CANADA

NATIONAL ADVISORY COMMITTEE ON RESEARCH IN THE GEOLOGICAL SCIENCES

EIGHTH ANNUAL REPORT

1957-58

(Including Survey of Current Research in the Geological Sciences in Canada, 1957-58)

Price 50 cents

OTTAWA

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Victoria Memorial Museum,
Ottawa, October 31, 1958.

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

Sir:

I have the honour to submit to you the Eighth Annual Report of the National Advisory Committee on Research in the Geological Sciences covering the period September 1st, 1957 to August 31st, 1958.

Respectfully submitted,

J. M. Harrison,
Chairman.

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MEMBERS OF COMMITTEE

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Dr. H.D.B. Wilson.....	University of Manitoba, Winnipeg, Manitoba.
Dr J.F. Henderson, Secretary ...	Geological Survey of Canada, Ottawa, Ontario.

Meetings:

April 19-20, 1958, Hotel Vancouver, Vancouver, British Columbia

EXECUTIVE COMMITTEE

Dr. J.M. Harrison, (Chairman) ..... Geological Survey of Canada, Ottawa, Ontario.

Dr. J.E. Gill ..... McGill University, Montreal, Quebec.

Dr. J.W. Ambrose ..... Queen's University, Kingston, Ontario.

Dr. C.S. Lord ..... Geological Survey of Canada, Ottawa, Ontario.

Meetings:

March 11, 1958, Royal York Hotel, Toronto, Ontario.

PROJECTS COMMITTEE

Dr. J.M. Harrison, (Chairman) ..... Geological Survey of Canada, Ottawa, Ontario.

Mr. Franc R. Joubin ..... Franc R. Joubin and Associates, Ltd., Toronto, Ontario.

Dr. C.S. Lord ..... Geological Survey of Canada, Ottawa, Ontario.

Dr. B.T. Denis ..... Dept. of Mines, Quebec, P.Q.

Dr. G.S. MacKenzie ..... University of New Brunswick, Fredericton, N.B.

Meetings:

June 27, 1958, 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 co-ordinate geological research carried on in Canada; to suggest research projects that should receive attention; and to aid in having these projects undertaken. The Committee does not carry on research. 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 September 1, 1957, to August 31, 1958. The second part contains the reports of the subcommittees covering the different fields of the geological sciences. These record developments in 1957-58 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

In last year's report[1] plans for initiating a co-operative comprehensive study of an ore deposit were outlined. Geological studies of mining districts provide much information but, in general, have been narrow in scope and deal with only one or two of the many facets of the overall problem of the nature of the geological processes responsible for the formation of orebodies. The project envisaged would be much broader in scope. It would be carried out by groups of scientists with diverse training and experience including geophysicists, geochemists, geologists and mineralogists. It would be a co-operative project by the staffs of the mines selected, the Geological Survey of Canada and the provincial department of mines of the province concerned and by the universities. Such a comprehensive integrated investigation should result in a more rapid advance in our knowledge of ore deposits, of the source of the metals and of how and why the orebodies attained their present position and form.

[1] National Advisory Committee on Research in the Geological Sciences, Seventh Annual Report, 1956-57, p. 1.

This project, originally proposed by the Subcommittee on Mineral Deposits, was first discussed at the annual meeting of the National Advisory Committee in April 1957, and later by a special committee chaired by Dean H.C. Gunning at a meeting held in Ottawa, in June, 1957. At these meetings several suitable ore deposits for study were suggested and discussed. It was agreed that the Geological Survey of Canada should sponsor the project with overall responsibility for carrying it through, and that the Director of the Survey, as chairman of a small working technical committee which he would appoint, would be entrusted with seeing the project got underway.

Following these meetings a detailed outline of a program for the comprehensive study was drawn up by Dr. R.W. Boyle and subsequently a lead-zinc orebody in New Brunswick was selected as being a particularly suitable ore deposit for study. In January, 1958

Dr. C.H. Stockwell and Dr. Boyle visited the mine and discussed the project with mine officials. Subsequently, however, low base metal prices forced the closing of the mine and the project in so far as these particular deposits are concerned, was abandoned.

It is hoped that another suitable mine will be selected and that eventually the study of its ore deposits will go ahead as originally envisaged.

RESEARCH GRANTS TO UNIVERSITIES

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

In the year under review grants totalling $50,000 were awarded to ten universities in support of 25 research projects, an increase of $10,000 over total awarded in 1957. Amounts of the grants and descriptions of the projects being supported are given in Appendix II (p. 71).

Thirty-eight projects in 12 universities are currently (September, 1958) being supported; 30 others have been completed. Since 1951 when the grants were initiated, 69 papers have been published in scientific periodicals recording the results of projects supported by the grants. Summaries on some of the projects on which results of interest are being obtained are given in Appendix I (p. 64).

Applications for grants in 1958 doubled in number over the preceding year. Applications for grants for projects already being supported alone totalled more than the $50,000 available. There were, in addition, an even larger number of applications for grants for new projects. With the limited funds available, the Committee was faced with the problem of supporting worthwhile continuing projects and also of providing support for some of the many new projects. Because a number of worthwhile projects could not be supported, and grants for others were much below the amounts requested, the Committee has recommended that the amount to be provided for grants-in-aid of geological research in 1959-60 be increased to $75,000.

GLACIAL MAP OF CANADA

The compilation and publication of a Glacial Map of Canada recommended in the first report of the Subcommittee on Pleistocene Geology and actively supported by the National Advisory Committee[1]

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[1]National Advisory Committee on Research in the Geological Sciences, Sixth Annual Report, 1955-56, p. 3 and Seventh Annual Report, 1956-57, p. 3.

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is now an accomplished fact. The map was published in the early part of 1958 by the Geological Association of Canada with support from the Geological Survey of Canada, Defence Research Board and National Research Council. Copies may be obtained from the Secretary, Geological Association of Canada, P.O. Box 4029, Terminal A, Toronto at $2.00 a copy.

It is an excellent multi-coloured lithographic map in a single sheet measuring more than 4 by 5 feet on a scale of 1 inch to 60 miles. An inset of the Canadian Shield indicates the proportions of rock outcrop to drift covered areas. Ice-flow features such as drumlins, glacial grooves and striations and glacio-fluvial features such as eskers, kames and glacial outwash deposits present a striking picture of the results of glaciation, particularly in northern Canada, and is by far the most detailed yet published. The Keewatin, Labrador, and Cordilleran recessional ice-divide areas are indicated on one map for the first time. Contours indicate the known limits of ice action in the Cordillera, and present day Cordilleran and Arctic glaciers are shown in detail. Also shown are moraines, unglaciated areas, extinct Pleistocene lakes, areas of marine submergence, marine and lacustrine strand lines and much other data.

The map serves to summarize our knowledge of the glacial history of Canada and will stimulate discussion of glaciation and of the many problems in this field that remain to be solved.

"THE CANADIAN MINERALOGIST"

As outlined in the Sixth Annual Report[1] the newly formed Mineralogical Association of Canada in 1955 sought the support of the National Advisory Committee in finding means of publishing the journal of the Association. The National Advisory Committee, recognizing that publication of results is one of the best ways of stimulating research, advised the Association to make application to the Geological Survey of Canada for a grant-in-aid for publication of the first number. On the recommendation of the National Advisory Committee grants of $2,478 and $2,400 were made in 1956, and 1957 for the publication of the journal.

[1] National Advisory Committee on Research in the Geological Sciences, Sixth Annual Report, 1955-56, p. 2-3.

The first number of the "Canadian Mineralogist" was published in September 1957 and the second in September 1958. The second number, also under the editorship of Dr. L.G. Berry, fully maintains the high standard of the first. It includes ten excellent papers and six shorter communications in the fields of crystallography, geochemistry, mineralogy and petrology several of which contain much new basic data. The quality of the papers, illustrations and general format compares most favourably with leading mineralogical journals from other countries.

Membership in the Mineralogical Association of Canada has increased from 100 in 1955 when the Association was incorporated to more than 400, and the list includes members from 25 countries. With maintenance of the excellent standard set by the first two numbers, membership in the Association and circulation of the "Canadian Mineralogist" should continue to grow, particularly outside Canada.

LIBRARY OF THE GEOLOGICAL SURVEY OF CANADA

The Geological Survey of Canada, with headquarters in the Victoria Memorial Museum in Ottawa, has the largest and most complete geological library in Canada. The National Museum of Canada, which is housed in the same building, formed part of the Geological Survey until a departmental reorganization in January 1950, when the National Museum became part of what is now the Department of Northern Affairs and National Resources. However, both organizations have continued to use the same library.

The Geological Survey will move to a new building in 1959. The division of the library presents many problems because many items, particularly serial publications of the learned societies, are of common interest to the Survey and the National Museum.

The National Advisory Committee considers it is most unfortunate that the library, dating from the founding of the Geological Survey in 1842, must be split. This library is the National geological research library of Canada, used not only by the Survey staff but also by the universities and geological research institutions across the country. At the 1958 annual meeting the National Advisory Committee expressed its views in regard to the division of the library as follows:

"This library has been built up by the Survey since its inception and now constitutes not only the best geological reference library in Canada, but one of the world's leading geological libraries. Many of the volumes are irreplaceable. They cannot be divided between the Survey and the Museum on an equitable basis. The library is a prime necessity for scientific research by the Survey, and to a lesser extent by the Museum. Furthermore, this library is used by the universities throughout Canada on an inter-library loan basis. Any move to alter the status and the effectiveness of this library would have serious reprecussions in geological work throughout the country."

