent structural and stratigraphic detail. Cross-sections included.

Rank II Examination and descriptions of elements as in Rank III; attitudes, character, and origin of folds established; interrelations of structural elements established; general structural synthesis, supporting and supported by an hypothesis as to processes and mechanics of origin. Whether the work is original, or is a compilation of previous work is not significant.

Rank I Structural analysis and synthesis as in Rank II; deductions tested by additional field observations; direct or scale model experiments.

With the information at hand this subcommittee cannot establish the rank of many of the projects listed. The ranks indicated are therefore tentative and subject to revision as further information becomes available. In fact, one of the recommendations of this subcommittee will be that, in future, projects be graded by those people reporting, following the divisions indicated above.

TABLE I

PROVINCE	TYPE OF STUDY	NO. OF EACH RANK (tentative)							
		I		II		III		IV	
Quebec	Areal	-	-	-	-	-	13	-	
	Mine geol.	-	-	-	-	-	5	-	
	Special	1	-	3	-	-	-	-	
	Special	-	-	-	3	-	-	-	
Ontario	Areal	3	-	-	-	-	2	-	
	Special	-	-	-	3	-	-	-	
	Special	2	-	3	-	-	-	-	
	Geophysical	1	-	-	-	-	-	-	
	2 Compilations	ungraded							
	3 Geophysical Studies	ungraded							
Note - Ont. Dept. Mines, Western, McMasters, and Univ. Toronto unreported at time of writing									
Manitoba	1 Geophysical Study	ungraded							
Note - Man. Dept. Mines and Forests and Univ. Manitoba unreported at time of writing									
Saskatchewan	Areal	-	-	1	-	13	-	-	
	Special	-	-	2	-	-	-	-	
	1 Compilation	ungraded							
	3 Geophysical Studies	ungraded							
Alberta	Dating Orogenies	ungraded							
Note - Info. from petroleum industry not available at time of writing									
British Columbia	Areal	1	-	-	-	-	-	Several	
	Special							2	
Northwest Territories		1	-	-	-	-	-	-	

Summary of Table I

Fifty-eight structural projects, or projects in which structural studies are significant, are listed. Of these only six are definitely first rank, three are first or second, nine are second rank and six are second or third. The remainder are mainly descriptive studies of third or fourth rank. If returns were complete the numbers would be different but the distribution might well be similar.

Geophysical investigations of the earth's deep interior, although highly significant in theories of the structure of the earth as a whole, are not included as structural projects.

Experimental investigations of structural problems are being undertaken by two people; the remainder of the projects are field studies. Most of these are areal studies, but three at least are studies of specific structural elements, one of the Rideau Lakes fault, one of joints near Kingston and one of lineations in the Labrador Trough.

Compilations are ungraded in Table I because information concerning their scope and intent is not at hand. Since a compilation consists of pertinent data from previous work, studies based on compilations can be ranked in the same categories as original field studies. The significant thing is not how the data were obtained but what data were obtained and to what use were they put. To cite a case in point, one may think of the revision of the tectonic map of Canada, one of the current projects of the Geological Survey of Canada. This compilation is bound to lead to comprehensive structural studies and hypotheses and thus is an essential first step towards better knowledge and understanding of the structural geology of this country.

PART III

Recommendations and Conclusions

M. S. Hedley agrees that, to make a contribution to structural theory, it is necessary to go beyond description of form and to enquire as to processes. This, he adds, generally means additional, time-consuming study, but he urges that where man and problem seem favourable such additional time may be very much worth while.

Dr. Hedley continues with other suggestions for research. Thinking of the structural environment of ore depositions he says, "... the matter of importance is not what is the shape of the orebody or the shape of the enclosing rocks, but when, why, and how did the mineral-bearing solutions find this a better place to relax in than others nearby." In particular, the structural environment favourable to replacement needs study, in Dr. Hedley's opinion.

He suggests, too, study of end products of deformation. He says: "In the Slocan, Lardeau, Big Bend, Cariboo, Salmo and elsewhere are structures that are not adequately

described in any textbook. What appears to be normal sequence turns out on close study to include repetitions and omissions due to deformation that has gone past the stage of isoclinal folding. This and similar situations are far more common than is generally accepted in the mountains. We know that a great deal of structure has escaped detection by many who are generally competent; structure that is very important on many counts. By 'we' I mean a few of us in the Department and some of the more alert company men in British Columbia. Some measure of the effects of super-deformation is needed."

Finally, Dr. Hedley notes that study of linear features on air photos may indicate areas favourable for rewarding field studies and urges all geologists to be on the lookout for such situations.

J.C. Sproule notes the close association of submarine topography, for example of pre-Palaeozoic topography, on later distribution of petroleum-forming organisms and the development of structural or stratigraphic reservoirs. Thus some prominent pre-Palaeozoic tectonic trends, recognizable in areas of exposed Precambrian rocks, can be traced by photogeology or other means long distances into areas overlain by Palaeozoic and later strata. Precambrian topographic highs along such trend lines are proving to be favourable sites for petroleum deposits. He cites, as illustrative examples, the southwestward extension of the Pine Point fault zone, the Peace River Arch, and probably the Leduc - Woodbend - Bonnie Glen - Rimbey, etc., reef series. These, he says, "... are known to have controlled oil-forming environments, as well as the development of oil-forming reservoirs, from early Palaeozoic on." He suggests a program of research as follows:

1. Study of facies at all horizons from well borings along and adjacent to known deep-seated tectonic trends, such as the Peace River Arch and the Pine Point trend (over 2,000 holes by American Metal Company and C.M. & S.).

2. Library research on some of the better known of the world's oil fields, with particular reference to published facies and lithofacies studies and the structural and tectonic histories of the same fields.

3. Photogeological studies of the sedimentary basin areas in Western Canada. Studies of known Precambrian basement features and their extensions into the basins should supplement basin photogeological studies for correlation purposes.

J.C. Sproule and his associates have undertaken to outline the principal known tectonic trends in the sedimentary basin of Western Canada from photo studies. This is part of the work of a subcommittee on geological structure mapping under Mr. J.C. Scott, Chairman. Additional studies of this sort, or as suggested under items 1 and 2 are recommended.

In conclusion, this incomplete survey indicates that, although rigorous structural research is decidedly limited at present, a few promising projects are underway, and others, it is

hoped, will be undertaken. The Subcommittee urges that all structural investigations be carried beyond the descriptive stage, and feels that much is to be learned by so doing. In order to emphasize this proposal, they recommend that structural projects be graded in some order of intensity as suggested. Specifically, they reiterate the recommendation of earlier Structural subcommittees, that the form, origin, interrelations and mechanics of specific structural elements, such as faults, lineations, cleavages, folds, and so forth, be selected for intensive investigations, with a view to ultimate synthesis of mechanical systems.

Finally, they recommend that all geologists engaged in field studies, no matter how routine or on what scale be encouraged to observe, record and describe all the structural elements - to upgrade their structural investigations and thus make possible enlightened and penetrating analyses of the structural - that is to say, the geological history of the area or feature under study.

APPENDIX I

GEOLOGICAL SURVEY OF CANADA RESEARCH GRANTS SUMMARY REPORTS ON PROJECTS

The Annual Reports for the past five years contain summary reports on projects supported by grants that were completed or that were achieving results of interest. Brief reports are given below on projects completed or reporting progress of interest in 1958-59.

Project 1-51- Geological Age Determinations

Under direction of Dr. J.T. Wilson, University of Toronto.

Analysis of a suite of samples from the Blind River region of Ontario shows conclusively that the detrital monzonite and zircon found in association with the Blind River uranium deposits are much older than the uranium ores in these deposits.

An improved method of making potassium - argon age determinations has been developed making possible simultaneous potassium and argon analyses on the same 2- or 3- gram sample of potassium mineral, where before two separate samples were necessary. A suite of samples from the region east of Blind River was dated by this method, and the results have had considerable bearing on the interpretation of the geological history of the area.

The results of eight years of research in the field of lead isotope variations in nature have been prepared by Professors R.D. Russell and R.M. Farquhar for publication as a monograph in 1959.

Professors R.M. Farquhar and J.T. Wilson have started work on compilation and discussion of all existing age determinations based on radioactivity (except C-14 ages) from all parts of the world.

Project 26-53- Enthalpy Changes in Metamorphic Reactions and their Geologic Significance

Under direction of Dr. V.A. Saull, McGill University.

The research effort in 1958-59 was divided into two parts. The first was to select a workable calorimeter model and to use it to obtain results on enthalpy changes. The results of this program are fully described in a Ph.D. thesis at McGill University in 1959 by John T. Cumberlidge entitled Some Experiments on Surface and Strain Energy in Minerals. In this work 40 heats of solution of various grain sizes of quartz, silica, glass, calcite, precipitated Ca CO_3, and fluorapatite are given with an accuracy of better than $\pm$ 0.6 per cent for fluorapatite and better than $\pm$ 0.4 per cent for the SiO_2 and the Ca CO_3 groups. The determinations were used to calculate the devitrification energy of silica glass and the recrystallizatio[illegible] glass of quartz, calcite and fluorapatite. The adiabatic [illegible] glass accompanying devitrification and recrystallization are given. Samples of SiO_2 and Ca CO_3 were

"deformed" in a bomb, and their heats of solution used to indicate possible devitrification and recrystallization rates. The strain energy in calcite was determined by comparing the heats of solution of fine grained calcite and precipitated $CaCO_3$ and that in quartz by comparison of ground and annealed samples.

This is the first general calorimeter study of surface and strain energy in minerals and shows that in metamorphism, heat released in mineral recrystallization can cause appreciable temperature rises.

The second part of the work was to continue development of a calorimeter for mineral studies more accurate than the best at present available by a factor of ten. It is considered that all the theoretical problems connected with the construction of a calorimeter for direct determination of enthalpy changes of any mineral reaction have been solved. This calorimeter is completely sealed and high internal pressures can be withstood permitting high solvent temperatures. The present model is made of polythene, but a Teflon model is semi-complete. The direct determination of enthalpy differences (by dissolving minerals in each calorimeter simultaneously) increases the accuracy by a factor of about ten, in the case of the silica - glass to quartz transition and by comparable factors for other minerals.

Project 1-54- Silicate and Sulphide Phase Relationships

Under direction of Drs. J.E. Gill, E.H. Kranck and V.A. Saull.

Five of the seven separate investigations that were in progress in 1958-59 have been completed. These investigations are:

(1) Experiments on the relative ability of different solutions to transport copper and iron sulphides. The experimental work has been completed and the results will be embodied in a Ph.D. thesis by J.A. Soles.

(2) Experiments on the behaviour of copper sulphides at temperatures up to 800°C. This is an experimental investigation of the nature and degree of replacement of silicates by sulphides. The results are embodied in a Ph.D. thesis by B.K. Meikle entitled Experiments with Copper Sulphides at Elevated Temperatures, McGill University, 1959, (copy available in Library, Geological Survey of Canada, Ottawa).

(3) Experiments on the mobility of sulphides in sulphur vapour, Sulphides of iron, copper, manganese, nickel, cobalt, molybdenum, lead and zinc were tested at temperatures up to 1,000°C. in various atmospheres to compare their mobilities. The results are described in an M.Sc. thesis by J.V. Guy-Bray entitled Mobility of Certain Sulphides in Sulphur Vapour, McGill University, 1959, (copy available in Library, Geological Survey of Canada, Ottawa).

(4) Experiments on the growth of sulphides in black shales. The Cameron-Wolofsky bomb was used to simulate natural conditions probably obtaining during the growth of pyrite in shales. The results are described in an M.Sc. thesis by R. Hay entitled Growth of Sulphides in Black Shales, McGill University, 1959, (copy available in Library, Geological Survey of Canada, Ottawa, Ontario).

(5) Experiments on the melting of rocks. The objective is to find out more about the behaviour of various rock minerals at temperatures approaching their melting points. The experimental work has been completed and the results will be embodied in a Ph.D. thesis by R.V. Oja.

(6) Differential thermal analysis of sulphides. A new type of sample chamber has been developed permitting simple vacuum differential thermal analysis of minerals. The device is simple, cheap and highly effective. The results will be embodied in an M.Sc. thesis by R. Kelly.

(7) Experiments on the use of the chromographic print method of examining metallic minerals. These are being carried out in connection with a study of trace metals in certain sulphides from the Chibougamau district of Quebec. It is hoped that the method will be useful in studying the materials used in the experimental studies of sulphides, insomuch as it can give a direct, two dimensional picture of the trace metal distribution over polished surfaces.

Project 2-54- Geochemical Studies

Under direction of Dr. D.M. Shaw, McMaster University.

During 1958-59 the following investigations were completed:

(1) Lithium distribution in the Preissac-Lacorne region of Quebec. A paper[1] describing the results of this study

[1] Siroonian, H.A., Shaw, D.M., and Jones, R.E., Lithium Geochemistry and the source of the Spodumene Pegmatites of the Preissac-Lamotte-Lacorne Region of Western Quebec.

was submitted for publication in the Canadian Mineralogist.

(2) Spectrographic analysis in an argon-oxygen atmosphere. A method of analysis has been developed and tested to eliminate the CN bands which commonly obscure a wide spectral region. The sample is burnt in an argon-oxygen atmosphere using the Stallwood jet. A paper[1] describing the method has been

[1] Shaw, D.M., Wickremasinghe, O., and Yip, C., A simple Device for the Spectrochemical Analysis of Minerals in an Inert Atmosphere using the Stallwood Jet, Spectrochim. Acta, Vol. 13, 197-201 (1958).

published.

(3) Trace elements in metamorphic pyroxenes. This study has contributed some interesting data and ideas to the sparse literature on the geochemistry of metamorphism. The

results are recorded in a thesis[1].

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[1] Moxham, R.L., Minor Element Distribution in some Pyroxenes of Metamorphic Origin, M.Sc. thesis, McMaster University, 1958.

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(4) Trace elements in the White Mountain magma series. The results of this study provide an example of trace-element behaviour in a series of plutonic syenites and granites of known magmatic origin. They are recorded in a thesis[1].

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[1] Deuters, B.E., A Geochemical Study of the White Mountain Magma Series, M.Sc. thesis, McMaster University, 1958 (for abstract, see Canadian Mining Journal, December 1958, p. 75).

Two papers have been written on topics arising out of these geochemical studies. One[1] concerns a spectral line

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[1] Shaw, D.M., Vanadium-Calcium Spectral Line Coincidence and its effects on Vanadium Abundance Data, Geo. Et Cosmochim. Acta, Vol. 15, 159-161 (1958).

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coincidence which bears on vanadium determinations.

The other paper is a general statement of spectrographic problems and procedures relevant to the scheme of trace element analysis in use in this laboratory. It has been submitted for publication.

Project 4-54- Spectrographic and Geochemical Research on Rocks and Minerals

Under direction of Dr. J.E. Hawley, Queen's University.

During the year 1958-59 research was continued on granitic rocks of the Grenville Province, southeastern Ontario and on the several other projects detailed below:

(1) Stratigraphy, petrography and genesis of the Elliot Group, including the uraniferous conglomerates, Quirke Lake syncline, Ontario, Ph.D. thesis by P.J. Pienaar, Queen's University, 1958. (For abstract, see Canadian Mining Journal, June 1959, p. 249).

This is an outstanding contribution on the uranium deposits of the Quirke Lake syncline for which is proposed a fluviatile sedimentary origin, subsequently modified to a minor extent by metamorphic and hydrothermal processes associated with nearby diabase intrusions. The conclusions are well documented with careful analyses.

(2) Structure and petrology of the Wesport area, Ontario, Ph.D. thesis by H.R. Wynne-Edwards, Queen's

University, 1959. (For abstract, see Canadian Mining Journal, July, 1959, p. 86).

This is a detailed study of the structure and metamorphism of Grenville sediments and of the development of granite masses. It includes 20 analyses of granitic rocks and gneisses.

(3) Origin of the kyanite occurrences in the Wanapitei and Crocan Lake area, Ontario, Ph.D. thesis, by W.J. Pearson, Queen's University, 1959. (For abstract, see Canadian Mining Journal, June 1959, p. 249).

This project is a unique combination of careful field observations and chemical studies of the development of metamorphic facies and indicates the need for some modification of present views on stable mineral assemblages in such metamorphic rocks. It includes 44 chemical and spectrographic analyses of metamorphic rocks.

(4) Pyrite zones in the hanging wall of the Steep Rock ore zone, M.Sc. thesis by C.M. Wright, Queen's University, 1959. (For abstract, see Canadian Mining Journal, October, 1959, p. 131).

This includes spectrographic analyses of the pyrites.

(5) Granitic rocks in the Grenville Province of southeastern Ontario, M.Sc. thesis by J.A. Grant, Queen's University, 1959. (For abstract, see Canadian Mining Journal, August 1959, p. 119).

The thesis includes 60 complete analyses of granitic masses and gneisses, and studies of the zircons in them.

(6) Copper-nickel deposits in amphibolite, Uchi Lake, Ontario, M.Sc. thesis by Colin Coats, Queen's University, 1959. (For abstract, see Canadian Mining Journal, September, 1959, p. 141).

The thesis includes analyses of two rocks and spectrographic analyses of 18 sulphides and 25 wall-rock specimens, including Ni, Co, Se and other determinations.

(7) Ordovician limestones of the Kingston area, Ontario, M.Sc. thesis by Ian D. Maycock, Queen's University, 1959.

This is a detailed study of the lithology and correlation of beds throughout the district. Aspects of the mineralogy are considered with reference to difficulties in the use of such limestones in concrete aggregates.

Research projects partly completed include: geochemical studies of granitic rocks in Algoma and areas adjacent to the Grenville; chromite and ultrabasic rocks of Mount Albert, Quebec; heat effects on sulphide and arsenide nickel-copper minerals; study of high and low iron sphalerites and associated sulphides in

the zinc ores of the Bluebell mine, B. C.; and geochemical studies of the Sullivan ore, B. C.

The following papers were published in 1958-59:

Palladium Bismuthides - Michenerite and Froodite, Hawley, J. E., and Berry, L. G., Canadian Mineralogist, Vol. 6, pt. 2, pp. 200-209, 1958.

Selenium in Some Canadian Sulphide Deposits, Hawley, J. E., and Nichol, Ian, Econ. Geology, Vol. 54, 1959.

Project 6-54- Pleistocene Stratigraphy Along Lakes Erie and Huron

Under direction of Professors G. H. Reavely and A. Dreimanis.

Detailed studies were continued along Lake Erie, around the section of the Port Talbot interstadial deposits and in the Catfish Creek area. Several of the new findings as well as the results of previous studies are included in a paper in a guidebook for the Friends of Pleistocene Geology, Eastern Section, that was prepared for their 22nd meeting held in the London - Lake Erie area, May 16 and 17, 1959.

Other publications include:

Beginning of the Nipissing Phase of Lake Huron, A. Dreimanis, Jour. Geol., Vol. 66, September, 1958, pp. 591-598.

Project 7-54- Scale Model Experiments of Airborne Electromagnetic Prospecting

Under direction of Dr. R. J. Uffen, University of Western Ontario.

The model work has confirmed theoretical predictions that (a) the results from certain types of airborne detecting equipment are effected by the relative orientation of flight paths and geological strike (b) mixtures of magnetic and electrically conducting minerals such as pyrrhotite and chalcopyrite may, at certain frequencies, produce zero in-phase component and a minimum E-M amplitude response.

Mr. Alvin Surkin presented a paper Electromagnetic Modelling to the Tri-College Conference at McMaster University, Nov. 8, 1958 and a paper Experiments with Scale Model Electromagnetic Systems at the annual meeting of the Canadian Institute of Mining and Metallurgy in Montreal, April 14, 1959. A paper Quantitative Interpretation of Airborne Electromagnetic Surveys by M. Edwards, A. Surkin and R. J. Uffen is in preparation.

Project 5-55- X-Ray Spectrographic Analyses of Mineral and Rocks

Under direction of L. G. Berry, Queen's University.

Much of the work carried out during 1958-59 forms part of Project 4-54 (74). It includes:

(1) Determination of Fe, Mn, Cd, Pb in sphalerites and of the cell edge of sphalerite by diffractometry in order to determine the iron content and probable temperature of formation of sphalerite. This was done on ores from the Bluebell mine, British Columbia.

(2) Preparation and checking of final working curves for the determination of the Se content in sulphides from Canadian mines.

(3) Setting up the technique and curves for analysis of Fe, Zn, Pb in mixed sulphides from the Sullivan mine, British Columbia.

(4) Determination of iron and chromium in chromites.

(5) Determination of Sr, Rb, in Uchi Lake amphibolites.

(6) Determination by X-ray methods of K, Sr, Rb, Fe in Grenville granites.

(7) Determination of Ca and Sr by X-ray spectrography in a study of the limestones of Kingston district. The clay minerals concentrated from these limestones were identified by X-ray diffractometry using a diffractometer and a Geiger or proportional counter.

Project 2-56- Heat Flow Measurements in Western Canada

Under supervision of Dr. G.D. Garland, University of Alberta.

The heat flow per unit area per second across a section of the crust is equal to the temperature gradient, multiplied by the thermal conductivity. In 1958-59 progress was made in the measurement of both these quantities. For the thermal conductivities core samples were obtained from holes in the same localities as those to be used for the gradient measurements. Samples were chosen from the collections of the Oil and Gas Conservation Board of Alberta and Imperial Oil Company. During the summer of 1958 an undergraduate student assistant was employed to prepare discs of rock cut from the original cores and measure their conductivities. Measurements were made in 33 discrete core samples chiefly from the Leduc and Redwater fields, each measurement being the average of three or four discs cut from the sample. These measurements are believed to give the fullest information available on the thermal properties of sedimentary rocks from Western Canada.

For the temperature gradient measurement a portable logging unit has been obtained that will log holes for temperature down to 3,000 feet. Preliminary tests have indicated satisfactory performance. For the temperature measurements, non-producing holes drilled some months previously, but which are not plugged are required. Arrangements have been made with

several companies, and initially, it is planned to measure the temperature in holes in the Leduc, Redwater, Rimbey and Princess areas.

Project 4-56- Trace Element Content of Some Rocks in Western Canada

Under supervision of Dr. H.V. Warren, University of British Columbia.

A hot aqua regia attack on various rocks has revealed wide variations in their content of readily extractible copper and zinc. The work to date suggests that these variations bear a direct relationship to mineralization in the vicinity. Soils and stream sediments, when treated to a parallel chemical attack, reflect closely the absolute and relative amounts of copper and zinc found in the associated country rock. This method of analysing representative samples of country rock offers encouraging possibilities of providing a worth while prospecting tool.

Some of the results of this research were presented at the annual meeting of the Royal Society of Canada, Saskatoon, 1959 in a paper by H.V. Warren and Robert E. Delevault entitled Zinc and Copper Relationships in Some Eruptive Rocks.

Project 5-56 - Age Determination of Igneous Rocks in Western Ontario and Manitoba

Under supervision of Drs. G.M. Brownell, H.D.B. Wilson and R.B. Ferguson.

Equipment has been set up for the determination of ages of rocks by measurement of the alpha particle emission and lead content of the zircon. It was hoped that this might prove to be a rapid routine method for determining relatively accurate ages of Precambrian granitic intrusions and that many simple and complex intrusions in western Ontario and in Manitoba might be so dated. The method may give reasonably accurate age determinations, but the time involved in making them seems excessive. The method seems neither rapid nor routine enough to be used as an ordinary tool to accompany geological mapping.

Two difficulties encountered were the scarcity of zircons in most of the western Ontario - Manitoba granites and their low content of lead which makes accurate determinations difficult. Less than half the granites examined contain enough zircons for analysis. In those that do the lead content of the zircons is so low that without a special lead-free laboratory the determinations are not reliable.

About ten age determinations have been made. Most indicate ages of about 1,700 million years, but two or three give in the order of 800 million years. Not enough confidence is felt in their accuracy to justify publication.

The research is the subject of two theses:

Age Determinations of Accessory Zircon from Granitic Rocks of the Kenora Area, Ontario, M.Sc. thesis by

R.F. Emslie, University of Manitoba, 1957. (For abstract, see Canadian Mining Journal, March 1958, p. 89).

Work for the second thesis has been completed and the final report is in preparation.

Project 6-56 - Publication of Canadian Mineralogist

L.G. Berry, Queen's University, Editor.

Two numbers of the Canadian Mineralogist have been published (part 1, 1957 and part 2, 1958). Manuscripts are on hand for a third part which went to press in May and should appear in September, 1959. The membership of the Mineralogical Association of Canada is now 480. Memberships, which usually include orders for both published parts of the Canadian Mineralogist, are being received slowly, but steadily. A good stock of both parts is on hand to fill these requests. As the journal becomes better known more libraries will join. In the spring of 1959 there were 95 corporation members, almost double the number in the spring of 1958.

Project 1-57 - Problems in Nuclear Geochronology

Under direction of Dr. R.E. Folinsbee, University of Alberta.

In 1958 the Department of Geology of the University of Alberta moved to new quarters and the facilities for research have been greatly expanded. The potassium-argon mass spectrometer, constructed in cooperation with the Department of Physics, is now in operation. The results of the first runs, made entirely at the University of Alberta, were presented at the meeting of the Royal Society of Canada, Regina, 1959 in a paper by H. Baadsgaard and R.E. Folinsbee entitled Potassium - Argon Age of Biotites from Cordilleran Granites.

A paper by R.E. Folinsbee and H. Baadsgaard entitled An Absolute Age for the Exshaw Shale has been published[1].

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[1] Guidebook, Eighth An. Field Conf., Nordegg, Alta., Alberta Soc. Pet. Geol., Aug. 1958, pp. 69-73.

An abstract of a paper giving some new dates for the palaeontologically controlled time scale has been submitted for presentation to the International Geological Congress in Copenhagen, 1960.

During the summer of 1958 samples from the Ordovician meta-bentonites of Lake Simcoe, Ontario and the Lower Devonian meta-bentonites of Cape Gaspé were collected and are being studied.

Project 2-57- Mineralogy and Petrography of the Oka Alkaline Intrusives, Quebec

Under direction of Dr. Guy Perrault, Ecole Polytechnique.

Most of the work so far has been mineralogical. Some of the many minerals present in the Oka rocks are: nepheline, pyrochlore, betafite, perovskite, hornblende, pyroxene, monticellite and melanite. A paper on the mineralogy of the district entitled Hornblende from Oka, Quebec was read at the meetings of the Mineralogical Association of Canada, Toronto, 1958. Results of a preliminary study of pyrochlore are given in a paper entitled Determination de la Composition Chimique du Pyrochlore, par Spectrofluorescence des Rayons-X which was submitted to L'Ingénieur for publication in 1959.

Project 3-57- Basic Intrusions of the Kenora - Fort William Area

Under direction of Dr. H. D. B. Wilson, University of Manitoba.

This project involves a detailed petrological and chemical study of some 15 basic intrusions mapped and sampled during the summers of 1956 and 1957. The grant was used for the purchase of equipment to convert the rock and mineral analysis laboratory to the new rapid analysis method developed by the United States Geological Survey. Satisfactory analytical results were obtained in the determination of SiO_2, Al_2O_3, total iron, TiO_2, P_2O_5, MnO, FeO and H_2O. In cooperation with chemists of the Manitoba Mines Branch some work was done on the determination of K_2O and Na_2O by the flame photometer, not using an internal standard. Results are consistent, but differ from results obtained from conventional analyses of these elements. Determination of MgO and CaO by titration has caused difficulty, although the results for MgO are satisfactory for most purposes. Until a better method for analysis of CaO is developed, both MgO and CaO will be determined by conventional methods. In general it appears that the rapid analysis method is sufficiently accurate for rocks but not for minerals.

Petrographic study of the rocks was continued in 1958-59, the main effort being in making numerous Rosiwal analyses. Little optical work was done on the minerals, but it is hoped that this will go ahead in 1959-60. Much time was spent on the separation of minerals from the various rocks. A graduate student will work on this problem at Cambridge University in 1959-60 where it is hoped spectrographic analyses will be made of all the minerals, including the standard oxides and traces of copper, lead and zinc in a few typical minerals.

Project 4-57- Greywackes of the Northern Appalachians

Under direction of Dr. G. V. Middleton, McMaster University.

Work was continued on the petrography of specimens collected during the summers of 1958 and 59 from the Normanskill Formation of New York and the Quebec Group (Charny Formation) of Quebec. Modes have been determined for 24 specimens which have also been analysed spectrographically. In addition the maximum and average size for each specimen has been determined micrometrically. This phase of the work is designed to investigate the within-bed variation in petrographic and trace-element characteristics of the Normanskill formation. It will be extended to include the Charny Formation (in detail) and selected specimens of a number of other greywacke formations for comparative purposes.

A paper by G. V. Middleton entitled The Chemical Composition of Sandstones was submitted to the Geological Society of America for publication. The abstract of a paper by G. V. Middleton and J. N. Weber entitled Petrographic and Geochemical Variation in Greywacke Formations was submitted for presentation to the Twenty-first International Geological Congress in Copenhagen in 1960.

Project 5-57- Microfauna of the Kettle Point and Port Lambton Shales

Under direction of Dr. G. C. Winder, University of Western Ontario.

The objective is to establish the age of the Kettle Point shale and thus place more accurately the Devonian - Carboniferous boundary.

In 1958 chip samples from 260 feet of the Kettle Point shales were obtained from a well in Sombra Township (maximum thickness is about 330 feet). About two to three pounds of the coarser fragments were saved with the complete section represented in 31 samples. Because previous attempts to disaggregate this shale have proved futile, surfaces of each individual fragment over four mesh in size are being examined for conodonts. In one sample an estimated 3,600 fragments had a yield of about 20 identifiable specimens.

The Kettle Point shale has been studied physically also. Distribution maps have been constructed, the stratigraphic distribution of the carbon and carbon dioxide determined and the physical chemistry for contemporanecus deposition of calcite and marcasite considered. The results are embodied in a senior thesis by William D. McDonald, University of Western Ontario, 1959 entitled The Kettle Point Formation.

Project 2-58- Distribution of Copper, Nickel, Cobalt and Iron in Silicate and Sulphide Phases

Under direction of Dr. H. D. B. Wilson, University of Manitoba.

Earlier studies are thought to indicate some of the controls that determine the metal ratios in Canadian base metal ores. The present project involves the determination of the distribution coefficients in silicate and sulphide phases by making melts at various temperatures and pressures to test these conclusions experimentally.

A large Temco furnace with Minneapolis - Honeywell control system and temperature recording device, and a smaller furnace with pressure jack for the pressure part of the experiment, has been purchased. The furnaces are now set up in a special fume chamber provided by the University and the first runs will be made in September, 1959.

Much library research has been completed on previous work and procedures and apparatus have been chosen for the experimental work.

Many analysed samples of copper and nickel ores from various mines have been prepared for firing. They have a large spread in metal ratios and it is planned to mix them with standard silicate samples to determine the partition ratios.

Project 5-58- Relationship Between Pyrochlore and Betafite

Under direction of Dr. J.S. Stevenson, McGill University.

The results from this completed project are embodied in a Ph.D. thesis by D.D. Hogarth entitled A Mineralogical Study of Pyrochlore and Betafite, McGill University, 1959.

Project 8-58- Internal Structures and Wall Composition of Certain Microfossils

Under direction of Prof. Alan McGugan, Queen's University.

Four hundred shale samples have been collected from the Upper Cretaceous succession of the Vancouver Island area. A most interesting foraminiferal fauna was separated from the shales of the Nanaimo Basin and systematic work on specific determinations is in progress. As many as 15 species of some genera are represented. A few ostracods, fish teeth and echinoid spines were also found.

At the present state of the study, it is apparent that distinct biofacies are developed. The Cedar District microfaunas are irregularly developed and the Northumberland formations contain a microfauna of marine, uppermost Campanian foraminifera. There is so far no definite evidence of Maestrichtian deposition. Most of the microfauna is characteristic of the Pacific province.

Generic counts show that the microfauna is dominantly of restricted type; that is, the shales were deposited in shallow shelf seas near land, bordering on estuarine conditions. However, here and there, in a geographical and stratigraphic pattern not yet fully understood, true marine forms occur in fair abundance and these are of stratigraphic value.

It is intended to treat samples from the Comox Basin in the same way and an attempt will then be made to correlate with other areas. Detailed studies of particular genera and species will continue.

It is suggested that samples already produced for foraminifera should be retained for studies of pollen and spores by some suitable specialist.

Project 10-58- Solubility of Metallic Sulphides in Water at Elevated Temperatures and Pressures

Under direction of Dr. F.G. Smith, University of Toronto.

Preliminary data have been obtained on the solubility of zinc sulphide in H_2S saturated water solutions at elevated temperatures and pressures and on the solubility of lead sulphide in H_2S saturated water at 30° C. and atmospheric pressure. It is planned to continue the latter study at 100° C. during the academic

session of 1959-60 and equipment and supplies are on hand to carry this out. The solubility data obtained from these investigations will be useful ultimately in developing realistic theories of genesis of hydrothermal mineral deposits.

Project 11-58- Stratigraphic Correlations of Glacial Deposits between Lake Huron and the St. Lawrence Lowland

Under direction of Prof. A. Dreimanis.

Field work has included examinations of sections of multiple tills along the north and west shores of Lake Ontario and in several scattered areas between the northeast corner of Pennsylvania and the Adirondacks. Laboratory investigations have included heavy mineral and carbonate analyses of till matrix and preparation of pebble grade for pebble counts. Results of analyses of 40 samples from scattered locations suggest that the centre of glacial outflow was farther east or northeast during Early Wisconsin than during at least the first half of the Main Wisconsin.

Results of these investigations were presented in a paper[1] at the meetings of the Geological Society of America, St.

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[1] Early Wisconsin Tills of the Lake Erie, Lake Ontario and St. Lawrence Regions, Geological Society of America, Bull. Vol. 69, 1958, pp. 1,555-1,556 (abstract).

Louis, 1958.

Another paper entitled Early Wisconsin in the Eastern Great Lakes Region, North America arising from these studies was submitted for publication in the Dr. E. Krauss Jubilee volume, Akademie-Verlag, Berlin, 1959.

Project 12-58- Methods of Operations Research Applied to Prospecting

Under direction of Dr. R. J. Uffen, University of Western Ontario.

A paper[1] by R. M. Ellis and J. H. Blackwell was

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[1] Optimum Prospecting Plans in Mining Exploration, Geophysics Vol. XXIV, No. 2, p. 344, April 1959.

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published.

A second paper, by R. J. Uffen entitled The Application of the Methods of Operations Research to Prospecting was presented at the annual meetings of the American Institute of Mining and Metallurgical Engineers, February 1959. It is being prepared for publication.

Project 6-58- Trace Element Distribution in Rocks and Ores of the Bathurst District, N.B.

Under supervision of Dr. W.E. Hale, University of New Brunswick.

More than 200 samples, including plutonic, extrusive, and sedimentary rocks and sulphide ores, have been semi-quantitatively spectrographically analysed for trace elements. The same number of samples were also colourmetrically analysed for copper, lead and zinc. The silicate samples were analysed for Ga, Sr, Ba, Ti, Mn, Sn, Zr, Ni, Cr, V, and Ge; the sulphides for Ga, Ti, Mn, Sn, Zn, Ni, Cr, V, and Ge.

The results of the analyses are being studied. Patterns of distribution are being sought that may indicate genetic relationships among certain rock types and sulphides. These patterns are being considered in absolute terms and in terms of the areal relationship of rocks to known ore occurrences.