TRANSLATION OF FOREIGN GEOLOGICAL LITERATURE

At the last two (1957 and 1958) annual meetings of the Committee, the translation of foreign geological literature was discussed. It has been found that much is being done and that the present facilities seem fully adequate. The translation services available in Canada, Breat Britain, and United States are, briefly, as follows:

Canada

The National Research Council provides translations of technical papers for its research staff. Many of these are made available to the scientific community at large. Cost is 50 cents for a 1 to 10 page article and 50 cents for each additional 10 pages. Complimentary copies are supplied to the universities. A list of technical translations by N.R.C. is available. The N.R.C. library receives complete English translations of many Russian scientific journals; a list of these is available.

As a service to Canadian and other enquirers the National Research Council Library maintains a card index to the location of completed translations in Canada, other countries of the Commonwealth, and the United States. The index which in late 1957 totalled 40,000 cards, is filed by author. The Library will handle enquiries on the existence and location of translations of specific papers. To help sustain the effectiveness of the index and avoid duplication of translation effort Canadian organizations should check with the index before translating, and also report or deposit translations when completed. Enquiries concerning National Research Council translations and the index should be addressed to Translations Section, Library, National Research Council, Sussex Drive, Cttawa 2.

The Defence Research Board also provides English translations for its research staff and many of these are made available to the scientific community at large.

The Geological Survey of Canada has from 25 to 40 articles a year translated (mainly from the Russian) for its officers by the Canadian Government Bureau for Translations. The translations are deposited in the Geological Survey Library.

Great Britain

The Department of Scientific and Industrial Research (U.K.) will prepare Russian translations. A translation may be commissioned at a cost of 3 to 12 shillings a page depending upon the length of the article. The D.S.I.R. also publishes a monthly bulletin entitled "Translated Contents Lists of Russian Periodicals" obtainable by subscription from Her Majesty's Stationery Office, P.O. Box 569, London, S.E. 1 at £3 10 s. per annum. This publication includes (1) a list of translated titles of the articles in each issue of a number of Russian periodicals, including ones in the geological sciences (2) a list of translations available from the Science Museum (London) and these translations may be borrowed by organizations or photo copies may be purchased (3) a list of the translations requested under the D.S.I.R. translation scheme that will be available shortly.

United States

The Library of Congress issues two publications (1) "Monthly Index of Russian Accessions" and (2) "East European Accession Index".

The first includes (1) lists of Soviet books and pamphlets with titles transliterated to Roman alphabet and translated into English, (2) list of Russian periodicals and titles of articles they contain both being transliterated and translated into English, (3) a subject guide in English to the books, pamphlets and periodical articles listed each month. The subscription is $15.00 a year.

The "East European Accessions Index" is a record of publications received from Albania, Bulgaria, Czechoslovakia, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, and Yugoslavia. The index lists each book title in the original language and in English. Titles of articles in all issues of the more important periodicals are also given in English; the others are listed in the original language followed by a descriptive annotation in English. It also contains a subject guide in English to both books and periodicals. The subscription is $12.50 a year.

There is the Special Libraries Association Translation Centre John Crerar Library, 86 East Randolph St., Chicago. The broad plan at this Centre is to develop a translation collection and information centre that can either provide or locate translations throughout the world. At the end of February, 1957 the Centre had over 14,000 translations on hand and was adding 500 a month to its collections. Translations are in all fields of science and technology and represent publications from many different languages. The Centre publishes an indexed monthly bulletin which classifies recent receipts of translations by broad subject matter and includes an author index. Subscription is $5.00 a year.

Photostat or microfilm copies of translations on file at the Centre are sold at cost. The Centre will search its holdings for particular items on request.

"The American Geological Institute recently received a grant of $130,000 from the National Science Foundation for the establishment of a translation program in the geological sciences. The prime objective of the program will be to make significant foreign literature, particularly Russian, available in English to research workers of this country and other English-speaking nations.

"An A.G.I. Translation Centre is being established at 601 West 115th St., New York 25, N.Y. to serve as a clearing house for translations and translation enquiries in the Geological Sciences."[1]

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[1]Geotimes, Vol. III, No. 3, October, 1958, p. 9-10.

CHANGES IN PERSONNEL OF COMMITTEE

Dr. G.H. Charlewood, Dr. D.R. Derry, Dr. J.E. Hawley and Dr. D.J. MacNeil retired from the Committee in 1957 and were succeeded by Mr. J.F. Davies, Mr. Franc R. Joubin, Dr. J.W. Ambrose and Dr. J.E. Blanchard.

All members join in expressing appreciation of the personal contribution 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 Statement)

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. The reports of these subcommittees, which were presented at the annual meeting of the National Advisory Committee in April, 1958, are given in full in a later (p. 12) section of this report. Summaries of the reports and of the discussions that followed are given below.

The Subcommittee on Mineral Deposits briefly reviews current research in this field mentioning in particular the study planned by Manitoba Department of Mines and Natural Resources and University of Manitoba in the Mystery-Moak lake area, which will include field investigation and laboratory studies of the effects of sulphur metasomatism on the nickel-bearing silicates and the related concentration of nickel sulphides. The publication of Vol. II of "Structural Geology of Canadian Ore Deposits" and its contents is also discussed.

During the past few years a number of rare elements have become essential for military research and industrial development. When the demand was made known these minerals were found in abundance. The demand for other metals will no doubt increase and they will likewise become commonplace in the future. Demand for presently hard to find minerals should be anticipated and deposits should be found to satisfy it.

Many major ore deposits are associated with sedimentary rocks that have not been strongly metamorphosed. Outside this continent increasing credence is being given to the concept that the enclosing sedimentary rocks are the source of the metals. Possible source beds of Proterozoic age cover large areas in the Northwest Territories and other parts of Canada. It is suggested that such source beds for ore deposits be studied and classified as a guide to exploration companies.

The Geological Survey of Canada is preparing a series of maps of metallogenetic provinces of Canada. A map for uranium has already been published, maps for columbium and beryllium have been compiled, and maps for iron, tungsten, lithium, chromium and molybdenum are being prepared.

The need for more data on wall rock alteration around ore deposits is stressed. Adequately determined chemical changes in the wall-rocks of orebodies can shed much light on the origin of the ore, besides being of practical value in exploration for more ore. Among the ore deposits suggested for study are those of the Anglo-Rouyn property in the Lac La Ronge area, Saskatchewan, and the Porcupine area, Ontario. Further work is suggested on the red alteration associated with the uranium deposits of Lake Athabasca, Alberta and Saskatchewan, as is a study of the alteration associated with the gold bearing veins of the Bridge River area, British Columbia.

In a discussion of the report Dr. Mawdsley said that a study of wall rock alteration associated with the ore deposits of the Flin Flon area was underway at the University of Saskatchewan under the direction of Dr. Byers. He noted Dr. Derry's comments on the Anglo-Rouyn property in the Lac La Ronge area and the availability of drill core from this property for studies of wall rock alteration and hoped that the University of Saskatchewan would undertake such studies. Dr. Langford mentioned the "spotted dog" alteration about the orebodies in the Noranda area as being a fruitful field for further study. It was agreed that the subcommittee on Mineral Deposits should give special thought to means of initiating wall rock alteration studies near mineral deposits.

The Subcommittee on Physical Methods Applied to Geological Problems lists the organizations in Canada reporting geophysical research projects and the general types of research they are undertaking. Each field of geophysical research--Gravity, Seismology, Geomagnetism, Palaeomagnetism, Glacialogy, Mining Geophysics, Petroleum Geophysics, and Water Supply is discussed under the respective headings and under each heading are brief reviews of current work of particular interest to geologists. Included in the report are accounts of recent developments in the study of the roots of mountains and isostacy; a project involving interpretation of extensive aeromagnetic data in Alberta; the significance of recent work in palaeomagnetism and its possible importance in determining the relative ages of rocks and providing evidence to support the theory of continental drift; and of recent developments in mining geophysics including the application of nuclear magnetic resonance adsorption to prospecting for orebodies. Adding to the information in last year's report on the success attained with various exploration methods, data are given on the principal methods used in the discovery of 11 nickel-copper orebodies in the Sudbury district.

The greater use of electronic computers in the study of geological problems is discussed. The use of such machines is well established for processing data obtained with geophysical instruments and in petroleum reservoir mechanics involving the prediction of recoverable reserves, probable performance for gas injection and water flooding projects. The use of computing machines in mineral exploration has been neglected. They may help to give the answer to many problems that have perplexed geologists for years such as the optimum spacing of drill holes when drilling an orebody and of traverse lines for surveys, picket lines etc.

Now that geology can be placed on a more quantitative basis the need for adequate data becomes more apparent. Because such data must be gathered from many organizations, it is suggested that some sort of data collecting group is necessary which should be sponsored by an authoritative body such as a government or mining organization.

Several new instruments of interest to geologists have been developed or tested within the past year. Among these are two types of magnetic instruments using the newer torsion and nuclear induction or nuclear magnetic resonance principles, portable seismographs using a hammer instead of an explosive, a portable instrument for the nuclear detection of beryllium in prospecting, and an airborne gravity instrument.

The report closes with an account of the International Geophysical Year and its interest to geologists. It is suggested that perhaps its greatest contribution to geology is the awareness it has brought to geologists that the crust is not a complete unit in itself, but can only be explained in terms of the whole earth; the crust is the grist, ground between the larger mills of mantle, sea, and air.