APPENDIX II

GEOLOGICAL SURVEY OF CANADA RESEARCH GRANTS TO CANADIAN UNIVERSITIES

1959-60

UNIVERSITY OF ALBERTA

1. **Problems in Nuclear Geochronology**

Applicant - R.E. Folinsbee — Amount $2,500.00

For the past three years Dr. Folinsbee has been studying the history of the Yellowknife Nucleus and of the Cordillera and related sedimentary rocks of the Western Canada basin using the potassium-argon, lead-alpha, and strontium-rubidium methods to date the ages of the rocks. He will continue this work with the objective of obtaining an absolute time scale from cosmic (circa 4.5 billion years) to historic times (5,000 years ago) and relating Cordilleran and other intrusives to this scale. Considerable progress was made in 1958-59 resulting in the publication of one paper and the presentation of four others. (See also p. 79).

2. **Heat Flow Measurements in Western Canada**

Applicant - G.D. Garland — Amount $1,150.00

The purpose of this project is to determine the outflow of heat from the earth's interior by measurements of the temperature gradient in abandoned oil wells and of the thermal conductivities of samples of the formations in which the gradients are measured. Knowledge of heat flow is necessary before any conclusion can be reached as to whether to earth is expanding or contracting and as to whether there are convection currents at moderate depths beneath the crust. It is also important to know if temperature measurements themselves can be used in the study of more local structure.

3. **Direct Numerical Interpretation of Resistivity Measurements**

Applicant - Keeva Vozoff — Amount $900.00

The geological interpretation of direct current resistivity measurements has relied mainly on the application of empirical rules-of-thumb or greatly over-simplified assumptions. Consequently, the resulting interpretations are seldom reliable. Dr. Vozoff has developed mathematically rigorous methods of analysis of two situations - horizontal layering, and for a body whose shape and resistivity distribution are completely arbitrary, enclosed in a uniform matrix. Work will be continued on the analysis of arbitrary shapes and the application of results to a variety of situations where geologic control exists.

UNIVERSITY OF BRITISH COLUMBIA

4. **Isotope Geology**

Applicant - J. A. Jacobs **Amount $2,000.00**

With funds from the National Research Council of Canada, a mass spectrometer of original design has been built for the precise isotopic analysis of lead. Construction has begun on a second mass spectrometer to be used with lighter elements. The first project which the present grant will support, will be investigation of the origin of sulphide ore deposits and the use of isotopic ratios of lead in minerals to determine the realtionships among different rock masses. During 1958-59, two manuscripts contributing to knowledge of sulphide deposits were completed and will be published shortly.

5. **Trace Element Content of Some Rocks in Western Canada**

Applicant - H. V. Warren **Amount $3,800.00**

This project involves the study of trace element relationships existing between soils and rocks. The investigation involves the development of special chemical techniques supplemented by spectroscopy. Preliminary results of one phase of this investigation suggest that, in the vicinity of mineralization, the readily extractable copper of plutonic rocks is from five to ten times greater than that from rocks unrelated to mineralization. This may provide a technique useful in exploration and prospecting. (See also p. 78).

CARLETON UNIVERSITY

6. **Submarine Geology of Selected Areas, St. Lawrence River System and Atlantic Shelf**

Applicants - John E. Riddell, K. Hooper and W. L. Young **Amount $2,500.00**

The Geological Department of Carleton University, with the cooperation of the Fisheries Research Board, is undertaking an investigation of the physical, chemical and palaeontological environments and characteristics of sedimentation in large bodies of fresh and salt waters, including distribution of modern and fossil foraminifera, distribution of heavy metals, minor structures in areas of turbidity current action, palaeomagnetic effects and age of the sediments. This grant will be used mainly for the construction of a special piston core apparatus at Carleton University for taking samples from the sea bottom.

DALHOUSIE UNIVERSITY

7. **Use of Pleochroic Halos for Age Measurement**

Applicant - G. C. Milligan **Amount $1,500.00**

It is possible that pleochroic halos in micas may be used to measure the ages of the micas because the development of the halos is caused by alpha-radiation from radioactive nucleii. If the present radioactivity of the nucleus and the number of alpha particles previously emitted can be compared (by density of the halo) the relative ages of two halos can be obtained without using the elaborate equipment usually required for radioactive age work. It is proposed to investigate the method to see if it is feasible to obtain radioactive ages in this way over a useful span of geological time.

8. Chemistry of Inland Seas

Applicant - W. R. Trost — Amount $2,500.00

Sediments and sedimentary processes will be studied in a laboratory model of an "inland sea". Simulated leaching processes will bring rocks into solution and disgorge the solution laden "river" into the inland sea with sedimentation occurring at places and in forms dependent on the chemical equilibria involved and flow rates and evaporation rates in the sea. The ultimate object is to obtain through the application of chemical principles, data on the composition, location and distribution of deposits of the elements.

ECOLE POLYTECHNIQUE

9. Mineralogy and Petrography of the Oka Alkaline Intrusions and Study of the Amphibole Minerals

Applicant - Guy Perrault — Amount $500.00

The alkaline rocks of the Oka district of Quebec are of particular interest because of deposits of columbium associated with them. This project includes a detailed study of the mineralogy and petrography of these intrusions, including study of the common rock-forming minerals and the columbium minerals. A study of the amphibole minerals, including precise determinations of their properties, may also be undertaken. (See also p. 79).

UNIVERSITY OF MANITOBA

10. Interpretation of Paragenesis in Ore Deposits

Applicant - H. D. B. Wilson — Amount $1,250.00

Recent work on the composition of Canadian sulphide ore deposits by Dr. Wilson has led him to question the assumption that paragenetic relationships in ore minerals indicate an order of deposition of the minerals from ore solutions. He proposes to study the mineralogical and textural changes that take place during heating and cooling of ore specimens with controlled pressures and temperatures ranging from room temperature to 1,100°C. Structural changes such as recrystallization, grain growth, precipitation, replacement and phase transformation in both ore and gangue will be studied visually at the temperature at which they occur.

McGILL UNIVERSITY

11. Silicate and Sulphide Phase Relationships

Applicants - J.E. Gill, E.H. Krauck and V.A. Saull — Amount $4,500.00

This project was initiated in 1954. It involves experiments on the behaviour of silicates and sulphides at high pressures and temperatures to find out more about the formation of ores and metamorphism of rocks. Current and recently completed projects include experiments in the relative ability of different solutions to transport copper and iron sulphides, experiments on the behaviour of copper sulphides at temperatures up to 800°C., the mobility of sulphides in sulphur vapour, the growth of sulphides in black shales, the melting of rocks, the differential thermal analysis of sulphides, and on the use of the chromographic print method of examining metallic minerals. Future work is planned involving experiments on the growth of sulphides from simulated sedimentary materials, the transport of metals as sulphates, and on the volatilization of metals and metallic minerals. (See also p.72).

12. Enthalpy Changes in Metamorphic Reactions and their Geologic Significance

Applicant - V.A. Saull — Amount $2,000.00

This project, which was initiated in 1953, involves fundamental research on the changes (metamorphism) that rocks undergo when deeply buried in the earth's crust.

Apparatus has been constructed that will measure the heat developed in any solution process that can be made to occur in a closed system. The first general calorimeter study of surface and strain energy in minerals has been completed and has shown that in metamorphism, heat released in mineral recrystallization can result in appreciable temperature rises. Much work remains, but calcite and quartz, the two most important minerals in natural recrystallization, have been studied in detail. In addition, work is nearing completion on a workable calorimeter for mineral studies more nearly accurate than the best present calorimeter by a factor of ten. (See also p.71).

13. Thermal History of Monteregian Intrusives

Applicant - J.S. Stevenson — Amount $750.00

The objective is to re-assess the thermal history of the intrusions forming the eight Monteregian hills near Montreal by detailed study of the feldspars in them. In this study use will be made of universal stage techniques; plagioclase twins will be identified and their incidence determined; and migration curves and Kohler angles will be used to determine the thermal state of the plagioclase.

McMASTER UNIVERSITY

14. Greywackes of the Northern Appalachians

Applicant - G. V. Middleton Amount $1,500.00

The objective is to learn more about the petrography and geochemistry of this type of sedimentary rock of which relatively few petrographic and still fewer geochemical studies have been made. The geochemical work will include study of the trace elements and selected major elements using spectrographic techniques. (See also p. 80).

UNIVERSITY OF NEW BRUNSWICK

15. Geochemical Study of St. Stephen Gabbro

Applicant - W. E. Hale Amount $1,000.00

A study will be made of the distribution of elements in the several differentiates of the gabbro which range in composition from peridotite to diorite. The work will involve chemical analyses for the major elements and spectrographic analyses for the minor elements.

QUEEN'S UNIVERSITY

16. Structural Investigation of Canoe Lake Fault and Related Structures

Applicant - J. W. Ambrose Amount $400.00

The objective is to determine the tectonic significance of the fault, and more significantly, the inter-relations and origins of associated structures in order to learn more of the mechanics of the system and thus gain a better understanding of faulting in general. Field studies will be followed by statistical analyses of the data, by microscopic examination of oriented specimens, and by attempts to duplicate the structures observed by dynamically similar model experiments.

17. Publication of Canadian Mineralogist

Applicant - L. G. Berry, Editor Amount $1,800.00

The Mineralogical Association of Canada was organized in 1954 and publishes the Canadian Mineralogist annually (the first number was published in September, 1957). Mineralogical studies are of interest to a relatively small group of readers and this makes it difficult to publish such a periodical without financial support. This will be on a diminishing scale as circulation, particularly outside Canada, is built up. Membership in the Association has increased from less than 100 when organized to almost 500 members. (See also p. 79).

18. X-Ray Spectrographic Analyses of Minerals and Rocks

Applicant - L.G. Berry Amount $3,000.00

The objective is to establish methods of quantitative analytical determination of elements in minerals and geological materials by X-ray fluorescent analysis. Problems studied in the review year include determination of Fe, Cd, Pb in sphalerites and determination of the cell edge of sphalerite by diffractometry to find out the iron content and probable temperature of formation of sphalerite; preparation and checking of final working curves for determination of Se in Canadian mines; setting up of techniques and curves for analysis of Fe, Zn, Pb in mixed sulphides from the Sullivan mine, B.C.; and determination of iron and chromium in chromites, of Sr, Rb in amphibolites from Uchi Lake, and of Ca and Sr in limestones of the Kingston district. Much of this work is complementary to studies under the supervision of Dr. Hawley on Spectrographic X-ray and Geochemical Research on Canadian Rocks, Minerals and Ores (see below; also p. 76).

19. Spectrographic, X-ray, and Geochemical Research on Canadian Rocks, Minerals and Ores

Applicant - Dr. J.E. Hawley Amount $3,000.00

This project, which has been supported for the past six years, embraces a wide range of studies. During the review year research was continued on studies of the granitic rocks of the Grenville Province, southeastern Ontario and on several other projects involving the geochemistry of rocks and ores. Included in the projects proposed for 1959-60 are (1) continued geochemical studies of the lead-zinc ores of the Sullivan mine, B.C. (2) other studies of lead-zinc ores from British Columbia and Eastern Canada (3) trace element studies of copper and copper-nickel sulphide ores in granitic intrusions and adjacent older rocks to determine whether such ores in granitic rocks have been modified on intrusion by, and inclusion within, granitic rocks (4) continued studies of ultrabasic rock in Quebec and British Columbia and (5) investigation of cobalt-nickel ratios in sulphides of three Sudbury mines to assess variations and their significance on type of ore fluid and origin. (See also p.74).

UNIVERSITY OF TORONTO

20. Partition of Rare Earth Elements

Applicant - F.G. Smith Amount $750.00

This is a study of the partition of rare earth elements between silicate liquid and water in the system granite-water and its application to the theory of formation of pegmatites. The method to be used will be to establish multi-phase equilibria at high pressure and temperatures followed by chilling and analysis of the phases. Analysis of critical minerals will be used to test the derived theory.

21. Geological Age Determinations

Applicant - J. T. Wilson — Amount $4,800.00

This project has been supported for the past eight years. In the review year the determination of geological ages by the isotopic lead method was extended to include samples in which only microgram amounts of lead are available for analysis. An improved method of making potassium-argon age determinations was developed making possible simultaneous potassium and argon analyses on the same two- three-gram sample of potassium mineral where before two samples were necessary. A program of rubidium strontium dating was started to extend the scope of age studies and cross-check dates obtained by the lead isotope and potassium argon methods. (See also p. 71).

UNIVERSITY OF SASKATCHEWAN

22. Palynological Investigations in Western Canada

Applicants - F. H. Edmunds, W. O. Kupsch and W. G. E. Caldwell — Amount $2,000.00

The purpose is to carry out pollen and spore analyses and thus obtain a greater knowledge of fossil plants in the sedimentary rocks of Western Canada. At present no palaeobotanical studies of this kind are being made in Western Canada. Such studies will be a great help in effecting and strengthening stratal correlations.

23. Genesis of Sulphide Ores and Studies of Metamorphism

Applicants - A. R. Byers and J. R. Smith — Amount $2,500.00

The objective is to investigate the genesis of barren and economic sulphide deposits in northern Saskatchewan. The work will include study of temperatures of formation of the deposits by determination of the Fe-Zn ratios in sphalerite and Fe_2S ratios in pyrrhotite, and investigation of trace element content of the sulphides and associated wall-rocks. Another and allied objective is to investigate the mineral assemblages, chemical compositions of minerals and rocks and metamorphic processes in the Amisk Lake area.

UNIVERSITY OF WESTERN ONTARIO

24. Stratigraphic Correlation of Glacial Deposits Between Lake Huron and the St. Lawrence Lowland

Applicant - A. Dreimanis — Amount $300.00

Previous studies by Prof. Dreimanis in areas near Lake Erie and Toronto and in the St. Lawrence Lowland indicate certain stratigraphic correlations may be made, but further information is required between studied areas. The work, which was initiated in 1958, will include

lithologic investigation of tills and studies of leaching of soils. Two papers have been submitted for publication and a third is in preparation. (See also p.83).

25. Detrital Minerals in Palaeozoic and Precambrian Rocks of Ontario and part of Quebec

Applicant - G.H. Reavely Amount $300.00

An investigation of the detrital minerals in glacial deposits in Ontario and Quebec has been underway for some time at the University of Western Ontario in an attempt to derive glacial flow directions. Much more could be accomplished if more were known of the refractory clastics of the Palaeozoic bedrock and the detrital forming elements of the contiguous Precambrian rocks. Also, more petrographic information is needed on the clastics of the Palaeozoic rocks so that more knowledge of their source and depositional environment will be available.

26. Measurement of Induced and Remanent Magnetism of Rocks in Situ

Applicant - R.J. Uffen Amount $1,000.00

The direction of the remanent magnetization of rocks may be quite different from that caused by the induced magnetization in the present earth's magnetic field; in some cases it is even reversed. One result is that extensive and rich magnetic mineral deposits may escape detection by conventional magnetic surveys if the two magnetizations cancel one another. The response of an alternating magnetic field detection system is not effected by the remanent magnetism, but only by the induced magnetism and the electrical conductivity of the rock. It is proposed to investigate the possibility of measuring the induced and remanent magnetization of rocks by the combined use of electromagnetic, magnetic and resistivity methods of exploration.

27. Method of Operations Research Applied to Prospecting

Applicant - R.J. Uffen Amount $1,150.00

By using the method of Operations Research which was developed during World War II, Slichter was able to give a method of determining the optimum drilling program, on a statistical basis. By substituting various values for the variables involved in drilling programs such as target size expected or sought, drilling cost, ore value, etc., it will be possible to examine their effects statistically on the "completeness of search", the "discovery hole economy" and the "prospecting profit ratio". The method can be programmed for solution with a high speed computor, thus permitting rapid evaluation or re-evaluation when new data become available. During 1959-60, it is hoped to apply the Slichter theory to the problem of drilling for petroleum-bearing reefs in southwestern Ontario; extend the theory to

the problem of optimum flight line spacing in airborne geophysical surveying; consider the solution of problems suitable for the computor that are likely to arise out of the proposed underground nuclear detonations; and continue with theoretical studies of the quantitative interpretation of electromagnetic surveys. (See also p. 83).

28. Scale Model Experiments of Electro-Magnetic Prospecting

Applicant - R. J. Uffen Amount $400.00

Several airborne electromagnetic prospecting devices have been developed in Canada and are in use by the larger mining companies. Interpretation of the field results is difficult and largely empirical.

This project, initiated in 1954, will continue scale model experiments of the electromagnetic response of typical geological structures as an aid to the interpretation of field surveys. Two papers entitled Electro-magnetic Modelling and Experiments with Scale Model Electro-Magnetic Systems were presented in 1958 and 1959 and a third on Quantitative Interpretation of Airborne Electro-Magnetic Surveys is in preparation. (See also p. 76).

29. Microfauna of Kettle Point and Port Lambton Shales

Applicant - C.G. Winder Amount $250.00

The age of these shales is in doubt -- they may be Devonian or Mississippian. It is hoped that the differentiation, description and correlation of the microfauna, particularly the conodonts, will aid in determining their correct stratigraphic position. (See also p. 81).

APPENDIX III

A BRIEF

SUBMITTED BY

THE ROYAL SOCIETY OF CANADA

SECTION IV

AND

THE GEOLOGICAL ASSOCIATION OF CANADA

TO THE

RIGHT HONOURABLE THE PRIME MINISTER

AND CABINET

WITH RESPECT TO

THE GEOLOGICAL SURVEY OF CANADA

October 21, 1958

SPECIAL COMMITTEE OF THE ROYAL SOCIETY OF CANADA

SECTION IV

Chairman . . . H.C. Gunning, University of British Columbia.
D.R. Derry, Rio Tinto Mining Company of Canada.
H.J. Fraser, Falconbridge Nickel Mines.
J.E. Gill, McGill University.
A.W. Jolliffe, Queen's University.
J.B. Mawdsley, University of Saskatchewan.
J.C. Sproule, Consultant, Calgary.

SPECIAL COMMITTEE OF THE GEOLOGICAL ASSOCIATION OF CANADA

Chairman . . . D.R. Derry, Tio Tinto Mining Company of Canada.
J.E. Gill, McGill University.
J.B. Mawdsley, University of Saskatchewan.
W.A. Roliff, Imperial Oil Company.

INTRODUCTION

The Report of the Royal Commission of Canada's Economic Prospects states:

" ... the excellent work of the Geological Survey should be speeded up through an expanded program ... "

A preliminary canvass of the major mining and petroleum companies brought out strong support for an expanded program of the Geological Survey.

Committees of the Royal Society of Canada, Section IV, and the Geological Association of Canada, after consultation with many of the scientific personnel of their own and associated groups in Canada, join is submitting the attached analysis and recommendations.

REASONS WHY THE GEOLOGICAL SURVEY SHOULD BE EXPANDED NOW

(1) THE DEVELOPMENT OF CANADA'S ARCTIC ISLANDS IS OF IMPORTANCE FROM THE STANDPOINTS OF NATIONAL SOVEREIGNTY AS WELL AS FOR MILITARY STRATEGY. GEOLOGICAL INVESTIGATION IS VITAL TO INTELLIGENT DEVELOPMENT OF THESE AREAS.

Current comment in the U.S., shows a misunderstanding of the national status of the Canadian Arctic. Concern over the much more advanced development of similar latitudes in Russia has prompted suggestions that disregard the fact of Canada's sovereignty over the Arctic Islands.

Only vigorous continuation and expansion of the program to lay a geographical, geological and geophysical foundation for further plans can ensure Canada's prestige and future independence of action.

(2) OPENING OF NORTHERN CANADA REQUIRES NEW TRANSPORTATION FACILITIES. EFFECTIVE PLANNING OF SUCH TRANSPORTATION DEPENDS ON GEOLOGICAL KNOWLEDGE OF THE AREAS TO BE SERVED.

As one goes North those resources dependent on climate become progressively of less importance and, therefore, the mineral resources become relatively more important, especially in potentially favourable areas of Precambrian rocks.

Reconnaissance geological mapping will indicate most likely areas for production of metals, industrial minerals and petroleum, as well as the broad controls of soil character.

(3) GEOLOGICAL STUDIES IN CANADA ARE NOT KEEPING PACE WITH THE GROWTH OF THE MINERAL AND PETROLEUM INDUSTRIES.

Studies by the Geological Survey are the foundation on which reserves of metals and non-metallic minerals and petroleum products are discovered and developed by industry in succeeding decades. At the moment there are substantial reserves of most such products, but the foundation of geological knowledge should be laid now for resources that will be needed some twenty years hence.

In recent years the lag in expansion of Government Geological Service as compared with the accelerated pace of industrial development has been very marked. (See Exhibit B).

(4) IN ADDITION TO THE ACCUMULATION OF UNPUBLISHED MATERIAL IN THE SURVEY, THERE IS A VAST AMOUNT OF GEOLOGICAL AND GEOPHYSICAL INFORMATION, BEING RAPIDLY AMASSED BY INDUSTRY AND AVAILABLE ON A VOLUNTARY BASIS TO GEOLOGICAL SURVEYS, WHICH CANNOT BE FULLY COORDINATED OWING TO LACK OF TECHNICAL STAFF AND COMPLEMENTARY SERVICES.

Only a large increase in the Cartography and Laboratory Departments of the Survey will permit the assimilation, publication and general use of this valuable information.

(5) GEOLOGISTS WITH THE QUALIFICATIONS DESIRABLE FOR ANY EXPANSION OF THE GEOLOGICAL SURVEY ARE NOW AVAILABLE FOR THE FIRST TIME IN RECENT YEARS.

This is the time to recruit them. In a few years time they may again be in short supply due to the demands of industry.

THE CURRENT SITUATION

(1) THE GEOLOGICAL SURVEY OF CANADA HAS A RECORD OF WHICH WE SHOULD BE PROUD, IN EXPLORING, MAPPING AND ELUCIDATING THE GEOLOGY OF OUR VAST COUNTRY.

Its work has led directly to the finding and development of such great mining camps as Blind River, Yellowknife, Labrador-Quebec Iron, the Gas Fields of the Foothills, and many others of apparently lesser importance.

(2) PRIOR TO 1952 ABOUT ONE MILLION SQUARE MILES WERE COVERED BY GEOLOGICAL RECONNAISSANCE MAPPING. SINCE 1952 THE USE OF HELICOPTERS IN SOME PARTS HAS PERMITTED A FASTER RATE AND INITIAL MAPPING HAS BEEN COMPLETED ON AN ADDITIONAL 500,000 SQUARE MILES. AT THE PRESENT RATE OF PROGRESS, RECONNAISSANCE GEOLOGICAL MAPPING OF CANADA (ON A SCALE OF 1" TO 4 MILES, OR IN CERTAIN CASES 1" TO 8 MILES) WOULD BE COMPLETED BY 1980. (SEE EXHIBIT A).

For reasons mentioned above this does not match the urgency of the situation. We understand that with sufficient additions to the various departments of the Geological Survey, as outlined in our recommendations it would be feasible to complete the preliminary mapping by 1970.

Reconnaissance mapping is only the first stage necessary for the proper understanding of the geology and potential mineral resources in Canada. As in the more fully developed countries, e.g. the United Kingdom, the need for more intensive geological studies will continue almost indefinitely.

(3) FROM 1927 TO 1957, HOWEVER, THE NUMBER OF FIELD PARTIES ACTIVE IN THE SUMMER INCREASED ONLY FROM 50 to 69. BY WAY OF COMPARISON, DURING THE SAME PERIOD THE VALUE OF CANADA'S MINERAL PRODUCTION INCREASED FROM $247 MILLION TO $2,133 MILLION. (SEE EXHIBIT B).

(4) THE BUDGET FOR THE GEOLOGICAL SURVEY FOR 1959, WAS $2,520,000 OR SLIGHTLY OVER 2 1/2% OF THE REVENUE TO THE FEDERAL GOVERNMENT BY TAXES FROM MINING COMPANIES, QUARRY OPERATIONS, AND OIL AND GAS PRODUCING COMPANIES ($90,000,000).

It is approximately 1% of the combined revenue from Federal taxes paid by the above companies plus secondary industries dependent on these products.

(5) THE PRACTICE OF ALLOCATING FUNDS ONLY FOR SPECIFIC PROJECTS GIVES THE SENIOR OFFICERS OF THE GEOLOGICAL SURVEY LITTLE ROOM FOR CHANGING PLANS AND MEETING EMERGENCIES AS THEY ARISE.

In view of the rapid and frequently unexpected developments in the mineral field, we strongly urge that some latitude be given within the framework of the allocated budget to meet such emergencies.

(6) WHILE AN INCREASED TEMPO IN THE RATE OF GEOLOGICAL MAPPING IS NOT POSSIBLE WITHOUT ADDITIONS TO THE GEOLOGICAL STAFF, THERE IS RELATIVELY STILL GREATER EXPANSION REQUIRED IN THE ANCILLARY SERVICES OF THE SURVEY.

For every qualified geologist, geophysicist or geochemist, the Geological Survey requires from two to two and a half persons in the form of chemists, laboratory technicians, secretarial staff and especially draftsmen and cartographers.

In August, 1958, there were 21 maps, of which the material had been completed in manuscript form awaiting the attention of the cartographers, in addition to 35 maps and sketch maps actually in the process of production.

RECOMMENDATIONS

(1) AFTER STUDYING THE PRESENT DISTRIBUTION OF THE PERSONNEL IN THE GEOLOGICAL SURVEY, WE RESPECTFULLY RECOMMEND THE FOLLOWING INCREASES IN ESTABLISHMENT OF THE VARIOUS DEPARTMENTS:-

Department	Present Number	Recommended Increase	Proposed Total on Recommended Program
Geologist	100	60	160
Geophysicists	9	5	14
Geochemists	9	6	15
Laboratory Staff	55	45	100
Cartography Section	38	37	75
Administration and Clerical	102	As required in keeping with above.	

(2) WE ALSO RECOMMEND A LESS RIGID APPROACH IN THE ALLOCATION OF FUNDS TO THE DIRECTOR OF THE GEOLOGICAL SURVEY TO GIVE A CONTINGENCY FUND REPRESENTING 10% TO 25% OF THE BUDGET FOR USE IN MEETING EMERGENCY PROGRAMS DURING EACH FISCAL YEAR.

(3) IN THE SUPPOSITION THAT OUR RECOMMENDATION TO INCREASE THE STRENGTH OF THE GEOLOGICAL SURVEY WILL BE ACTED UPON, WE ALSO WISH TO STRESS THE NEED FOR CLOSE COOPERATION BETWEEN FEDERAL, PROVINCIAL AND INDUSTRIAL AGENCIES IN ALL FUTURE LARGE SCALE PLANNING OF GEOLOGICAL SERVICES.

CURRENT RESEARCH IN THE GEOLOGICAL SCIENCES IN CANADA, JUNE, 1958 - MAY, 1959

Compiled by J. F. Henderson

CONTENTS

INTRODUCTION

The lists of research projects in the bibliography have been obtained from the universities, federal and provincial departments of mines, and other non-industrial institutions carrying on research in geological sciences in Canada; it does not include research by mining and oil companies. The survey was made from December 1958 to April 1959 and the bibliography records research in progress for about the period June 1958 to May 1959.

The bibliography is useful in indicating lines of geological research receiving the greatest attention, and by inference, those being neglected; and in enabling research workers to see who are working in similar fields and on similar problems. It also serves as a record of the large number of research projects undertaken as graduate student theses in our universities, many of which are available only in manuscript form in university libraries.

Success in assembling project titles for a bibliography such as this depends on the response of institutions and individual research workers. Acknowledgement is made in particular to those who assembled and forwarded data on research projects in institutions under their direction. However, in spite of general excellent cooperation, many projects on which no information was received have not been recorded. So that succeeding compilations may be more complete, any reader doing research projects or knowing of projects that have been omitted, is requested to send information of them to the Secretary, National Advisory Committee on Research in the Geological Sciences, 601 Booth Street, Ottawa.

Use of the Bibliography

In the bibliography projects are grouped under main headings that cover the different branches of the geological sciences. The reader can thus find out readily the research in progress in any field in which he is interested. Many projects that seem to fall equally well under more than one heading will be found repeated under those headings. An author index lists after each author the numbers of projects, as listed in the bibliography, on which he is currently engaged. Thus by reference to the author index, the fields of research and projects of any worker can be found readily.

INTRODUCTION

Use of the public library

AREAL GEOLOGY

Alberta

1. Mountjoy, E. W., Geol. Surv., Canada:
   Miette Map-area, 1 inch to 1 mile, 1957-58;
   Ph.D. thesis, Univ. of Toronto.

2. Godfrey, John D., Research Council of Alberta:
   Mapping and Petrologic Studies of the Precambrian Shield of Northeastern Alberta, 1956-
   See "Mineralization in the Andrew and Johnson Lakes area, Northeastern Alberta", Res. Coun. of Alberta, Prel. Rept. 58-4.

British Columbia

3. Bostock, H., Geol. Surv., Canada (part-time):
   Squamish Map-area, 1 inch to 4 miles, 1958-60.

4. Brown, A., Sutherland, B.C. Dept. of Mines:
   Moresby Island, Queen Charlotte Island, 1958-60.
   Shore line and land traverses compiled on a 1: 50,000 base have yielded information on six accumulations of volcanic rocks of two ages separated by a layer of sedimentary rocks, and by a variety of plutonic bodies including granitic and monzonitic masses and hornblende-diorite in batholitic proportions.

5. Fyles, J.G., Geol. Surv., Canada:
   East Coast of Vancouver Island, 1 inch to 4 miles, 1956-58.
   Mapping of surficial formations with special attention to groundwater supply.
   Reconnaissance Mapping of Surficial Geology of Islands and East Shore of Strait of Georgia, B.C., 1958.

6. Fyles, J.T., B.C. Dept. of Mines:
   Study of the Columbia River valley from Bluewater Creek near Donald to Nagle Creek near Mica Creek, 1958.
   The study was made for the Water Rights Branch of the British Columbia Department of Lands.

7. Fyles J.T., and Eastwood, G.E.P., B.C. Dept. of Mines:
   Study of Lardeau Series from Trout Lake to the Southwestern Margin, British Columbia, 1957-58.
   Work done in 1958 completes the study of a section across the Lardeau Series from the northeastern margin at the head of Gainer Creek along Gainer Creek, Lardeau River and up Trout Creek to the southwestern margin of the Lardeau Series.

8. Gabrielse, H., Geol. Surv. Canada:
Kechika and Rabbitt River Map-areas, 1 inch to 4 miles, 1957-60.

9. Hughes, J. E., B. C. Dept. Mines:
Stratigraphy and Structural Studies of Post-Palaeozoic Rocks along the John Hart Highway, 1954-58.
The Geology of the Pine River Area, B. C., 1956-59; Ph. D. Thesis, McGill Univ.

10. Leech, G. B., Geol. Surv., Canada:
Fernie Map-area, B.C., 1 inch to 4 miles, 1956-60.

11. Little, H. W., Geol. Surv. Canada:
Kettle River map-area, 1 inch to 4 miles, 1958.
See Geol. Surv. Canada map 6-1957.

12. McTaggart, K. C., and Thompson, R. M., Univ. of British Columbia.
Geology of the Southeast Corner of the Hope Map-Area, 1957-60.

13. McTaggart, K.C., and Trettin, H. T., B.C. Dept. of Mines (part-time), Univ. of British Columbia:
Detailed Geological Study of Strip Along Fraser River Extending from Lillooet, Upstream to Big Bar, 1957-58.
Field work was carried but throughout the 1957-58 field season by Mr. Trettin with general guidance from Professor McTaggart. This work was done for the British Columbia Department of Mines and is supported by the Water Rights Branch of the Department of Lands and Forests for the Fraser River Board.

14. Pelletier, B.R., and Brady, W. D., Geol. Surv. Canada:
Tetsa River Map-area, 1 inch to 1 mile, 1958.

15. Price, R. A. Geol. Surv. Canada:
Fernie (east half) Map-area B. C. and Alberta, 1 inch to 4 miles, 1958-60.

16. Read, Peter B., Univ. of British Columbia:
Geology of the Area Around Hope, British Columbia, 1958-59.

17. Souther, J. G., Geol. Surv. Canada;
Sumdum (Chutine) and Tulsequah, B. C., 1 inch to 4 miles, 1958-60.

18. Tipper, H. W., Geol. Surv. Canada:
Quesnel Map-area, 1 inch to 4 miles, 1957-60.

19. Williams, Michael G., Univ. of British Columbia:
Geology of the Leech River Series, Southern Vancouver Island, 1958-59; M.A.Sc. thesis.

Manitoba

20. Barry, G. S., Manitoba Mines Branch:
Geology of the Oxford Lake-Knee Lake Area, 1958-59.

21. Barry, G.S. and Allen, C.N., Manitoba Dept. Mines:
Geology of Knee Lake Area, 1958-
This is part of a larger scale geological mapping project covering the Oxford-Knee Lake Area.

22. Godard, John D., Manitoba Mines Branch:
Geology of the Island Lake Area, 2 inches to 1 mile, 1958-60.

23. Kretz, R., Geol. Surv., Canada:
Northern Indian Lake Map-area, 1 inch to 4 miles, 1958.

24. Milligan, G.C., Manitoba Mines Branch (part-time), Dalhousie Univ.
Geology and Mineral Deposits, Lynn Lake Area, 1 inch to 1 mile, 1954-59.
Comprehensive study of the geology, structure, metamorphism and mineral occurrences of the entire Lynn Lake district, based on work of previous geologists and several summers field work by the author.

25. Moore, J.M., and Emslie, R.S., Manitoba Mines Branch (part-time):
Lynn Lake-Frances Lake Area, 4 inches to 1 mile, 1958-60.
A detailed study of a small area around and south of Lynn Lake with special emphasis on the "gabbro" intrusions which form the host rocks for the nickel deposits. Mr. Emslie will make a laboratory and field study of the gabbro as part of his Ph.D. thesis at Northwestern University.

26. Patterson, John M., Manitoba Mines Branch (part-time), Univ. of Manitoba:
Geology of Moak Lake-Burntwood River Area, Man., 1 inch to 1 mile, 1958-60.
Supplementing the field and normal laboratory studies will be a detailed study of metamorphism, the basic intrusions, and nickel mineralization with special emphasis on genesis. These detailed studies are being carried out by J.M. Patterson (Ph.D. thesis) and J.A. McDonald (M.Sc. thesis) at the University of Manitoba.

27. Quinn, H. A., Geol. Surv., Canada:
Kettle Rapids Map-area, 1 inch to 4 miles, 1958.

28. Williams, Harold, Geol. Surv., Canada (part-time);
Detailed Mapping of the Chisel Lake Map-area, 1958-59; Ph.D. thesis.

New Brunswick

29. Anderson, F. D., Geol. Surv., Canada:
Big Bald Mountain Map-area, 1 inch to 1 mile, 1956-58.
See Geological Survey Canada Map-1957.

30. Anderson, F.D., Greenshields, R.A., MacGregor, I.D., Geol. Surv., Canada:
Netisiquit Lakes, Riley Brook, and Serpentine Lake Map-areas, 1 inch to 1 mile 1958-59.

31. Johnston, J. M., Geol. Surv., Canada:
St. Leonard Map-area, 1 inch to 4 miles, 1958.

32. Kindle, E. D., Geol. Surv., Canada:
Waterford and Salmon River Map-areas, 1 inch to 1 mile, 1957-58.

33. Lee, H. A., Geol. Surv., Canada:
St. John River Valley, Edmundston to Fredericton, Standard 1 inch to 1 mile mapping of surficial formations.

34. Poole, W. H., Geol. Surv., Canada:
Napadogan Map-area, 1 inch to 1 mile, 1957-58.
See Geol. Surv., Canada Map 11-58.

Newfoundland and Labrador

35. Henderson, E. P., Geol. Surv., Canada:
Surficial Formations of Conception Bay Map-area, Newfoundland, 1 inch to 4 miles, 1956-58.

36. Jackson, Garth D., McGill Univ.:
Geology of an Area West of Wabush Lake, Labrador, 1955-59; Ph. D. Thesis.

37. Baird, D.M., Geol. Surv., Canada (part-time), Univ. of Ottawa:
Deer Lake Map-area, Newfoundland, 1 inch to 4 miles, 1958.

38. Mann, E. L., McGill Univ.:
Geology of the Seal Lake Area, Central Labrador, 1956-59; Ph. D. Thesis.

39. Morrison, D. R., McGill Univ.
Geology of a Portion of Central Labrador, Including Some Uranium Deposits, 1957-59; Ph. D. Thesis.

40. Neale, E. R. W., Geol. Surv., Canada:
Baie Verte Map-area, Newfoundland, 1 inch to 1 mile 1957-58.
See Geol. Surv. Canada, Map 10-1958.

41. Riley, G. C., Geol. Surv., Canada:
Burgeo-Ramea Map-area, Newfoundland, 1957-58, 1 inch to 1 mile and 1 inch to 4 miles.

Northwest Territories

42. Blackadar, R. G., Geol. Surv., Canada:
Hobart Island and White Bear Map-area, District of Franklin, 1 inch to 4 miles, 1958-59.

43. Christie, R.L., Geol. Surv., Canada:
Hazen Lake, Northern Ellesmere Island, 1 inch to 8 miles, 1957-58.

44. Donaldson, J. A., Geol. Surv., Canada (part-time):
Marion Lake Map-area, 1 inch to 1 mile, 1957-58.

45. Fraser, J. A., Geol. Surv., Canada:
Fort Enterprise Map-area, 1 inch to 4 miles, 1957-58.
See Geol. Surv. Map 16-58.
Operation Copper Mine, Mackenzie District, 1 inch to 8 miles, using helicopters, 1958-59.

46. Jackson, Garth D., Geol. Surv., Canada:
Belcher Islands, Franklin District, 1 inch to 4 miles, 1958-59.

47. Lawrence, R.D., Geol. Surv., Canada (part-time):
Rodrigues Lake Map-area (east half) Mackenzie district, 1 inch to 1 mile, 1958.

48. Ross, J.V., Geol. Surv., Canada (part time), Univ. of B.C.:
Mesa Lake Map-area (west half) Mackenzie district, N.W.T., 1 inch to 1 mile, 1958.

49. Taylor, F.C., Geol. Surv., Canada:
Southeast Mackenzie District., N.W.T., 1 inch to 4 miles, 1958.

50. Thorsteinsson, R., and Tozer, E.T., Geol. Surv., Canada:
Mellville, Rock, Borden and MacKenzie King Islands, District of Franklin, 1958.
Reconnaissance mapping plus stratigraphic-palaeontological studies.

Nova Scotia

51. Collins, G.A., Geol. Surv., Canada:
Arichat Map-area, 1 inch to 1 mile, 1958.

52. Kelley, D.G., Geol. Surv., Canada:
St. Ann's Map-area, 1 inch to 1 mile, 1958-59.

53. Smitheringale, W.G., Geol. Surv., Canada (part-time):
Nictaux and Torbrook Map-areas, 1 inch to 1 mile, 1956-58.
Clementsport Map-area, 1 inch to 1 mile, 1958-59.

54. Stevenson, I.M., Geol. Surv., Canada:
Chedabucto Bay Map-area, 1 inch to 1 mile 1957-58.

Ontario

55. Chown, E. H., Geol. Surv., Canada (part-time):
Carroll Lake Map-area (East Half), 1 inch to 4 miles, 1958.

56. Ferguson, S.A., Ontario Dept. Mines:
Tisdale Township, District of Cochrane, 1 inch to 1,000 feet, 1956-58

57. Frarey, M.J., Geol. Surv., Canada:
Huronian Rocks North of Lake Huron in Echo River Map-area, 1 inch to 1 mile, 1956-58.
Geological mapping with special emphasis on the Huronian rocks.

58. Gadd, N.R., Geol. Surv., Canada:
Surficial Formations of Ottawa Map-area, Ontario and Quebec, 1 inch to 1 mile, 1956-58.

59. Ginn, R. M., Ontario Dept. Mines (part-time):
Nairn and Lorne Townships, District of Sudbury, 1 inch to 1/2 mile, 1958.

60. Kirwan, L., Geol. Surv., Canada (part-time):
Deer Lake Map-are, (East Half), 1 inch to 4 miles, 1958.

61. Laakso, R. K., Ontario Dept. Mines (part-time):
Lake Township, Hastings Co, Ont., 1 inch to 1/2 mile, 1958-59.

62. McMurchy, R.C., Ontario Dept. Mines (part-time):
Fenton, Slack, Seaton and Griffin townships, District of Cochrane, 1 inch to 1/2 mile, 1958.

63. Mirynech, E., Geol. Surv., Canada:
Surficial Geology of Trenton and Presqu'ile Map-areas, Ontario, 1 inch to 1 mile, 1958-59.

64. Phemister, T. C., Ontario Dept. Mines (part-time):
Aberdeen Univ.:
Neelon and Dill Townships, District of Sudbury, 1 inch to 1/2 mile, 1956-59.

65. Pye, E. G., Ontario Dept. Mines:
Georgia Lake-Cosgrove Lake area, District of Thunder Bay,
1 inch to 1 mile, 1956-59.

66. Robertson, James A., Ontario Dept. Mines (part-time)
Queen's Univ.:
Geology of a Part of the Blind River Uranium Area, 1 inch to 1320 ft., 1957-59; M.Sc. Thesis.
In collaboration with the Ontario Department of Mines.

67. Satterly, J., Ontario Dept. Mines:
Melgund, Ravell and Hyndman townships, District of Kenora, 1 inch to 1 mile, 1958.

68. Shaw, D. M., Ontario Dept. Mines (part-time):
McMaster Univ.
Chandos Township, Peterboro County, 1 inch to 1/2 mile, 1958-59.

69. Smajovic, I., McGill Univ.:
Geochemical Study of the Renfrew Area, Ontario, 1958-60; M.Sc. Thesis.

70. Tuominen, H.V., Ontario Dept. Mines (part-time), Lehigh Univ.:
Port Coldwell area, District of Thunder Bay, Ont., 1 inch to 1/2 mile 1958-59.

71. Williamson, W. R. M., Ontario Dept. Mines (part-time):
Wapesi Lake-Lac Seul area, District of Kenora, Ont., 1 inch to 1 mile, 1958.

72. Wynne-Edwards, H.R., Geol. Surv., Canada:
Westport Map-area, Ont., 1 inch to 1 mile, 1957-58.

73. Young, W.L., Ontario Dept. Mines (part-time), Carleton Univ:
Tanner and Bennett townships, District of Rainy River, 1 inch to 1 mile, 1958-59.

Prince Edward Island

74. Prest, V.K., and Crowl, C.H., and Frankel, L., Geol. Surv., Canada:
Geology of Prince Edward Island, 1 inch to 1 mile, 1953-59

Quebec

75. Archibald, Gary M., Quebec Dept. Mines (part-time):
Southwest Quarter Levy Township, Opemiska District, 1 inch to 1000 feet, 1958-59; Ph.D. thesis, University of Michigan.

76. Baragar, W.R.A., Geol. Surv., Canada:
Wakuach Lake Map-area, Quebec and Labrador, 1 inch to 4 miles, 1958-59.

77. Beall, G.H., Quebec Dept. Mines, (part-time):
Cross Lake Area, Cape Smith-Wakeham Bay Belt, 1 inch to 1 mile, 1958-59; Ph.D. thesis.

78. Béland, J., Quebec Dept. Mines:
Reconnaissance of Matapedia River-Temiscouata Lake Area,
1 inch to 4 miles, 1958-61.

79. Beland, Rene, Quebec Dept. Mines (part-time), Université Laval:
Petrography and Geology Region of Rawdon, St. Gabriel, Que., 1958-59.
Includes study of the transition from quartzite-paragneiss-limestone Grenville to granulite-hornblende-plagioclase gneiss Grenville.
St. Gabriel-de Brandon Area, (West Half) 1 inch to 1 mile, 1958-59.

80. Benoit, F. W., Quebec Dept. Mines:
Beland-Paquet Area, 1 inch to 1 mile, 1958-60.

81. Berard, Jean, Quebec, Dept. Mines (part-time):
Leaf Lake Area, New Quebec, 1 inch to 1 mile, 1958-59; D.Sc. thesis, Université Laval.

82. Bergeron, R., Quebec Dept. Mines:
Apercu de la Geologie de la Zone de Cape Smith-Wakeham Bay, Nouveau-Quebec.
Presented to 25th Congress of A.C.F.A.S. at Quebec, Nov. 2, 1957.
Proterozoic Rocks of the Northern Part of the Labrador Geosyncline, the Cape Smith Belt, and the Richmond Gulf Area.
A contributory paper published in "The Proterozoic in Canada", Roy. Soc. Can. Special Publications, No. 2, Univ. of Toronto Press, 1957.
Late Precambrian Rocks of the North Shore of the St. Lawrence River and of the Mistassini and Otish Mountains Areas, Quebec.
Contributory paper published in "The Proterozoic in Canada", Roy. Soc. Can. Special Publications, No. 2, Univ. of Toronto Press, 1957.
The Cape Smith-Wakeham Bay Belt, Northern Ungava, Quebec.
Presented to the Prospectors and Developers Association, Toronto, March 12, 1958. Published in Canadian Mining Journal, vol. 79, No. 4, pp. 115-117, 1958.
Ungava Bay-Ungava Peninsula, published in Canadian Geographical Journal, vol. IV, No. 4, pp. 20-30, 1958.
Povungnituk Range Area, Cape Smith-Wakeham Bay Belt, 1 inch to 2 miles, 1958-59.

83. Berrangé, J., Quebec Dept. Mines (part-time):
La Trappe-Hudon Area, 1 inch to 1 mile, 1958-59; Ph.D. thesis.

84. Bray, J.V.G., Quebec Dept. Mines (part-time):
La Lievre Area, 1 inch to 1 mile, 1958-60; Ph.D. thesis.

85. Clark, T. H., Quebec Dept. Mines (part-time), McGill Univ.:
Geology of St. Lawrence Lowlands in Quebec, 1 inch to 1 mile, 1938-60.
See St. Jean-Beloeil Area, Quebec Dept. Mines Geol. Rept. No. 66, 1955.

86. De Montigny, P.A., Quebec Dept. Mines (part-time):
Upper Deception River Area, 1 inch to 1 mile, 1958-59; M.Sc. thesis.

87. de Romer, Henry, McGill Univ.:
Geology of the Eastman Area, 1957-59, Ph.D. Thesis.

88. Duffell, S., Geol. Surv. Canada;
Iron Range and West half of the Mount Wright Map-area, southwest Labrador and New Quebec, 1 inch to 4 miles, 1956-58.
Geological mapping and study of the developments and geological problems of the iron range.

89. Dugas, Jean, Quebec Dept. Mines:
Compilation of the Geology of the Rouyn-Noranda District, Quebec.
A continuing program over a period of years; maps are issued at the scale of 1 inch equals 1000 feet and each covers one quarter of a township.

90. Duquette, Gilles, Quebec Dept. Mines, (part-time):
Weedon Township, Wolfe District, 1 inch to 1000 feet, 1958-59; D.Sc. thesis, Laval Université.

91. Eade, K.E., and Heywood, W.W., Geol. Surv., Canada:
Southwestern New Quebec (Operation Fort George), 1 inch to 8 miles, using helicopter, 1957-58.

92. Freedman, R.O., Quebec Dept. Mines (part-time):
Ford Lake Area, 1 inch to 1 mile, 1958-59; M.Sc. thesis.

93. Gaucher, E.H.S., Quebec Dept. Mines (part-time):
Southeast Quarter Barlow Township, Chibougamau District, 1 inch to 1000 feet, 1958-59; Ph.D. thesis, Yale University.

94. Gelinas, Leopold, Quebec Dept. Mines (part-time):
Fort Chimo Area, 1 inch to 1 mile, 1956-59; Ph.D. thesis.
See Phevenet Lake Area, (east half), Quebec Dept. Mines Prel. Rept. No. 363, 1958 and Gabriel Lake Area (West Half), Quebec Dept. Mines Prel. Rept. No. 373, 1958.

95. Gilman, W. F., Quebec Dept. Mines (part-time):
North Half Desmeloizes Township, Normetal District, 1 inch to 1000 feet, 1958-59; Ph.D. thesis, Univ. of Toronto.

96. Gold, D.P., Quebec Dept. Mines (part-time):
Hopes Advance Bay Area, 1 inch to 1 mile, 1958-59.

97. Grondin, Gaston-Guy, Univ. Laval:
La Geologie Regionale des Appalaches dans la Province de Quebec, 1958-59; M.Sc. thesis

98. Hogg, Wm. A., Quebec Dept. Mines (part-time):
Northeast Quarter of Montbray, Rouyn-Noranda Co., 1958-59;
Ph.D. Thesis, McGill Univ.

99. Jenkins, John T., McGill Univ.:
Geology of the Manitou River and Manitou Lake Areas, Saguenay, 1955-59;
Ph.D. Thesis.

100. Latulippe, Maurice, Quebec Dept. Mines:
Compilation of the Geology of the Val d'Or district, Quebec.
A continuing program over a period of years; maps are issued at the scale of 1 inch to 1000 ft. and each covers one quarter of a township.
Examination of Mining Properties and Development in Val d'Or District, Quebec.
A continuing program of investigation of mining properties and development work being carried out from year to year in the Val d'Or district.

101. Laurin, A., Quebec Dept. Mines:
Larouche Lake Area, 1 inch to 1 mile, 1958-59.

102. Laurin, A., Quebec Dept. Mines:
Relations Between Chibougamau-Abitibi Region and the Grenville Region, Quebec.
Presented to Geological Association of Canada, Toronto, March 9-12, 1958, and published in Canadian Mining Journal, vol. 79, no. 4, pp. 125-126, 1958.
The Geology of Ducharme-Mignault Map-area.
Presented to La Societe Geologique de Quebec, Feb. 20, 1958.

103. Lesperance, P.J., Quebec Dept. Mines (part-time):
Squatec Area, 1 mile to 1 inch, 1958-60;
Post-Taconic Formations of the Temiscouata Region, Quebec, 1958-60; Ph.D. Thesis, McGill Univ.

104. Leuner, W. R., Quebec Dept. Mines (part-time):
Southwest Quarter and Part of Northwest Quarter of LaMotte Township, Barraute-Val d'Or District, 1 inch to 1000 feet, 1958-59;
M.Sc. thesis, McGill Univ.

105. Lyall, H. B., Quebec Dept. Mines:
McLachlin-Booth Area, 1 inch to 1 mile, 1958-59.

106. MacKean, B. E., Quebec Dept. Mines (part-time):
Mount Reed Area, 1 inch to 1 mile, 1958-60;
Ph.D. thesis.

107. Marleau, R. A., Quebec Dept. Mines:
Perche-Poitou Area, 1 inch to 1 mile, 1958-59.
Les Roches de la Periode Post-Taconienne a la Téte de la Riviere Chaudiere.
Presented to 25th Congress of L'A.C.F.A.S. at Quebec, Nov. 2, 1957.

108. McGerrigle, John I., Quebec Dept. Mines:
South Half Wexford Tp., 1 inch to 1000 feet, 1958-59.

109. McPhee, D.S., Quebec Dept. Mines (part-time):
Aguanish Area, 1 inch to 1 mile, 1958-60;
Ph.D. thesis.

110. Moyer, P. T., Quebec Dept. Mines;
Verette Lake Area, East Half, 1 inch to 1 mile, 1958-59.

111. Murphy, D. L., Quebec Dept. Mines (part-time):
Mount Wright Area, 1 inch to 1 mile, 1958-60;
Ph.D. thesis.

112. Phillips, L. S., Quebec Dept. Mines (part-time):
Tuttle Lake-Peppler Lake Areas, 1 inch to 1 mile 1957-59; Ph.D. thesis
See Tuttle Lake Area, Quebec Dept. Mines, Prel. Rept. No. 377, 1958.

113. Remick, J. H., Quebec Dept. Mines (part-time):
Margry-Prevert Area, 1 inch to 1 mile 1958-59;
Ph.D. thesis.

114. Rondot, J. A., Quebec Dept. Mines:
Mékinac Area, 1 inch to 1 mile, 1958-59.

115. Sabourin, R.J.E., Université Laval:
Geology of the Seigneurie de Beaupre, Que., 1957.

116. Sauvé, Pierre, Quebec Dept. Mines:
Leaf Bay Area, 1 inch to 1 mile, 1958-59.
The Geology of the Eastern Border of the Labrador Trough Near Port Chimo, Northern Quebec.
Published in Canadian Mining Journal, Vol. 79 No. 4 pp. 123-124, 1958.

117. Sharpe, John I., Quebec Dept. Mines (part-time);
Lac Stukely District, Shefford Co., 1 inch to 1000 feet, 1958-59; M.Sc. thesis, Univ. of New Brunswick.

118. Skidmore, W.B., Quebec Dept. Mines:
Escuminac Area, 1 inch to 1 mile, 1958-59.

119. Spat, A.G., McGill Univ.:
Iron Formation and Associated Rocks in Mount Wright Area, Que., 1958-59; M.Sc. thesis.

120. Stearn, C. W., Quebec Dept. Mines (part-time); McGill Univ.
Causapscal Area, East Half, 1 inch to 1 mile, 1958-59.

121. Sylvestre, Yves, Université Laval:
Geologie de la Region de Couteau Lac, et de Grey River, Terre-Neuve, Canada, 1958-59; M.Sc. thesis.

122. Urquhart, Glen, McGill Univ.:
Areal Geology Northwest of Maniwaki, Que., 1959 - ; M.Sc. thesis.

123. Van Loan, P. R., Quebec Dept. Mines (part-time)
Southeast Quarter Fiedmont, Barraute Tp., 1 inch to 1000 feet, 1958-59; M.Sc. thesis, Univ. of Toronto.

Saskatchewan

124. Bell, C. K., Geol. Surv., Canada:
Milliken Lake Map-area, Northern Saskatchewan, 1954-58.
Detailed mapping with special reference to radio-active mineral deposits.

125. Cheesman, R. L., Saskatchewan Dept. of Mineral Resources:
Geology of Wapus Bay Area, 1956-59.

126. Kirkland, S.J.T., Saskatchewan Dept. of Mineral Resources:
Geology of the Brabant Lake Area, Northern Sask., 1 inch to 1/2 mile, 1958-59.
Detailed mapping of an area containing an interesting copper-zinc deposit.

127. Ledebur, Karl-Heinrich, Saskatchewan Dept. Mineral Resources:
Study of the Bon Creek-Instow Area, 1958-59.

128. Mawdsley, J.B., Univ. of Saskatchewan:
Iron Ore Occurrences, Northwestern Saskatchewan, 1956-59.

129. Pearson, W. J., and Froese, E., Saskatchewan Dept. of Mineral Resources:
Geology of the Forbes Lake area, Northern Sask., 1 inch to 1 mile, 1957-59.
Particular attention will be paid to pyrrhotite bodies occurring in the area. The area has been covered by airborne geophysical surveys and by airphoto interpretation and geological mapping will therefore be of particular interest.

130. Scott, J. S., Geol. Surv., Canada;
Surficial Geology of Elbow, Hawarden and Outlook (East Half) Map-areas, Sask., 1 inch to 1 mile, 1958-60.

131. Tremblay, L. P., Geol. Surv., Canada:
Geology of the Beaverlodge area Athabasca Lake, Sask., 1952-57.
Standard detailed mapping on 1 inch to 1,000 feet, with special reference to radioactive mineral deposits.

Yukon

132. Green, L. H., Geol. Surv., Canada:
Dawson-Peel Plateau, 1 inch to 4 miles, 1958-62.
Study and mapping of large unexplored area of Cordillera, including Dawson-Peel Plateau road.

133. Roddick, J. A., and Wheeler, J. O., Geol. Surv., Canada:
Operation Pelly, 1 inch to 4 miles 1958-60.
Standard mapping with air support.

ENGINEERING GEOLOGY

134. Bostock, J. M., Geol. Surv., Canada:
Compilation of Drift Thickness in the City of Ottawa, Ontario, 1957-58.
To make an isopach (drift-thickness) map of the overburden and to make bedrock surface contour map in the city of Ottawa area. See Geol. Surv., Canada, Map 13-1958.

135. Bozozuk, M., Div. Building Research, Nat. Res. Council:
Swelling and Shrinkage of Clays, 1954-
The extensive damage to houses due to swelling and shrinkage of clays in central Ottawa has been under investigation since 1954 to find the relation, if any, between damage and soil type. Laboratory study of swelling and shrinking clays was also carried out. See "Volume Changes Measured in Leda Clay", presented 12th Can. Soil Mech. Conf., Saskatoon, December, 1958.

136. Brown, R.J.E., Div. Building Research, Nat. Res. Council:
Permafrost Boundary in Canada, 1953-

This project has been resumed, following the return from post-graduate study at the Scott Polar Research Institute of the Research Officer responsible for this work.

137. Burn, K.N., Crawford, C.B., Eden, W.J., and Hamilton, J.J., Division of Building Research, Nat. Res. Council:
Geotechnical Properties of Eastern Marine Clay, 1951-

Attempts are being made to collect and correlate geotechnical data on eastern marine clay. Laboratory investigations include study of the behaviour of sensitive clays in triaxial and consolidation tests. A study of regain in strength after remolding has been started. Field work includes measurements of settlements due to surcharge of heavy fills, case record studies of landslides at Nicolet, Hawkesbury and Green Creek (near Ottawa) and finally on the evaluation of sampling and vane testing techniques. See "Use of Field Vane Shear Testing of Sensitive Clay" Symposium on Vane Shear Testing of Soils, S.T.P. No. 193, Am. Soc. for Testing Materials. Nov. 1957, and "The Nicolet Landslide", submitted to Engineering Geology Case Histories, Geol. Soc. of Am.

138. Chapman, L.J., Ontario Research Foundation and Brown, R.J.E., Pihlainen, J.A., and Johnston, G.H., Div. Building Research, Nat. Res. Council:
Evapotranspiration Studies, Norman Wells, N.W.T., 1953-

This field study of evapotranspiration at Norman Wells is being carried out by the staff of the Division of Building Research, National Research Council for the Ontario Research Foundation under the direction of Mr. Chapman.

139. Crawford, C.B., and Eden, W.J., Div. of Building Research, Nat. Res. Council:
Quebec North Shore and Labrador Railway, 1953-

The performance of various soil formations encountered by the railway are under observation by railway officials. Assistance has been given the railway regarding frost action and slope stability problems. Attention is drawn to two other recent publications on the subject of this railway namely (1) "Investigation of banded sediments along St. Lawrence North Shore in Quebec" by R.W. Pryer and K.B. Woods, presented to 61st Ann. Meeting A.S.T.M. June 1958, and "Frost Action and Railroad Maintenance in the Labrador Peninsula" by R.W. Pryer, presented to 37th Ann. Meeting, Highway Research Board, January, 1958. See also "Soil Engineering Problems on the Quebec North Shore and Labrador Railway" by K.B. Woods, R.W. Pryer, and W.J. Eden, Bull. Am. Ry. Eng. Ass'n, Feb. 1959.

140. Hutcheon, N.B., Pearce, D.C., Gold, L.W., and Penner, E., Div. Building Research, Nat. Res. Council: Ground Temperatures and Frost Action, 1948-

See "An Analysis of Frost Action Beneath Cold Storage Warehouses", by D.C. Pearce, submitted to Transactions E.I.C., March, 1958. And "Frost Action Beneath Cold Storage Plants" by D.C. Pearce and N.B. Hutcheon, Refrigeration Engineer, vol. 66, No. 10, Oct. 1958.

141. Johnston, G.H., Div. Building Research, Nat. Res. Council: Dyke Studies at Kelsey Generating Station, Northern Manitoba, 1958-

A study of dyke construction in an area of sporadic permafrost conducted at the Grand Rapid site of the Kelsey Generating Station on the Nelson river in northern Manitoba.

142. Legget, Robert F., Div. of Building Research, Nat. Res. Council: Geology and Engineering.

A continuing study of case histories involving the application of geology and engineering, both in field and laboratory, with a view to a complete revision of the text book "Geology and Engineering" which it is hoped may be completed in 1959.

143. Legget, R.F., and Eden, W.J., Division of Building Research, Nat. Res. Council: Steep Rock, 1948-

In the course of stripping operations at Steep Rock Iron Mines, large deposits of varved clay were uncovered. It was necessary to cut large slopes in the clays and with the cooperation of the mine, the performance of the slopes have been kept under observation. Other problems, such as settlements, have been studied in less detail. See "Soil Engineering at Steep Rock Iron Mines, Ontario, Canada", paper No. 6304, Proc. Inst. of Civ. Eng., vol. XI, pp. 169-188, Oct. 1958.

144. MacFarlane, Ivan C., Division of Building Research, National Research Council: Muskeg Research, 1954-

A survey of relevant literature on peat and muskeg is continuing, with the ultimate view of compiling a comprehensive annotated bibliography. Laboratory investigations will include the measurement of physical and mechanical properties of the peaty material. Appropriate field tests will be carried out in an attempt to correlate the classification system which has been developed for muskeg, with the strength characteristics of the peaty material. See "Guide to a Field Description of Muskeg", Technical Memo. No. 44, Nat. Res. Coun, of Canada, Assoc. Committee on Soil and Snow Mechanics, Ottawa, June, 1958, and "Review of the Engineering Characteristics of Peat", Proc. Am. Soc. civ, Eng., Soil Mechs. Div., 1959.

145. Owen, E. D., Geol. Surv., Canada:
St. Lawrence Seaway, 1953-58.
To advise and assist in geological and geological engineering matters concerning the planning and construction of the St. Lawrence Seaway and Power Development between Iroquois and Montreal.

146. Pihlainen, J. A., and Johnston, G. H., Div., Building Research, Nat. Res. Council:
Observations at Inuvik, N. W. T. (new location of townsite of Aklavik), 1954-
Soil temperature measurements under roads, air strip and buildings were continued and further observations carried out on the rate of annual thaw during the summer of 1958. Observations were also continued on physical changes to the terrain caused by melting of the permafrost resulting from construction in the area.

147. Pihlainen, J. A., Div. Building Research, Nat. Res. Council:
Permafrost Investigations at Fort Simpson, N. W. T., 1958.
Information on soil type and ice content of permafrost is obtained by core drilling.

148. Terasmae, J., Geol. Surv., Canada:
The Study of Core Samples from the Ontario Hydro Generating Station Site at Hamilton, Ont., 1958.
By the application of the principles of Pleistocene geology, to advise the Ontario Hydro concerning geological features that might affect their site investigations.

149. Williams, P. J., Div. Building Research, Nat. Res. Council:
Construction of Instrument for Field Recording of Small Progressive Soil Movements, 1957-59.
See "Direct Recording of Solifluction Movement", Am. Jour. Sci., Dec. 1957.

150. Williams, P. J., Div. Building Research, Nat. Res. Council:
Studies of Freeze-Thaw Processes in Soils, 1954-
See "An Investigation into Processes Occurring in Solifluction", Am. Jour. Sci., 1959 (in press).

151. Zelonka, F., Div. Building Research, Nat. Res. Council:
Determination of Depth to Permafrost by Geophysical Methods, 1958.
Initial investigations which were completed during the summer of 1958, were carried out to assess the practicability of determining the depth to the permafrost layer using seismic (shallow refraction seismograph) and electrical resistivity methods.

GEOCHEMISTRY

152. Anderson, G.M., Grad. Stud., Univ. of Toronto:
Solubility of Lead Sulphide in Hydrogen Sulphide-Water Mixtures at Low Temperatures, 1957-59.

153. Azzaria, L.M., Grad. Stud. Univ. of Toronto:
Distribution of Copper, Lead, and Zinc in the Minerals of a Granite, 1957-59.

154. Baadsgaard, H., and Stelmach, A., Univ. of Alberta:
Research in Methods for the Chemical Analysis of Geologic Materials, 1958-

155. Baadsgaard, H., Univ. of Alberta:
Argon Leakage from Sanidine, 1958-59.
Involves a valuation of sanidine as a suitable material for the A40/K40 dating of sediments of volcanic origin.

156. Bayrock, L.A., and Pawluk, S., Research Council of Alberta:
A Study of Some Aspects of Soil Formation, 1958-61.
Experiments have been set up to measure the electrical potentials (largely redox potentials) in soils. From the data gathered to date, potentials of up to 0.5 volts exist between the A and C horizons. It is possible that clays and iron migrate under these potentials.

157. Belyea, H.R., Maxwell, J.A., and Wanless, R.K., Geol. Surv., Canada:
Isotopic Studies of Sulphur from Canadian Petroleum Deposits, 1955-
To determine whether variations in the isotopic composition of sulphur derived from petroleum from oil field waters and from petroleum-bearing strata can be used to aid in correlation and dating of strata at and near petroleum-bearing horizons, and in determining the source rocks from which petroleum in various fields was originally derived.

158. Boone, Gary, McG., Lecturer, Univ. of Western Ont.
Feldspar-Quartz Phase Relations in the Crystallization of a Granite-Rhyolite Body, Gaspe Peninsula, Quebec, 1958-61.
The compositions and structural states of feldspars are being investigated in detail for this pluton of known high-level tectonic setting. From the detailed phase relations of feldspars and quartz as they are now known, the thermal history and rate of cooling can be inferred within petrologically significant limits. The states of oxidation of Fe in alkali feldspars and associated mafic minerals may provide useful criteria upon which to judge the potential of a silicate melt to have yielded an ore-forming phase at a late stage of crystallization.

159. Boyle, R. W., Geol. Surv., Canada:
Geochemistry of the Bathurst-Newcastle District, N.B., 1957-59.
To provide information on the geochemistry of the gossans, supergene and primary phases of the basemetal deposits of the district, and to evaluate the geochemical prospecting techniques used in that district by mining and exploration companies.

160. Boyle, R. W., and Wanless, R. K., Geol. Surv., Canada:
Lead and Sulphur Isotope Geology of Keno and Galena Hills, Yukon Territory, 1958-59.
To determine the isotopic abundances of lead and sulphur in the lead-zinc-sulphur deposits and their host rocks, and from the data to determine, if possible, the source of the elements in the deposits and the processes which have lead to their concentration.

161. Bray, J. V. G., McGill Univ.:
Mobility of Certain Sulphides in Sulphur Vapor, 1957-59; M.Sc. Thesis.

162. Bright, N. F. H., and Webster, A. H., Mines Branch, Dept. Mines and Technical Surveys:
High Temperature Phase Equilibrium of Titania Slag Constituents in the System Fe-Ti-O, 1954-59.
The ranges of stability with variations of temperature, oxygen partial pressure and composition of the compounds obtainable from the system Fe-Ti-O, such as $2FeO.TiO_2$, $FeO.TiO_2$, $FeO.2TiO_2$, $Fe_2O_3.TiO_2$ and the possible solid solution systems, are being investigated.

163. Burley, Brian J., McMaster Univ:
Stability of Minerals Under Hydrothermal Conditions and Elevated Pressures and Temperatures, 1957-
Two projects have been now almost completed (1) a study of the variation in the X-ray powder patterns and analcites synthesized at different pressures and temperatures and (2) a study of the variation in the X-ray powder pattern of nephelines synthesized at different pressures and temperatures.

164. Cameron, E. M., Geol. Surv., Canada:
Geochemistry of Sandstones, 1958-
To determine the geochemical characteristics of sandstones that may be of importance to the petroleum industry.

165. Carswell, H. T., Queen's Univ.:
Mineralographic and Chemical Studies of Banded Red-Zinc Ores of British Columbia, 1958-60; Ph. D. thesis.
This study is being carried out in collaboration with the Consolidated Mining and Smelting Co. of Canada, Limited. It will include, besides mineralographic studies, complete chemical analyses (trace elements) on various horizons.

166. Clark, Lloyd A., McGill Univ.:
Phase Relations in the System Fe-As-S, 1957-59; Ph. D. thesis.

167. Colwell, J. A., Queen's Univ.:
Mineralographic and Chemical Study of Bedded Copper-Zinc Deposits, New Brunswick, 1958-60; M. Sc. thesis.

168. Cumberlidge, John T., McGill Univ.:
Surface and Strain Energy in Minerals, 1956-59; Ph. D. thesis.

169. Davies, J. L., Univ. of New Brunswick:
Some Aspects of the Geochemistry of the Bathurst-Newcastle District, N. B., 1957-59; M. Sc. thesis.

170. Davies, John C., Univ. of Manitoba:
Petrology and Geochemistry of Gabbro Intrusions in the District of Kenora, Ont., 1956-59; Ph. D. thesis.

171. Dawson, K. R., and Maxwell, J. A., Geol. Surv., Canada:
Compilation of Canadian Rock and Mineral Analyses, 1957-
To collect, evaluate and publish in appropriate form and at appropriate intervals all Geological Survey of Canada rock and mineral analyses; and if, and when practicable, to expand this to include similar data from other sources.

172. Folinsbee, R. E., Baadsgaard, H., Lipson, J., Waller, P. J., and Orr, J. B., Univ. of Alberta: Establishing a Stratigraphically Controlled Absolute Geologic Time Scale, 1954-
Mr. Waller is studying Cambrian Geochronology and Sedimentary Petrology of the Rockies; M. Sc. thesis, 1959. Mr. Orr is studying "Ordovician Metabentonites of Ontario", M. Sc. thesis, 1959.

173. Folinsbee, R. E., Baadsgaard, H., and Lipson, J. I., Univ. of Alberta:
Dating Cordilleran Orogenies, 1954-59.
See "An Absolute Age for the Exshaw Shale", Guidebook, 8th Ann. Field Conference; Alberta Soc. Pet. Geol., Aug. 1958, pp. 69-73.

174. Fraser, D. C., Univ. of New Brunswick:
Study of Recent Copper-Rich Sediments near Dorchester, New Brunswick, 1958-60; M.Sc. thesis.

175. Gill, J.E., Meikle, B.K., and Guy-Bray, J. B., McGill Univ.:
Behaviour of Copper Sulphides at Elevated Temperatures, Alone and in Contact with Silicates, 1954-

176. Gleeson, Christopher F., McGill Univ.:
Studies of the Distribution of Metals in Muskegs and Lakes, 1957-59; Ph.D. Thesis.

177. Goldak, G.R., Univ. of Saskatchewan:
X-ray Geothermometry of Mineral Deposits, Brabant Lake, Sask., 1958-59; M.Sc. thesis.

178. Grant, James A., Queen's Univ.:
Petrology and Chemistry of Granitic Rocks of the Grenville of Eastern Ontario, 1957-59; M.Sc. Thesis.

179. Gravenor, C.P., and Govett, G.J., Research Council of Alberta:
Rate of Dissolution of Silicates, 1958-59.
The project is designed to measure the rates of dissolution of nepheline under varying pH and temperature conditions. Rates of dissolution will be calculated by chemical analysis and weight loss determinations. See "Weathering of Silicates", A.A.P.G., October, 1958.