In concluding the presentation of this report Dr. Wilson stressed the large amount of important technical data in the hands of companies but not readily accessible to those engaged in geophysical and geological research. For example, data in the causes of geophysical anomalies that had been investigated by mining companies was of great interest but was not usually released; likewise much analytical data on ores and wall rocks of great interest in the implementation of many research projects are in the files of mining companies. He suggested a committee might be more successful than an individual in soliciting information of this type. Dr. Blanchard said the gathering of such data from industry was also a matter of some concern to the National Research Council Associate Committee of Geodesy and Geophysics but such success as was attained was the result of efforts by individuals rather than of a committee. A case in point was the compilation of gravity maps incorporating information gleaned from industry. It was the individual approach for specific information that had been most successful. Several members expressed the view that most companies are co-operative in furnishing specific data requested by individuals for research projects and that it would not be practical for a committee to act as a clearing house for undigested data accumulated by industry. Perhaps some means might be found for making the individual's approach to companies easier and also to prevent two or more enquiries for the same information by different individuals, but no workable scheme was put forward for accomplishing this. It was agreed that the subject should be discussed further at the next annual meeting.

The Subcommittee on Scholarship and Research Training reports on the result of a questionnaire sent to geology departments of Canadian universities regarding the facilities available for advanced training in geology in Canada. The results are reported in three tables listing the various undergraduate courses offered by different geology departments in Canada, the advanced or graduate courses leading to post graduate degrees that are available, and the special equipment now possessed by each department giving graduate work.

The tables also give the dates at which these courses and special equipment became available. It is interesting to see to what extent the facilities for advanced work have increased in the last few years.

The report discusses also the replies to a questionnaire on the need for scholarships for students to carry on advanced or graduate work in geology. The replies indicate there are more than enough scholarships for brilliant students but not enough for a sizeable proportion of men of lesser ability but worth further advanced training.

The Subcommittee on Mineralogy, Geochemistry and Petrology expresses appreciation of the long and valuable service of Dr. J.E. Hawley as chairman of the subcommittee and for the part he played in establishing the National Advisory Committee.

An analysis is made of current research in mineralogy, geochemistry and petrology. Three tables indicate the numbers of researchers and their levels, the level of the projects in the subdivision of projects amongst the several fields, and the distribution of projects by institutions, listed geographically from east to west.

Progress is described on several projects most of which were recommended in previous reports of the subcommittee. These include a survey of physical and chemical methods of analysis of rocks and minerals including a general review of modern methods, their accuracy, sensitivity, and rapidity; the compilation of geochemical data on Canadian rocks and minerals on which considerable progress is reported; the nomenclature of metamorphic rocks, facies and phenomena, which has resulted in publication of a paper with suggested nomenclature for metamorphic rocks; and the correlation of age determination with mineralogical and petrological data.

New research data on the geological sciences is accumulating rapidly but much of this highly specialized information does not become useful until it is weighed, compared with other pertinent data and incorporated in general review papers. The report stresses that these types of study that involve the assembly of data and the search for patterns therein, constitute research just as much as does the production of new data. Support of this type of research is recommended.

In discussion of the report Dr. Gunning expressed interest in the suggestion (p.45) that more review studies were needed involving the assembly of available data on various subjects, and in the view that such studies were as much research as the production of new data. Such library or compilation studies might provide suitable projects for graduate student theses. Projects of this type might be broken down and divided among several graduate students who, in the preparation of theses, would produce summaries and bibliographies of existing knowledge on the subject. This material in the hands of the professors supervising the studies would give them a good start in the preparation of review articles such as were suggested in the report (p. 45). This would make use of the work of graduate students in a systematic way rather than dissipating it on many minor disconnected projects.

Dr. Ambrose thought the acceptance of purely library theses for degrees would involve considerable change in the philosophy of most university geology departments; many considered field work and the production of new data to be essential in graduate theses.

There was some discussion of the suggestion in the report (p. 45) that some money from Geological Survey of Canada grants-in-aid of geological research to the universities be retained for distribution to directors of research projects for the purchase of consumable materials and supplies, and general laboratory maintenance and operation. The general conditions governing the grants state specifically that grants are not to be used for the purchase of standard apparatus or materials that a well equipped laboratory should possess. It was agreed this was a desirable condition; that the money should not be used for general laboratory maintenance and operation.

The Subcommittee on Stratigraphy, Palaeontology, and Fossil Fuels notes that the main practical application of the results of research in stratigraphy, palaeontology and sedimentation is connected with the search for oil, gas, and coal because research on the origin, age, history and structure of sedimentary rocks provides data basic to successful exploration and exploitation of these resources. As most of our resources of oil and gas are in Western Canada most of the research effort is directed to this region. Current research in the region is discussed.

Reference is made to the Alberta Society of Petroleum Geologists with its more than 900 members and to the research committee that the Society established recently. The function and purposes of this committee are outlined.

It is noted that some of the specific projects recommended in previous reports of the subcommittee are being implemented. A number of additional projects are suggested.

The report notes that the future will bring increased demands for electrical energy in Canada, and that because in many regions hydro power sites have already been fully developed, a large part of this increased demand must be met by development of generating plants using coal, natural gas or perhaps nuclear power. Two thermal plants in Alberta are using 100,000 to 200,000 tons of coal annually and a third being built in Saskatchewan will use an estimated 1,000,000 tons. There is a growing realization of the need for more geological information to aid in finding the large deposits of coal at depths permitting recovery by strip mining that will be needed in the future to satisfy the insatiable demand for power.

In discussing the report Dr. Sproule said that the American Association of Petroleum Geologists proposed to compile tectonic maps of the basement rocks underlying the Plains. This formed part of a project he had suggested at last year's meeting of the National Advisory Committee, but it did not go far enough. He had suggested that tectonic features in the Precambrian basement that extend beneath the younger (Palaeozoic) rocks may have provided features such as scarps along which reefs developed in the younger rocks. Such structures may be responsible for the formation and accumulation of oil. Also rejuvenations of such old Precambrian features may provide similiar favourable conditions. For example, the Leduc and Bonnie Glen reefs likely formed on such old basement structures; oil bearing reefs in southeastern Manitoba were probably of similiar origin; and the Rabbit Lake well in the Northwest Territories is on the projection of an old Precambrian fault. Reefoid features tended to appear at several levels in the geologic column over these basement features. 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 such as at Pine Point, N.W.T., should be a most

fruitful field of research. Such work was being done on a small scale by some of the oil companies but could be done better by organizations such as the Geological Survey of Canada and the universities. It was agreed that such a project must be very broad in scope and would require the co-ordinated 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 broad project. It was further agreed that this project should be a main concern of the Subcommittee on Stratigraphy, Palaeontology and Fossil Fuels.

The Subcommittee on Pleistocene Geology in stressing the need for fundamental research in Pleistocene geology in Canada, suggests that some post-doctorate fellowships be awarded to applicants in this field. Some outstanding accomplishments and publications in the past year are discussed including the publication of a "Glacial Map of Canada". A summary is given of Pleistocene and groundwater work in progress in different parts of Canada.

It is suggested that geologists give far too little attention to engineering geology in Canada both in regard to practical and research work, and that geologists with a practical bent for engineering should be offered adequate course work in soil mechanics, strength of materials, etc., so that they may become conversant with engineering principles as applied to their work

At the 1957 annual meeting of the National Advisory Committee it was decided that the fields of geomorphology and glacialogy would no longer be covered by the Subcommittee on Pleistocene Geology. However, after further consideration by members of the subcommittee it is felt that these fields are the concern of the Subcommittee and should continue to be covered by it. Because the work of physical geographers and Pleistocene geologists overlaps, it is suggested that research projects by physical geographers be included in future annual compilations of current geological research.

A number of research problems are suggested in addition to those outlined in last year's report.

In discussion of the report, Dr. Gunning emphasized that men training in engineering geology should receive specific engineering training and be in the science faculty. Basically they are engineers who take options in geology. Dr. Ambrose said Queen's University had initiated recently a degree course in engineering geology for geology students in the Faculty of Applied Science with specialization starting at the end of the second year.

THE REPORT OF THE SUBCOMMITTEE ON MINERAL DEPOSITS

Presented by H.C. Gunning

Members of Subcommittee

H.C. Gunning (Chairman)	-	University of British Columbia, Vancouver, British Columbia.
G.H. Charlewood	-	Heath and Sherwood Drilling Ltd., Kirkland Lake, Cntario.
D.R. Derry	-	Rio Canadian Exploration Ltd., Toronto, Ontario.
A.H. Lang	-	Geological Survey of Canada, Ottawa, Ontario.
G.B. Langford	-	University of Toronto, Toronto, Ontario.
C.E. Michener	-	International Nickel Co. of Canada, Limited, Copper Cliff, Ontario.

CURRENT RESEARCH

Judging by the number of current research projects reported to the Advisory Committee, 1957-58 has seen a modest but healthy increase of 18 per cent in activity. Of some interest is the fact that the number of projects of a broad, basic nature shows the greatest increase, being over 100 per cent. As in previous years, many projects overlap in the fields of two or more subcommittees. This is especially so for the Subcommittees on Mineral Deposits and Mineralogy, Geochemistry and Petrology. The number of research projects on ferrous metals is reduced, compared with last year, from twelve to seven. Fifteen projects deal with problems of industrial minerals. The complete list (p. 77) is: base metals, 37, ferrous metals, 7, radioactive deposits, 12, other metals, 5, general problems, 33.

In last year's report, Dr. Michener discussed some of the problems relating to ore genesis and the nature of the ore-forming fluid. In relation to the genesis of nickel deposits, he expressed the opinion that one of the processes to be considered was "sulphur leaching, a process whereby original olivine-bearing peridotites which contain nickel in the silicate form are subject to regional and thermal metamorphism, including sulphur in gaseous or liquid form, resulting in the removal of silicate nickel and its combination with sulphur to produce sulphide deposits associated with, and disseminated in, peridotite masses. This type of deposit has practically no copper". (See also the statement by Dr. Michener on page 14). It is of interest to note that this year the Manitoba Department of Mines and Natural Resources in co-operation with the University of Manitoba, has planned a two-year field investigation in the Mystery-Moak Lake area in which special attention will be paid to regional metamorphism. The effects of sulphur metasomatism on the nickel-bearing silicates and the related concentration of nickel sulphides will be studied in the laboratory. If significant results are obtained they should be of great interest to many geologists.

In its last two reports the Committee made reference to R.L. Stanton's post-doctorate research project, underway at Queen's University since 1954. The project is due for completion in 1958. It deals with the variability of abundance of individual metals in some "conformable" orebodies.

Mention was made last year of the work in the Sudbury district by the Ontario Department of Mines. In 1957 detailed reports by Thompson, Phemister and Williams appeared in the Annual Report, Ontario Department of Mines, Volume 65, part III, 1956. The reports are well worth the attention of all mining geologists for the new light they shed and the new interpretations they give on the fundamental geology of the world's greatest nickel-producing district.

STRUCTURAL GEOLOGY OF CANADIAN ORE DEPOSITS - VOLUME II

Late in 1957 Volume II of Structural Geology of Canadian Ore Deposits was published by the General Committee of the Sixth Commonwealth Mining and Metallurgical Congress. The volume was prepared by the Geology Division of the Canadian Institute of Mining and Metallurgy as a complement to Volume I, the Jubilee volume, published in 1948, and is a worthy companion, 524 pages in length. Most of the 62 articles are by mine geologists or consultants and they describe new and old properties from Wabana, Newfoundland to Vancouver Island. Most of them contain new information of great value to mining geologists. As was to be expected, the various statements on ore genesis reflect, by guarded statements about hydrothermal processes, the change in philosophy that has taken place in the ten years since 1948. Nine articles deal with radioactive deposits, whereas there was only one such article in the Jubilee Volume. A long-overdue up-to-date contribution on Cobalt, Ontario is included. Of special interest is an excellent paper on the Frood-Stobie mine by the staff of the International Nickel Company of Canada, Limited. It gives complete vertical sections along and across the deposits as well as some very helpful data on the zonal distribution of minerals and precious metals. The quartz diorite outlier in which the ore occurs is represented as a downward extension of the main basin-shaped nickel intrusive, the connection having been removed by erosion. The intimate relation between quartz diorite and ore, and the gradation between massive sulphide and diorite with disseminated sulphides, is strongly emphasized. It is worth noting again that only very minor wall-rock alteration has been recognized--"crosscuts that have advanced to within one round of the orebody ordinarily yield no evidence of its presence." Alterations to talc or actinolite alongside ore are measurable in thicknesses of inches or less; garnet is similarly restricted when it does occur. The Copper Cliff rhyolite is classified with the other volcanic rocks of the south rim.

One of the major changes in fundamental geology between Volume I and Volume II is to be found in the article "The Northeastern Part of the Cariboo District, B.C." by Brown and Holland. This is the result of many years of painstaking work by the B.C. Department of Mines, plus a good deal of fine work by local mine geologists. The major structure and the stratigraphic succession of this region of exceedingly complex structure at last seem to make sense.

Similar statements are merited by the article "Lead-zinc Deposits of the Salmo Area, B.C." In both cases a much better understanding of the ore deposits is one result of the new regional data. How helpful it would be and how economic, if the areal geology could be well understood before the mines are developed!

It is not fair to single out two or three articles in a volume of this importance. The entire volume merits careful study and the gratitude of our profession.

SUGGESTIONS BY SUBCOMMITTEE MEMBERS

In December of 1957 each member of the Subcommittee was approached for contributions that might be embodied in this report. The following paragraphs are extracted from their replies.

C.E. Michener writes as follows:

"Over the past few years an unusual situation has arisen in the mineral exploration field. A number of rare elements were found to be essential for military research and industrial development and when it became known that the demand was there, mining exploration companies and individuals in various countries were able to find these minerals in abundance. Reference is made to lithium, uranium, potash, iron ore, columbium, tungsten, cobalt, and titanium. The most outstanding example of course is uranium, but the most interesting is probably columbium. Through the active exploration of columbium ores, a distinctly new type of geological mineral occurrence has been discovered in numerous places throughout the world, a type of deposit that was formerly considered a geological curiosity. Adequate reserves of all six of these elements have now been established.

"With the advent of Sputnik and the future possibilities of large-scale expenditures for the development and use of high-temperature alloys, other metals will no doubt make their appearance and become commonplace in the near future. Two of these are likely to be zirconium and beryllium. The presently known types of deposits, which contain these metals in commercial quantities, do not lend themselves to large-scale production. However, it is not inconceivable that new types of deposits will be found, once the demand is established. For example, the minerals which might be used as a source of beryllium are possibly five in number: beryl, chrysoberyl, phenacite, helvite, vesuvianite. The mineral phenacite is the most interesting of these and carries the highest beryllium content. However, this mineral has physical properties so nearly identical with quartz that it is not only possible but quite likely that commercial deposits may exist in well-explored mineral localities and have simply been overlooked. Is there some method of channelling research into a project designed to produce results in anticipation of the future demand for these 'hard to find' elements?

"After having had a look at some of the large producing mining districts in other parts of the world, it has become very apparent that many major districts consist of single large geological units, which make for a large and sustained operation. It would also appear that these large producing areas are connected with sedimentary rocks, which have not been metamorphosed to an extreme degree. Gently dipping Proterozoic rocks, which occur in large units, would therefore be a prime target for the discovery of a large new mineral-producing district. The iron ore deposits of Labrador, New Quebec and Western Ontario

and the lead-zinc deposits of Pine Point, Northwest Territories are outstanding Canadian examples that come to mind. The recent work of Sullivan and Edwards, both Australians and writing independently, has stressed this viewpoint. In looking back over my files, I find that Edward's work has been discussed by our own group, but perhaps it has not been given the importance it deserves. Most South African geologists in both Copper Belt and the Witwatersrand districts believe in the sedimentary origin of these deposits. Most American geologists, on the other hand, favor a hydro-thermal origin and also include the uranium deposits of the Blind River type in the same category.

"Should not some consideration be given to the idea that source beds be studied and classified and brought to the attention of the exploration companies, who could then proceed to the necessary field work? Unexplored source beds of Proterozoic age are known to occur in the Northwest Territories and various other parts of Northern Canada. The concept of the source bed may be extended to include layered igneous rocks such as the Bushveld and the Sudbury intrusives as well as flow rocks such as the basalts of Michigan and the Coppermine. The peridotites of Manitoba could also fit into the source bed concept."

G. H. Charlewood has these comments:

"The recently discovered nickel, copper, and zinc deposits in Manitoba and northern Saskatchewan are proceeding toward the production stage, particularly in the Chisel and Mystery Lakes regions. Railways and roads being built as a result of these developments are crossing important territory hitherto not easily accessible.

"There are signs of interest in the use of the large chromite deposits in southeastern Manitoba which have lain idle due to the high cost of beneficiation.

"Aeromagnetic surveys have been conducted by the Geological Survey of Canada in northern Manitoba for the second consecutive year. This is the first overall survey for geological purposes in Manitoba, north of latitude 58 and is to be followed by systematic four-mile to the inch geological surveys by the G.S.C. and half-mile surveys in selected areas by the provincial geological survey. A large magnetic anomaly north of the Seal River is to be investigated.

"In the southeastern corner of Manitoba the Provincial Department of Mines and Natural Resources made an aeromagnetic survey over a completely drift-covered area, revealing some interesting anomalies and attracting attention to that hitherto neglected section of the Precambrian shield within 100 miles of Winnipeg.

"An important development, in a negative sort of way, relative to the development of mineral resources is the reduction of effort that reflects the decline of metal prices. The immediate economic reasons for this are obvious and quite compelling. However, it took quite an effort to overcome the shortages of the not too distant past and these shortages are chronic even though not at present apparent. This Committee, among others, has been pointing up the increasing difficulty of discovering some types of ore and has tried to find new aids for the search. If the search is curtailed or abandoned during the next 2 or 3 years the effect will be felt 5 or 10 years later. Another all-out and still more expensive effort will have to follow at a time when ore deposits are even harder to find and shortage will be even more critical.

"Two ways to help avert this situation are (1) for mining exploration companies to take advantage of times such as the present when competition is less to press their search for new mines, and (2) for research to continue to seek new ideas and techniques to aid in the search for orebodies so that they may be ready for use when the chronic state of metal shortage will again be apparent.

G.B. Langford has written as follows:

"To my mind the outstanding mineral development in these parts is due t the realization by furnace men that if one could get a 65% Fe Furnace feed, instead of a 51-52%, it could increase the furnace capacity by some 20% and reduce costs. Now every magnetite deposit from the Great Lakes to Hudson's Straits is being investigated, and some very large tonnages of magnetite in the 20-31% Fe category, are being turned up.