180. Hansuld, John A., McGill Univ.:
Electrochemical Studies and Ore Deposition, 1958-60; Ph.D. Thesis.

181. Hawkins, Wm. M., McGill Univ.:
Spectrochemical Study of Rocks Associated with the Sulphide Ore Deposits of Chibougamau District, Quebec, 1958-59; Ph.D. thesis.

182. Hawley, J. E., MacDonald, G., Grant, J.A., Pearson, G.R., and others, Queen's Univ.
Granitic Rocks of the Grenville in Eastern Ontario, 1959-60.
One doctorate thesis has been completed by G.R. Pearson on the Clare River Syncline area and includes many analyses of granitic rocks in that district. Theses by W.J. Pearson on cyanite occurrences in Ontario, by H.R. Wynne-Edwards on the geology of the Westport area, and by A.M. Evans on the Centre Lake uranium area, will all include data on the geochemistry of granitic rocks in these areas. J. A. Grant is completing a petrographic study of some twenty-five granitic masses in other parts of eastern Ontario for which very complete chemical analyses have been made.

183. Hay, R. E., McGill Univ.:
Growth of Sulphide Crystals in Sediments, 1958-59; M.Sc. thesis.

184. Hodgson, C.J., McGill Univ.
Graphite in Archaean Sediments, 1958-60; M.Sc. thesis.

185. Hogarth, Donald D., McGill Univ.:
A Study of Certain Minerals of the Pyrochlore and Betafite Groups, 1956-59; Ph.D. thesis.

186. Holman, R.H.C., Geol. Surv., Canada:
Geochemical Exploration of Nova Scotia, 1956-58.
To explore by chemical means as much of southwestern Nova Scotia as practicable in an effort to locate and outline areas likely to contain valuable deposits of base or other metals. See Geol. Surv., Canada, Paper 58-1.

187. Jones, R. E., McMaster Univ.
Sulphur Isotope Ratios in Sulphide and Sulphate Minerals in Rocks of Niagara Escarpment, 1958-69.

188. Kidd, Donald J., Research Council of Alberta:
Diagenesis of Ferruginous Sediments, 1956-61.
Results of preliminary work on Clear Hills oolitic goethite sandstone are still under study. See "Stability Relations of Hematite and Goethite in Neutral and Alkaline Solutions at Elevated Temperatures and Pressures", Amer. Min. 1949.
Geochemistry of Beryllium, 1956-60.
Both projects will be continued when new bombs with better control of temperature and pressures are ready in 1959.

189. Koesmoeno, M.D., Grad. Stud., Queen's Univ.:
Endothermic Changes in Syenite Intrusive into Brucitic Limestones Near Wakefield, Que., 1958-59.
Syenite intrusive into brucitic limestones is greatly enriched in iron-rich pyroxene near its contacts, apparently by endothermic processes. The reason for course and extent of these changes is being studied.

190. Kramer, James R., N.R.C. Post-doctorate Fellow, Univ. of Western Ontario:
Geochemical Facies Analysis of Salina Formation in Southwestern Ontario, 1958-59.
Includes detailed chemical analysis of 1 to 2,000 samples of the Salina formation (a) to determine the nature of the sea that covered southwestern Ontario and surrounding areas during Silurian Salina time, (b) to correlate the chemistry of the Salina rocks with known petroliferous areas, and (c) to deduce probable petroliferous areas from the information obtained in (a) and (b).
Geochemistry of Calcite, Dolomite, and Aragonite in Sea Water, 1955-
Includes (a) determination of solubility products of calcite, dolomite, and aragonite in well brines (b) verification of solubility product values (see reference) in sea water (c) effect of amino acids on calcite, dolomite, and aragonite equilibria in sea water to interpret the oceanographic environment in which calcite, dolomite and aragonite form. See Kramer, J.R., (1958) Study of Calcite and Dolomite in Sea Water; (abstract) Geol. Soc. America Annual Meeting, St. Louis.

191. Lapointe, Guy, Univ. of Manitoba:
Diffusion of the TiO_2 Content of Magnetite by Granitization, 1958-59; M.Sc. Thesis.
In magnetite-ilmenite segregation deposits where there is ilmenite in excess, the TiO_2 in magnetite should be of the order of 5 per cent to 20 per cent. This fact does not hold true in a deposit of this sort situated in Lake St. John area, Que. The reason for the anomaly is believed to be granitization by an intrusive pegmatitic granite into the orebody, or regional metamorphism, or of the action of both combined.

192. LeBreton, E., Gordon, Research Council of Alberta:
An Analysis of the Chemical Properties of the Groundwater of Alberta, 1958-

193. Maxwell, J. A., Courville, S., McGahey, M.S., Geol. Surv. Canada:
Rock and Mineral Analysis, a Continuing Project.
The provision for Geological Survey geologists of complete or partial qualitative analyses of rocks, analyses of special minerals and special analyses. In addition efforts will be made to investigate and apply new methods of analysis where possible.

194. Maxwell, J. A., Geol. Surv., Canada:
Cooperative Evaluation of Methods of Fluorine Determination, 1958-59.
To evaluate methods of fluorine determination by interlaboratory cooperation.

195. Meikle, B.K., McGill Univ.:
The Behaviour of Cu S at Elevated Temperatures in the Presence of Silicates, 1957-59; Ph.D. thesis.

196. Mloszewski, M.J., Univ. of Toronto:
Solubility of Zinc Sulphide in Hydrogen Sulphide-Water Mixtures at Elevated Temperatures and Pressures, 1957-59.

197. Montgomery, D.S., and Goodspeed, F., Mines Branch, Dept. Mines and Technical Surveys:
The Infra-red Absorption Spectra of Bituminous Substances, 1951-

198. Nash, Walter, Univ. of New Brunswick:
Trace Element Studies in the St. Stephen, N.B., Mafic Rocks, 1958-60; M.Sc. thesis.

199. Oja, R.V., McGill Univ.:
Experimental Studies of Anatexis, 1957-59; Ph.D. Thesis.

200. Papezik, Vladimir S., McGill Univ.:
Geochemistry of Anorthosites, 1958-59; Ph.D. thesis.

201. Prince, A.T., Bright, N.F.H., Jongejan, A., and Rowland, J.F., Mines Branch, Dept. Mines and Technical Surveys:
High Temperature Phase Equilibrium Studies in the System $CaO-Nb_2O_5-SiO_2$, 1956-59.
The quench technique for silicate equilibria studies is being used to find the fields of primary crystallization in a substantial portion of this ternary system. A phase having X-ray properties similar to natural niocalite occurs in this system. The optical and X-ray crystallographic data of three calcium niobates have been determined. See "Compounds in the $CaO-Nb_2O_5$ System" presented at 7th Ann. Conf. of the Industrial Applications of X-rays, Denver, Aug. 1958.

202. Prince, A. T., Bright, N. F. H., and Jongejan, A., Mines Branch, Dept. of Mines and Technical Surveys:
High Temperature Phase Equilibrium Studies in the System $MgO-TiO_2-Fe_2O_3-SiO_2$, 1955-
Related to basic refractory materials, particularly to effect of TiO_2 on forsterite and on magnesite clinkers.

203. Raychaudhuri, S. K., McGill Univ.
Trace Elements in Sulphide Deposits of Chibougamau District, Quebec, 1957-59; Ph. D. thesis.

204. Riddell, J. E., Carleton University, and Gleeson, C., McGill University:
The Dispersion of Copper-Lead-Zinc and Nickel in Areas Covered by Bog and Muskeg, 1957-59.
This research is an attempt to determine the factors controlling metal dispersion in bog and muskeg, in order to explain anomalously high values in certain organic soils of these areas. This project was started with the cooperation and backing of Kennco Explorations, Limited.

205. Riddell, J. E., Carleton Univ.:
Dispersion of Iron and Manganese in Glaciated Terrains, 1957-58.
An investigation into the application of geochemical techniques to the detection of enriched iron ore formation in glaciated terrains.

206. Saull, V. A., McGill Univ.:
Silicate and Sulphide Phase Relationships, 1953-
Involves experiments with silicates and sulphides at high pressures and temperatures.
See "A New Method of Determining Solubilities of Sulphides", Econ. Geol. (In press), by B. H. Relly.
Enthalpy Changes in Metamorphic Reactions, 1953-
Determination of heat effects of metamorphic changes. See Geochim. et Cosmochim. Acta 8, 86-107, (1955)

207. Shaw, D. M., McMaster Univ.:
Geochemistry of Grenville Skarn Minerals.
Trace element analyses and mineralogical studies are being made on scapolite, pyroxene and calcite from Grenville skarns.

208. Simony, P. S., and Shaw, D.M., McMaster Univ.:
Geochemistry of the Biotite Paragneisses of Chandos Tp., Ont., and adjacent regions.

209. Sims, Walter A., McGill Univ.:
Sorption of Base Metals on Clay, 1956-59.

210. Smajovic, I., McGill Univ.:
Geochemical Study of the Renfrew Area, Ontario, 1958-60; M.Sc. thesis.

211. Smith, A.Y., Queen's Univ.:
Thermal Studies of Primary and Secondary Copper Nickel-Iron Sulphides and Arsenides, 1958-59; M.Sc. thesis.

212. Smith, F.G., Univ. of Toronto:
Thermodynamics of Solution of Metallic Sulphides in Water, 1957-60.

213. Smith, J.R., Univ. of Saskatchewan:
Subsolidus Relations in Plagioclase Feldspars, 1958.

214. Soles, James A., McGill Univ.:
Experimental Studies of Transportation and Deposition of Sulphides in an Open System at High Temperatures and Pressures, 1957-59; Ph.D. Thesis.

215. Spring, Val. Univ. of Toronto:
Wallrock Alteration at Opemiska Mine, Quebec, 1958-59; M.Sc. thesis.

216. Thomas, J.F.J., Mines Branch, Dept. Mines and Technical Surveys:
Water Quality Surveys of Canadian Drainage Basins with Special Reference to the Heavy Metals, 1957-
Water quality surveys have been underway for the past ten years but have covered mainly the alkalies and alkali earths. Greater attention is now being given to Cu, Pb and Zn, and radioactivity of natural waters. See "Water Survey Reports, 1-8", Industrial Water Resources of Canada, Dept. Mines and Technical Surveys.

217. Traill, R.J., Abbey, S., Wanless, R.K., Paris, J.C., and Robinson, S.C., Geol. Surv., Canada:
Age Determinations of Rocks and Minerals, 1954-
To make concentrations of minerals from bulk samples of rocks and ores; to analyse these concentrations for specific elements and make chemical concentrations of specific elements for isotope analysis; and by means of the mass spectrometer to make isotope analyses of the above and to compute the age of the minerals and enclosing rocks from this data.

218. Wilson, H. D. B., and Grad. Students, Univ. of Manitoba:
Distribution of Metals in Canadian Ore Deposits, 1955-

219. Wanless, R. K., Maxwell, J. A., and Smith, C. H., Geol. Surv., Canada:
Magnesium Isotopes, 1947-58.
A survey of the variations in abundance of magnesium isotopes from different geological environments, to determine if a fractionation of isotopes takes place and whether distinctive abundances are indicative of distinctive environments; and to use the results to elucidate various geological processes.

220. Wanless, R. K., and Lowdon, J. A., Geol. Surv. Canada:
Isotopic Study of Canadian Ore Leads, 1956-
The objectives are to determine the lead (and possibly sulphur) isotope distribution in lead ores; to investigate possible isotope variations with geological environment; to determine the direction and magnitude of isotopic fractionation of lead isotopes as a result of chemical and physical processes in nature; and when applicable, to establish the age, employing the "common lead" method of dating.

221. Warren, Harry V., Delevault, R. E., and Boyle, S., Univ. of British Columbia:
Trace Elements in Rocks, Soils, and Marine and Stream Sediments and Possible Relationships to Ore Formation, 1957-60.
It is becoming increasingly clear that with most metals there is a close relationship between the contents of vegetation and the underlying rocks; this may prove to be of interest to foresters and agriculturalists as well as geologists. See "Rubeanic Acid Field Test for Copper in Soils and Sediments", Mining Engineering, Vol. 10, No. 11, pp. 1186-1188, Nov. 1958.
Biogeochemical Prospecting, 1945-60.
This work now shows enough evidence to justify hope that before long it will be possible to designate geochemical districts, and on the basis of either or both stream sediments and rocks, to determine the suitability of a district for prospecting for any specific metal. See "Prospecting for Cobalt" Trans. Royal Soc. Can., Third Series, Sec. IV, Vol. 51, pp. 33-37, June 1957.

222. Webber, G. R., Research Associate, McGill Univ.:
Investigation into the Application of Instrumental Methods to the Quantitative Chemical Analysis of Geological Materials, 1955-
See "Applications of X-ray Emission Spectrometry to Ore and Rock Analysis", C.I.M., Transactions, vol. LX, p. 138-143.

223. Weber, J.N., Shaw, D.M., and Middleton, G.V., McMaster Univ.:
Geochemistry of Greywackes,
Trace element studies on Appalachian greywackes.

224. Wesemeyer, H., and Washkurak, S., Geol. Surv., Canada:
Development of Magnetic Resonance Apparatus for Laboratory Chemical Analyses, 1958-60.
To develop apparatus for the qualitative and quantitative analysis of rocks and minerals by means of magnetic resonance techniques. Both nuclear paramagnetic and electron paramagnetic resonances are to be employed.

225. Westervelt, R.D., Queen's Univ.:
Geochemical Study of the Bluebell Lead-Zinc Deposit, B.C., 1957-59; M.Sc. thesis.
Particular attention has been given to geothermometric methods applicable to mineralization in limestone and siliceous zones.

GEOMORPHOLOGY

226. Ambrose, J. W., Queen's Univ.:
Exhumed Pre-Palaeozoic Surfaces in the Canadian Precambrian Shield, 1934-
Palaeozoic sediments were deposited on a Precambrian surface etched by a well-developed sub-aerial drainage pattern. As the Palaeozoic rocks are stripped away the ancient drainage pattern (and associated hills and valleys) are exhumed and the surface can be identified completely around the periphery of the Canadian Shield, and in numerous places in its interior. This study is aimed to determine the criteria for recognition of exhumed topography and its extent in this country.

227. Bird, J. Brian, and Drummond, N.D., and Kroger, A., McGill Univ.:
McGill Arctic Terrain Study, 1955-62.
An extended program of geomorphological studies with the objective of producing a physiographic account of the Canadian Arctic south of 75° N. In 1958 a field party connected with this project worked in to Somerset and Prince of Wales Islands.

228. Brown, J.C., McGill Univ.:
The Deglaciation of the St. Lawrence Lowland, 1958-60.
Ph.D. thesis.

229. Farvolden, R.N., Research Council of Alberta:
Bedrock Topography and Preglacial Drainage of Alberta, 1956-59.

230. Ives, J.D., Loken, O., Derbyshire, E., and Tomlinson, R., McGill Univ.:
McGill Sub-arctic Research Laboratory at Knob Lake, 1956-
A series of coordinated projects directed by Professor Ives from the Research Laboratory at Knob Lake with the intention of determining the main features of the late glacial history of northeastern Quebec and the Labrador coast. This work has been undertaken for the Geographical Branch, Dept. of Mines and Technical Surveys in some areas and with the aid of Arctic Institute grants elsewhere.

231. Mackay, J. Ross, Univ. of British Columbia:
Geomorphology of the Mackenzie Delta Area, N.W.T., 1954-60.
This project is being done for the Geographical Branch, Dept. of Mines and Technical Surveys, Ottawa. See "Subsurface Organic Layer Associated with Permafrost in the Western Arctic", Geographical Paper No. 18 Geographical Branch, Dept. Mines & Technical Surveys, Ottawa, 1958.
Freeze-up and Break-up of the Mackenzie River. N.W.T., 1958-60.
This project is being done for the Geographical Branch, Ottawa.
Solifluction at Mount Garibaldi, B.C., 1958-61.
This project is supported by the National Research Council and is being done in collaboration with Dr. W. H. Mathews (Geology) and Dr. V.C. Brink (Plant Science) of Univ. of British Columbia.

232. Smith, D. Ingle, and Sagar, B., McGill Univ.:
Some Aspects of the Glaciology and Geomorphology of the Lake Hazen area, Ellesmere Island, N.W.T., 1957-61.
Work was begun while employed by the Defence Research Board; it is being continued under an Arctic Institute of North America grant.

233. Thompson, Hugh R., McMaster Univ.:
A Quantitative Study of the Terrain of the Hamilton District, 1958-65.
The area is being studied first in terms of local relief measured by unit areas of 1 min. lat. by 1 min. long. on topographic maps. Angles and directions of surface slope will be measured to produce statistical slope orientation diagrams. These and other quantitative data will be correlated with the glacial geology with the aim of refining our knowledge of late glacial and post glacial events in the landscape's evolution.

234. Wood, Harold, A., McMaster Univ.:
Analysis of the Relations Between Prevailing Winds and Shoreline Changes on Lake Erie, 1958-59.
An attempt is being made to evaluate the relative changes in magnitude and direction of the longshore component of wave energy, and to relate these changes to the rate of shore progradation and retrogradation. Particular attention is being paid to Long Point.

GEOPHYSICS

Electrical

235. Blanchard, J. E., Nova Scotia Research Foundation:
Theoretical Studies of Electromagnetic Methods of Geophysical Prospecting, 1956-
An attempt is being made to determine the effect of overburden on the resolving power of the various types of electromagnetic prospecting equipment presently being used.

236. Uffen, Robert and Surkin, Alvin, Univ. of Western Ontario:
Scale Model Experiments of Airborne Electromagnetic Prospecting, 1954-60.
Scale model measurements are being made of the electromagnetic response of typical geological structures for airborne prospecting techniques.

Gravity

237. Innes, M.J.S., Dominion Observatory:
Large Scale Gravitational Features of Canada, 1957-59.
An historical review of the gravity measurements has been completed; a gravity map on a scale of 1 inch to 100 miles has been completed but not yet released; and a manuscript dealing with the interpretation of the broader gravitational features is nearing completion.
Gravity Investigations of the Area of the North Shore of Lake Huron, 1957-59.
A study is in progress to determine if certain gravitational features observed in Manitoulin Island are due to relief or to lithological changes of the Precambrian basement rocks. A gravity map on scale of 4 miles to 1 inch has been completed.

238. Innes, M.J.S., Hamilton, A.C., and others, Dominion Observatory:
Gravity Measurements in the Prairie Provinces, 1955-
The establishment of a primary network for control of gravity measurements has been completed. 11 oil companies have contributed data for 6,300 townships. During 1958, 400 of these were tied to the Dominion Observatory network and 600 new regional stations established. The compilation of three 1 inch to 8 mile map-sheets in Alberta and Saskatchewan between the International Boundary and latitude 52° is under way.

239. Innes, M.J.S., and Thompson, L.G.D., Dominion Observatory:
Gravity Results for the Canadian Shield in Northern Ontario and Manitoba, 1947-59.
The geological and structural implications of the anomalies have been re-examined and an isostatic study and revised manuscript are nearing completion.

240. Tanner, J.G., Dominion Observatory, and Uffen, R.J., Univ. of Western Ontario:
Geological Interpretation of Gravity Anomalies in the Gaspe Peninsula, 1954-59.
Analysis of the results including geological interpretation and isostatic study has been completed and a final report is nearing completion.

241. Tanner, J. G., Dominion Observatory:
Gravity and Isostasy in Northern Quebec, 1954-
During the field season of 1954 and 1956 nearly 350 stations were established. In 1957 seven base stations were set up throughout a wide area to the east of Hudson Bay. In 1958 approximately 1,000 stations were established over a wide region bordering Hudson and James Bays. Reduction and analysis of the results are in progress. It is proposed to publish the gravity data on four 8-mile map-sheets. See "Gravity Isostasy in Central Quebec", Trans. A.G.U., vol. 38, no. 2, 1957.

Magnetic

242. Bower, M.E. and Morley, L.W., Geol. Surv., Canada:
Interpretation of Geological Survey of Canada Aeromagnetic Maps of Alberta, 1958-59.
With the aid of an electronic computer, to determine the depth and configuration of the Precambrian basement surface underlying sedimentary strata and to infer basement lithology from the aeromagnetic data.

243. Cameron, H. L., Nova Scotia Research Foundation:
Correlation Between Structure of Meguma Series and Aeromagnetic Map Data, 1958-59.
Involves the correlation between 1 inch to 1 mile geological maps of eastern Nova Scotia and aeromagnetic (GSC) maps of the same region, and extrapolation to area west of Lake Rossignol where mapping has not been done in detail.

244. Cook, Anne B., and Niblett, E.R., Dominion Observatory:
Telluric Currents, 1956-
Continuous records of telluric currents phenomena are being made at Meanook Magnetic Observatory, Athabasca, Alberta, for the study of electrical conductivity with depth, and of magnitudes of potential differences due to natural causes which affect many types of commercial installations.

245. DuBois, P.M., Geol. Surv., Canada:
Construction of Anisotropic Susceptibility Meter, 1958-
To construct an Ising-type meter to measure the anisotropic component of the magnetic susceptibility of weakly magnetized rocks. The measurements are expected to help determine the mode of magnetizations found in rocks, show if any correlation exists between the direction of remanent magnetism and the direction of the principal axes of isotropic susceptibility, and to aid in petrofabric studies.

246. DuBois, P.M., and Larochelle, A., Geol. Surv., Canada:
Palaeomagnetic Studies, 1955-
The collection and preparation of rock samples to measure the direction of remanent magnetism, and accumulation of data expected to reveal the direction of the earth's magnetic field during geologic history and thus throw light on age and structural relationships of rock formations.

247. Hall, D. H., Geol. Surv., Canada:
Aeromagnetic Interpretation, Meadow Lake Area, Sask; 1958-
To produce a basement topographical map and to infer basement structure and lithology from aeromagnetic data by depth calculations on basement anomalies and extrapolating known geology from adjacent Shield area.

248. Larochelle, A., Geol. Surv., Canada:
Construction of a Curie-Point Meter, 1957-58.
To obtain an instrument capable of accurately measuring the Curie-Point of ferromagnetic minerals and use this in an investigation of negatively polarized igneous rocks.
Palaeomagnetism in Rocks from Yamaska and Brome Mountains, Quebec, 1957-59; Ph.D. thesis, McGill Univ.

249. Owens, K., Sawatzky, C., Houlihan, J., Eisener, K., Geol. Surv., Canada:
Aeromagnetic Survey of Gulf of St. Lawrence Region, 1958.
To aid geological mapping and prospecting.

250. Potter, R.R., Univ. of New Brunswick:
Correlation of Aeromagnetic Surveys and Geology in New Brunswick, 1956-58; M.Sc. thesis.

251. Roy, J.L.M., Dominion Observatory:
Rock Magnetism in Meteorite Craters, 1958-
A study is being made of rock cores from suspected meteorite craters for the purposes of (1) detection of meteorite fragments and (2) ascertaining whether the magnetic properties of disturbed rocks and those in situ indicate changes due to impact and heating.

252. Serson, T.H., and Clark, J. F., Dominion Observatory:
Magnetic Surveys, Ground and Airborne - A Continuing Project.
Ground magnetic surveys in 1958 operated between Ottawa, Ontario and Good Hope, N.W.T. Three-component airborne surveys were conducted over British Columbia and the Pacific Ocean. Results will be used in magnetic chart construction and the delineation of regional magnetic anomalies.

253. Wesemeyer, H., and Washkurak, S., Geol. Surv., Canada:
Development of Magnetic Resonance Apparatus for Laboratory Chemical Analyses, 1958-60.
To develop apparatus for the qualitative and quantitative analysis of rocks and minerals by means of magnetic resonance techniques. Both nuclear paramagnetic and electron paramagnetic resonances are to be employed.

Radioactivity

254. Baadsgaard, H., Univ. of Alberta:
Argon Leakage from Sanidine, 1958-59.
Involves a valuation of sanidine as a suitable material for the A40/K40 dating of sediments of volcanic origin.

255. Brownell, George M., Univ. of Manitoba:
A Beryllium Detector for Field Exploration, 1957-58.
A scintillation counter has been developed for detection of beryllium in rocks and minerals. Also a technique has been worked out for determining the content of beryllium in samples. The instrument named a "Beryllometer", has been developed and is now available in a portable form for field exploration and prospecting.

256. Cormier, Randall, F., St. Francis Xavier Univ.:
Rubidium-Strontium Dating of Rocks and Minerals, 1958-
Initial work will be concerned with dating additional glauconites (see reference below) in an attempt to more clearly define the post-Precambrian time scale. Investigation of other methods for the dating of sediments by rubidium-strontium analysis is being given consideration. See "Sediment Age Determination by Rubidium-Strontium Analysis of Glauconite", Bull. A.A.P.G., vol. 42, No. 4, 1958.

257. Eichholz, G.G., Mines Branch, Dept. of Mines & Technical Surveys:
Radiometric Assaying of Uranium and Thorium Ores, 1951-59.
The remaining work is mainly concerned with a comparison of methods for determining small amounts of thorium in the presence of large proportions of uranium. A considerable amount of experimental results is on hand and requires correlation. See "The Determination of Uranium and Thorium in Ores", Can. Jour. of Physics, vol. 31, 613, 1952.

258. Folinsbee, R.E., Baadsgaard, H., Lipson, J., Waller, P.C., and Orr, J.B., Univ. of Alberta:
Establishing a Stratigraphically Controlled Absolute Geologic Time Scale, 1954-
Mr. Waller is studying "Cambrian Geochronology and Sedimentary Petrology of the Rockies"; M.Sc. thesis, 1959. Mr. Orr is studying "Ordovician Metabentonites of Ontario"; M.Sc. thesis, 1959.

259. Gregory, A.F., Geol. Surv., Canada:
Gamma Ray Spectrometer Studies, 1959-
Previous work established that distinct contrast in gamma ray spectra may exist between various lithologic sources. Proposed research includes a laboratory study of thick source emission spectra to be followed, if feasible, by in situ measurements on rocks. Continuing research would investigate (1) the degradation of energy spectra with increasing air distance and (2) the significance of diurnal variations in the gamma field of the earth. These data will allow evaluation of a potential technique for areal mapping of geology in which radioactive contrasts exist. Suitable in situ measurements would be useful in stratigraphic and petrogenic correlations.
Evaluation of Aeroradiometric Surveying as an Aid to Geological Mapping and Petrogenetic Analyses, 1958.

260. Horwood, J.L., Mines Branch, Dept. Mines and Technical Surveys:
Measurement of Gamma-ray Spectra of Airborne Dust Samples, 1957-58.
This project was intended originally as a check on airborne radon activity. Radioactivity was found to consist of long lived fall-out products in secular equilibrium. See "Gamma-ray Analysis of Atmospheric Dust Samples", Mines Branch Res. Rept. R24.

261. Horwood, J.L., Mines Branch, Dept. Mines and Technical Surveys:
Degradation of Gamma-ray Spectra from Uranium and Thorium Ores on Passage Through Rocks and Soil, 1958-59.
Determination of changes in characteristic gamma-ray spectra from uranium and thorium ores as a result of scattering effects in overlying rocks and soil. This is expected to assist in developing improved methods for aerial radioactive surveys.

262. Lapointe, C.M., Mines Branch, Dept. Mines and Technical Surveys:
Carbon-14 Age Determination, 1956-59.
Equipment is being set up to determine the ages of archaeological and geological samples by the carbon-14 method.

263. Riddell, J. E., Carleton Univ. and Sikka, D. B., McGill Univ.:
Radioactive Anomalies Related to Gas and Oil Fields, 1956-59.

264. Ross, D. B., and Blanchard, J. E., Dalhousie Univ.:
Carbon-14 Dating Using Proportional Counter 1957-

265. Sikka, D. B., McGill Univ.:
Radiometric Survey of Redwater Oilfield, Alberta, Canada, 1956-59; Ph. D. thesis.

SEISMIC

266. Blanchard, J. E., Nova Scotia Research Foundation and Dalhousie Univ.:
Application of Seismic Methods of Geophysical Exploration to Geological Problems in Nova Scotia, 1956-
A Study of the Energy Released by Bumps in the Springhill Coal Mine Area, Nova Scotia, 1956-59.
This work is being done in cooperation with the Dominion Observatory and the Mines Branch of the Department of Mines and Technical Surveys, Ottawa. Records of the microseismic activity in the Springhill area were obtained using a Willmore seismograph. The number and time of microseisms is now being determined and an attempt will be made to correlate these with convergence measurements made at the same time by the Mines Branch of the Department of Mines and Technical Surveys in cooperation with the Nova Scotia Research Foundation.

267. Bancroft, P. M., Dominion Observatory:
General Crustal Studies, 1958-
Future seismic field work of the Dominion Observatory will be concentrated mainly in the distance range of 25-3,000 miles i.e. excluding short range explosion observations except when specifically required for the interpretation of work carried out over long distances. To this end new field equipment is being collected in preparation for field tests during 1959.

268. Hodgson, J. H., and others, Dominion Observatory:
Fault Plane Studies, 1949-
By studying the displacements produced by an earthquake at stations all over the world, it is possible to determine the direction of faulting at the origin. By combining data of this type conclusions on regional tectonics can be drawn. The work which has been published to date refers only to compressional waves but current efforts are being directed towards utilization of transverse wave data.
See "Direction of Faulting in Some of the Large Earthquakes of 1955-56", pub. of Dom. Obs. vol. 19, no. 8.

269. Willmore, P.L. and others Dominion Observatory:
Construction of Directionally Sensitive Seismograph. 1957-60.
By recording seismic movements on magnetic tape, it is hoped to be able to play back and mix the three recorded components to simulate the response of a seismograph having any desired orientation and frequency response. The use of optimum orientation for the simulated detectors is expected to clarify greatly seismic interpretation.

270. Willmore, P. L., Milne, W. G., and White, W. R. H., Dominion Observatory:
Crustal Studies in British Columbia and Alberta, 1956-59.
The work refers to the long-range observations of the Ripple Rock explosions and to related depth charge studies in the waters around Vancouver Island.

General Problems

271. Blanchard, J. E., Nova Scotia Research Foundation and Dalhousie Univ.:
Gravity and Magnetic Studies of the Sedimentary Basins of Nova Scotia, 1952.
Because of large density contrasts in the Windsor section of the Mississippian, gravity has been found particularly useful in helping to solve structural problems in the sedimentary basins.

272. Beals, C.S., Dominion Observatory:
Meteorite Crater Search, 1955-61.
A search for meteorite craters is being conducted, making use of areal photographs and large-scale maps. Several circular features have been found which may be due to this cause. One crater at Holleford, Ont. has been investigated by diamond drilling. See Jour. Roy. Astr. Soc. Can., 50, 207, 1956, and Sky and Telescope 16, 11, 1957, and Nature 181, 559, 1958.

273. Butler, R. D., McGill Univ.:
Terrestrial Heat Flow in the St. Lawrence Plain, 1958-59; M.Sc. thesis.

274. Collett, L.S., Wesemeyer, H., and Knapp, H., Geol. Surv., Canada;
Nuclear Adsorption Studies, 1956.
The investigation of the capabilities of the nuclear resonance adsorption technique for determining buried mineral deposits.

275. Grant, F.S., Weber, J.R., Arnold, K.C., Filo, J.D., Sandstrom, H., Def. Res. Board, McGill Univ., and Univ. of Toronto:
Geophysical Research on Gilman Glacier and on the Ice-cap on Northern Ellesmere Island, 1957-59.
The research involved seismic and gravity measurements, and survey work to establish thicknesses and profiles of the ice. See "Operation Hazen: Narrative and Preliminary Reports 1957-58", Def. Res. Bd. Ottawa (in press).

276. Gregory, A. F., Geol. Surv., Canada:
Interpretation of Geophysical Data from Operation Franklin, 1959.
To complete the interpretation of magnetic and radiometric profiles from the aerogeophysical traverses of Operation Franklin.

277. Hattersley-Smith, G., Def. Res. Bd., and Sagar, R.B., McGill Univ.:
Glaciological Research on Gilman Glacier and on the Ice-cap on Northern Ellesmere Island, 1957-59.
The research was combined with accumulation, ablation, crystallographic and temperature measurements, and studies of marginal glacial features. See "Operation Hazen: Narrative and Preliminary Reports 1957-58". Def. Res. Bd., Ottawa, (in press).

278. Innes, M.J.S., Dominion Observatory, and Pearson, W.J., Saskatchewan Dept. of Mineral Resources:
Geophysical Investigations of Fossil Meteorite Craters, 1953.
Geophysical investigations have been carried out over circular features near Brent, Ontario, Holleford, Ont., Franktown, Ont., Macamic, Que., and Reindeer Lake, Sask. Additional field measurements are to be made during 1959. Reports are in preparation. See "A Possible Meteorite Crater at Deep Bay, Sask.", Jour. of the Roy. Ast. Soc. Can. vol. LI, for 1957.

279. Lennox, D.H., Research Council of Alberta:
Geophysical Determination of Depths to Bedrock in Alberta, 1957-
Terrestrial Heatflow Measurements in Alberta, 1958-59; M.Sc. thesis, Univ. of Alberta.

280. Pajari, G. E., McGill Univ.:
Deformation of Rocks at High Temperature and Pressures, 1958-60; M.Sc. thesis.

281. Roots, E. F., and others, Department of Mines and Technical Surveys:
Polar Continental Shelf Project, 1958-

The project will undertake oceanographic, geophysical and geological studies of those parts of the continental shelf of the Arctic ocean that are adjacent to Canada, including the straits and channels between the adjacent islands of the Arctic Archipelago. Field work will commence with a reconnaissance survey in 1959, with the first full year of survey in 1960. Studies in geological and related fields will include complete gravity and magnetic surveys, bottom sampling, coring (expected to begin 1960 or 1961) with attendant stratigraphic and micro-palaeontological studies, seismic refraction surveys and possibly airborne geophysical surveys.

The submarine geological investigations of the Polar Continental Shelf Project are intended to be the beginning of a continuing program to be undertaken by the Department of Mines and Technical Surveys in conjunction with investigations in the field of physical oceanography and to be eventually expanded to include studies of the geology of the Atlantic and Pacific coasts of Canada.

282. Saull, V. A., McGill Univ.:
Terrestrial Heat Flow in the St. Lawrence Lowlands of Quebec, 1958-60.

Involves determination of terrestrial thermal gradient and heat flow using various abandoned boreholes in the St. Lawrence lowlands.

283. Traill, R. J., Abbey, S., Wanless, R. K., Paris, J. C. and Robinson, S. C., Geol. Surv., Canada:
Age Determinations of Rocks and Minerals, 1954-

To make concentrations of minerals from bulk samples of rocks and ores; to analyse these concentrations for specific elements and make chemical concentrations of specific elements for isotope analyses; and by means of the mass spectrometer to make isotope analyses of the above and to compute the age of the minerals and enclosing rocks from this data.

284. Wesemeyer, H., Geol. Surv., Canada:
Electron Spin Resonance at Very Low Fields, 1958-

Investigation as to the feasibility of using the principle of electron spin resonance at very low magnetic fields for prospecting purposes.

285. Zelonka, F., Div. Building Research, National Research Council:
Determination of Depth to Permafrost by Geophysical Methods, 1958.

Initial investigations which were completed during the summer of 1958 were carried out to assess the practicability of determining the depth to the permafrost layer using seismic (shallow refraction seismograph) and electrical resistivity methods.

INVENTORIES, ETC.

286. Anderson, F.D., and Poole, W.H., Geol. Surv., Canada:
Compilation of the Geology of the Fosterville-Napadogan Area, N.B., 1958-59.

287. Bolton, T. E., Wagner, F.J.E., Geol. Surv., Canada:
Lexicon of Stratigraphic Names Used in Canada, 1958-60.

288. Dawson, K. R., Geol. Surv., Canada:
Petrological Collections, 1957-
To obtain and maintain representative suites of rocks from all map-areas of Canada for future petrological, geochemical and other scientific studies.
Meteorite Collection, 1957-
To catalogue, study, describe, and otherwise be responsible for the maintenance, growth, use, and display of the Geological Survey meteorite collection.

289. Dawson, K. R. and Maxwell, J. A., Geol. Surv., Canada:
Compilation of Canadian Rock and Mineral Analyses, 1957-
To collect, evaluate and publish in appropriate form and at appropriate intervals all Geological Survey of Canada rock and mineral analyses; and, if and when practicable, to expand this to include all similar data from other sources.

290. Frebold, H., and Staff of Stratigraphic Palaeontology Section, Geol. Surv., Canada:
Maintenance of Palaeontological Collections - a continuing project.
To catalogue, store and maintain incoming, and type collections of fossils so that they are readily available; and to prepare exchange material.

291. Johnston, A. G., Burns, E.N., and Lemoine, A., Geol. Surv., Canada:
Economic Geology Files, 1940-
To file and cross-index all published authentic geological information and geological maps on all Canadian occurrences of economic metals and minerals; and to assist in preparing for publication maps and reports showing the distribution and mode of occurrence of specific metals or minerals.

292. Lang, A.H., and Steacy, H. R., Geol. Surv., Canada:
Laboratory Investigation of Samples of Radioactive Substances and Filing, Collating, and Abstracting Other Information Supplied Under the Regulations of the Atomic Energy Control Board, 1945-
To maintain a complete inventory of all occurrences of uranium and thorium deposits in Canada and to aid in the discovery and exploitation of such deposits by making deductions and generalizations from this data.

293. Manitoba Mines Branch:
Bibliography of Geology, Palaeontology, Industrial Minerals, and Fuels in the Post-Cambrian Regions of Manitoba 1950-57.
This is a supplement to Manitoba Mines Branch publication 51-2 which covers the period up to 1950.

294. Manitoba Mines Branch:
Bibliography of Geology of the Precambrian areas of Manitoba, 1950-57.
This is a supplement to Manitoba Mines Branch publication 51-1 which covers the period up to 1950.

295. Traill, R. J., Geol. Surv., Canada:
Compilation of an Up-to-Date List of Canadian Mineral Occurrences Including all Available Analytical Data, 1958-60.

296. Winder, C. G., University of Western Ontario:
Lexicon of Palaeozoic Formation Names in Southern Ontario, 1957-58.
Summarizes for each group, formation, and member the original author, type or reference locality, lithology, thickness, distribution, and nature of upper and lower contact along with a list of important references.

297. Wright, J. F., Geol. Surv., Canada:
Compilation of Indices to Geological Survey of Canada reports 1951.
Preparation of a complete index of Memoirs, Economic Geology Series, Museum Bulletins, Geological Bulletins, Preliminary Papers, Summary Reports and maps since 1927.

MINERALOGY

X-Ray, Crystal Structure, Specific Minerals

298. Ambrose, J.W., Queen's Univ.:
Two Spodumene-Eucryptite Bearing Pegmatite Dykes in Southeastern Manitoba, 1958-59.
Two pegmatite dykes in southeastern Manitoba carry commercial quantities of exceptionally pure spodumene and small amounts of associated eucryptite. The principal optical and physical properties of this pure spodumene are recorded, the literature relating to eucryptite is reviewed, and the conclusion is reached that eucryptite formed probably as a consequence of introduction of sodium.

299. Faulkner, E. L., Univ. of Saskatchewan:
X-Ray Analysis of Pyrite-Pyrrhotite, Northern Saskatchewan, 1958-60; M.Sc. thesis.

300. Ferguson, R. B., and Grad. Students, Univ. of Manitoba:
An Investigation of the Feldspars, 1950-
An attempt to clarify the room temperature phase relationships of the feldspars. See "Crystal Structures of Low Temperature and High Temperature Albites", Acta Crystallographica, Vol. II, pp. 331-348, 1958.

301. Hogarth, Donald D., McGill Univ.:
A Study of Certain Minerals of the Pyrochlore and Betafite Groups, 1956-59; Ph.D. thesis.

302. Hughson, M. R., Mines Branch, Dept. Mines and Technical Surveys:
Britholite from Oka, Quebec, 1957-59.
Includes the determination of the chemical composition and some physical properties.

303. Jongejan, A., Mines Branch, Dept. Mines and Technical Surveys:
Iron-bearing Gehlenites, 1957-59.
This study is related to the constitution studies of dolomitic magnesite refractory clinkers.

304. Jongejan, A., and Bright, N.F.H., Mines Branch, Dept. Mines and Technical Surveys:
Magnesia-Ferric Oxide-Alumina Spinels, 1957-59.
This study relates to the constitution of dolomitic magnesite refractory clinkers.

305. Kaiman, S., Mines Branch, Dept. Mines and Technical Surveys:
The Ideal Composition of Brannerite, 1956-59.
The conditions of synthesis of an artifical compound with the properties of natural brannerite are being investigated.

306. Nickel, E. H., Mines Branch, Dept. Mines and Technical Surveys:
Study of a Native Nickel-Iron Alloy in Serpentinized Rock from the Eastern Townships of Quebec, 1957-59.
The native nickel-iron has the following composition: Ni 71.0%: Fe 25.3%; Co 3.5%; and Cu 0.2%. It occurs as a single phase alloy with a face-centred cubic structure and a cell constant of 3.55A. It appears to have been formed as the result of the serpentinization of nickel-bearing olivine and enstatite. See "The Occurrence of native Nickel-Iron in the Serpentine Rock of the Eastern Townships of Quebec", presented Ann. Meeting Geol. Soc. Am., St. Louis, Nov. 1958.

307. Nickel, E. H., Mines Branch, Dept. Mines and Technical Surveys, and Karpoff, B. S., Quebec Lithium Corporation:
Mineralogical and Geological Investigation of a Canadian Occurrence of Holmquistite, 1957-59.
The chemical composition and the physical, optical and crystallographic properties of the Holmquistite have been determined. Its geological occurrence is now being investigated.

308. Perrault, Guy, Ecole Polytechnique:
Single Crystal X-ray Diffraction Study of Selected Amphiboles, 1957-65.
Research on the Potassium Feldspars, Their Atomic Structure and Properties, 1956-
See "La Structure Atomique des Feldspaths", L'Ingenieur, Hiver 1957, pp. 24-27.

309. Pyke, Murray William, Univ. of Saskatchewan:
Microclines from a Precambrian Granodiorite, Forbes Lake Area, Sask., 1958-59; M.Sc. thesis.

310. Riddell, J. E., Carleton Univ., and Petruk, W., McGill Univ.:
The Application of X-ray Diffractometer Techniques to the Probelm of Wallrock Alteration, 1958-59.

310-a. Robinson, S. C., and Sabina, A. P., Geol. Surv., Canada:
Investigation of the Variation in the Lattice Parameter of Specimens of Pitchblende and Uraninite from Various Localities, 1948-58.
To ascertain whether variations can be attributed to any of the following (1) different mineralogical provinces, (2) age of the deposits, (3) degree of alteration, and (4) variations in a solid solution series.

311. Rowland, J. F., Mines Branch, Dept. Mines and Technical Surveys:
Crystallography of Holmsquistite, Anthophyllite and Glaucophane, 1957-59.
The work is aimed at determining whether Holmsquistite should be regarded as a lithium-bearing anthophyllite rather than a lithium-bearing glaucophane.

312. Smith, J. R., University of Saskatchewan:
Sobsolidus Relations in Plagioclase Feldspars, 1958-

General Problems

313. Benson, David, G., McGill Univ.:
The Mineralogy of the New Brunswick Sulphide Deposits, 1956-59; Ph.D. thesis.

314. Brady, J. G., Buchanan, R. M., and Sadler, A. G., Mines Branch, Dept. Mines and Technical Surveys:
Mineralogical Constitution and Physical and Chemical Properties of Canadian Clays, 1958-
The principal aim is to determine the types and characteristics of Canadian clays, and to compile such information for publication. However, most of this work will be related to industrial applications of clays. It is expected that the work will break down into several projects.

315. Burley, Brian, J., McMaster Univ.:
Stability of Minerals Under Hydrothermal Conditions and Elevated Pressures and Temperatures, 1957-
Two projects have now been almost completed (1) a study of the variation in the X-ray powder patterns of analcites synthesized at different pressures and temperatures and (2) a study of the variation in the X-ray powder pattern of nephelines synthesized at different pressures and temperatures.

316. Byrne, T. J. S. and Farvolden, R. N., Research Council of Alberta:
Clay Mineralogy of the Bearpaw Shale, 1955-59.

317. Carswell, H. T., Queen's Univ.:
Mineralographic and Chemical Studies of Banded Lead-Zinc Ores of British Columbia, 1958-60; Ph.D. thesis.
This study is being carried out in collaboration with the Consolidated Mining and Smelting Co. of Canada Limited. It will include, besides mineralographic studies, complete chemical analyses (trace elements) on various horizons.

318. Colwell, J. A., Queen's Univ.:
Mineralographic and Chemical Study of Bedded Copper-Zinc Deposits, New Brunswick, 1958-60; M.Sc. thesis.

319. Cumberlidge, John T., McGill Univ.:
Surface and Strain Energy in Minerals, 1956-59; Ph.D. thesis.

320. Dell, J. Carol, Ontario Research Foundation:
Study of Mineralogical Composition of Sand Fraction of Tills and Stratified Sands of Southern Ontario, 1956-59; M.A. thesis, Univ. of Toronto.
The laboratory work has been completed and the results are being prepared for publication.

321. Gorman, D.H., and Deane, R. E., Univ. of Toronto:
Alteration of Minerals to Clays, 1957-

322. Halferdahl, L. D., Research Council of Alberta:
Heavy Minerals in River Sediments in Alberta, 1957-

323. Hawley, J.E., and Stanton, R.L., Queen's Univ.:
Mineralogy of the Sudbury Ores and Their Genesis, 1956-59.
This study includes a detailed mineralographic and geochemical investigation of the Sudbury ores. The manuscript is in course of preparation. See "Michenerite and Froodite, Palladium Bismuthide Minerals", Canadian Mineralogist, vol. 6, pt. II, p. 200-209.

324. Haycock, M.H., Mines Branch, Dept. Mines and Technical Surveys:
Research in Ore Microscopy - The Development of Apparatus for Determining the Spectral Reflectivity of Ore Minerals, 1955-
This is the first step in a project designed to exploit the application of electronics to the field of mineralogy.

325. Kaiman, S., Mines Branch, Dept. Mines and Technical Surveys:
Uranium Minerals in Leach Residues of Blind River Ores, 1959.
The study of acid leach residues to determine the mineralogical nature of the refractory uranium, in connection with a general metallurgical study of the Blind River ore.

326. Kaiman, S., and Hughson, M.R., Mines Branch, Dept. Mines and Technical Surveys:
X-ray Powder Patterns of Metamict Minerals, a continuing program.
The preparation of standard reference patterns for use in identification of metamict minerals. This involves the investigation of the method of heat treatment.
Mineralogical Reports on Radioactive Ore Samples.
These reports cover the mineralogical composition of radioactive ores and mill products. Their main purpose is to supply mineralogical information in connection with ore treatment investigations.

327. Loudon, J.R., Univ. of Toronto:
Study of Porphyry Rocks from the Devil's Elbow Area, N.B., 1956-59; Ph.D. thesis.
An investigation of the petrography and mineralogy of "porphyries" in this area to throw some light on the significance of these rocks which are so often associated more or less closely with base metal ores in the Bathurst area.

328. Milne, Victor G., Univ. of Toronto:
The Non-Radioactive Heavy Minerals in the Uraniferous Conglomerate, Blind River, Ontario, 1957-58; M.A. thesis.
An X-ray and optical study of the heavy minerals in the Blind River conglomerate ore-zone, to determine the character and proportions of the heavy minerals other than the radioactive minerals.

329. Mirynech, E., Univ. of Toronto:
Mineralogical Soil Profile Studies, Southern Ontario, 1956-59; M.A. thesis.

330. Patchett, J. E., Grad. Stud., Univ. of Toronto:
A Study of the Radioactive Minerals of the Uraniferous Conglomerate, Blind River Area, Ontario, 1957-59; Ph.D. thesis.
An attempt to determine nature, proportions and origin of the radioactive minerals in a typical ore zone in the Blind River area. It will include X-ray and optical studies, and selection of material for age determination.

331. Peach, Peter, A., and Hobbs, L. G., Univ. of Toronto:
A Mineralogical Investigation of Ultrabasic Rocks, 1958-59.

332. Perrault, Guy, Ecole Polytechnique:
Petrography and Mineralogy of the Oka Alkaline Intrusives, 1957-61.

332-a. Prince, A.T., Bright, N.F.H., and Jongejan, A., and Rowland, J.F., Mines Branch, Dept. Mines and Technical Surveys:
High Temperature Phase Equilibrium Studies in the System $CaO-Nb_2O_5-SiO_2$, 1956-59.
The quench technique for silicate equilibria studies is being used to find the fields of primary crystallization in a substantial portion of this ternary system. A phase having X-ray properties similar to natural niocalite occurs in this system. The optical niobates have been determined. See "Compounds in the $CaO-Nb_2O_5$ System" presented at 7th Ann. Conf. of the Industrial Applications of X-rays, Denver, Aug. 1958.

333. Reinhardt, E. W., Univ. of Saskatchewan:
Petrology and Mineralogy of a Radioactive Area, Northwestern Saskatchewan, 1958-59; M.Sc. thesis.

334. Remick, J. H., Quebec Department of Mines:
Some Anorthosites of the Chibougamau Region, Quebec. Presented to Michigan Academy of Science, Arts and Letters, Detroit, March 22, 1957.
A Chart Showing the Spheres of Influence of Atoms and Ions in Minerals, American Min., vol. 43, Jan.-Feb., pp. 166-168, 1958.

335. Shephard, Norman, Univ. of Toronto:
Petrology and Mineralogy of the Cross Lake Area, Ungava, Quebec, 1957-59; Ph.D. thesis.
A study of the mineralogy and petrography of the peridotites, mineralization and the associated rocks in a part of the Wakeham Bay-Cape Smith mineralized belt. The purpose is to determine the origin and significance of the peridotites and the relationship of the mineralization to them. The study is based on field work for the American Smelting and Refining Company and the Quebec Bureau of Mines.

336. Smith, C. H., and MacGregor, I. D., Geol. Surv., Canada:
Study of Mineralogical Petrographical, and Chemical Variations in the Mount Albert Ultrabasic Intrusion, Quebec, 1957-60.
The purpose is to test the chemical homogeneity of the intrusion and to set up techniques for the study of other ultrabasic bodies, and to determine whether optical, X-ray, or chemical analyses will be preferable in future work in connection with the study of ultrabasic rocks of Canada.

337. Stevenson, John S., McGill Univ.:
Mineralogical and Structural Studies, Bridge River Mining Camp, B.C., 1947-59.
Mineralogical and Structural Studies Sudbury Nickel Irruptive, Sudbury, Ontario, 1951-

338. Stevenson, John S., McGill Univ. and MacIntosh, John, Royal Victoria Hospital:
Mineralogical and Petrographical Study of Nasal Calculus, 1958-

339. Traill, R. J., Geol. Surv., Canada:
The Compilation of an Up-to-date List of Canadian Mineral Occurrences, Including All Available Analytical Data, 1958 60.

340. Traill, R. J., and Sabina, A. P., Geol. Surv., Canada:
Preparation of X-ray Powder Photographs of Minerals, 1949-
The preparation of a collection of photographs of material identified accurately by chemical or other means, and the development of new techniques in powder photography.

MINERAL DEPOSITS

Base Metals

341. Anderson, G. M., Grad. Stud., Univ. of Toronto:
Solubility of Lead Sulphide in Hydrogen Sulphide-Water Mixtures at Low Temperatures, 1957-59.

342. Azzaria, L. M., Grad. Stud., Univ. of Toronto:
Distribution of Copper, Lead, and Zinc in the Minerals of a Granite, 1957-59.

343. Benson, David, G., McGill Univ.:
The Mineralogy of the New Brunswick Sulphide Deposits, 1956-59; Ph.D. thesis.

344. Boyle, R. W., Geol. Surv., Canada:
Geochemistry of the Bathurst-Newcastle District, N.B., 1957-59.
To provide information on the geochemistry of the gossans, supergene and primary phases of the base-metal deposits of the district, and to evaluate the geochemical prospecting techniques used in that district by mining and exploration companies.

345. Boyle, R. W., and Wanless, R. K., Geol. Surv., Canada:
Lead and Sulphur Isotope Geology of Keno and Galena Hills, Yukon Territory, 1958-59.
To determine the isotopic abundances of lead and sulphur in the lead-zinc-sulphur deposits and their host rocks, and from the data to determine if possible the source of the elements in the deposits and the processes which have lead to their concentration.

346. Boyle, R.W., Geol. Surv., Canada:
Lead Ores of the Mayo Mining Camp, 1953-58.
Investigation of the nature, geochemistry origin and mode of formation of the silver-lead ores.

347. Buckley, R. A., McGill Univ.:
The Geology of the Weedon Mine, Weedon Tp., Quebec, 1958-59; M.Sc. thesis.

348. Carr, J.M., British Columbia Department of Mines:
Study of Guichon Batholith with Particular Reference to Mineralization in Highland Valley, 1957-59.

349. Carswell, H. T., Queen's Univ.:
Mineralographic and Chemical Studies of Banded Lead-Zinc Ores of British Columbia, 1958-60; Ph.D. thesis.
This study is being carried out in collaboration with the Consolidated Mining and Smelting Co. of Canada, Limited. It will include, besides mineralographic studies, complete chemical analyses (trace elements) on various horizons.

350. Coats, Colin, Queen's Univ.:
Origin of Copper-Nickel Mineralization in Gabbroic Intrusive, Uchi Lake, Ontario, 1957-59; M.Sc. thesis.

351. Colwell, J. A., Queen's Univ.:
Mineralographic and Chemical Study of Bedded Copper-Zinc Deposits, New Brunswick, 1958-60; M.Sc. thesis.

352. Faulkner, E. L., Univ. of Saskatchewan:
X-Ray Analysis of Pyrite-Pyrrhotite, Northern Saskatchewan, 1958-60; M.Sc. thesis.

353. Fraser, D. C., Univ. of New Brunswick:
Study of Recent Copper-Rich Sediments near Dorchester, New Brunswick, 1958-60; M.Sc. thesis.

354. Gill, J. E., and Meikle, B. K., and Guy-Bray, J. B., McGill Univ.:
Behaviour of Copper Sulphides at Elevated Temperatures Alone and in Contact with Silicates, 1954-

355. Hawkins, Wm. M., McGill Univ.:
Spectrochemical Study of Rocks Associated with the Sulphide Ore Deposits of Chibougamau District, Quebec, 1958-59; Ph.D. thesis.

356. Hawley, J. E. and Stanton, R. L., Queen's Univ.:
Mineralogy of the Sudbury Ores and Their Genesis, 1956-59.
This study includes a detailed mineralographic and geochemical investigation of the Sudbury ores. The manuscript is in course of preparation. See "Michenerite and Froodite, Palladium Bismuthide Minerals", Canadian Mineralogist, vol. 6, pt. II, p. 200-209.

357. Hill, Patrick Arthur, Carleton Univ.:
Structure and Mineralization, Thompson Lake, Northwest Territories, 1948-60.
Includes analyses of joint systems and study of aplites and pegmatites and their zoning in relation to structure; mineralization of Thompson Lake area; and metasomatism of Thompson Lake area as evidenced by mineral veinlets.
Pyritization and Gossanization, 1955-59.
Includes study of forms of pyrite and their significance, gossanization of pyritic deposits and role of phosphorous (if any) in gossanization. See "Banded Pyrite of Minas Carlota, Cuba", Econ. Geol., Dec. 1958.

358. Jeffery, W. G., McGill Univ.:
Geology of the Campbell Chibougamau Mine, Quebec, 1956-59; Ph. D. thesis.

359. Jones, R. A., Univ. of New Brunswick:
Genesis of Massive Sulphide Deposits, Bathurst District, N. B., 1957-59; M. Sc. thesis.

360. Kirkland, S. J. T., Saskatchewan Department of Mineral Resources:
Geology of the Brabant Lake Area, Northern Saskatchewan, 1 inch to 1/2 mile, 1958-59.
Detailed mapping of an area containing an interesting copper-zinc deposit.

361. Loudon, J. R., Univ. of Toronto:
Study of Porphyry Rocks from the Devil's Elbow Area, N. B., 1956-59; Ph. D. thesis.
An investigation of the petrography and mineralogy of "porphyries" in this area to throw some light on the significance of these rocks which are so often associated more or less closely with base metal ores in the Bathurst area.

362. McConnell, George W., Grad. Stud., Univ. of Toronto:
The Ore Deposits of the Brunswick Mining and Smelting Co., New Brunswick, 1958-59.

363. Milligan, G. C., Manitoba Mines Branch (part-time), Dalhousie Univ.:
Geology and Mineral Deposits Lynn Lake Area, Manitoba, 1 inch to 1 mile, 1954-59.
Comprehensive study of the geology, structure, metamorphism and mineral occurrences of the entire Lynn Lake district, based on work of previous geologists and several summers field work by the author.

364. Moore, J. M., and Emslie, R. S., (part-time) Manitoba Mines Branch:
Lynn Lake-Frances Lake Area, Manitoba, 4 inches to 1 mile, 1958-60.
A detailed study of a small area around and south of Lynn Lake with special emphasis on the "gabbro" intrusions which form the host rocks for the nickel deposits. Mr. Emslie will make a laboratory and field study of the gabbro as part of his Ph. D. thesis at Northwestern University.

365. Muraro, T. W., Queen's Univ.:
Origin of the Lardeau Lead-Zinc Mineralization, British Columbia, 1958-59; M. Sc. thesis.

366. Patterson, J. M., Manitoba Mines Branch (part-time), Univ. of Manitoba:
Geology of Moak-Lake-Burntwood River Area, Man., 1 inch to 1 mile, 1958-60.
Supplementing the field and normal laboratory studies will be a detailed study of metamorphism, the basic intrusions, and nickel mineralization with special emphasis on genesis. These detailed studies are being carried out by J. M. Patterson (Ph. D. thesis) and J. A. McDonald (M. Sc. thesis) at the University of Manitoba.
Metamorphism and Its Relation to the Cu-Ni Deposits of the Moak-Mystery Lake Area, Manitoba, 1957-60; Ph. D. thesis.
A study of regional metamorphism in Moak-Mystery Lake area plus experimental work on nickel silicates under heat and pressure.

367. Pearson, W. J., and Froese, E., Saskatchewan Department of Mineral Resources:
Geology of the Forbes Lake Area, Northern Saskatchewan 1 inch to 1 mile, 1957-59.
Particular attention will be paid to pyrrhotite bodies occuring in the area. The area has been covered by airborne geophysical surveys and by airphoto interpretation. Geological mapping will therefore be of particular interest.

368. Petruk, W., McGill Univ.:
The Clearwater Copper-Zinc Deposit and Its Setting, 1957-59; Ph. D. thesis.

369. Raychaudhuri, S. K., McGill Univ.:
Trace Elements in Sulphide Deposits of Chibougamau District, Quebec, 1957-59; Ph. D. thesis.

370. Riddell, J. E., Carleton Univ. and Gleeson, C., McGill Univ.:
The Dispersion of Copper-Lead-Zinc and Nickel in Areas Covered by Bog and Muskeg, 1957-59.
This research is an attempt to determine the factors controlling metal dispersion in bog and muskeg in order to explain anonymously high values in certain organic soils of these areas. This project was started with the cooperation and backing of Kennco Explorations, Limited.

371. Shepherd, Norman, Univ. of Toronto:
Petrology and Mineralogy of the Cross Lake Area, Ungava, Quebec, 1957-59; Ph.D. thesis.
A study of the mineralogy and petrology of the peridotites, associated mineralization and the associated rocks in part of the Wakeham Bay-Cape Smith mineralized belt. The purpose is to determine the origin and significance of the peridotites and the relationship of the mineralization to them. The study is based on field work for the American Smelting and Refining Company and the Quebec Bureau of Mines.

372. Relly, B.H., McGill Univ.:
The Geology of Buchans Mine, Newfoundland, 1957-59; Ph.D. thesis.

373. Sims, Walter A., McGill Univ.:
Sorption of Base Metals on Clay, 1956-59.

374. Spring, Val, Univ. of Toronto:
Wallrock Alteration at Opemiska Mine, Quebec, 1958-59; M.Sc. thesis.

375. Stevenson, John S., McGill Univ.:
Mineralogical and Structural Studies, Sudbury Nickel Irruptive, Sudbury, Ontario, 1951.

376. Vollo, N.B., McGill Univ.:
The Geology of the Henderson Copper Deposit, Chibougamau District, Quebec, 1957-59; M.Sc. thesis.

377. Wanless, R. K., and Lowdon, J. A., Geol. Surv., Canada:
Isotopic Study of Canadian Ore Leads, 1956-
The objectives are to determine the lead (and possibly sulphur) isotope distribution in lead ores; to investigate possilbe isotope variations with geological environment; to determine the direction and magnitude of isotopic fractionation of lead isotopes as a result of chemical and physical processes in nature; and when applicable, to establish the age, employing the "common lead" method of dating.

378. Westervelt, R. D., Queen's Univ.:
Geochemical Study of the Bluebell Lead-Zinc Deposit, B.C., 1957-59; M.Sc. thesis.
Particular attention has been given to geothermometric methods applicable to mineralization in limestone and siliceous zones.

379. Williams, H., Geol. Surv., Canada (part-time):
Detailed Mapping of the Chisel Lake Map-area, Man., 1958-59; Ph.D. thesis, Univ. of Toronto.
Includes a petrographic study of the metamorphic rocks.

Ferrous Metals

380. Bergeron, R., Quebec Department of Mines:
Quebec, A Future Iron Kingdom, Educational Record, vol. XXIV, No. 3, July-Sept., pp. 195-200, 1958.

381. Duffell, S., Geol. Surv., Canada:
Iron Range and West half of the Mount Wright Map-area, Southwest Labrador and New Quebec, 1 inch to 4 miles, 1956-58.
Geological mapping and study of the developments and geological problems of the Iron Range.

382. Giblin, P. E., Grad. Stud., Univ. of Toronto:
The Origin of Iron Ores in Mayo Tp., 1955-59.

383. Gross, G.A., Geol. Surv., Canada:
Iron Deposits of Canada, 1957-
To provide information on the size, composition, mode of occurrence, origin, potentialities, and other geological features of the main known iron deposits of Canada. Initial work has been mainly in New Quebec, Labrador and Newfoundland, and Ontario.

384. Kidd, Donald J., Research Council of Alberta:
Diagenesis of Ferruginous Sediments, 1956-61.
Results of preliminary work on Clear Hills oolitic goethite sandstone are still under study. See "Stability Relations of Hematite and Goethite in Neutral and Alkaline Solutions at Elevated Temperatures and Pressures", Amer. Min. 1949.
Geochemistry of Beryllium 1956-60.
Both projects will be continued when new bombs with better control of temperature and pressure are ready in 1959.

385. Lapointe, Guy, Univ. of Manitoba:
Diffusion of TiO_2 Content of Magnetite by Granitization, 1958-59; M.Sc. thesis.
In magnetite-ilmenite segregation deposits where there is ilmenite in excess, the TiO_2 in magnetite should be of the order of 5% to 20 %. This fact does not hold true in a deposit of this sort situated in Lake St. John area, Que. The reason for the anomaly is believed to be granitization by an intrusive pegmatitic granite into the orebody, or regional metamorphism, or of the action of both combined.

386. Machamer, J. F., McGill Univ.:
The Geology of the Forsyth and Associated Iron Deposits, Hull Tp., Quebec, 1958-59; M.Sc. thesis.

387. Riddell, J. E., Carleton Univ.:
Dispersion of Iron and Manganese in Glaciated Terrains, 1957-58.
An investigation into the application of geochemical techniques to the detection of enriched iron ore formations in glaciated terrains.
The Application of Atomized Suspension Technique Reactor to the Reduction of Titaniferous Magnetite Ore, 1957-58.
This project was carried out under Dr. Riddell's direction in the laboratories of the Canadian Pulp and Paper Research Institute and the Geochemical Laboratories at McGill University.

388. Spat, A. G., McGill Univ.:
Iron Formation and Associated Rocks in Mount Wright Area, Que., 1958-59; M.Sc. thesis.

Other Metals

389. Campbell, Finley, A., Univ. of Alberta:
Geology of Torbrit Silver Mine, B.C., 1956-59.

390. Cheesman, D. R., Grad. Stud., Univ. of Toronto:
A Study of Manganese Deposits in the Maritime Provinces, 1958-59.

391. Gill, J. E., McGill Univ.:
Gold Deposits of the Malartic District, 1950.

392. Johnston, F. J., Univ. of New Brunswick:
Geology of the Stratmat Pine Lake Ore Zone, 1957-58; M.Sc. thesis.

393. Lewis, Wm. L., Grad. Stud., Acadia Univ.:
Possibilities of Placer Gold Deposits in Southwestern Nova Scotia, 1958-59.

394. Parsons, G. E., Ontario Department of Mines (part-time)
Niobium Deposits in the District of Algoma and Sudbury, Ontario, 1958.

395. Vokes, F. M., Geol. Surv., Canada:
Molybdenum Deposits of Canada:
To study problems related to the geology, origin and distribution of molybdenum deposits to permit preparation of a comprehensive report including the results of these studies and summaries of published data, many of which are out of print.

Radioactive Deposits

396. Bell, C. K., Geol. Surv., Canada:
Milliken Lake Map-area, Northern Saskatchewan 1954-58.
Detailed mapping with special reference to radioactive mineral deposits.

397. Eichholz, G. G., Mines Branch, Dept. Mines and Technical Surveys:
Radiometric Assaying of Uranium and Thorium Ores, 1951-59.
The remaining work is mainly concerned with a comparison of methods for determining small amounts of thorium in the presence of large proportions of uranium. A considerable amount of experimental results is on hand and requires correlation.
See "The Determination of Uranium and Thorium in Ores", Can. Jour. of Physics, vol. 31, 613, 1952.

398. Hogarth, Donald D., McGill Univ.:
A Study of Certain Minerals of the Pyrochlore and Betafite Groups, 1956-59; Ph. D. thesis.

399. Horwood, J. L., Mines Branch, Dept. Mines and Technical Surveys:
Degradation of Gamma-ray Spectra from Uranium and Thorium Ores on Passage Through Rocks and Soil, 1958-59.
Determination of changes in characteristic gamma-ray spectra from uranium and thorium ores as a result of scattering effects in overlaying rocks and soil. This is expected to assist in developing improved methods for aerial radioactive surveys.

400. Kaiman, S., Mines Branch, Dept. Mines and Technical Surveys:
Uranium Minerals in Leach Residues of Blind River Ores. 1959.
The study of acid leach residues to determine the mineralogical nature of the refractory uranium, in connection with a general metallurgical study of the Blind River ore.

401. Kaiman, S., and Hughson, M. R., Mines Branch, Dept. Mines and Technical Surveys:
Mineralogical Reports on Radioactive Ore Samples
These reports cover the mineralogical composition of radioactive ores and mill products. Their main purpose is to supply mineralogical information in connection with ore treatment investigations.

402. Lang, A. H., Field Studies of Uranium Deposits, a continuing project.
The investigation of geology, structure, mineralogy, origin, age and economics of uranium and other radioactive mineral deposits of Canada.

403. Lang, A. H., and Steacy, H. R., Geol. Surv., Canada:
Laboratory Investigation of Samples of Radioactive Substances and Filing, Collating, and Abstracting Other Information Supplied Under the Regulations of the Atomic Energy Control Board, 1945-
To maintain a complete inventory of all occurrences of uranium and thorium deposits in Canada and to aid in the discovery and exploitation of such deposits by making deductions and generalizations from this data.

404. Milne, Victor G., Univ. of Toronto:
The Non-Radioactive Heavy Minerals in the Uraniferous Conglomerate, Blind River, Ont., 1957-58; M. A. thesis.
An X-ray and optical study of the heavy minerals in the Blind River conglomerate ore-zone, to determine the character and proportions of the heavy minerals other than the radioactive minerals.

405. Morrison, D. R., McGill Univ.:
Geology of a Portion of Central Labrador, Including Some Uranium Deposits, 1957-59; Ph. D. thesis.

406. Patchett, J. E., Univ. of Toronto:
A Study of the Radioactive Minerals of the Uraniferous Conglomerate, Blind River Area, Ontario, 1957-59; Ph. D. thesis.
An attempt to determine nature, proportions and origin of the radioactive minerals in a typical ore zone in the Blind River area. Will include X-ray and optical studies, and selection of material for age determination.

407. Pienaar, P. J., Queen's Univ.:
The Stratigraphy, Petrography and Genesis of the Elliott Group, Including the Uraniferous Conglomerates, Quirke Lake Syncline, Ontario, 1956-58; Ph.D. thesis. In collaboration with the Geological Survey of Canada.

408. Reinhardt, E. W., Univ. of Saskatchewan:
Petrology and mineralogy of a Radioactive Area, Northwestern Saskatchewan, 1958-59; M.Sc. thesis.

409. Robertson, James A., Queen's Univ.:
Geology of a Part of the Blind River Uranium Area, Ontario, 1957-59; M.Sc. thesis.
In collaboration with the Ontario Department of Mines.

410. Robinson, S. C., and Sabina, A. P., Geol. Surv., Canada:
Investigation of the Variation in the Lattice Parameter of Specimens of Pitchblende and Uraninite from Various Localities, 1948-58.
To ascertain whether variations can be attributed to any of the following: (1) different mineralogical provinces, (2) age of the deposits, (3) degree of alteration, and (4) variations in a solid solution series.

411. Sinclair, B. D., Queen's Univ.:
Alteration Zones along Diabase Dykes and Faults in the Algoma Uranium Area, Ontario, 1958-59; M.Sc. thesis.

412. Steacy, H. R., Griffith, J. W., and Traill, R. J., Geol. Surv., Canada:
Laboratory Investigation of Uraninite in Greywacke from Creelman Township, Sudbury District, Ont., 1958.
To describe the mode of occurrence, mineralogy age, and other geological features of this unusual radioactive deposit; and to demonstrate (or otherwise) the presumably detrital origin of the uraninite found in greywacke interlayered with Gowganda conglomerate.

413. Thomson, J. E., Ontario Department of Mines:
Uranium Deposits in the District of Sudbury, Ont. 1958.

414. Tremblay, L. P., Geol. Surv., Canada:
Geology of the Beaverlodge Area, Athabasca Lake, Sask., 1952-57.
Standard detailed mapping on 1 inch to 1,000 feet, with special reference to radioactive mineral deposits.

Industrial Minerals

415. Bannatyne, Barry B., Manitoba Mines Branch:
The Geology of the Gypsum and Anhydrite Deposits of Manitoba, 1958-59.

416. Bourret, P. E., Quebec Dept. of Mines:
Industrial Minerals Investigations.
A continuing program of investigation with the purpose of advising owners as to the value of industrial mineral deposits and to furnish information regarding the developing, mining, milling and marketing of their product.