"As you know, the industry in Ontario is very conscious of the stock market. During the past year the new promotions have been about half of what they were in 1956. This has meant less need for young geologists, and there are a number of them looking for jobs. Many of them would not take our advice and put in a summer or two in the mines. They preferred the more attractive field work. Now some of them look upon getting a job in a mine like being banished to the "salt mines". Perhaps they will have an opportunity to complete their eduction via the muck-stick.

"I still have hopes that at some time we shall have a Precambrian Institute in Canada. Of course, to me, Canada will have to be interpreted in a very limited sense. The ideas I have had to date have envisaged a new building, equipment etc. The tentative plan of University of Toronto for expansion has given us the entire Mining Building, on which they expect to spend some $400,000 for renovations. This will not come to pass before 1963. So that is the deadline for setting up such an Institute. There will be adequate space, consequently our needs for financing are very materially reduced. I still believe that if I keep on long enough I shall find someone who will want to sponsor such a project."

A.H. Lang refers to the preparation of the forthcoming metallogenic map of the world for the International Geological Congress. Because the Geological Survey of Canada is preparing the Canadian part of this world map, it was decided to go further and, in line with previous suggestions by this Subcommittee, begin the preparation of a series of maps of metallogenic provinces for Canada. He says:

"I have completed the manuscript for such a map for uranium. It is now being drawn for publication and will probably be published in 1958 [1]. It is to be on transparent paper, on the same scale as our

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[1] Metallogenetic Map, Uranium in Canada, Scale 1 inch to 120 miles; Geol. Surv., Canada, Map 1045-A-M-1, 1958.

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geological map of Canada, so that the metallogenic map can be laid over the geological map in order to relate information on distribution of deposits to the main features of the geology as shown on the geological

map. It is not practicable to combine the two kinds of information on a single map and still show any degree of detail. The metallogenic data is subdivided into the three principal types of uranium deposits plus an undivided category. Isolated occurrences are shown separately and areas containing several occurrences are shown by shading; the combined data represents about 10,000 occurrences. Marginal notes outline the scope of the map and the way of using it, and explain the limitations of a separate pattern used on the map to indicate what appear to be the principal favourable areas in which deposits have not yet been found. All the localities are named on a marginal list and references to the principal published literature are given. The map, therefore, is not only an attempt to delimit metallogenic provinces, but also serves to supply general information for prospectors and as a guide to the literature.

"Maps for columbium and beryllium have also been compiled and the drafting of them will be begun as soon as the uranium one is finished. Maps for iron, tungsten, lithium, chromium and molybdenum are being prepared, and we hope to prepare several others within the next two or three years.

"Considerable progress has been made in the study of uranium-thorium ratios and stratigraphic relationships of ore in the Blind River camp, as well as in compilation of data on ore reserves for this and other uranium camps. The general study of uranium deposits in Canada was continued and the confidential inventory that we prepare each year for the Atomic Energy Control Board has been brought up to date. Progress has been made in studies of lithium deposits of Canada, iron deposits of Canada, and chromite deposits of Canada. The reports on lithium and chromite should be completed in 1958. The study of iron deposits will still require several years, but a preliminary report will probably be published in 1959. Work on a comprehensive study of beach sands was begun in the Maritime Provinces last year, but we do not yet have sufficient analytical results to indicate whether anything of special interest was obtained. Many occurrences that might contain the 'heavy' group of rare earths were examined in the Grenville region but the results of analyses are not yet available."

Wall Rock Alteration Studies

The members of the Subcommittee were canvassed late in 1957 in an attempt to determine if agreement could be reached on some specific research project or problem that seems to be particularly deserving of promotion and encouragement by the National Committee. No complete unanimity was achieved but attention was centred on the need for more data on wall rock alteration around ore deposits. It is believed that we should focus attention upon this problem and lend all possible assistance to increased research upon it.

In the November 1957 issue of Economic Geology, Hugh McKinistry wrote on the Source of Iron in Pyritized Wallrocks. He recalculated nearly 150 published chemical analyses of fresh rocks and their altered equivalents and converted the iron content into total iron (Fe). His article emphasizes the paucity of data adequate to afford satisfactorily quantitative conclusions on the chemical changes that have taken place. He stresses particularly the need for representative sampling and for determination of bulk density of the samples.

Adequately determined, chemical changes in the wall rock of orebodies can shed much light on the origin of ore, besides being of direct practical value in exploration for more ore. R.W. Boyle's studies

at Yellowknife (Economic Geology, Vol. 50, 1955) are a good recent example of the kind of work that is needed, and a forthcoming paper (Proc. Royal Soc. Can. Section IV, 1958) by Boyle indicates the kind of conclusions on genesis of ore that may evolve from such careful studies. The work of Sayles and Meyer at Butte (A.I.M.E. Trans. Vol. 178, 1948) is another well-known study of the type that is needed in greater abundance.

Encouragement of work of this kind in no way belittles the importance of and necessity for more data on the distribution of metals in sedimentary strata and their migration and concentration under metamorphic environments. Indeed, as suggested by Boyle's work at Yellowknife, studies of wall-rock alteration around presumed "hydrothermal" deposits may produce evidence that lends additional support to "The Source Bed Concept" that has become so much more popular since this Subcommittee recommended increased research upon the problem in the report for 1954-55. (See C.L. Knight, Ec. Geol. Vol. 52, No. 7, Nov. 1957 for a somewhat extreme recent view of the concept.)

The following comments were obtained from members of the Subcommittee in reply to the Chairman's canvass on this matter:

D.R. Derry:

"I quite agree that the study of wall-rock alteration would be a very good subject on which to centre attention this year. I have been thinking over the various properties on orebodies with which we have had experience over the last year or so, and I believe one that might be of interest is the Anglo-Rouyn property in the Lac La Ronge area of Saskatchewan.

The present situation at Anglo-Rouyn is that the underground work has been suspended and the mine allowed to flood, so there would not be any opportunity of obtaining wall samples underground. However, there is a great deal of drill core that would be available for sampling at regular distances from the walls, from the zone of copper mineralization. The wall rocks are relatively uniform, being all gneisses or granitized rocks of probable sedimentary origin. There is some indication that the concentration of mineralization has some relationship to the distance from a granite contact, but whether this is an intrusive contact or merely a more completely granitized bed is uncertain. There is certainly a characteristic wall-rock alteration involving epidote that seems to be associated with the copper as distinct from the more prevalent pyrrhotite.

"If this were selected as one of the bodies to be studied from the standpoint of wall-rock alteration, we would be very glad to make available all the data we have as well as the drill core on the property.

"Naturally we have been spending a large part of our efforts on the uranium deposits of Blind River, and as far as we know, wall-rock alteration has little connection here. However, we may find eventually that there is some type of alteration, even if the source of uranium were originally of placer origin and was later redistributed. I think this is, however, a little different problem from the one you have in mind."

G.H. Charlewood writes as follows:

"A special research effort directed to the study of wall-rock alteration might yield some useful clues in the search for mineral deposits. While there is more and more reliance on geophysics we still try to examine all available bedrock. Too often it yields no indication of metallic ores hidden nearby. This was brought home to me forcibly when I visited Chisel Lake in Manitoba and the Coronation mine in Saskatchewan. The rocks quite near the covered surface location of these deposits give no obvious indication of the orebody nearby. Yet there might be a clue which, if found, could be used to good effect in these and other areas.

"Then there are those odd deposits in gneiss along the borders of peridotite, such as the nickel along the Grass River and the Bird River sill in Manitoba and the Werner Lake belt of Ontario. What, if any, was the reaction between these gneisses and the basic rocks and what alteration products were formed?"

G.B. Langford makes these comments:

"I think the Porcupine area might be a good place to do wall-rock studies. The association of sericite (paragonite) and auriferous pyrite in the walls is usually a marked feature. In the coarser grained flows it would sometimes be tens of feet wide. Perhaps we could call upon the resident geologist of the Ontario Department of Mines for assistance. In fact we might call upon all such persons for advice and assistance in such a study. If they could find suitable spots for work, then we would try to get graduate students to work on them. Someone would have to find some funds."

A.H. Lang wrote:

"Wall-rock Alteration. I agree that it would be desirable for our subcommittee to focus attention on another major project and that wall-rock alteration would be a suitable one. It is possible, however, that the deposit(s) chosen for the comprehensive study (p. 1 may be suitable for a mjaor attack on alteration, so that an entirely separate project might be unnecessary. The subject of alteration can be divided into two fundamental categories, namely: 1) detailed studies of one or more deposits, which would almost certainly take several years, particularly in view of the number of analyses required and the time taken to interpret results adequately, 2) a separate phase of the project to comprise review, co-ordination, and evaluation of studies made previously and of work to be undertaken within the next few years. Both of these phases of the subject have been recommended by the subcommittee at different times.

"Regarding studies of individual deposits, in addition to those mentioned in McKinistry's paper, some fairly thorough studies were made in Canada during the last few years. So far as I know the two that have been most intensive and most useful are the studies made by Noranda in connection with its deposits in Gaspe and the one made by Dawson on the red alteration associated with pitchblende deposits at Beaverlodge (G.S.C. Bulletin 33). Although a paper was published on the Gaspe studies it is probable that the Noranda's geologists have further data which they could be encouraged to publish. At least it might be desirable to solicit their advice in connection with any future project, perhaps through a special subcommittee or else on an informal basis.