417. Brady, J. G., Buchanan, R. M., and Sadler, A. G., Mines Branch, Dept. Mines and Technical Surveys:
Mineralogical Constitution and Physical and Chemical Properties of Canadian Clay, 1958-
The principal aim is to determine the types and characteristics of Canadian clays, and to compile such information for publication. However, most of this work will be related to industrial applications of clays. It is expected that the work will break down into several projects.

418. Brownell, George M., Univ. of Manitoba:
A Beryllium Detector for Field Exploration, 1957-58.
A scintillation counter has been developed for detection of beryllium in rocks and minerals. Also a technique has been worked out for determining the content of beryllium in samples. The instrument, named a "Berylometer" has been developed and is now available in a portable form for field exploration and prospecting.

419. Byrne, T. J. S., and Farvolden, R. N., Research Council of Alberta:
Clay Mineralogy of the Bearpaw Shale, 1955-59.

420. Gillespie, C. R., Newfoundland Dept. Mines and Resources:
Brick Shales of Eastern Newfoundland, 1959-
Includes the detailed mapping, sampling and laboratory testing of Cambrian and Ordovician shales with special emphasis on their buff brick potential.
Manuels Pyrophyllite Deposit, Conception Bay, Newfoundland, 1956-59.
A study of the nature and extent of a pyrophyllite deposit based on the evidence of extensive diamond drilling.

421. Gravenor, C. P., and Govett, G. J., Research Council of Alberta:

Rate of Dissolution of Silicates, 1958-59.

The project is designed to measure the rates of dissolution of nepheline under varying pH and temperature conditions. Rates of dissolution will be calculated by chemical analysis and weight loss determinations. See "Weathering of Silicates", A. A. P. G., October, 1958.

422. Haw, V. A., Mines Branch, Dept. Mines and Technical Surveys:

Petrography of Stone, Sand and Gravel; Applied to Their Use as Aggregate in Concrete, 1958-

The purpose of the work is to determine the petrographic characteristics of rock bearing on the durability of aggregates in concrete.

423. Hewitt, D. F., Ontario Department of Mines:

Limestone Deposits in Southern Ontario, 1958.

424. Maycock, B. A., Queen's Univ.:

The Ordovician Limestones of the Kingston Area, Their Composition, Distribution and Use in Concrete Aggregate, 1957-59; M. Sc. thesis.

425. McKillop, J. H., Newfoundland Dept. Mines and Resources:

Limestone Deposits at Humbermouth, Newfoundland, 1958-59.

The compilation and analytical study of the results of extensive diamond drilling with particular attention to zones of low magnesium limestone.

Chromite in Newfoundland, 1959-

The economic reassessment of chromite occurrences, employing detailed geological mapping and modern geophysical and sampling techniques, to be supplemented as warranted, by diamond drilling programs.

Gypsum Deposits at Flat Bay, Newfoundland, 1956-

Involves geological mapping, diamond drilling and chemical analysis of an existing deposit and further assessment of the gypsum potential of the general district.

426. Paquet, Raymond, Quebec Dept. of Mines:

Industrial Minerals Investigations.

A continuing program of investigations, with the purpose of advising owners as to the value of industrial mineral deposits and to furnish information regarding the developing, milling and marketing of their product.

427. Pare, Conrad, Quebec Dept. of Mines:
Industrial Minerals Investigations.
A continuing program of investigations with the purpose of advising owners as to the value of industrial mineral deposits and to furnish information regarding the developing, mining, milling and marketing of their product.

428. Pearson, W. J., Saskatchewan Dept. of Mineral Resources:
Industrial Minerals in Saskatchewan, 1958-
Work will be particularly concerned with the extent, mineralogical nature and the mode of origin of the potash deposits of Saskatchewan.

429. Perkins, G. D., Univ. of Saskatchewan:
Sedimentary Structures of the Shaft of the Potash Corp., of America, Saskatoon, Sask., 1958-59; M. Sc. thesis.

Petroleum

430. Belyea, H. E., Maxwell, J. A., and Wanless, R. K., Geol. Surv., Canada:
Isotopic Studies of Sulphur from Canadian Petroleum Deposits, 1955-
To determine whether variations in the isotopic composition of sulphur derived from petroleum, from oil field waters and from petroleum-bearing strata can be used to aid in correlation and dating of strata at and near petroleum-bearing horizons, and in determining the source rocks from which petroleum in various fields was originally derived.

431. Caley, J. F., and Sanford, B. V., Geol. Surv., Canada:
Studies of Drift Thickness and Bedrock Topography in Southern Ontario, 1948-
By means of bore-hole data to determine the Pre-Pleistocene bedrock topography and the drift thickness and to deduce the preglacial drainage and the probable location of reservoirs of groundwater. Because the pre-Pleistocene topography may reflect the underlined structure of the bedrock, this knowledge will assist in the search for oil and natural gas.

432. Cameron, E. M., Geol. Surv., Canada:
Geochemistry of Sandstones, 1958-
To determine the geochemical characteristics of sandstones that may be of importance to the petroleum industry.

433. Burwash, R. A., Univ. of Alberta:
Age Relations of Granites in the Western Canadian Shield, Exposed and Buried, 1958-
See "Age of the Alberta Precambrian Basement", Journal of the Alberta Soc. of Petroleum Geologists, vol. 6, No. 9, 1958.

434. Edmunds, F. H., Univ. of Saskatchewan:
Geology of the Lloydminster Oil Field.

435. Hogg, Wm. A., McGill Univ.:
Building and Industrial Stones of Eastern Canada, 1955-59; Ph. D. thesis.

436. Horn, R.D.R., Univ. of Saskatchewan:
Mississippian of the Steelman Oilfield, Sask., 1958-59; M.Sc. thesis.

437. Kramar, James R., N.R.C., Post-doctorate Fellow, Univ. of Western Ontario:
Geochemical Facies Analysis of Salina Formation in Southwestern Ontario, 1958-59.
Includes detailed chemical analysis of 1 to 2,000 samples of the Salina formation (a) to determine the nature of the sea that covered southwestern Ontario and surrounding areas during Silurian Salina time (b) to correlate the chemistry of the Salina rocks with known petroliferous areas, and (c) to deduce probable petroliferous areas from the information obtained in (a) and (b)
Geochemistry of Calcite, Dolomite, and Aragonite in Sea Water, 1955-
Includes (a) determination of solubility products of calcite, dolomite, and aragonite in well brines (b) verification of solubility product values (see reference) in sea water (c) effect of amino acids on calcite, dolomite, and aragonite equilibria in sea water to interpret the oceanographic invironment in which calcite, dolomite and aragonite form. See Kramer, J.R. (1958) Study of Calcite and Dolomite in Sea Water; (abstract) Geol. Soc. America Annual Meeting, St. Louis.

438. Magas, I.O., Saskatchewan Dept. of Mineral Resources:
Study of the Glen-Ewen Oilfield, 1959.
A general study of the reservoir beds.

439. Riddell, J. E., Carleton Univ., and Sikka, D.B., McGill Univ.:
Radioactive Anomalies Related to Gas and Oil Fields, 1956-59.

440. Sanford, B. V., and Quillian, R. G., Geol. Surv., Canada:
Sub-surface Studies of Each of the Palaeozoic Systems of Southwestern Ontario (Cambrian, Ordovician, Silurian, and Devonian), 1958-61.
By the study of samples and data obtained from wells drilled for oil and gas, to describe and interpret the geological features of the formations of each system and to assess their economic potentialities.

441. Sikka, D. B., McGill Univ.:
Radiometric Survey of Redwater Oilfield, Alberta, Canada, 1956-59; Ph.D. thesis.

442. Stott, D. F., Geol. Surv., Canada:
Cretaceous of Western Foothills, 1958-60.
Stratigraphic palaeontological study of Cretaceous strata with emphasis on their possibilities as a source of fossil fuels.

Coal

443. Blanchard, J. E., Nova Scotia Research Foundation:
A Study of the Energy Released by Bumps in the Springhill Coal Mine Area, Nova Scotia. 1956-59.
This work is being done in cooperation with the Dominion Observatory and the Mines Branch of the Department of Mines and Technical Surveys, Ottawa. Records of the microseismic activity in the Springhill area were obtained using a Willmore seismograph. The number and time of microseisms is now being determined and an attempt will be made to correlate these with convergence measurements made at the same time by the Mines Branch of the Department of Mines and Technical Surveys in cooperation with the Nova Scotia Research Foundation.

444. Hacquebard, P. A., Geol. Surv., Canada:
Research on the Petrography and Spore Analysis of Coal, 1948-
Investigations of the character and correlation of the various coal seams in Nova Scotia and Western Canada coal-fields, such as will aid their development. See Geol. Surv., Canada, Bull. 19, "Carboniferous Spore Assemblage in Coal from South Nahanni River", 1958.

445. Latour, B. A., Geol. Surv., Canada:
Coal Reserves of Canada, a continuing project.

446. Montgomery, D. S., and Goodspeed, F., Mines Branch, Dept. of Mines and Technical Surveys:
The Infra-red Adsorption Spectra of Bituminous Substances, 1951-

447. Swartzmann, E., and Burrough, E. J., Mines Branch, and Hacquebard, P., Geol. Surv., Canada:
Study of Coking Characteristics on Laboratory and Plant Scales of Coal Seam Sections in Relation to Petrographic Constituents, 1956-
See "The Value of a Quantitative Separation of the Maceral Vitrinite into its Constituents Telinite and Collinite for the Petrography of Coking Coals", presented by P. A. Hacquebard to International Coal Congress, Sept., 1958.

General Problems

448. Assad, J., Robert, Quebec Dept. of Mines:
Examination of Mining Properties and Development in Chibougamau District.
A continuing program of investigation of mining properties and development work being carried out from year to year in the Chibougamau district.

449. Blanchard, J. E., Nova Scotia Research Foundation:
Theoretical Studies of Electromagnetic Methods of Geophysical Prospecting, 1956-
An attempt is being made to determine the effect of overburden on the resolving power of the various types of electromagnetic prospecting equipment presently being used.

450. Bray, J. V. Guy, McGill Univ.:
Mobility of Certain Sulphides in Sulphur Vapor, 1957-59; M.Sc. thesis.

451. Brown, A., Mines Branch, Dept. Mines and Technical Surveys:
Ground Stress Investigations in Underground Mines, 1950-
A cooperative project with the Geological Survey of Canada, Dominion Observatory, and Provincial Mining Departments and Research Groups.
See "Rock Pressure Investigations in the Spring Hill Mines, Nova Scotia", Mining Section, Fuel Division, Mines Branch, Tech. Memo. 41-58, Feb. 1958, "Ground Stress Investigations in Canadian Coal Mines", Min. Eng., August 1958, "Ground Stress Studies in Coal Mines of Western Canada", C.I.M., Jour., Nov. 1958, "Canadian Ground Stress Investigations", Mines Branch, Invest. Rept. 58-116, May 1958.

452. Brown, A., Sutherland, British Columbia Dept. of Mines:
Studies of Geology and Mineral Deposits of Moresby Island, Queen Charlotte Islands, B. C., 1958-60.
Shore line and land traverses compiled on a 1:50,000 base have yielded information on six accumulations of volcanic rocks of two ages separated by a layer of sedimentary rocks, and by a variety of plutonic bodies including granitic and monzonitic masses and hornblende-diorite in batholithic proportions.

453. Clark, Lloyd A., McGill Univ.:
Phase Relations in the System Fe-As-S, 1957-59; Ph.D. thesis.

454. Clark, T. H., McGill Univ.:
Structure, Stratigraphy, Palaeontology and Economic Possibilities of the Palaeozoic Rocks of the St. Lawrence Lowland of Quebec, 1938-62.
See Quebec Dept. Mines, Geol. Rept. No. 66, Bel Oeil, St. Jean Area, 1956.

455. Collett, L. S., Wesemeyer, H., and Krapp, H., Geol. Surv., Canada:
Nuclear Adsorption Studies, 1956.
The investigation of the capabilities of the nuclear resonance adsorption technique for determining buried mineral deposits.

456. Deland, Andre, Quebec Dept. of Mines:
Examination of Mining Properties and Development in Montreal District, Quebec.
A continuing program of investigation of mining properties and development work being carried out from year to year in the Montreal district.

457. Dugas, Jean, Quebec Dept. of Mines:
Examination of Mining Properties and Development in Rouyn-Noranda, District, Quebec.
A continuing program of investigations of mining properties and development work being carried out from year to year in the Rouyn-Noranda district.

458. Dugas, Jean, Dept. of Mines:
Compilation of the Geology of the Rouyn-Noranda District, Quebec.
A continuing program over a period of years; maps are issued at the scale of 1 inch equals 1,000 feet and cover one quarter of a township each.

459. Ghose, Santanu Kumar, Univ. of Manitoba:
Compilation of the Data on Metal Composition of Canadian Ore Deposits, 1958-59; M.Sc. thesis.

460. Gleeson, Christopher, F., McGill Univ.:
Studies of the Distribution of Metals in Muskegs and Lakes, 1957-59; Ph.D. thesis.

461. Goldak, G. R., Univ. of Saskatchewan:
X-ray Geothermometry of Mineral Deposits, Brabant Lake, Sask., 1958-59; M.Sc. thesis.

462. Grenier, D. E., Quebec Dept. of Mines:
Examination of Mining Properties and Development in Quebec District, Quebec.
A continuing program of investigation of mining properties and development work being carried out from year to year in the Quebec district.

463. Halferdahl, L. D., Research Council of Alberta:
Heavy Minerals in River Sediments in Alberta, 1957-

464. Hansuld, John A., McGill Univ.:
Electrochemical Studies and Ore Deposition, 1958-60; Ph.D. thesis.

465. Haycock, M. H., Mines Branch, Dept. Mines and Technical Surveys:
Research in Ore Microscopy - Development of Apparatus for Determining the Spectral Reflectivity of Ore Minerals, 1955-
This is the first step in a project designed to exploit the application of electronics to the field of mineralogy.

466. Holman, R. H. C., Geol. Surv., Canada:
Geochemical Exploration of Nova Scotia, 1956-58.
To explore by chemical means as much of southwestern Nova Scotia as practicable in an effort to locate and outline areas likely to contain valuable deposits of base or other metals.
See Geol. Surv., Canada Paper 58-1.

467. Jones, R. E., McMaster Univ.:
Sulphur Isotope Ratios in Sulphide and Sulphate Minerals in Rocks of Niagara Escarpment, 1958-60.

468. Lang, A. H., and Staff, Geol. Surv., Canada:
Preparation of a Series of Metallogenic Maps of Canada, 1957-62.
The preparation for publication of maps of Canada for selected metals, and perhaps nonmetallic minerals, and to aid in elucidating metallogenic provinces and to supply information useful in selecting areas for prospecting.
See Geol. Surv. Maps 1045-A-M1 and Beryllium.

469. Latulippe, Maurice, Quebec Dept. of Mines:
Compilation of the Geology of the Val d'Or district, Quebec.
A continuing program over a period of years; maps are issued at the scale of 1 in. to 1,000 ft. and cover one quarter of a township each.
Examination of Mining Properties and Development in Val d'Or District, Quebec.
A continuing program of investigation of mining properties and development work being carried out from year to year in the Val d'Or district.

470. McLeod, C.R., Geol. Surv., Canada:
Heavy Minerals of Beach and Other Placer Deposits in Canada, 1957-59.
To provide data concerning the occurrence in beaches, beach placers, and similar deposits, of minerals of commercial or possible commercial importance; and to test and improve techniques for detecting and evaluating such occurrences. Initial work has been mainly in New Brunswick, Nova Scotia and Prince Edward Island.

471. Meikle, D.K., McGill Univ.:
The Behaviour of Cu S at Elevated Temperatures in the Presence of Silicates, 1957-59; Ph.D. thesis.

472. Mloszewski, M.J. Grad. Stud., Univ. of Toronto:
Solubility of Zinc Sulphide in Hydrogen Sulphide-Water Mixtures at Elevated Temperatures and Pressures, 1957-59.

473. Moorhouse, W.W., Univ. of Toronto:
Petrography of Vein Deposits, 1958-
A compilation of information in the literature, plus original investigation of the textures and structures of vein deposits as seen in thin sections. This study is particularly concerned with other than gold veins.
Studies of Precambrian Sediments, 1950-
This study is presently concerned primarily with sedimentation features of the Animikie iron formations and is based on field work for the Ontario Dept. Mines.

474. Norris, D.K., Geol. Surv., Canada:
Carbondale Map-area, Alberta, 1 inch to 1 mile, 1958.
Geological mapping with special emphasis on the evaluation of oil, gas and coal possibilities.

475. Rondot, Jehan, Quebec Dept. of Mines:
Quelques Considerations sur la Tectonique et les Resources Minieres de la Turquie.
Presented Nov. 2, 1957, to the 25th Congress de L'A.C.F.A.S.
Zoneographie des Roches Cristallophylliences d'apres Maurice Roques.
Presented Mar. 20, 1958, to La Societe Geologique de Quebec.

476. Saull, V. A., McGill Univ.:
Silicate and Sulphide Phase Relationships, 1953-
Involves experiments with silicates and sulphides at high pressures and temperatures.
See A New Method of Determining Solubilities of Sulphides, Econ. Geol. (In press) by B. H. Relly.

477. Smith, C. H., Geol. Surv., Canada:
Ultrabasic Intrusions of Canada, 1957.
Detailed mapping of representative ultrabasic intrusions with special emphasis on their scientific and economic features. Probably will include study of intrusions in Tulameen, B. C., Bird River, Manitoba; Thetford, Gaspe, Quebec; and Bay of Islands, Newfoundland.

478. Smith, F. G., Univ. of Toronto:
Thermodynamics of Solution of Metallic Sulphides in Water, 1957-60.

479. Soles, James A., McGill Univ.:
Experimental Studies of Transportation and Deposition of Sulphide in an Open System at High Temperatures and Pressures, 1957-59;
Ph.D. thesis.

480. Stevenson, John S., McGill Univ.:
Mineralogical and Structural Studies, Bridge River Mining Camp, B. C., 1947-59.

481. Warren, Harry V., Delavault, R. E., and Boyle, S., Univ. of British Columbia:
Biogeochemical Prospecting, 1945-60.
This work now shows enough evidence to justify hope that before long it will be possible to designate geochemical districts, and on the basis of either, or both stream sediments and rocks, to determine the suitability of a district for prospecting for any specific metal. See "Prospecting for Cobalt" Trans. Royal Soc. Can., Third Series, Sec. IV, Vol. 51, pp. 33-37, June, 1957.

Trace Elements in Rocks, Soils, and Marine and Stream Sediments and Possible Relationships to Ore Formation, 1957-60.

It is becoming increasingly clear that with most metals there is a close relationship between the contents of vegetation and the underlying rocks; this may prove to be of interest to foresters and agriculturalists as well as geologists. See "Rubeanic Acid Field Test for Copper in Soils and Sediments" Mining Engineering, vol. 10, No. 11, pp. 1186-1188, Nov. 1958.

482. Wesemeyer, H., Geol. Surv., Canada:
Electron Spin Resonance at Very Low Fields, 1958-
Investigation as to the feasibility of using the principle of electron spin resonance at very low magnetic fields for prospecting purposes.

483. Wilson, H. D. B., and Grad. Students, Univ. of Manitoba:
Distribution of Metals in Canadian Ore Deposits, 1955-

PALAEONTOLOGY

484. Best, R. V., and Vince, G. J., McMaster Univ.:
Intraspecific Variation in Enerinurus (Glabella), 1958-59.

Variation in a single local population of one species of trilobite may exceed differences accorded specific status in Europe.

485. Best, R. V., McMaster Univ.:
Revision of Olenellid Trilobites of North America, 1956-59; Ph. D. thesis, Princeton University.

The first revision of this family of Lower Cambrian trilobites was made nearly 40 years ago. North American Olenellidae are defined as trilobites with serially developed thorax and no facial sutures. They are distributed among four sub-families (1 new) twelve genera (2 new) and 70 species (13 new). Keys to all taxonomic categories are provided.

486. Brindle, John E., Saskatchewan Dept. of Mineral Resources:
Mississippian Fossils of Southeastern Saskatchewan, 1957-59.
Lower Palaeozoic Fossils of Saskatchewan, 1959-60.

487. Caldwell, W.G.E., Univ. of Saskatchewan:
The Coral-Brachiopod Faunas of Certain Middle Devonian Formations, N.W.T., 1958-
Molluscan Fauna of the Bearpaw Shale, Saskatchewan, 1958-

488. Clark, T. H., McGill Univ.:
Structure, Stratigraphy, Palaeontology, and Economic Possibilities of the Palaeozoic Rocks of the St. Lawrence Lowland of Quebec, 1938-62.
See Quebec Dept. Mines, Geol. Rept. No. 66-Beloeil, St. Jean area, 1956.

489. Copeland, M. J., and Bolton, T. L., Geol. Surv., Canada:
Contributions to Canadian Fossil Arthropoda, 1958-
This project includes the study of genera Echinocaris and Spathiocaris in western Canada, occurrence of Silurian Ceratiocaris in Canadian Arctic, some Canadian Silurian and Devonian Eurypterida, and the preparation of a bibliographic list of Canadian Euripterida.

490. Copeland, M. J., Geol. Surv., Canada:
Jurassic Micro-faunas, 1957-
Stratigraphic palaeontological study with special emphasis on Jurassic ostracod occurrences.

491. Fritz, Madeleine A., and Cranswick, J.S., (deceased), Univ. of Toronto:
Corals of the Upper Abitibi River formation, Ontario, 1950-58.

492. Green, Robert, Research Council of Alberta:
Mississippian Microfaunas of Alberta, 1956-60.
The first stage of the project is a study of the ostracod faunas of the type section of the Banff formation. The second stage will be a study of the ostracod faunas of the type section of the Rundle formation.

493. Greggs, R. G., Univ. of British Columbia:
Cambrian and Ordovician Faunas of the Rocky Mountains near Banff, Alberta, 1957-60; Ph.D. thesis.

494. Hooper, K., Carleton Univ.:
Microradiography of Foraminifera (Including Stereomicroradiography), 1955-
Population Studies of Foraminifera Based upon X-ray Microscopy Techniques.
Biometrical and Statistical Study of the Genus Operculina, 1958-59.

495. Kramer, James R., N. R. C., Post-doctorate Fellow, Univ. of Western Ontario:

Geochemical Facies Analysis of Salina Formation in Southwestern Ontario, 1958-59.

Includes detailed chemical analysis of 1 to 2,000 samples of the Salina formation (a) to determine the nature of the sea that covered southwestern Ontario and surrounding areas during Silurian Salina time, (b) to correlate the chemistry of the Salina rocks with known petroliferous areas, and (c) to deduce probable petroliferous areas from the information obtained in (a) and (b).

Geochemistry of Calcite, Dolomite, and Argonite in Sea Water, 1955-

Includes (a) determination of solubility products of calcite, dolomite, and aragonite in well brines (b) verification of solubility product values (see reference) in sea water (c) effect of amino acids on calcite, dolomite, and aragonite equilibria in sea water to interpret the oceanographic environment in which calcite, dolomite and aragonite form. See Kramer, J. R., (1958) Study of Calcite and Dolomite in Sea Water; (abstract) Geol. Soc. America Annual Meeting St. Louis.

496. Langston, Wann, National Museum of Canada:

Vertebrate Fauna of the Lower St. Mary River Beds at Scabby Butte, Alberta, 1957-59.

Description of dinosaurs and other vertebrate fossils, and discussion of the faunal association.

Vertebrate Faunas of the Foremost and Oldman Formations of Southeastern Alberta, 1957-60.

Field work on this project continued in 1958, and should be completed in 1959.

Vertebrate Fauna of the Oldman and Bearpaw Formations of South Saskatchewan River Valley, Saskatchewan, 1959-61.

A joint survey with the Saskatchewan Museum of Natural History of the area to be flooded by the Saskatchewan Power and Irrigation Project.

497. McCannon, Helen, Manitoba Mines Branch (part-time), Indiana Univ.:

Fauna of the Manitoba Group (Devonian), Manitoba, 1957; Ph. D. thesis.

A study of the fauna, especially brachiopods, from the Manitoba Group (Devonian) as exposed around Lake Winnipegosis.

498. McGugan, Allan, Queen's Univ.:
Upper Cretaceous Foraminifera from Northern Island, 1956-
See "Upper Cretaceous Foraminifera from Northern Island", Journal of Palaeontology, March 1957.
Upper Cretaceous Foraminifera, Vancouver Island Area, British Columbia, 1958-65.
Shell samples from the east coast of Vancouver Island and adjoining islands contain sparse faunas of foraminifera of Upper Cretaceous Age. Preliminary work is proceeding.

499. Merrill, Wm. M., Research Council of Alberta:
Stratigraphy, Sedimentation and Palaeoecology of Terrestrial Rocks which include the Mesozoic Cenezoic Boundary in West Central Alberta, 1958-62.

500. Okulitch, V.J., Univ. of British Columbia:
Continuing Research on the Faunas and Stratigraphy of Lower Cambrian in Western Canada, 1941.
See "Archaeocyathid Localities in Washington, British Columbia and the Yukon Territory", Journal Palaeontology vol 32, no. 3, May, 1958, pp. 617-623.

501. Ollerenshaw, N.C., Univ. of Toronto:
Corals of the Thornloe Formation, Lake Timiskaming, 1956-59; Ph.D. thesis.

502. Rice, H.M.A., Geol. Surv., Canada;
Study of Geological Survey of Canada Collections of Fossil Insects, 1955-
Project includes organization and arrangement of Survey collections, identification of orders, genera and species as far as practicable, consideration of stratigraphic significance of collections, and figuring and description of specimens.

503. Russell, L.S., National Museum of Canada, in collaboration with the Royal Ontario Museum:
The Tertiary Mammalian Faunas of Southern Saskatchewan, 1948-59.
Description of the mammalian Faunas of the Upper Eocene, Lower Oligocene, and Miocene of Southern Saskatchewan.

504. Stelck, C. R., Univ. of Sask., Wall, J. H., Research Council of Alberta, and Grad. Students:
Micropalaeontology of Cretaceous of Western Canada, 1947-
See "Cenomanian Foraminifera of Peace River Area, Western Canada", Res. Coun. of Alberta, Bull. 2, Pt. 1, 1958.

505. Stearn, C. W., McGill Univ.:
Devonian Stromatoporoids of Alberta Rocky Mountains, 1955-59.
See "Devonian Stromatoporoids of the Canadian Rocky Mountains" (Abstract) Geol. Soc. Amer., Bull., December, 1957.

506. Stott, D. F., Geol. Surv., Canada:
Cretaceous of Western Foothills, 1958-60.
Stratigraphic palaeontological study of Cretaceous strata with emphasis on their possibilities as a source of fossil fuels.

507. Thorsteinsson, R., and Tozer, E. T., Geol. Surv., Canada:
Mellville, Brock, Borden and MacKenzie King Islands, District of Franklin, N.W.T., 1958.
Reconnaissance mapping plus stratigraphic-palaeontological studies.

508. Warren, P. S., and Stelck, C. R., Univ. of Alberta:
Mesozoic Invertebrate Studies, 1930-
See "Lower Cenomanian Mollusca of the Peace River Area, Western Canada", Res. Coun. of Alberta, Bull. 2, pt. 2, 1958.

509. Yule, Ray, Univ. of British Columbia:
Upper Devonian Faunas and Their Environmental Relationships, 1958-61; Ph.D. thesis.

510. Wall, John H., Research Council of Alberta:
Jurassic Microfaunas from Saskatchewan, Western Canada, 1954-58; Ph.D. thesis, 1958, Univ. of Missouri.
This project describes, illustrates, and gives the stratigraphic distribution of many of the common species of foraminifera and ostracoda in the Jurassic of Saskatchewan. The stratigraphic and ecological implications of the microfaunal assemblages are discussed.
Microfaunal Study of the Wapiabi and Blackstone Formations in Western Alberta, 1958-61.
It is hoped that a study of the microfaunal assemblages across the interval embracing the Cardium and Bad Heart Sands will assist stratigraphers in the recognition and correlation of the sands.

511. Winder, C.G., with student assistants, Univ. of Western Ontario:
Age of the Kettle Point Shales in Southwestern Ontario, 1957-59.
Study of the conodont fauna at the type locality has been completed; in progress is a study of the structural disposition of the formation and the stratigraphic distribution of trace elements; also in progress is a study of the stratigraphic distribution of the microfauna.

512. Westermann, G., McMaster Univ.:
Monograph Monotis Ochotica of the Upper Triassic, a Species Distributed Around the Globe and Related Forms, 1958-60.
This is one of the most abundant and most widely distributed species known and even stratigraphically fixed, hence it offers great possibilities for variation statistics and immigration theories, etc.
Revision of M. Bajocian (Jurassic) Ammonites of America, 1958-61.
Mainly a comparison of the forms described with those of Europe, and some new descriptions.
New Invertebrate Mesozoic Fossils of Canada, 1958-59.
Ammonites, brachiopods and pelecypods mainly of Triassic and Jurassic age, important phylogenetically, fauninstically and for international time-correlation.
Middle Jurassic of Germany, 1955-59.
Being prepared for "Lexique Stratigraphique International."

PETROLOGY AND PETROGRAPHY

Alberta

513. Godfrey, John D., Research Council of Alberta:
Mapping and Petrologic Studies of the Precambrian Shield of Northeastern Alberta, 1956-
See "Mineralization in the Andrew and Johnson Lakes area, Northeastern Alberta", Res. Coun. of Alberta, Prel. Rept. 58-4.

514. Kryczka, A., Univ. of Alberta:
Petrology of the Nikanassin Formation, Cadomin Area, Alberta, 1958-59; M.Sc. thesis.

515. Lerbekmo, John F., Univ. of Alberta:
Petrology of the Belly River Formation, Alberta, 1957-60.

516. McMullen, R.M., Univ. of Alberta:
Petrography of the Cardium Formation, Pembina Oilfield, Alberta, 1958-59; M.Sc. Thesis.

517. Mellon, George Barry, Research Council of Alberta:
The Petrology of the Blairmore Group, 1956-59.
The results of this work will be published shortly as a Research Council of Alberta Preliminary report entitled "The Stratigraphy of the Blairmore Group, Alberta Foothills".

British Columbia

518. Garr, J. M., British Columbia Dept. of Mines:
Study of Guichon Batholith with Particular Reference to Mineralization in Highland Valley, 1957-59.

Manitoba

519. Ambrose, J. W., Queen's Univ.:
Two Spodumene-Eucryptite Bearing Pegmatite Dykes in Southeastern Manitoba, 1958-59.
Two pegmatite dykes in southeastern Manitoba carry commercial quantities of exceptionally pure spodumene and small amounts of associated eucryptite. The principal optical and physical properties of this pure spodumene are recorded, the literature relating to eucryptite is reviewed, and the conclusion is reached that eucryptite formed probably as a consequence of introduction of sodium.

520. McDonald, John A., Univ. of Manitoba:
Petrological Study of the Basic and Ultrabasic Dyke Rocks of the Cuthbert Lake Region, Man., 1958-59; M.Sc. thesis.

521. Patterson, John M., Univ. of Manitoba:
Metamorphism and Its Relation to the Cu-Ni Deposits of the Moak-Mystery Lake Area, Man. 1957-60; Ph.D. thesis.
A study of regional metamorphism in Moak-Mystery Lake area plus experimental work on nickel silicates under heat and pressure.

522. Williams, Harold, Univ. of Toronto:
A Petrographic Study of the Metamorphic Rocks of the Chisel Lake Area, Manitoba, 1958-60; Ph.D. thesis.

New Brunswick and Nova Scotia

523. Friedlaender, C. G. I., and Allen, R. G., Dalhousie Univ.:
Granitic Rocks of Nova Scotia, 1958-

524. Gordon, K. R., Univ. of New Brunswick:
Devonian Granites of Northern Charlotte County, New Brunswick, 1958-60; M. Sc. thesis.

525. Loudon, J. R., Univ. of Toronto:
Study of Porphyry-like Rocks from the Devil's Elbow Area, N. B., 1956-59; Ph. D. thesis.
An investigation of the petrography and mineralogy of "porphyries" in this area to throw some light on the significance of these rocks which are so often associated more or less closely with base metal ores in the Bathurst area.

526. Mullins, W. J., Univ. of New Brunswick:
Stratigraphy and Sedimentary Petrology of the Carboniferous Beds of the Fredericton District, N. B., 1958-60; M. Sc. thesis.

527. Nash, Walter, Univ. of New Brunswick:
Trace Element Studies of the St. Stephen, N. B., Mafic Rocks, 1958-60; M. Sc. thesis.

Newfoundland and Labrador

528. Hutchison, Wm. W., Univ. of Toronto:
A Petrographic Study of the Quartz Monzonite Associated with the Holyrood Granite, Newfoundland, 1957-58; M. A. thesis.
Based on field work in the area for the Geological Survey of Canada.

529. Innes, J. Gordon, Univ. of Toronto:
A study of the Ultrabasic Rocks of the Baie Verte Area, Newfoundland, 1958-60; Ph. D. thesis.
A study based on field work in the area for the Geological Survey of Canada.

530. Morse, S. A., McGill Univ.:
Petrology of the Lopolith, Coast of Labrador, Newfoundland, 1958-59; Ph. D. thesis.

Ontario

531. Davies, John C., Univ. of Manitoba:
Petrology and Geochemistry of Gabbro Intrusions in the District of Kenora, Ontario, 1956-59; Ph. D. thesis.

532. Ginn, Robt. M., Univ. of Toronto:
Granites Between Sudbury and Blind River and Their Relationship to the Bruce Series, 1956-59; Ph.D. thesis.
Examination of stratigraphic and structural problems in this area, based on detailed mapping for the Ontario Dept. Mines.

533. Grant, James A., Queen's Univ.:
Petrology and Chemistry of Granitic Rocks of the Grenville of Eastern Ontario, 1957-59; M.Sc. thesis.

534. Hawley, J.E., MacDonald, G., Grant, J.A., Pearson, G.R. and others, Queen's Univ.:
Granitic Rocks of the Grenville in Eastern Ontario, 1956-60.
One doctorate thesis has been completed by G.R. Pearson on the Clare River Syncline area and includes many analyses of granitic rocks in that district. Theses by W.J. Pearson on syenite occurrences in Ontario, by H.R. Wynne-Edwards on the geology of the Westport area, and by A.M. Evans on the Centre Lake uranium area, will all include data on the geochemistry of granitic rocks in these areas. J.A. Grant is completing a petrographic study of some twenty-five granitic masses in other parts of eastern Ontario for which very complete chemical analyses have been made.

535. Pienaar, P.J., Queen's Univ.:
The Stratigraphy, Petrography and Genesis of the Elliott Group, Including the Uraniferous Conglomerates, Quirke Lake Syncline, Ont., 1956-58; Ph.D. thesis.
In collaboration with Geological Survey of Canada.

536. Simony, P.S., and Shaw, D.M. McMaster Univ.:
Geochemistry of the Biotite Paragneisses of Chandose Tp., Ont., and adjacent regions.

537. Sinclair, B.D., Queen's Univ.:
Alteration Zones along Diabase Dykes and Faults in the Algoma Uranium Area, Ontario, 1958-59; M.Sc. thesis.

538. Wynne-Edwards, H.R., Queen's Univ.:
The Geology of the Westport Area, Ontario, 1955-59; Ph.D. thesis.
A detailed structural and petrographic study of Grenville gneisses and plutons; in collaboration with the Geological Survey of Canada.