"Our study of red alteration at Beaverlodge was handicapped by the fact that at that time uranium ore reserves were closely guarded secrets and Dawson was not permitted access to the information on grades of ore shoots and submarginal material. It would have been much more useful if this study could have been related to variations in the tenor of the associated ore and submarginal material. As it is, the results although useful in a qualitative way are more academic than they would otherwise have been. Restrictions on uranium figures have now been eased, and although I do not think it would be possible to arrange for Dawson or any other Survey man in the near future to round out this work in the way I have indicated, it might be possible to encourage the Eldorado geologists themselves to publish such supplementary information. It would not be necessary to publish the absolute figures for the grades of various parts of the deposit; it would be necessary only to ascertain whether there is significant relationship between intensity or type of alteration and variations in tenor, and if so, publish the results according to such categories as high-grade, medium-grade, low-grade, submarginal ore, and ultra low-grade material, or some such classification. Perhaps this matter might also be worth mentioning in connection with any other studies that are attempted, for any kind of deposits. If the owners of the deposit did not wish figures for the grades of various parts of the deposit to be released, the study could still be made sufficiently quantitative in the way mentioned above.

"With regard to the second phase of the subject, that of trying to co-ordinate the existing and future information, I have been hoping for several years to get a project of this kind started in the Mineral Deposits Division of the Geological Survey as recommended by some of the members of the subcommittee, but staff shortage prevented it. I think this would be our most reasonable role, rather than to attempt the study of a single deposit, which would most likely be done by a company or university group. I doubt if I can get a review project underway during the coming year because we are concentrating to a large extent on metallogenic maps, but a recommendation from the subcommittee, if it sees fit, might help in assuring that a man could be available in 1958 or 1959. Such a project might comprise at least the review of significant literature on studies made on Canadain deposits, classifying them according to the type of alteration, types of deposits, amount of sampling and analytical work done, and quality of such work, noting of any differences in variations in alteration with respect to tenor, types of mineralization of deposits, types of wall-rock, and variations in alteration at the sides, top, or bottom of the deposit. It would also be very desirable to obtain information as to the extent to which alteration data are used in prospecting and exploration and with what success. To obtain information of this kind it would probably be necessary for the geologist to visit mines and consult their staffs and to conduct some supplementary studies to round out missing data or to check data. I do not think that such a co-ordinating study could be done by a Ph.D. thesis project because of its scope and the number of years required."

This Subcommittee recommends to the National Committee that a particular effort be made this year to arrange and support specific studies on the wall rock alteration of several Canadian ore deposits. In the Chairman's opinion, in addition to suggestions given in the preceding paragraphs, one or more of the gold-bearing veins of Bridge River, B.C., either in the Bralorne or Pioneer mines, would prove very suitable. In the Bralorne mine in particular, the wall rock setting is peculiarly suitable in that it is about as homogeneous as can be found in any mineral deposit. Furthermore, a fair amount of analytical data is already available. Other suitable occurrences will occur to members of the main committee.

Dr. Lang's recommendation of a review and analysis of available information also is recommended for action by the Advisory Committee.

INDUSTRIAL MINERALS

Research projects dealing with industrial minerals have been compiled by the secretary of the Advisory Committee. This Sub-committee has not found it possible to devote special attention this year to this part of its obligation. It is hoped that, within the next year or two, a more concerted attack can be made upon this important part of our mineral industry and the research that is being done or is needed to maintain or expand its production.

THE REPORT OF THE SUBCOMMITTEE ON PHYSICAL METHODS APPLIED TO GEOLOGICAL PROBLEMS

Presented by H.D.B. Wilson

Members of Subcommittee

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H. Carmichael	-	Atomic Energy of Canada, Ltd., Chalk River, Ontario.
G.D. Garland	-	University of Alberta, Edmonton, Alberta.
J.H. Hodgson	-	Dominion Observatory, Ottawa, Ontario.
M.J.S. Innes	-	Dominion Observatory, Ottawa, Ontario.
A.A. Koffman	-	Hudson Bay Mining and Smelting Co., Ltd., Flin Flon, Manitoba.
A.D. Misener	-	University of Western Ontario, London, Ontario.
G.P. Mitchell	-	Falconbridge Nickel Mines Ltd., Toronto, Ontario.
L.W. Morley	-	Geological Survey of Canada, Ottawa, Ontario.
R.J. Uffen	-	University of Western Ontario, London, Ontario.
J.T. Wilson	-	University of Toronto, Toronto, Ontario.

INTRODUCTION

The International Geophysical Year has turned the world spotlight on geophysics this year. Aside from the scientific value, this publicity has undoubtedly done much to forward the science of geophysics by interesting students in the science, by interesting governments in financing and supporting geophysical projects, and in general, by aiding the establishment and support of geophysical laboratories and programs.

Trends in employment of geophysicists are somewhat mixed. There is still a great demand for qualified geophysicists, both from industry and from institutions whose chief interest is in fundamental research. For example, the Gravity Division of the Dominion Observatory has been searching for three qualified geophysicists to fill out its staff. On the other hand, several of the geophysical contracting companies may have to release highly qualified technicians because of the great decline in prospecting activity and these men may be lost to geophysics permanently because they will be absorbed by other types of industry.

LOCATION OF GEOPHYSICAL RESEARCH IN CANADA

Part of the subcommittee's duty is to suggest places where geophysical research might be undertaken. It is appropriate, therefore, to list the organizations that have reported research projects and the general type of research that is being undertaken. The following organizations have reported:

University of Western Ontario - Electromagnetic prospecting, gravity, paleomagnetism, radioactive, seismic, thermal conductivity.

University of Toronto - Gravity, geomagnetism, radioactive.

University of Alberta - Gravity, radioactive.

Queen's University - Geomagnetism.

University of Manitoba - Gravity, radioactive.

McGill University - Radioactive, geomagnetism.

Geological Survey of Canada - Geomagnetism, paleomagnetism, radioactive, electromagnetic.

Dominion Observatory - Gravity, geomagnetic, paleomagnetism, seismic.

Research Council of Alberta - Earth resistivity.

Nova Scotia Research Foundation - Electromagnetic, gravity, seismic.

British Columbia Department of Mines - Geomagnetism.

Private companies also do considerable fundamental research.

GRAVITY

Regional field measurements of gravity for geodetic purposes and large scale geophysical studies were again concentrated in the Dominion Observatory. However, activity in some of the other government organizations and in the universities is gradually increasing. Oil companies and geophysical groups have also released regional data for the prairies as part of a co-operative program in connection with the International Geophysical Year.

The current regional gravity research program in Canada is largely covered in the compilation of current research (p. 77). In addition, progress continues in developing a uniform gravity standard for North America and in improving ties between the primary network of Canada and the First Order world network. Complete loop measurements in both directions were made over the Ottawa-Washington calibration line using two Worden gravimeters recently calibrated against European standards. The Dominion Observatory's newly constructed bi-pendelum apparatus, which measures differences in gravity

of approximately one tenth milligal, has been used to provide an absolute basis of measurement for the Ottawa-Washington calibration standard and to make direct comparisons between Ottawa and Winnipeg, and Ottawa and Vancouver, which are important base stations for regional and world surveys. Dominion Observatory laboratory research on instruments includes an electronic reading system to improve the recording of pendelum instruments, and the development of a vibration gravimeter for measuring gravity at sea. The latter instrument has reached the testing stage.

Many research problems in gravity could be suggested, but the high cost of instruments and field work make such problems difficult for individuals or universities to undertake so that undoubtedly most of the field observation will be done by the Dominion Observatory or other government organizations. There is a field for individual geological research in applying the data published by the research organizations to the solution of geological problems because several interpretations may be possible from a given set of data. Geologists should be aware of the numerous published gravity maps and publications because they may supply important clues to the solution of such diverse problems as continental structures, local structures and the location of ore deposits.

SEISMOLOGY

Two stations, Knob Lake and Kirkland Lake, have been dropped from the network maintained by the Seismology Division of the Dominion Observatory because of inadequate buildings or unsatisfactory location. New stations have been established or are being established at Resolute, N.W.T., Lillooet, B.C., and Penticton, B.C., the last two to obtain information on the seismicity of the interior of British Columbia.

The work of Dr. Hodgson at the Dominion Observatory on the direction of motion of faulting associated with earthquakes continues to show the predominance of transcurrent (strike-slip) motion at all depths. It is still not clear why more evidence of thrust motion is not present in active belts.

Interesting developments have taken place in the study of mountain roots and isostasy. Gravity measurements over the Cordillera, both in the United States and Canada, strongly suggest compensation through a thickened crust (i.e. depression of the Mohorovicic discontinuity) beneath the mountains. However, seismic reflections obtained at a few places in the United States suggested that the Mohorovicic discontinuity was not depressed, so that an apparent inconsistency between the gravity and seismic results existed. Further seismic work by the group at the California Institute of Technology, using the dispersion of guided waves in the crust, definitely suggests a thickened crust, so that the gravity results are confirmed. It is probable that isolated reflection measurements, especially in mountainous areas, will pick up sheets of basic material upthrust into the crust, rather than the true Mohorovicic discontinuity. More work of this type is needed in Canada, since we already have the gravity field over the southern Canadian Cordillera. The studies on the Ripple Rock explosion will be useful in this regard. The Dominion Observatory, the University of Alberta, and a number of

commercial geophysical companies co-operated in the recording of seismic waves from this blast. From the combined work it should be possible to define seismic velocities in British Columbia and to determine whether or not the mountains have roots.

The Geological Survey of Canada is adding a seismic surveying field party to the staff of the Geophysics Division to aid geologists in their studies of buried geologic structure. This party will also be of assistance to the Pleistocene, Groundwater and Engineering Geology Section by determining the depth of bedrock in buried valleys where much of Canada's groundwater is stored.

GEOMAGNETISM

The summary of current research projects (p. 77) describes most of the magnetic research being carried on in Canada. In addition an important project will be started shortly on the interpretation of extensive aeromagnetic data that have accumulated in Alberta. Using this data, Miss M.E. Bower of the Geophysics Division, Geological Survey of Canada will make mathematical calculations of the basement depths while working at the University of Alberta where time on the electronic computer will be made available. This information should be of great help in oil prospecting and should also yield some interesting correlations between the Alberta basement and the adjoining geology of the Precambrian Shield.

Dr. Morley points out the need for aeromagnetic work in mountain regions. Such data are lacking because of dangerous flying conditions and the rapidly varying heights above ground at which aircraft must fly over the rugged terrain. Although slow and expensive at first, mathematical methods could be worked out for interpreting aeromagnetic data with variable terrain clearance. With experience, it should be possible to develop better methods of flying aeromagnetic surveys in mountainous terrain.

PALEOMAGNETISM

Paleomagnetism is a new tool which has been seriously studied by scientists only in the past six years. Some think that this may prove to be another major single 'break through' in determining the relative ages of rocks. The discovery that certain rocks acquire remanent magnetism at the time of deposition in a direction which corresponds to the direction of the earth's magnetic field at the time, coupled with the discovery that the direction of the earth's magnetic field has been constantly changing throughout geological history because of pole wandering, give a potential means of telling the age of the rock and also the amount it has been moved since deposition. A number of problems are being actively investigated and their solution will have important consequences for geology, even though their full significance is not yet understood. For example, the results of paleomagnetic studies are pointing more and more strongly to continental drift, though physicists have never been able to understand how such a phenomenon is mechanically possible. On the other hand, it may be that remanent magnetism in rocks is subject to complicated physical changes bound up with their mineralogy which can obscure the original magnetization. For example, the Geological Survey of Canada is doing research on the construction of an instrument for

measuring the 'Curie Point' of rocks, which is the temperature of which all magnetism is destroyed. Canadian scientists have an important role to play in these studies, because much more data is needed from Precambrian rocks to trace polar wandering and possible continental drift in Precambrian time.

An immediate and practical outcome of paleomagnetic research will be in the help it will give in interpretation of the mass of aeromagnetic maps being published by the Geological Survey of Canada.

GLACIALOGY

The I.G.Y. programs have implications in glacial geology. In particular, the University of Toronto - University of Alberta 1957 Expedition to the Salmon Glacier in British Columbia included a detailed photogrammetric study of the ice-sheet and moraines, as well as micrometereological studies. In co-operation with Dr. Mathews of the University of British Columbia, the varved clays of Tide Lake were studied, and gravity measurements were made to indicate the thickness of the varves.

One project that will have long term results of great interest is the installation of a tide gauge at Resolute, in the Canadian Arctic. This should provide much more definite information on the possible rise of northern North America.

MINING GEOPHYSICS

Mining exploration slackened considerably towards the end of 1957, but research on new or improved geophysical instruments has continued apparently unabated. The Geophysics Division of the Geological Survey of Canada is doing considerable work on new types of equipment. One method concerns a system of creating intense magnetic fields by means of spark discharges from condensers. If this work is successful, the size and power required by airborne electromagnetic systems will be considerably reduced, and because many different frequencies are bound up in such a discharge, it should be possible to obtain information on the nature of the conductor detected. A method of recording the field strength of electromagnetic radiation from distant transmitters is also being investigated as a method of measuring the conductivity of underlying rocks. This would be done automatically in an aircraft equipped with airborne magnetometer and obtained along with other data.

The Geological Survey has been studying the recently discovered technique of nuclear magnetic resonance absorption in an effort to apply it to geophysical prospecting. Audio frequencies are generated and propagated in a manner similar to the method used in electromagnetic prospecting, but instead of radiating a single frequency, the transmitter sweeps through a band of frequencies. The receiver sweeps through the same band in synchronism with the transmitter and absorption curves which are diagnostic of the underlying material are measured. This research is in the preliminary stage and may or may not prove fruitful.

Mining company geologists on the committee have suggested that the following field research studies are in need of investigation and that the results would be of considerable benefit to the industry:

(1) A study of the penetration of a given electromagnetic outfit when operated at different frequencies.

(2) A study of the sensitivity of a given electromagnetic outfit when operated at different frequencies.

(3) A study of the sensitivity is desirable in the Precambrian area. (Maximum sensitivity to conductors without too much reaction to swamps and other topographical features).

(4) A study of the masking effects of different types of overburden materials over conductors (e.g., water, muskeg, gravel, clay).

(5) The development of instruments to measure the depth of overburden, if possible, to depths as great as 400 feet. This is needed because of the excessive cost of diamond drilling in a district where the depth of overburden is unknown.

The relative success of various exploration methods used by the Hudson Bay Mining and Smelting Co. Ltd. was described in last year's report[1]. To add to this data and help geologists determine the relative value of various exploration methods, the experience of Falconbridge Nickel Mines Ltd. is summarized below by listing the principal method or methods used in the discovery of each of that company's orebodies in the Sudbury district:

[1]National Advisory Committee on Research in the Geological Sciences, Seventh Annual Report, 1956-57, p. 36-38.

Falconbridge, Falconbridge East and Hardy each discovered by a magnetic anomaly, using the geological locus of the norite contact.

Boundary A small outcrop in the centre of a magnetic anomaly with the ore found by drilling the norite contact 1,000 feet down dip.

McKim, Fecunis and Strathcona Each discovered by geology and drilling.

Blezard Discovered by drilling down dip from a known orebody.

Denison Township Discovered by drilling down dip from known ore.

Mount Nickel and Longvac. Each outcropped and was purchased.

Summing up, of the eleven ore deposits, two relatively small orebodies outcropped, two are extensions of known surface deposits, and the remaining seven had to be found. Of these, three were found mainly as a result of magnetic anomalies, but in three others the magnetic data was of no use because of interfering magnetic formations.

PETROLEUM GEOPHYSICS

Professor Garland reports that the decrease in petroleum exploration in Western Canada presents personnel problems for companies

who wish to maintain an adequate body of trained men. Many companies, however, are making very considerable advances in instrumentation, with more and more emphasis on magnetic recording and elaborate playback laboratories in Calgary. This advanced instrumentation is undoubtedly proving useful, but fundamentally it provides nothing new, and we have not had a major advance in petroleum exploration methods for several years.

WATER SUPPLY

The problem of water supply is causing increasing concern in many parts of Canada. Several organizations are starting geological and geophysical ground-water investigations, as, for example, the program on earth resistivity and its relation to shallow aquifers by the Research Council of Alberta.

COMPUTERS

Professor Uffen has elaborated on the suggested use of electronic computers in attacking geological problems. The high speed computers have their greatest value when the problem requires a numerical solution which would otherwise require an inordinate amount of calculation.

The use of computing machines is well established in the processing of data obtained with geophysical instruments. The seismic exploration organizations are well advanced in the use of these machines and similiar processing of gravimeter, magnetometer data, etc., with necessary corrections for topography, etc., will likely increase. The interpretation of geophysical data is frequently only qualitative, involving a process of correlation only. It is likely that in the future more quantitative methods will be required involving the solution of complicated boundary value problems.

Already, computing machines are being used in the general fields of petroleum reservoir mechanics for the prediction of recoverable reserves and probable performance for gas injection and water flooding projects. Similar calculations are being carried out in the field of hydrology. Sufficient numbers of geologists and geophysicists are likely to become involved with such phases of the earth sciences that in the near future it will be necessary to provide an opportunity for undergraduate students to learn to program such problems for the machines.

The use of computing machines in the field of mineral exploration has been neglected; it will in the future affect a much larger proportion of earth scientists. The methods of "Operations Research" should be particularly valuable where one is faced with a problem involving many variables whose values may be imperfectly known or which may be subject to change. In effect the machine solves a numerical problem many times and the results may be recorded in the form of graphs or charts for ready reference.

Expanded theoretical development and routine practical use of procedures like Professor L.B. Slichter's "optimum prospecting plans" is foreseen (see Economic Geology, 50th Anniversary, Volume, page 886-915, 1955). Here the object is to determine a plan of drilling which maximizes the value of the ore likely to be discovered in relation to

the total cost of prospecting. The method provides a means of expressing quantitatively, the relative importance of the many factors affecting the success of a drilling program. Any exploration program can be reviewed rapidly when new data become available (e.g. a sudden change might be the selling price of the metal or ore). The method is equally useful for petroleum exploration programs.

At the University of Western Ontario, one graduate student is trying to extend the theory for optimum spacing of drill holes, to include the effect of variable depth to the target. This will permit applying Slichter's method to bedded deposits in dipping horizons. This approach has also been used to calculate the "completeness of search" and the "exploration effectiveness" for a particular property in terms of the methods of exploration used, and the target size, shape, depth, and value. These can be compared with the results for other properties as an aid in determining the desirability or otherwise of further work. The calculations are lengthy and tedious even with an electric calculator but it is hoped that the problem can be programed for solution with an electronic computer.

Dr. Morley reports than an automatic geophysical compiling machine has just been delivered to the Geological Survey at a cost of $30,000. Indications are that it will do the work of from four to seven map compilers and computers.