539. Young, W.L., Carleton Univ.:
The Seine River Conglomerate, Ontario, 1958-59;
Preliminary investigation of this formation gave rise to the suspicion that it was not a true sediment. Petrographic and chemical investigations of the boulders and matrix are underway to try and establish its nature, and its true relation to the other rock formations in the area - notably the Steep Rock Series.

Quebec

540. Beland, Rene, Université Laval:
Petrography and Geology, Region of Rawdon, St. Gabriel, Que., 1958-59.
Includes study of the transition for quartzite-paragneiss-limestone Grenville to granulite-hornblende-plagioclase gneiss Grenville.

541. Berube, Magloire, Université Laval:
Problems of the Kamouraska Quartzites, Quebec, 1958-59; M.Sc. thesis.

542. Boone, Gary, McG., Univ. of Western Ontario;
Felspar-Quartz Phase Relations in the Crystallization of a Granite-Rhyolite Body, Gaspé Peninsula, Quebec, 1958-61.
The compositions and structural states of feldspars are being investigated in detail for this pluton of known high-level tectonic setting. From the detailed phase relations of feldspars and quartz as they are now known, the thermal history and rate of cooling can be inferred within petrologically significant limits. The states of oxidation of Fe in alkali feldspars and associated mafic minerals may provide useful criteria upon which to judge the potential of a silicate melt to have yielded an ore-forming phase at a late stage of crystallization.

543. Koesmoeno, M.D., Grad., Queen's Univ.:
Endothermic Changes in Syenite Intrusive into Brucitic Limestones Near Wakefield, Quebec, 1958-59.
Syenite intrusive into brucitic limestones is greatly enriched in iron-rich pyroxene near its contacts, apparently by endothermic processes. The reason for, course and extent of these changes is being studied.

544. MacGregor, Ian, Queen's Univ.:
Petrology of an Ultrabasic Pluton, Mount Alberta, Gaspé, Que., 1957-59; M.Sc. thesis.
In collaboration with Geological Survey of Canada.

545. Perrault, Guy, Ecole Polytechnique:
Petrography and Mineralogy of the Oka Alkaline Intrusives, 1957-61.

546. Philpotts, A.R., McGill Univ.:
Genesis of Serpentinites in Chukatat Group, Cape Smith-Wakeham Bay Belt, Northern Quebec, 1958-59; M.Sc. thesis.

547. Sauvé, Pierre, Quebec Dept. Mines:
Metamorphism and Structure of the Labrador Trough at 58° N. Lat.
Presented to La Société Geologique de Quebec, Dec. 12, 1957.

548. Remick, J.H., Quebec Dept. Mines:
Some Anorthosites of the Chibougamau Region, Quebec.
Presented to Michigan Academy of Sciences, Arts and Letters, Detroit, March 22, 1957.
A Chart Showing the Spheres of Influence of Atoms and Ions in Minerals, American Min., vol. 43, Jan. - Feb. pp. 166-168, 1958.

549. St. Julien, Pierre, Université Laval:
La Petrologie des Laves de la Partie Nord-est du Canton de Montvray, District Electoral de Rouyn, Noranda, 1958-59; M.Sc. thesis.

550. Shepherd, Norman, Univ. of Toronto:
Petrology and Mineralogy of the Cross Lake Area, Ungava, Quebec, 1957-59; Ph.D. thesis.
A study of the mineralogy and petrography of the peridotites, associated mineralization, and the associated rocks in a part of the Wakeham Bay-Cape Smith mineralized belt. The purpose is to determine the origin and significance of the peridotites and the relationship of the mineralization to them. The study is based on field work for the American Smelting and Refining Company and the Quebec Bureau of Mines.

551. Smith, C.H., and MacGregor, I.D., Geol. Surv., Canada:
Study of Mineralogical, Petrographical, and Chemical Variations in the Mount Albert Ultrabasic Intrusion, Quebec, 1957-60.
The purpose is to test the chemical homogeneity of the intrusion and to set up techniques for the study of other ultrabasic bodies, and to determine whether optical, X-ray, or chemical analyses will be preferable in future work in connection with the study of the ultrabasic rocks of Canada.

552. Spring, Val., Univ. of Toronto:
Wallrock Alteration at Opemiska Mine, Quebec, 1958-59; M.Sc. thesis.

Saskatchewan

553. Lane, David M., Saskatchewan Dept. Mineral Resources:
Petrology and Sedimentation of the Dawson Bay Evaporites, 1958-59.

554. Mawdsley, J.B., and Smith, J.R., Univ. of Saskatchewan:
Metamorphism in Precambrian of Saskatchewan, 1956.

555. Pyke, Murray William, Univ. of Saskatchewan:
Microclines from a Precambrian Granodiorite, Forbes Lake Area, Sask., 1958-59; M.Sc. thesis.

556. Reinhardt, E.W., Univ. of Saskatchewan:
Petrology and Mineralogy of a Radioactive Area, Northwestern Saskatchewan, 1958-59; M. Sc. thesis.

General Problems

557. Burwash, R.A., Univ. of Alberta:
Age Relations of Granites in the Western Canadian Shield Exposed and Buried, 1958-
See "Age of the Alberta Precambrian Basement", Journal of the Alberta Soc. of Petroleum Geologists, vol. 6, No. 9, 1958.

558. Cormier, Randall, F., St. Francis Xavier Univ.:
Rubidium-Strontium Dating of Rocks and Minerals, 1958-
Initial work will be concerned with dating additional glauconites (see reference below) in an attempt to more clearly define the post-Precambrian time scale. Investigation of other methods for the dating of sediments by rubidium-strontium analysis is being given consideration. See "Sediment Age Determination by Rubidium-Strontium Analysis of Glauconite", Bull. AAPG, vol. 42, No. 4, 1958.

559. Dawson, K.R., Geol. Surv., Canada.
Petrological Collections, 1957-
To obtain and maintain representative suites of rocks from all map-areas of Canada for future petrological, geochemical and other scientific studies.

560. Folinsbee, R.E., Baadsgaard, H., and Lipson, J.I., Univ. of Alberta:
Dating Cordilleran Orogenies, 1954-59.
See "An Absolute Age for the Exshaw Shale" Guidebook, 8th Ann. Field Conference; Alberta Soc. Pet. Geol., Aug. 1958, pp. 69-73.

561. Gregory, A.F., Geol. Surv., Canada:
Evaluation of Aeroradiometric Surveying as an Aid to Geological Mapping and Petrogenetic Analysis, 1958.

562. Haw, V.A., Mines Branch, Dept. Mines and Technical Surveys:
Petrography of Stone, Sand and Gravel, Applied to Their Use as Aggregate in Concrete, 1958-
The purpose of the work is to determine the petrographic characteristics of rock bearing on the durability of aggregates in concrete.

563. Hoffmann, H.J., McGill Univ.:
The Occurrence and Petrology of Basic Intrusions in the Northern Mackenzie Mountains, 1958-59; M.Sc. thesis.

564. Hunt, G.H., Univ. of Alberta:
Precambrian Igneous Activity in the Southern Canadian Cordillera, 1958-62; Ph.D. thesis.

565. Lapointe, Guy, Univ. of Manitoba:
Diffusion of the TiO_2 Content of Magnetite by Granitization, 1958-59; M.Sc. thesis.
In magnetite-ilmenite segregation deposits where there is ilmenite in excess, the TiO_2 in magnetite should be of the order of 5 per cent to 20 per cent. This fact does not hold true in a deposit of this sort situated in Lake St. John area, Que. The reason for the anomaly is believed to be granitization by an intrusive pegmatitic granite into the orebody, or regional metamorphism, or of the action of both combined.

566. Middleton, G.V., Weber, J.N., and Smoor, Peter, McMaster Univ.:
Greywackes of the Northern Appalachians, 1957-60.

567. Moorhouse, W.W., Univ. of Toronto:
Petrography of Vein Deposits, 1958-
A compilation of information in the literature plus original investigation of the textures and structures of vein deposits as seen in thin sections. This study is particularly concerned with other than gold veins.
Studies of Precambrian Sediments, 1950-
This study is presently concerned primarily with sedimentation features of the Animikie Iron formations and is based on field work for the Ontario Dept. Mines.

568. Oja, Reino, McGill Univ.:
Experimental Study of Anatexis, 1957-59; Ph.D. thesis.

569. Peach, Peter A., and Hobbs, L.G., Univ. of Toronto:
A Mineralogical Investigation of Ultrabasic Rocks, 1958-59.

570. Papezik, Vladimir S., McGill Univ.:
Geochemistry of Anorthosites, 1958-59; Ph.D. thesis.

571. Reesor, J.E., Geol. Surv., Canada:
Granitic bodies of Canada, 1957-
Detailed mapping of representative granitic bodies, initially mainly in southern B.C., with special attention to providing comprehensive geological information concerning their scientific and economic aspects.

572. Riddell, J.E., Carleton Univ., and Petruk, W., McGill Univ.:
The Application of X-ray Diffractometer Techniques to the Problem of Wall-rock Alteration, 1958-59.

573. Shaw, D.M., McMaster Univ.:
Geochemistry of Grenville Skarn Minerals.
Trace element analyses and mineralogical studies are being made on scapolite, pyroxene and calcite from Grenville skarns.

574. Sabourin, R.J.E., Université Laval:
Orbicular Structures (Igneous), 1957-59.

575. Smith, C.H., Geol. Surv., Canada:
Ultrabasic Intrusions of Canada, 1957-
Detailed mapping of representative ultrabasic intrusions with special emphasis on their scientific and economic features. Probably will include study of intrusions in Tulameen, B.C.; Bud River, Manitoba; Thetford and Gaspé, Quebec; and Bay of Islands, Newfoundland.

576. Saull, V.A., McGill Univ.:
Enthalpy Changes in Metamorphic Reactions, 1953-
Determination of heat effects of metamorphic changes. See Geochim. et Cosmochim. Acta 8, 86-107 (1955).

577. Swartzmann, E., and Burrough, E.J. Mines Branch, and Hacquebard, P., Geol. Surv., Canada:
Study of Coking Characteristics on Laboratory and Plant Scales of Coal Seam Sections in Relation to Petrographic Constituents, 1956-
See "The Value of a Quantitative Separation of the Maceral Vitrinite into its Constituents Telinite and Collinite for the Petrography of Coking Coals", presented by P.A. Hacquebard to International Coal Petrology Congress, Sept. 1958.

578. Weber, J.N., Shaw, D.M., and Middleton, G.V., McMaster Univ.:
Geochemistry of Greywackes.
Trace element studies on Appalachian greywackes.

PLEISTOCENE AND GROUNDWATER

Alberta

579. Bayrock, L.A., and Hughes, G.M., Research Council of Alberta:
Glacial Geology of the Edmonton District, Alberta, 1958-60.

580. Bayrock, L.A., Research Council of Alberta:
Glacial Geology of the Wainwright District, Alberta, 1957-59.

581. Christiansen, E.A., and Ross, W.C., Research Council of Alberta:
Pleistocene Geology as Related to the Occurrence of Groundwater in Alberta, 1958-

582. Common, R., Research Council of Alberta:
Surficial Geology and Groundwater, Medicine Hat District, Alta., 1958-59.

583. Ellwood, Brian, Research Council of Alberta:
Surficial Geology of the St. Paul Area, Central Alberta, 1958-59; Ph.D. thesis.

584. Farvolden, R.N., Research Council of Alberta:
Bedrock Topography and Preglacial Drainage of Alberta, 1956-59.

585. Gravenor, C.P., and Bayrock, L.A., Research Council of Alberta:
Origin of Dead Ice Features in Alberta, 1956-60.
See paper (with W.O. Kupsch) "Ice Disintegration Features in Western Canada", Jour. Geol. (In press).

586. Jones, John F., Research Council of Alberta:
Groundwater and Glacial Geology, Beaver Lodge Area, Alberta, 1958-59.
Investigation of Macrofabrics and Macrofabrics in Varved Clays, 1958-60.

587. LeBreton, E. Gordon, Research Council of Alberta:
An Analysis of the Chemical Properties of the Groundwater of Alberta, 1958-.

588. Lennox, D.H., Research Council of Alberta:
Geophysical Determination of Depths to Bedrock in Alberta, 1957-

589. Meneley, W.A., Research Council of Alberta:
Ground-water Geology, Stettler Area, 1957-59.
Microfabric Study of Flutings, St. Paul Area, 1958-60.

590. Meyboom, Peter, Research Council of Alberta:
Milk River Sandstone (Geology and Hydrology), 1958-60.
The Milk River Sandstone is a large Cretaceous aquifer in southern Alberta. This investigation will trace the lateral extension of the aquifer and find the geological reasons for its hydrological behaviour.

591. Stalker, A.M., Geol. Surv., Canada:
Dead-ice Plateaux of Alberta, 1955-58.
By combining past field data with current study of air-photos, to describe the location, composition, formation, significance and other features of many of the larger dead-ice plateaux of the moraine areas of Alberta.

592. Tharin, J.C., Research Council of Alberta:
Surficial Geology of the Calgary District, Alberta, 1958-59; Ph.D. thesis.

British Columbia

593. Fyles, J.G., Geol. Surv., Canada:
East Coast of Vancouver Island, B.C., 1 inch to 4 miles, 1956-58.
Mapping of surficial formations with special attention to groundwater supply.
Reconnaissance Mapping of Surficial Geology of Islands and East Shore of Strait of Georgia, B.C., 1958.

594. Fyles, J.T., British Columbia Dept. of Mines:
Study of the Columbia River Valley from Bluewater Creek near Donald to Nagle Creek near Mica Creek, B.C., 1958.
The study was made for the Water Rights Branch of the British Columbia Department of Lands.

595. McTaggart, K.C., and Trettin, H.T., British Columbia Dept. of Mines (part-time), Univ. of British Columbia:
Detailed Geological Study of Strip Along Fraser River Extending from Lillooet Upstream to Big Bar, 1957-58.
Field work was carried out throughout the 1957-58 field season by Mr. Trettin with general guidance from Professor McTaggart. This work was done for the British Columbia Department of Mines and is supported by the Water Rights Branch of the Department of Lands and Forests for the Fraser River Board.

Manitoba

596. Johnston, G.H., Div. Building Research, Nat. Res. Council:
Dyke Studies at Kelsey Generating Station, Northern Manitoba, 1958-
A study of dyke construction in an area of sporadic permafrost conducted at the Grand Rapid site of Kelsey Generating Station on the Nelson River in northern Manitoba.

New Brunswick

597. Lee, H.A., Geol. Surv., Canada:
St. John River Valley, Edmunston to Fredericton, N.B.
Standard 1 inch to 1 mile mapping of surficial formations.

Newfoundland

598. Henderson, E.P., Geol. Surv., Canada:
Surficial Formations of Conception Bay Map-area, Newfoundland, 1 inch to 4 miles, 1956-58.

Northwest Territories

599. Chapman, L.J., Ontario Research Foundation, and Brown, R.J.E., Pihlainen, J.A., and Johnston, G.H., Div. Building Research, Nat. Res. Council:
Evapotranspiration Studies, Norman Wells, N.W.T., 1953-
This field study of evapotranspiration at Norman Wells is being carried out by the staff of the Division of Building Research, National Research Council for the Ontario Research Foundation under the direction of Mr. Chapman.

600. Craig, B.G., Fyles, J.G., and Lee H.A., Geol. Surv., Canada:
Surficial Geology of Parts of the Districts of Keewatin and Mackenzie, N.W.T., 1958.

601. Deane, R.E., Defence Res. Board, Dept. Nat. Defence;
Pleistocene Geology and limnology of the Lake Hazen Area of Northern Ellesmere Island, 1957-59.
The research was mainly concerned with sedimentation bathymetry in the Lake, and with the glacial history and deposits of the Lake area. See "Pleistocene Geology and Limnology" in "Operation Hazen: Narrative and Preliminary Reports 1957-58", Def. Res. Bd. Ottawa, (in press).

602. Grant, F.S., Weber, J.R., Arnold, K.C., Filo, J.D., Sandstrom H., Def. Res. Board, McGill Univ., and Univ. of Toronto:
Geophysical Research on Gilman Glacier and on the Ice-cap on Northern Ellesmere Island, 1957-59.
The research involved seismic and gravity measurements, and survey work to establish thicknesses and profiles of the ice. See "Operation Hazen; Narrative and Preliminary Reports 1957-58", Def. Res. Bd. Ottawa (in press).

603. Hattersley-Smith, G., Def. Res. Bd., and Sagar R.B., McGill Univ.
Glaciological Research on Gilman Glacier and on the Ice-cap on Northern Ellesmere Island, 1957-59.
The research was combined with accumulation, ablation, crystallographic and temperature measurements. See "Operation Hazen": Narrative and Preliminary Reports 1957-58. Def. Res. Bd., Ottawa, (in press).

604. Lee, H.A., Geol. Surv., Canada:
Pleistocene Ice-Dome in Hudson Bay, 1958.
To assemble, evaluate, and present the evidence pointing to the former existence of a Pleistocene ice-dome in Hudson Bay.
"Beach Moraines" Along the east Coast of Hudson Bay and James Bay, 1958-
To describe the "beach moraines"; to present and support an adequate theory for their origin; and to relate their origin to the glacial and post-glacial geological history of the area.

605. Pihlainen, J.A., and Johnston, G.H., Div. Building Research, Nat. Res. Council:
Observations at Inuvik, N.W.T. (new location of townsite of Aklavik), 1954-
Soil temperature measurements under roads, air strip and buildings were continued and further observations carried out on the rate of annual thaw during the summer of 1958. Observations were also continued on physical changes to the terrain caused by melting of the permafrost resulting from construction in the area.

606. Pihlainen, J.A., Div. Building Research, Nat. Res. Council:
Permafrost Investigations at Fort Simpson, N.W.T., 1958-
Information on soil type and ice content of permafrost is obtained by core drilling.

607. Smith, D. Ingle, and Sagar, B., Grad. Studs. McGill Univ.:
Some aspects of the Glaciology and Geomorphology of the Lake Hazen area, Ellesmere Island, N.W.T., 1957-61.
Work was begun while employed by the Defence Research Board; it is being continued under an Arctic Institute of North America grant.

Nova Scotia

608. Langille, James D., Grad. Stud., Acadia Univ.:
Groundwater Resources in Berwick Area, N.S., 1958-59.

609. Cameron, H.L., Nova Scotia Research Foundation:
Tidal Current Mapping of Complete Tidal Cycle - Tiverton Westport Areas, Nova Scotia, 1958-59.
It is possible to measure the position of maximum flowlines and the velocities of currents by aerial photography. This method has been applied at Bellot Strait in the Arctic. The present research photography is sponsored by the Dominion Public Works Department. Photo strips were taken of Petit and Grad Passages at 15 minute intervals throughout a tidal gale.

610. Cameron, H.L., and MacNeil, R.H., Nova Scotia Research Foundation and Acadia Univ.
Pleistocene Surveys of Nova Scotia.
The maps showing the superficial deposits are being used by the Department of Highways and Nova Scotia Power Commission.

Ontario

611. Bostock, J.M., Geol. Surv., Canada:
Compilation of Drift Thickness in the City of Ottawa, Ontario, 1957-58.
To make an isopach (drift-thickness) map of the overburden and to make bedrock surface contour map in the city of Ottawa area. See Geol. Surv. Map 13-1958.

612. Caley, J.F., and Sanford, B.V., Geol. Surv., Canada:
Studies of Drift Thickness and Bedrock Topography in Southern Ontario, 1948-
By means of bore-hole data to determine the pre-Pleistocene bedrock topography and the drift thickness and to deduce the preglacial drainage and the probable location of reservoirs of groundwater. Because the pre-Pleistocene topography may reflect the underlying structure of the bedrock, this knowledge will assist in the search for oil and natural gas.

613. Dell, J. Carol, Ontario Research Foundation:
Study of Mineralogical Composition of Sand Fraction of Tills and Stratified Sands of Southern Ontario, 1956-59; M.A. thesis, Univ. of Toronto.
The laboratory work has been completed and the results are being prepared for publication.

614. Dreimanis, A., and Reavely, G.H., Univ. of Western Ontario:
Pleistocene Stratigraphy along Lakes Erie and Huron, 1952-60.
This project forms part of a systematic study of the Pleistocene deposits of southern Ontario. See "Wisconsin Stratigraphy of Port Talbot on the North Shore of Lake Erie, Ontario", Ohio. Jour. Sci. vol. 58, p. 65-84 and "Beginning of the Nipissing Phase of Lake Huron", Jour. Geol., vol. 66, p. T591-594.

615. Gadd, N.R., Geol. Surv., Canada:
Surficial Formations of Ottawa Map-area, Ontario and Quebec, 1 inch to 1 mile, 1956-58.

616. Jones, A.H.M., Univ. of Toronto:
Direction of Ice Flow in Southern Ontario from Study of Tills, 1958-59.

617. Karrow, P.F., Ont. Dept. Mines:
Pleistocene Geology of the Hamilton-Galt area, Ont., 1 inch to one-half mile, 1958-59.

618. Legget, R.F., and Eden W.J., Division of Building Research, Nat. Res. Council:
Steep Rock, 1948-
In the course of stripping operations at Steep Rock Iron Mines, large deposits of varved clay were uncovered. It was necessary to cut large slopes in the clays and with the cooperation of the mine, the performance of the slopes has been kept under observation. Other problems, such as settlements, have been studied in less detail. See "Soil Engineering at Steep Rock Iron Mines, Ontario, Canada", paper No. 6304, Proc. Inst. of Civ. Eng., vol. XI, pp. 169-188, Oct. 1958.

619. Liberty, B.A., and Sanford, B.V., Geol. Surv., Canada:
The Logging of Bedrock Cores to Aid the Study of Ground-water Resources of the Ottawa Area, 1958-59.

620. Mirynech, E., Geol. Surv., Canada (part-time):
Surficial Geology of Trenton and Presqu'ile Map-areas, Ontario, 1 inch to 1 mile, 1958-60; Ph.D. thesis, Univ. of Toronto.
Mineralogical Soil Profile Studies, Southern Ontario, 1956-58; M.A. thesis, Univ. of Toronto.

621. Terasmae, J., Geol. Surv., Can.:
The Study of Core Samples from the Ontario Hydro Generating Station Site at Hamilton, Ontario, 1958.
By application of the principles of Pleistocene geology, to advise the Ontario Hydro concerning geological features that might affect their site investigations.
Pleistocene Palynology and Stratigraphy, Lake Erie to Cochrane, Ontario, 1956-
The study of Pleistocene palynology from samples of bog and lake deposits as an aid in determining the glacial history and correlating glacial deposits.

622. Thompson, Hugh R., McMaster Univ.:
A Quantitative Study of the Terrain of the Hamilton District, 1958-65.
The area is being studied first in terms of local relief measured by unit areas of 1 min. lat. by 1 min. long. on topographic maps. Angles and directions of surface slope will be measured to produce statistical slope orientation diagrams. These and other quantitative data will be correlated with the glacial geology, with the aim of refining our knowledge of late glacial and post glacial events in the landscape's evolution.

623. Vagners, U.J., and Wilkinson, R.S., Univ. of Toronto:
A Precise Level Survey of the Iroquois Shoreline, Ontario, 1958-59.
This survey will cover the Iroquois shoreline from Niagara Falls to Whitby. The continuation of the survey around the remaining area of Lake Ontario is contemplated for the summer of 1959.

624. White, Owen L., Univ. of Toronto:
The Application of Soil Consolidation Tests to the Determination of Wisconsin Ice Thicknesses in the Toronto Region, 1958-59; M.A. Thesis.

Quebec

625. Crawford, C.V., and Eden, W.J., Div. of Building Research, Nat. Res. Council:
Quebec North Shore and Labrador Railway, Quebec, 1953-
The performance of various soil formations encountered by the railway are under observation by the railway officials. Assistance has been given the railway regarding frost action and slope stability problems. Attention is drawn to two recent publications on the subject of this railway namely (1) "Investigation of Banded Sediments along St. Lawrence North Shore

in Quebec" by R.W. Pryer and K.B. Woods, presented to 61st Ann. Meeting A.S.T.M. June, 1958, and "Frost Action and Railroad Maintenance in the Labrador Peninsula" by R.W. Pryer, presented to 37th Ann. Meeting Highway Research Board, January, 1958.

See also "Soil Engineering Problems on the Quebec North Shore and Labrador Railway" by K.B. Woods, R.W. Pryer, and W.J. Eden, Bull. Am. Ry. Eng. Ass'n., Feb. 1959.

Saskatchewan

626. Hall, E., Geol. Surv., Canada:
Reconnaissance Study of Groundwater of the Souris River, Basin, Sask., 1958.

627. Kupsch, W.O., Univ. of Saskatchewan:
Radiocarbon Dated Organic Sediments Near Herbert, Sask., 1956-59.
Investigation of fauna and flora associated with willowwood dated at 10,050 ± 300 years.

628. Scott, J.S., Geol. Surv., Canada (part-time):
Surficial Geology of Elbow, Hawarden and Outlook (East Half) Map-areas, Sask., 1 inch to 1 mile, 1958-60.

General Problems

629. Bayrock, L.A., and Pawluk, S., Research Council of Alberta:
A Study of Some Aspects of Soil Formation, 1958-61.
Experiments have been set up to measure the electrical potentials (largely redox potentials) in soils. From the data gathered to date potentials of up to 0.5 volts exist between the A and C horizons. It is possible that clays and ions migrate under these potentials.

630. Bird, J. Brian, Drummond, N.D., and Kroger, A., McGill Univ.:
McGill Arctic Terrain Study, 1955-62.
An extended program of geomorphological studies with the objective of producing a physiographic account of the Canadian Arctic south of 75° N. In 1958 a field party connected with this project went to Somerset and Prince of Wales Islands.

631. Bozozuk, M., Div. Building Research, Nat. Res. Council:
Swelling and Shrinkage of Clays, 1954-
The extensive damage to houses due to swelling and shrinkage of clays in central Ottawa has been under investigation since 1954 to find the relation, if any, between damage and soil type. Laboratory study of swelling and shrinking clays was also carried out. See "Volume Changes Measured in Leda Clays", presented 12th Can. Soil Mech. Conf., Saskatoon, December, 1958.

632. Brown, J. C., McGill Univ.:
The Deglaciation of the St. Lawrence Lowland, 1958-60; Ph. D. thesis.

633. Brown, R. J. E., Div. Building Research, Nat. Res. Council:
Permafrost Boundary in Canada, 1953-
This project has been resumed, following the return from post-graduate study at the Scott Polar Research Institute of the Research Officer responsible for this work.

634. Burn, K. N., Crawford, C. B., Eden, W. J., and Hamilton, J. J., Division of Building Research, Nat. Res. Council:
Geotechnical Properties of Eastern Marine Clay, 1951-
Attempts are being made to collect and correlate geotechnical data on eastern marine clay. Laboratory investigations include study of the behaviour of sensitive clays in triaxial and consolidation tests. A study of regain in strength after remolding has been started. Field work includes measurements of settlements due to surcharge of heavy fills, case record studies of landslides at Nicolet, Hawkesbury and Green Creek (near Ottawa) and finally on the evaluation of sampling and vane testing techniques. See "Use of Field Vane Apparatus in Sensitive Clay", Symposium on Vane Shear Testing of Soils, S. T. P. No. 193, Am. Soc. for Testing Materials, Nov. 1957, and "The Nicolet Landslide", submitted to Engineering Geology Case Histories, Geol. Soc. of Am.

635. Dreimanis, A., Univ. of Western Ontario:
Till Fabric Techniques, 1957-59.
Experiments with techniques of fabric measurements in field and laboratory aimed to shorten the time required for fabric studies.
Depth of Leaching in Glacial Deposits as a Criterion in Pleistocene Chronology, 1953-60.
Stratigraphic Correlation of Glacial Deposits in the Region Between Lake Huron and St. Lawrence Lowland, 1953-60.
Correlation is attempted principally by lithologic investigations of tills. Heavy mineral and carbonate studies of till matrix suggest that the centre of glacial outflow was farther east during the Early Wisconsin time than during the maximum of the Main Wisconsin. See "Stratigraphy of Wisconsin Glacial Deposits of Toronto Area", Geol. Ass. Canada Proc. vol. 10, 1958 (In press), and "Early Wisconsin Tills of the Lake Erie, Lake Ontario, and St. Lawrence River region" (abstract) Geol. Soc. Amer. Ann. Meeting, 1958.

636. Elson, J.A., McGill Univ.:
Pleistocene History of St. Lawrence Lowlands, 1958-
Comparison of marine fossil fauna with marine fauna along present coast of north Atlantic, including study of size and growth distribution, vertical distribution of fauna in raised beaches and radiocarbon dating of the shells.

637. Gorman, D.H., and Deane, R.E., Univ. of Toronto:
Alteration of Minerals to Clays, 1957-

638. Hutcheon, N.B., Pearce, D.C., Gold, L.W., and Penner, E., Div. Building Research, Nat. Res. Council:
Ground Temperatures and Frost Action, 1948-
See "An Analysis of Frost Action Beneath Cold Storage Warehouses", by D.C. Pearce, submitted to transactions E.I.C., March 1958, and "Frost Action Beneath Cold Storage Plants", by D.C. Pearce and N.B. Hutcheon, Refrigeration Engineer, vol. 66, no. 10, Oct. 1958.

639. Ives, J.D., Loken, O., Derbyshire, E., and Tomlinson, R., McGill Univ.:
McGill Sub-arctic Research Laboratory at Knob Lake, 1956-
A series of coordinated projects directed by Professor Ives from the Research Laboratory at Knob Lake with the intention of determining the main features of the late glacial history of north-eastern Quebec and the Labrador coast. This work has been undertaken for the Geographical Branch, Dept. of Mines and Technical Surveys in some areas and with the aid of Arctic Institute grants elsewhere.

640. Lapointe, C.M., Mines Branch, Dept. Mines and Technical Surveys:
Carbon-14 Age Determinations, 1956-59.
Equipment is being set up to determine the ages of archaeological and geological samples by the carbon-14 method.

641. MacFarlane, Ivan C., Division of Building Research, National Research Council:
Muskeg Research, 1954-
A survey of relevant literature on peat and muskeg is continuing with the ultimate view of compiling a comprehensive annotated bibliography. Laboratory investigations will include the measurement of physical and mechanical properties of the peaty material. Appropriate field tests will be carried out in an attempt to correlate the classification system which has been developed for muskeg, with the strength characteristics of the peaty material. See "Guide to a Field Description of Muskeg", Tech. Memo. No. 44, Nat. Res. Coun. of Canada, Assoc. Committee on Soil and Snow Mechanics, Ottawa, June 1958, and "Review of the Eng. characteristics of Peat", Proc. Am. Soc. Civ. Eng., Soil Mechs. Div., 1959.

642. Mackay, J. Ross, Univ. of British Columbia:
Geomorphology of the Mackenzie Delta Area, N.W.T., 1954-60.
This project is being done for the Geographical Branch, Dept. of Mines and Technical Surveys, Ottawa. See "Subsurface Organic Layer Associated with Permafrost in the Western Arctic", Geographical Paper No. 18, Geographical Branch, Dept. Mines & Technical Surveys, Ottawa, 1958.
Freeze-up and Break-up of the Mackenzie River, N.W.T., 1958-60.
This project is being done for the Geographical Branch, Ottawa.
Solifluction at Mt. Garibaldi, B.C., 1958-61.
This project is supported by the National Research Council and is being done in collaboration with Dr. W.H. Mathews (Geology) and Dr. V.C. Brink (Plant Sciences) of Univ. of B.C.

643. Mathews, W.H., Univ. of British Columbia:
Hydrology and Sediment Transport of a Glacial Stream, 1957-
Data are now on hand for a statistical analysis by which runoff from the glacier can be compared with meteorological records, as a means of forecasting stream flow.

644. Meneley, W.A., Research Council of Alberta:
Till Microfabrics, 1956-59; M.Sc. thesis, Univ. of Saskatchewan.

645. Ross, D.B., and Blanchard, J.E., Dalhousie Univ.:
Carbon-14 Dating Using Proportional Counter 1957-

646. Taylor, Richard Spence, Univ. of Alberta:
Pleistocene Research in Alberta and the Adjacent Northwest Territories, 1957-
Emphasis is on periglacial phenomena; their modes of occurrence, physical natures and distribution.

647. Williams, P.J., Div. Building Research, Nat. Res. Council:
Studies of Freeze-Thaw Processes in Soils, 1954.
See "An Investigation into Processes Occurring in Solifluction", Am. Jour. Sci., 1959 (in press).
Construction of Instrument for Field Recording of Small Progressive Soil Movements, 1957-59.
See "Direct Recording of Solifluction Movement", Am. Jour. Sci., Dec. 1957.

648. Wood, Harold A., McMaster Univ.:
Analysis of the Relations Between Prevailing Winds and Shoreline
Changes on Lake Erie, 1958-59.
An attempt is being made to evaluate the relative changes in magnitude and direction of the longshore component of wave energy, and to relate these changes to the rate of shore progradation and retro-gradation. Particular attention is being paid to Long Point.

649. Zelonka, F., Div. Building Research, Nat. Res. Council:
Determination of Depth to Permafrost by Geophysical Methods, 1958.
Initial investigations which were completed during the summer of 1958 were carried out to assess the practicability of determining the depth to the permafrost layer using seismic (shallow refraction seismograph) and electric resistivity methods.

SEDIMENTATION

650. Beales, F.W., Univ. of Toronto:
Ecology of Shallow Water Limestones, a Continuing Project.
See "Ancient Limestones of Bahaman Type" A.A.P.G., 1958.

651. Belyea, H.R., Geol. Surv., Canada:
Sub-surface Studies of the Devonian System of the Alberta Plains, 1951-
The preparation from data from cores, samples, and electric and radioactivity logs of cross sections to show correlations and facies changes in the Devonian system of the Alberta plains; and the preparation of maps showing isopachs and regional variations in the facies of the various formations.

652. Berube, Magloire, Université Laval:
Problems of the Kamouraska Quartzites, Quebec, 1958-59; M.Sc. thesis.

653. Clark, T.H., McGill Univ.:
Research on Ventifacts, 1955-59.

654. Clark, T.H., and Dean, R.S., McGill Univ.
The Black Shale Problem, 1957-61.

655. Carrigy, Maurice, Research Council of Alberta:
Sedimentation of the McMurray Formation, 1957-
See "General Geology of the McMurray Area", Res. Counc. of Alberta, Mem. No. 1.

656. Dean, R.S., McGill Univ.:
The Black Shales of the St. Lawrence Lowlands of Quebec, 1958-60; Ph.D. thesis.

657. Deane, R.E., Defence Res. Board, Dept. Nat. Defence:
Pleistocene Geology and Limnology of the Lake Hazen Area of Northern Ellesmere Island, 1957-59.
The research is mainly concerned with sedimentation and bathymetry in the Lake, and with the glacial history and deposits of the lake area.
See "Pleistocene Geology and Limnology" in "Operation Hazen; Narrative and preliminary Reports 1957-58", Def. Res. Bd. Ottawa (in press).

658. Dell, J. Carol, Ontario Research Foundation:
Study of Mineralogical Composition of Sand Fraction of Tills and Stratified Sands of Southern Ontario, 1956-59; M.A. thesis, Univ. of Toronto.
The laboratory work has been completed and the results are being prepared for publication.

659. Dreimanis, Aleksis, Univ. of Western Ontario:
Till Fabric Techniques, 1957-59.
Experiments with techniques of fabric measurements in field and laboratory aimed to shorten the time required for fabric studies.
Depth of Leaching in Glacial Deposits as a Criterion in Pleistocene Chronology, 1953-60.
Stratigraphic Correlation of Glacial Deposits in the Region Between Lake Huron and St. Lawrence Lowland, 1953-60.
Correlation is attempted principally by lithologic investigations of tills. Heavy mineral and carbonate studies of till matrix suggest that the centre of glacial outflow was farther east during Early Wisconsin time than during the maximum of the Main Wisconsin. See "Stratigraphy of Wisconsin Glacial Deposits of Toronto Area", Geol. Ass. Canada Proc, vol. 10, 1958 (In press), and "Early Wisconsin Tills of the Lake Erie, Lake Ontario and St. Lawrence River region" (abstract). Geol. Soc. Amer., Ann. Meeting, 1958.

660. Halferdahl, L.D., Research Council of Alberta:
Heavy Minerals in River Sediments in Alberta, 1957-

661. Hodgson, C.J., McGill Univ.:
Graphite in Archaean Sediments, 1958-60; M.Sc. thesis.

662. Jeletzky, J.A., Geol. Surv., Canada:
Cretaceous Marine Zones of the Western Interior of Canada, 1956-
The preparation of a comprehensive description of the palaeontology and stratigraphy of marine Cretaceous strata of the western interior of Canada.

663. Kent, Donald, M., Saskatchewan Dept. Mineral Resources:
Evaporites and Associated Rocks in the Ordovician System of Saskatchewan, 1958-59.

664. Kidd, Donald, J., Research Council of Alberta:
Diagenesis of Ferruginous Sediments, 1956-61.
Results of preliminary work on Clear Hills oolitic goethite sandstone are still under study. See "Stability Relations of Hematite and Goethite in Neutral and Alkaline Solutions at Elevated Temperatures and Pressures", Amer. Min. 1949.
Geochemistry of Berylium, 1956-60.
Both projects will be continued when new bombs with better control of temperature and pressures, are ready in 1959.

665. Lane, David M., Saskatchewan Dept. Mineral Resources:
Petrology and Sedimentation of the Dawson Bay Evaporites, 1958-59.

666. MacQueen, R. W., Univ. of Toronto:
Ecology of the Flume Formation (Devonian), Jasper National Park, Alberta, 1958-60; M. A. thesis.

667. Mathews, W. H., Univ. of British Columbia:
Hydrology and Sediment Transport of a Glacial Stream, 1957-
Data are now on hand for a statistical analysis by which runoff from the glacier can be compared with meteorological records, as a means of forecasting stream flow.

668. Mellon, George Barry, Research Council of Alberta:
The Petrology of the Blairmore Group, 1956-59.
The results of this work will be published shortly as a Research Council of Alberta Preliminary report entitled "The Stratigraphy of the Blairmore Group, Alberta Foothills".

669. Middleton, G. V., Best, R. V., and Oliphant, F. J., McMaster Univ.:
Stratigraphic Analysis of Silurian of the Dundas Valley, Ont., 1958-59.
Sections of the Silurian have been measured in greater detail than by previous workers. It is hoped that stratigraphic analysis of this data will lead to conclusions on problems of classification and facies change, particularly in the Thorold, Grimsby and Cabot Head Formations.

670. Middleton, G. V., Weber, J., and Smoor, Peter, McMaster Univ.:
Greywackes of the Northern Appalachians, 1957-60.

671. Milne, Victor G., Univ. of Toronto:
The Non-Radioactive Heavy Minerals in the Uraniferous Conglomerate, Blind River, Ont., 1957-58; M. A. thesis.
An X-ray and optical study of the heavy minerals in the Blind River conglomerate ore-zone, to determine the character and proportions of the heavy minerals other than the radioactive minerals.

672. Mullins, W. J., Univ. of New Brunswick:
Stratigraphy and Sedimentary Petrology of the Carboniferous Beds of the Fredericton District, N. B., 1958-60; M. Sc. thesis.

673. Oldale, Harry R., Acadia Univ.:
Coarser-grained Clastics of the Albert Mississippian Formation of the Sussex and Elgin Areas of New Brunswick, 1958-59; M.Sc. thesis.

674. Roots, E.F., and others, Department of Mines and Technical Surveys:
Polar Continental Shelf Project, 1958-
The project will undertake oceanographic, geophysical and geological studies of those parts of the continental shelf of the Arctic ocean that are adjacent to Canada, including the straits and channels between the adjacent islands of the Arctic Archipelago. Field work will commence with a reconnaissance survey in 1959, with the first full year of survey in 1960. Studies in gravity and magnetic surveys, bottom sampling, coring (expected to begin 1960 or 1961) with attendant stratigraphic and micropalaeontological studies, seismic refraction surveys and possibly airborne geophysical surveys.

675. Winder, C.G., Univ. of Western Ontario:
Lexicon of Palaeozoic Formation Names in Southern Ontario, 1957-58.
Summarizes for each group, formation and member, the original author, type or reference locality, lithology, thickness, distribution, and nature of upper and lower contact, along with a list of important references.

676. Wood, Harold A., McMaster Univ.:
Analysis of the Relations Between Prevailing Winds and Shoreline Changes on Lake Erie, 1958-59.
An attempt is being made to evaluate the relative changes in magnitude and direction of the longshore component of wave energy, and to relate these changes to the rate of shore progradation and retrogradation. Particular attention is being paid to Long Point.

677. Young, W.L., Carleton Univ.:
The Seine River Conglomerate, Ontario, 1958-59.
Preliminary investigation of this formation gave rise to the suspicion that it was not a true sediment. Petrographic and chemical investigations of the boulders and matrix are under way to try and establish its nature, and its true relation to the other rock formations in the area - notably the Steep Rock Series.

STRATIGRAPHY AND PALAEONTOLOGY

Precambrian

678. Brett, B.D., McGill Univ.:
An Interpretation of Recorded Information Relating to the Grenville Front, 1957-59; M.Sc. Thesis.

679. Fahrig, W.F., Geol. Surv., Canada:
Stratigraphic Investigations of Rocks of the Athabasca Series, Sask., 1957-58.

680. Frarey, M.J., Geol. Surv., Canada:
Huronian Rocks North of Lake Huron in Echo River Map-area, Ontario, 1 inch to 1 mile, 1956-58.
Geological mapping with special emphasis on the Huronian rocks.

681. Hunt, G.H., Univ. of Alberta:
Precambrian Igneous Activity in the Southern Canadian Cordillera, 1958-62; Ph.D. thesis.

682. Pienaar, .J., Queen's Univ.:
The Stratigraphy, Petrology and Genesis of the Elliott Group, Including the Uraniferous Conglomerates, Quirke Lake Syncline, Ontario, 1956-58; Ph.D. thesis.

Cambrian to Silurian

683. Beales, F.W., Univ. of Toronto:
Stratigraphy of the Black River Group in Southern Ontario and Quebec, 1955-.

684. Dean, Ronald S., McGill Univ.:
The Black Shales of the St. Lawrence Lowlands of Quebec, 1958-60, Ph.D. thesis.

685. Fyles, J.T., and Eastwood, G.E.P., British Columbia Dept. of Mines:
Study of Lardeau Series from Trout Lake to the Southwestern Margin, British Columbia, 1957-58.
Work done in 1958 completes the study of a section across the Lardeau Series from the north-eastern margin at the head of Gainer Creek along Gainer Creek, Lardeau River and up Trout Creek to the southwestern margin of the Lardeau Series.

686. Kent, Donald M., Saskatchewan Dept. Mineral Resources:
Evaporites and Associated Rocks in the Ordovician System of Saskatchewan, 1958-59.

687. Kramer, James R., N.R.C. Post-doctorate Fellow, University of Western Ontario:
Geochemical Facies Analysis of Salina Formation in Southwestern Ontario, 1958-59.
Includes detailed chemical analysis of 1 to 2,000 samples of the Salina formation (a) to determine the nature of the sea that covered southwestern Ontario and surrounding areas during Silurian Salina time (b) to correlate the chemistry of the Salina rocks with known petroliferous areas, and (c) to deduce probable petroliferous areas from the information obtained in (a) and (b).
Geochemistry of Calcite, Dolomite, and Aragonite in Sea Water, 1955-
Includes (a) determination of solubility products of calcite, dolomite, and aragonite in well brines (b) verification of solubility product values (see reference) in sea water (c) effect of amino acids on calcite, dolomite, and aragonite equilibria in sea water to interpret the oceanographic environment in which calcite, dolomite and aragonite form. See Kramer, J.R., (1958) Study on Calcite and Dolomite in Sea Water: (abstract) Geol. Soc. America Annual Meeting, St. Louis.

688. McCabe, Hugh R., Manitoba Mines Branch:
Mississippian Stratigraphy of Manitoba, 1956-59.

689. McLean, Douglas D., Saskatchewan Dept. Mineral Resources:
Stratigraphy and Correlation of the Winnipeg Sandstones in East Central Saskatchewan, 1958-59.

690. Middleton, G.V., Best, R.V., and Oliphant, F.J., McMaster Univ.:
Stratigraphic Analysis of Silurian of the Dundas Valley, Ont., 1958-59.
Sections of the Silurian have been measured in greater detail than by previous workers. It is hoped that stratigraphic analysis of this data will lead to conclusions on problems of classification and facies changes, particularly in the Thorold, Grimsby and Cabot Head Formations.

691. Mullins, W.J., Univ. of New Brunswick:
Stratigraphy and Sedimentary Petrology of the Carboniferous Beds of the Fredericton District, N.B., 1958-60; M.Sc. thesis.

692. Okulitch, V.J., Univ. of British Columbia:
Continuing Research on the Faunas and Stratigraphy of Lower Cambrian in Western Canada, 1941-
See "Archaeocyathid Localities in Washington, British Columbia and the Yukon Terr.", Journal Palaeontology, vol. 32, no. 3, May, 1958, pp. 617-623.

693. Rickard, M. J., McGill Univ.:
Structural Investigation of the Relation Between the Oak Hill Series and Sutton Schists, Southern Quebec, 1957-60.
A detailed investigation of minor structures is being undertaken in an attempt to determine the effect of the various Palaeozoic orogenies on a series of Cambrian and possibly older schistose sediments. In particular the study is concerned with the nature of the junction between the lower Cambrian Oak Hill series and the Sutton schist.

694. Winder, C.G., with student assistants, Univ. of Western Ontario:
Age of the Kettle Point Shales in Southwestern Ontario, 1957-59.
Study of the conodont fauna at the type locality has been completed; in progress is a study of the structural disposition of the formation and the stratigraphic distribution of trace elements; also in progress is a study of the stratigraphic distribution of the microfauna.

Devonian to Permian

695. Beales, F.W., Univ. of Toronto:
Stratigraphy of the late Palaeozoic Limestones of Southwestern Alberta, 1948-

696. Belyea, H.R., Geol. Surv., Canada:
Sub-surface Studies of the Devonian System of the Alberta Plains, 1951-
The preparation from data from core samples, and electric and radioactivity logs, of cross-sections to show correlations and facies changes in the Devonian system of the Alberta plains; and the preparation of maps showing isopachs and regional variations in the facies of the various formations.

697. Edmunds, F.H., Univ. of Saskatchewan:
Devonian Stratigraphy of Saskatchewan.

698. Horn, R.D.R., Univ. of Saskatchewan.
Mississippian of the Steelman Oilfield, Sask., 1958-59; M.Sc. thesis.

699. Fuzesy, Laszlo M., Saskatchewan Dept. Mineral Resources:
Study of the Mississippian Subcrop in Southeast and South Saskatchewan, 1958-59.

700. Kents, Paul, Saskatchewan Dept. Mineral Resources:
Three Forks-Bakken Stratigraphy in West Central Saskatchewan, 1958-59.

701. Lane, David M., Saskatchewan Dept. Mineral Resources:
Petrology and Sedimentation of the Dawson Bay Evaporites, 1958-59.

702. Lesperance, P. J., McGill Univ.:
Post-Taconic Formations of the Temiscouata Region, Quebec, 1958-60; Ph. D. thesis.

703. MacQueen, R. W., Univ. of Toronto:
Ecology of the Flume Formation (Devonian), Jasper National Park Alberta, 1958-60; M. A. thesis.

704. McGugan, Allan, Queen's Univ.:
The "Permo-Pennsylvanian" of Western Canadian Rocky Mountains, Alberta and Northeastern B. C., 1958-65.
A preliminary reconnaissance of the interval was completed during the summer of 1958. In the summer of 1959 work will continue in more detail and will include field mapping, detailed measured sections, stratigraphy, petrology and palaeontology. See "Lower Permian Fusulinids from Wapiti Lake, B. C.", Journal of Alberta Soc. of Pet. Geol. (In press).

705. Oldale, Harry R., Acadia Univ.:
Coarser-grained clastics of the Albert Mississippian Formation of the Sussex and Elgin Areas of New Brunswick, 1958-59; M. Sc. thesis.

706. Scott, Darcy, Univ. of B. C.:
Geology of Wasootch Creek, Kananaskis Valley, Alberta, (Devonian-Mississippian), 1958-59; M. Sc. thesis.

707. Yule, Ray, Univ. of British Columbia:
Upper Devonian Faunas and Their Environmental Relationships, 1958-61; Ph. D. thesis.

708. Yont, D. R., Univ. of Saskatchewan:
The Winnipegosis Formation of the Meadow Lake Area, Sask., 1958-59; M. Sc. thesis.

Mesozoic to Cretaceous

709. Byers, A. R., Univ. of Saskatchewan:
Structural Study of Deformation of the Whitemud Formation, Claybank Area, Sask., 1958-59.

710. Carrigy, Maurice, Research Council of Alberta:
Sedimentation of the McMurray Formation, 1957-
See "General Geology of the McMurray Area" Res. Coun. of Alberta, Mem. No. 1.

711. Frebold, H., Geol. Surv., Canada:
Jurassic Rocks of the Nelson and Salmo Map-areas, B.C., 1957-58.
To determine the age of the various Jurassic beds of the above map-areas and to describe their contained fauna.
Jurassic Rocks of the Canadian Arctic Islands, 1957-58.
To describe the fauna, age and correlation of the Jurassic rocks of the Canadian Arctic Islands, these data to be derived particularly from collections of fossils obtained by 'Operation Franklin'.

712. Jeletzky, J.A., Geol. Surv., Canada:
Cretaceous and Uppermost Jurassic Strata Southwest of the Mackenzie River Delta and Arctic Coast Between Rat River and Babbage River, N.W.T., 1955-58.
See Geol. Surv., Canada Paper 58-2.
Cretaceous Marine Zones of the Western Interior of Canada, 1956-
The preparation of a comprehensive description of the palaeontology and stratigraphy of marine Cretaceous strata of the western interior of Canada.

713. Kryczka, A., Univ. of Alberta:
Petrology of the Nikanassin Formation, Cadomin Area, Alberta, 1958-59; M.Sc. thesis.

714. Lerbekmo, John F., Univ. of Alberta:
Petrology of the Belly River Formation, 1957-60.

715. McMullen, R.M., Univ. of Alberta:
Petrography of the Cardium Formation, Pembina Oilfield, Alberta, 1958-59; M.Sc. thesis.

716. Mellon, George Barry, Research Council of Alberta:
Petrology of the Blairmore Group, 1956-59.
The results of this work will be published shortly as a Research Council of Alberta Preliminary Report entitled "The Stratigraphy of the Blairmore Group, Alberta Foothills".

717. Merrill, Wm. M., Research Council of Alberta:
Stratigraphy, Sedimentation and Palaeocology of Terrestrial Rocks which include the Mesozoic-Cenozoic Boundary in West Central Alberta, 1958-62.

718. Meyboom, Peter, Research Council of Alberta:
Milk River Sandstone (Geology and Hydrology), 1958-60.
The Milk River Sandstone is a large Cretaceous aquifer in southern Alberta. This investigation will trace the lateral extension of the aquifer and find the geological reasons for its hydrological behaviour.

719. Stott, D.F., Geol. Surv., Canada:
Cretaceous of Western Foothills, 1958-60.
Stratigraphic palaeontological study of Cretaceous strata with emphasis on their possibilities as a source of fossil fuels.

720. Wall, John H., Research Council of Alberta:
Jurassic Microfaunas from Saskatchewan, Western Canada, 1954-58;
Ph.D. thesis, 1958, Univ. of Missouri.
This project describes, illustrates, and gives the stratigraphic distribution of many of the common species of Foraminifera and Ostracoda in the Jurassic of Saskatchewan. The stratigraphic and ecological implications of the microfaunal assemblages are discussed.
Microfaunal Study of the Wapiabi and Blackstone Formations in Western Alberta, 1958-61.
It is hoped that a study of the microfaunal assemblages across the interval embracing the Cardium and Bad Heart sands will assist stratigraphers in the recognition and correlation of the sands.

721. Williams, Michael G., Univ. of British Columbia:
Geology of the Leech River Series, Southern Vancouver Island, 1958-59; M.A. Sc. thesis.

General Problems

722. Benoit, F.W., Quebec Dept. Mines:
Un Essai d'Interpretation d'une Section de l'Axe de Sutton pres de la Riviere Chaudiere.
A paper presented to the 25th Congres de l'Academie Canadienne-Française pour l'avancement des Sciences (A.C.F.A.S.), at Quebec, Nov. 2, 1957.

723. Bolton, T.E., Wagner, F.J.E., Geol. Surv., Canada:
Lexicon of Stratigraphic Names Used in Canada, 1958-60.

724. Clark, T.H., McGill Univ.:
Structure, Stratigraphy, Palaeontology and Economic Possibilities of the Palaeozoic Rocks of the St. Lawrence Lowland of Quebec, 1938-62. See Quebec Dept. Mines, Geol. Rept. No. 66 -
Bel Oeil, St. Jean Area, 1956.

725. Clark, T.H., and Dean, R.S., McGill Univ.:
The Black Shale Problem, 1957-61.

726. Danner, Wilbert, R., Univ. of British Columbia:
Stratigraphy and Palaeontology of Southwestern B.C. and Northwestern Washington, 1957-

727. Dreimanis, A., and Reavely, G.H., Univ. of Western Ontario:
Pleistocene Stratigraphy along Lakes Erie and Huron, 1952-60.
This project forms part of a systematic study of the Pleistocene deposits of southern Ontario. See "Wisconsin Stratigraphy of Port Talbot on the North Shore of Lake Erie, Ontario", Ohio Jour. Sc. vol. 58, p. 65-84 and "Beginning of the Nipissing Phase of Lake Huron", Jour. Geol., vol. 66, p. T591-594.

728. Hughes, J.E., British Columbia Dept. of Mines:
Stratigraphy and Structural Studies of Post-Palaeozoic Rocks along the John Hart Highway, B.C., 1954-58.

729. Kupsch, W.O., Univ. of Saskatchewan:
Sedimentary Strata of the Prairies.

730. Folinsbee, R.E., Baadsgaard, H., Lipson, J., Waller, P.C., and Orr, J.B., Univ. of Alberta:
Establishing a Stratigraphically Controlled Absolute Geologic Time Scale, 1954-
Mr. Waller is studying "Cambrian Geochronology and Sedimentary Petrology of the Rockies", M.Sc. thesis, 1959. Mr. Orr is studying "Ordovician Metabentonites of Ontario", M.Sc. thesis, 1959.

731. Liberty, B.A., Geol. Surv., Canada:
Palaeozoic Outliers of the Canadian Shield, 1957-
To compile and maintain all available data on the distribution and geology of the Palaeozoic outliers in the Canadian Shield, and to evaluate their palaeogeographical and geological significance.

732. Ollerenshaw, N.C., Univ. of Toronto:
Study of the Palaeozoic Section as Revealed in the Simcoe Drill Core in Southwestern Ontario, 1957-58; M.A. thesis.

733. Roots, E.F., and others, Department of Mines and Technical Surveys:
Polar Continental Shelf Project, 1958-

The Project will undertake oceanographic, geophysical and geological studies of those parts of the continental shelf of the Arctic ocean that are adjacent to Canada, including the straits and channels between the adjacent islands of the Arctic Archipelago. Field work will commence with a reconnaissance survey in 1959, with the first full year of survey in 1960. Studies in geological and related fields will include complete gravity and magnetic surveys, bottom sampling, coring (expected to begin 1960 or 1961) with attendant stratigraphic and micropalaeontological studies, seismic refraction surveys and possibly airborne geophysical surveys.

The submarine geological investigations of the Polar Continental Shelf Project are intended to be the beginning of a continuing program to be undertaken by the Department of Mines and Technical Surveys in conjunction with investigations in the field of physical oceanography, and to be eventually expanded to include studies of the geology of the Atlantic and Pacific coasts of Canada.

734. Sanford, B.V., and Quillian R.G., Geol. Surv., Canada:
Sub-surface Studies of Each of the Palaeozoic Systems of Southwestern Ontario (Cambrian, Ordovician, Silurian and Devonian), 1958-61.

By the study of samples and data obtained from wells drilled for oil and gas, to describe and interpret the geological features of the formations of each system and to assess their economic potentialities.

735. Thorsteinsson, R., and Tozer, E.T., Geol. Surv., Canada:
Mellville, Brock, Borden, and MacKenzie King Islands, District of Franklin, N.W.T., 1958.

Reconnaissance mapping plus stratigraphic-palaeontological studies.

736. Winder, C.G., Univ. of Western Ontario:
Lexicon of Palaeozoic Formation Names in Southern Ontario, 1957-58.

Summarizes for each group, formation, and member, the original author, type or reference locality, lithology, thickness, distribution, and nature of upper and lower contact, along with a list of important references.

STRUCTURAL GEOLOGY

British Columbia

737. Hughes, J.E., British Columbia Dept. of Mines:
Stratigraphy and Structural Studies of Post-Palaeozoic Rocks along the John Hart Highway, B.C., 1954-58.

738. Stevenson, John S., McGill Univ.:
Mineralogical and Structural Studies, Bridge River Mining Camp, B.C., 1947-59.

Northwest Territories

739. Hill, Patrick Arthur, Carleton Univ.:
Structure and Mineralization, Thompson Lake, Northwest Territories, 1948-60.
Includes analyses of joint systems and study of aplites and pegmatites, and their zoning in relation to structure; mineralization of Thompson Lake area, and metasomatism as evidenced by mineral veinlets.

Nova Scotia

740. Cameron, H.L., Nova Scotia Research Foundation:
Correlation Between Structure of Meguma Series and Aeromagnetic Map Data, 1958-59.
Involves the correlation between 1 inch to 1 mile geological maps of eastern Nova Scotia and aeromagnetic (GSC) maps of the same region, and extrapolation to area west of Lake Rossignol where mapping has not been done in detail.

Ontario

741. Brown, D.D., Queen's Univ.:
Investigation of the Odessa-Westport Fault, 1958-60; M.Sc. thesis.
The objective is to determine the tectonic history by means of a complete investigation of a prominent fault cutting rocks of Grenville age between Odessa and Westport, Ont. Related structural elements such as dragfolds, lineations, subsidiary faults, directions and amounts of movement, and possibly micro-structures in oriented specimens will be studied.

742. Clarke, P. J., Queen's Univ.:
A Study of Joints in Palaeozoic and Precambrian Rocks in Eastern Ontario, 1957-59; M. A. thesis.

Joints in Palaeozoic rocks reflect, in eastern Ontario generally, joints in underlying Precambrian rocks, but sets not present in the Precambrian are found in the Palaeozoic. The problem of the origin of the several sets is being investigated. The possibility is being studied that the joint sets in Palaeozoic rocks are related to and can be used to predict the form of the buried topography of the basement.

743. Ginn, Robt. M., Univ. of Toronto:
Granites Between Sudbury and Blind River and Their Relationship to the Bruce Series, 1956-59; Ph. D. thesis.

Examination of stratigraphic and structural problems in this area, based on detailed mapping for the Ontario Dept. Mines.

744. Hawley, J. E., MacDonald, G., Grant, J. A., Pearson, G. R. and others, Queen's Univ.:
Granitic Rocks of the Grenville in Eastern Ontario, 1956-60.

One doctorate thesis has been completed by G. R. Pearson on the Clare River Syncline area and includes many analyses of granitic rocks in that district. Theses by W. J. Pearson on cyanite occurrences in Ontario, by H. R. Wynne-Edwards on the geology of the Westport area, and by A. M. Evans on the Centre Lake uranium area, will all include data on the geochemistry of granitic rocks in these areas. J. A. Grant is completing a petrographic study of some twenty-five granitic masses in other parts of eastern Ontario for which fairly complete chemical analyses have been made.

745. Innes, M. J. S., Dominion Observatory:
Gravity Investigations of the Area of the North Shore of Lake Huron, 1957-59.

A study is in progress to determine if certain gravitational features observed in Manitoulin Island are due to relief or to lithological changes of the Precambrian basement rocks. A gravity map on scale of 4 miles to 1 inch has been completed.

746. Wynne-Edwards, H. R., Queen's Univ.:
The Geology of the Westport Area, Ontario, 1955-59; Ph. D. thesis.

A detailed structural and petrographic study of Grenville Gneisses and Plutons; in collaboration with the Geological Survey of Canada.

Quebec

747. Benoit, F.W., Quebec Dept. of Mines,
Un Essai d'Interpretation d'une Section de l'Axe de Sutton pres de la Riviere Chaudiere.
A paper presented to the 25th Congress de l'academie Canadienne-Française pour l'advancement des Sciences (A.C.F.A.S.), at Quebec, Nov. 2, 1957.

748. Clark, T.H., McGill Univ.:
Structure, Stratigraphy, Palaeontology and Economic Possibilities of the Palaeozoic Rocks of the St. Lawrence Lowland of Quebec, 1938-62.
See Quebec Dept. Mines, Geol. Rept., No. 66, Bel Oeil, St. Jean Area, 1956.

749. Grondin, Gaston-Guy, Université Laval:
La Geologie Regionale des Appalaches dans la Province de Quebec, 1958-59; M.Sc. thesis.

750. Rickard, M.J., McGill Univ.:
Structural Investigation of the Relation Between the Cak Hill Series and Sutton Schists, Southern Quebec, 1957-60.
A detailed investigation of minor structures is being undertaken in an attempt to determine the effect of the various Palaeozoic orogenies on a series of Cambrian and possibly older schistose sediments. In particular the study is concerned with the nature of the junction between the lower Cambrian Oak Hill series and the Sutton schist.

751. Sauve, Pierre, Quebec Dept. of Mines:
Metamorphism and Structure of the Labrador Trough at 58° N., Lat.
Presented to La Societe Geologique de Quebec, Dec. 12, 1957.

Saskatchewan

752. Byers, A.R., Univ. of Saskatchewan:
Structural Study of Deformation of the Whitemud Formation, Claybank Area, Sask., 1958-59.

753. Hall, D.H., Geol. Surv., Canada:
Aeromagnetic Interpretation, Meadow Lake Area, Sask., 1958-
To produce a basement topographical map and to infer basement structure and lithology from aeromagnetic data by depth calculations on basement anomalies and extrapolating known geology from adjacent Shield area.

754. Perkins, G.D., Univ. of Saskatchewan:
Sedimentary Structures of the Shaft of the Potash Corp., of America, Saskatoon, Sask., 1958-59; M.Sc. thesis.

General Problems

755. Ambrose, J.W. and Carlyon, Ronald, Queen's Univ.:
An Experimental Investigation of Fracture Cleavage, 1958-59.
An investigation by dynamically similar models of the origin of fracture cleavage in incompetent beds.

756. Ambrose, J.W., Queen's Univ.:
Exhumed Pre-Palaeozoic Surfaces in the Canadian Precambrian Shield, 1954-
Palaeozoic sediments were deposited on a Precambrian surface etched by a well-developed sub-aerial drainage pattern. As the Palaeozoic rocks are stripped away the ancient drainage pattern (and associated hills and valleys) are exhumed and the surface can be identified completely around the periphery of the Canadian Shield, and in numerous places in its interior. This study is aimed to determine the criteria for recognition of exhumed topography and its extent in this country.

757. Brown, A., Mines Branch, Dept. Mines and Technical Surveys:
Ground Stress Investigations in Underground Mines, 1950-
A cooperative project with the Geological Survey of Canada, Dominion Observatory, and Provincial Mining Departments and Research groups.
See "Rock Pressure Investigations in the Spring Hill Mines, Nova Scotia", Mining Section, Fuels Division, Mines Branch, Tech. Memo. 41-58, Feb. 1958, "Ground Stress Investigations in Canadian Coal Mines", Min. Eng., August 1958, "Ground Stress Studies in Coal Mines of Western Canada", C.I.M. Bull., Nov. 1958, "Canadian Ground Stress Investigations", Mines Branch, Invest. Rept. 58-116, May 1958.

758. Bancroft, P.M., Dominion Observatory:
General Crustal Studies, 1958-
Future seismic field work of the Dominion Observatory will be concentrated mainly in the distance range of 2,500 to 3,000 miles i.e. excluding short range explosion observations except when specifically required for the interpretation of work carried out over long distances. To this end new field equipment is being collected in preparation for field tests during 1959.

759. Brett, B.D., McGill Univ.:
An Interpretation of Recorded Information Relating to the Grenville Front, 1957-59; M.Sc. thesis.

760. Burwash, R. A., Univ. of Alberta:
Age Relations of Granites in the Western Canadian Shield, Exposed and Buried, 1958-
See "Age of the Alberta Precambrian Basement", Journal of the Alberta Soc. of Petroleum Geologists, vol. 6, No. 9, 1958.

761. Dubois, P.M., and Larochelle, A., Geol. Surv., Canada:
Palaeomagnetic Studies, 1955-
The collection and preparation of rock samples to measure the direction of remanent magnetism, and accumulation of data expected to reveal the direction of the earth's magnetic field during geologic history, and thus throw light on age and structural relationships of rock formations.

762. Folinsbee, R.E., Baadsgaard, H., and Lipson, J.I., Univ. of Alberta:
Dating Cordilleran Orogenies, 1954-59.
See "An Absolute Age for the Exshaw Shale", Guidebook, 8th Ann. Field Confererence; Alberta Soc. Pet. Geol., Aug., 1958, pp. 69-73.

763. Hill, Patrick Arthur, Carleton Univ.:
Structure of Northwest Trinidad, Cuba.

764. Hodgson, J.H., and others, Dominion Observatory:
Fault Plane Studies, 1949-
By studying the displacements produced by an earthquake at stations all over the world, it is possible to determine the direction of faulting at the origin. By combining data of this type, conclusions on regional tectonics can be drawn. The work which has been published to date refers only to compressional waves but current efforts are being directed towards utilization of transverse wave data. See "Direction of Faulting in Some of the Large Earthquakes of 1955-56", publ. of Dom. Obs. vol. 19, no. 8.

765. Hunt, G.H., Univ. of Alberta:
Precambrian Igneous Activity in the Southern Canadian Cordillera, 1958-62; Ph.D. thesis.

766. Innes, M.J.S., and Thompson, L.G.D., Dominion Observatory:
Gravity Results for the Canadian Shield in Northern Ontario and Manitoba, 1947-59.
The geological and structural implications of the anomalies have been re-examined and an isostatic study and revised manuscript are nearing completion.

767. Innes, M.J.S., Dominion Observatory, and Pearson, W.J., Saskatchewan Dept. of Mineral Resources:
Geophysical Investigations of Fossil Meteorite Craters, 1953-
Geophysical investigations have been carried out over circular features near Brent, Ontario, Holleford, Ont., Franktown, Ont., Macamic, Quebec, and Reindeer Lake, Sask. Additional field measurements are to be made during 1959. Reports are in preparation. See "A Possible Meteorite Crater at Deep Bay, Sask." Jour. of the Roy. Astr. Soc. Can. vol. LI, for 1957.

768. Innes, M.J.S., Dominion Observatory:
Large Scale Gravitational Features of Canada, 1957-59.
An historical review of gravity measurements has been completed; a gravity map on a scale of 1 inch to 100 miles has been completed but not yet released; and a manuscript dealing with the interpretation of the broader gravitational features is nearing completion.

769. Innes, M.J.S., Hamilton, A.C., and others, Dominion Observatory:
Gravity Measurements in the Prairie Provinces, 1955-
The establishment of a primary network for control of gravity measurements has been completed. 11 oil companies have contributed data for 6,300 townships. During 1958, 400 of these were tied to the Dominion Observatory network and 600 new regional stations established. The compilation is under way of three 1 inch to 8 mile map-sheets in Alberta and Saskatchewan between the International Boundary and latitude 52°.

770. Oja, Reino, McGill Univ.:
Experimental Study of Anatexis, 1957-59; Ph.D. thesis.

771. Pajari, G.E., McGill Univ.:
Deformation of Rocks at High Temperature and Pressures, 1958-60; M.Sc. thesis.

772. Rondot, Jehan, Quebec Dept. of Mines:
Quelques Considerations sur la Tectonique et les Resources Minieres de la Turquie.
Presented Nov. 2, 1957, to the 25th Congress of L'A.C.F.A.S.
Zoneographie des Roches Cristallophyllienes d'apres Maurice Roques.
Presented Mar. 20, 1958, to La Societe Geologique de Quebec.

773. Roots, E.F., and others, Department of Mines and Technical Surveys:
Polar Continental Shelf Project, 1958-

The project will undertake oceanographic, geophysical and geological studies of those parts of the continental shelf of the Arctic ocean that are adjacent to Canada, including the straits and channels between the adjacent islands of the Arctic Archipelago. Field work will commence with a reconnaissance survey in 1959, with the first full year of survey in 1960. Studies in geological and related fields will include complete gravity and magnetic surveys, bottom sampling, coring (expected to begin 1960 or 1961) with attendant stratigraphic and micropalaeontological studies, seismic refraction surveys and possibly airborne geophysical surveys.

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774. Sabourin, R. J. E., Université Laval:
Orbicular Structures (Igneous), 1957-59.

775. Stevenson, John S., McGill Univ.:
Mineralogical and Structural Studies, Bridge River Mining Camp, B. C., 1947-59.
Mineralogical and Structural Studies Sudbury Nickel Irruptive, Sudbury, Ontario, 1951-

776. Stockwell, C. H., Chairman of Tectonic Map Committee, Geol. Surv., Canada:
Tectonic Map of Canada, 1958-60.

UNCLASSIFIED

777. Cameron, H. L., Nova Scotia Research Foundation:
Tidal Current Mapping of Complete Tidal Cycle - Tiverton Westport Areas, Nova Scotia, 1958-59.

It is possible to measure the position of maximum flowlines and the velocities of currents by aerial photography. This method has been applied at Bellot Strait in the Arctic. The present research photography is sponsored by the Dominion Public Works Department. Photo strips were taken of Petit and Grand Passages at 15 minute intervals throughout a tidal gale. The data is now being processed.

778. Calkin, Parker, E., Univ. of British Columbia:
The Geology of Lummi Island, Whatcom County, Washington, 1958-59; M.Sc. thesis.

779. Hill, Patrick Arthur, Carleton Univ.:
Geology of the Guaos Area, Cuba, 1956-59.
See Preliminary Map, Carleton Univ., Geological Series 58-1, Dec. 1958.
Source and Route of Sarsen Stones, Wiltshire, England, 1958.

780. Pelletier, B.R., Geol. Surv., Canada:
Methods of Study of Submarine Geology, 1959-
It is proposed to undertake a review of the literature pertaining to submarine geological investigations and to contact various institutions and individuals working in the field with a view to determining the scope of the subject and the need for such work in Canada.

781. Stockwell, C.H., Geol. Surv., Canada:
Geological Map of Canada, 1958-60.
The preparation of a revised geological map of Canada as a contribution to the World Geological Map being prepared under the auspices of the International Geological Congress.

AUTHOR INDEX