The use of electronic computers may give the answers to many problems that have perplexed geologists for years. For example, we might determine the optimum spacing of drill holes when drilling off an orebody, or the optimum spacing of traverse lines for geological surveys, or picket lines for geophysical surveys. Geologists are always wondering whether it is worth the extra cost to do a geophysical survey on 200-foot lines as against 300- or 400-foot lines. If the data can be made available there should be no great difficulty in answering such problems with computers.

Now that geology can be placed on a more quantitative basis the need for adequate data is becoming more apparent. Because this data must be gathered from a great many organizations, some sort of data collecting group appears to be necessary. Any such group should be sponsored by some authoratitive body such as a government organization, or one of the mining organizations, so that requests for data would have some official backing and the data would more likely be forthcoming from the various companies who could supply it.

SUBMARINE GEOLOGY

An aeromagnetic survey of the Gulf of St. Lawrence is planned for 1958-59 in order to discover the geological relationship between Gaspe, New Brunswick, and Nova Scotia on the one hand, and Newfoundland on the other. Interest is added to this survey, because oil companies have taken prospecting leases in coastal areas of New Brunswick and Prince Edward Island and plan test drilling, very little of which has been done before in the Maritimes.

Four profiles were made with an airborne magnetometer over the continental shelf in the Arctic Ocean in 1955 as part of "Operation Franklin", the geological reconnaissance of a large area in the Arctic.

It is evident from these profiles that a great thickness of sedimentary rocks is present in this shelf, but more work must be done to establish the actual thickness of the deposits.

A single profile with airborne magnetometer was made across Hudson Bay from Churchill to the Belcher Islands in 1957. The data show that the Palaeozoic basin in northern Ontario extends into the centre of Hudson Bay and crude approximations can be made of the depth of the basin.

It is suggested that aeromagnetic, gravity, and seismic surveys of the area underlying the Great Lakes would be valuable because nothing is known of the geology underlying the lakes.

Within the last five years, supersonic echo-sounding machines of special design have been used not only to measure water depth but to get information on the relatively unconsolidated sedimentary material on the ocean and lake bottoms. This sort of information is as valuable to the Pleistocene geologist as seismic information is to the stratigrapher.

GEOPHYSICS IN THE GEOLOGICAL SURVEY OF CANADA

Since 1947 when the geophysics section was organized in the Geological Survey it has done little else than survey and compile approximately six hundred aeromagnetic map-sheets. It has recently been possible to begin to build up a research group in geophysics as applied to geology, and in future the section will be not only a service division to meet the needs of the other divisions but will be able to carry on some independent research.

As of April 1, 1958, the research group will consist of one geologist, four geophysicists and one physicist supported by six full-time technicians engaged in the following fields of geophysical research: aeromagnetic interpretation, paleomagnetism and magnetic properties of rocks, magnetic resonance as a means of detection and non-destructive analysis of minerals, seismic reflection and shallow refraction, a pulsed method of electromagnetic prospecting, and radio frequency field strength measurements as a means of mapping surface conductivity.

NEW INSTRUMENTS

Several new instruments of interest to geologists were developed or tested during the past year. Two types of magnetic instruments using the newer torsion and nuclear induction or nuclear magnetic resonance principles are now available for reported high quality ground magnetic work. If these instruments prove reliable they should speed up ground work and cut costs because the newer instruments do not require the tripods and orientation of the older Schmidt balance type of instrument.

Small highly portable seismographs using a hammer instead of an explosive are available for shallow depth determinations and possibly even for subsurface bedrock mapping.

A portable instrument called a berylometer has been developed for the nuclear detection of the element beryllium. Its operation is based upon the photoneutron reaction with beryllium metal. A source of

gamma radiation, having an energy above the threshold value of 1.65 Mev. is attached to the bottom of an instrument, this being enclosed in a cavity under a lead shield. When the instrument is set down on a rock surface to be tested, the gamma radiation penetrates the underlying rocks for a short distance and if beryllium is present, the resulting neutrons, which penetrate upwards pass through the lead shield and are detected in a scintillation counter. A phosphor possessing a high neutron to gamma sensitivity ratio permits the biasing off of all scintillations due to gamma rays. The resultant reading on the ear phones records neutrons only and the counting rate is directly proportional to the beryllium content of the rock or sample. As a protection to personnel the instrument is suspended from a pole about eight feet long carried by two men because a strong source of gamma rays is employed. For this reason also, such equipment will not be available to prospectors in general but only to responsible technical persons who can obtain the necessary licence from the proper authorities.

In the field of mining exploration, considerable interest has arisen over the "airborne gravity gradiometer" which has been described by one company. The idea is attractive for base metal exploration in difficult country, but most geophysicists are taking a very cautious view, as both instrumental problems and terrain effects appear to be very difficult to solve. The Division of Gravity of the Dominion Observatory hopes to carry out objective tests with this airborne gravity instrument.

Most mining geologists feel that the testing of geophysical instruments and their capabilities by disinterested parties is urgently needed, so that the various instruments can be evaluated for exploration purposes. It seems that such testing could only be done by a government agency.

GEOLOGY AND THE INTERNATIONAL GEOPHYSICAL YEAR

Much is heard about the International Geophysical Year in which many nations are co-operating in the scientific study of the earth and its atmosphere. This is geophysics in the broad sense and encompasses such subjects as meteorology, oceanography, upper air physics, cosmic rays, geomagnetism and a number of other subjects which heretofore were always thought of as separate subjects not having much in common with each other. The one thing they do have in common is that they are all a study of the physics of the earth or its atmosphere. Geologists who study only the thin crust of the earth, have come to think of geophysics as the study or use of the methods of physics as applied to the investigation of the earth's crust or in short, a geological tool. In the past, because of the wide gap between physics and geology, geophysics in this narrow sense was always thought of as a thing apart from geology. Nowadays, the physical sciences are incorporated into geological study and this type of geophysics has been largely absorbed by geology.

Because geologists may be somewhat uncertain about their position with respect to the International Geophysical Year, Dr. J.T. Wilson has contributed the following on "Geology and the International Geophysical Year".

"In brief, the IGY may be regarded as a study of sunlight and its effects on the earth. From a geological point of view, the principal effects are those causing erosion, that is, wind, water and ice.

Other important aspects concern the topography of the ocean floor which was hitherto little known; the ionization of water vapor in the ionosphere which allows hydrogen to escape producing free oxygen in the atmosphere; fundamental data about climate which may explain the origin of ice ages; and basic information about climate and its causes which might be important in ascertaining the former position of the poles and continents. The IGY has not been much concerned with the study of the solid parts of the earth because these change so slowly that their study is not helped by synoptic observations made over a one year period. On the other hand, the breadth of view, encouraged by these great studies, is leading to a clearer realization of the place of crustal rocks in the earth as a whole. In recent years seismic studies have shown that the crust is a thin layer averaging less than one per cent of the total thickness of the mantle. It is quite evident from quantitative studies of elements and isotopes that the whole crust could perhaps have escaped from the mantle during geological time, and the fact that there are sound arguments for believing that the atmosphere and oceans have done the same strengthens this view that the crustal rocks originated as lavas escaping from the mantle.

"It can also be seen that the forces which operate on the crust arise for the most part either in the fluid envelopes above the crust or in the mantle beneath it. Most ores, magma and volcanoes must find their way through the crust from the mantle. Most earthquakes are due to fracturing in the mantle. Mountains are uplifted by movements taking place within the mantle. Modifications are brought about by erosion by the fluid oceans, rivers and air.

"It follows from this that the observations of the complex surface of the earth made by geologists can only be expected to be understood when we have a clearer understanding of the processes which operate in the atmosphere and oceans and the processes which operate in the mantle. Fortunately these layers of the earth appear to be very much more homogeneous than does the crust, which is distinctly heterogeneous. There remains a great deal to be done in studying the earth, but field geology, like analytical chemistry, is by itself a matter of collecting data. If we are to understand what has happended in the earth, the processes by which the crust has been formed, we will require a knowledge of the whole earth, not just the accessible land surface which constitutes less than one third of the surface and less than one per cent of the total volume.

"The greatest contributions of the I.G.Y. to geology is the awakening it has brought to geologists to the fact that the crust is not a complete unit in itself, but that it can only be explained in terms of studies of the whole earth. The crust lies on the boundary between the solid mantle from which it arose and the fluid envelopes by which it is modified. It is the grist, ground between these larger mills of mantle, sea and air. To comprehend geology scientists must study the whole earth machine and not just the flour it produces. On the other hand, that flour is the land on which we live. It will always be the part of the earth we know best and the part which is most important to us. No theories about the whole earth can be correct unless they take geological knowledge into account. Fortunately new knowledge and new methods are rapidly closing the gap which has sometimes existed between geology and geophysics and between students of these disciplines."

THE REPORT OF THE SUBCOMMITTEE ON SCHOLARSHIP AND RESEARCH TRAINING

Presented by J.B. Mawdsley

Members of Subcommittee

J.B. Mawdsley, - University of Saskatchewan, Saskatoon, Saskatchewan.

H.S. Armstrong - McMaster University, Hamilton, Ontario.

P.E. Auger - Laval University, Quebec, P.Q.

V.J. Okulitch - University of British Columbia, Vancouver, British Columbia.

G.S. Mackenzie - University of New Brunswick, Fredericton, New Brunswick.

J.L. Usher - Queen's University, Kingston, Ontario.

FACILITIES NOW AVAILABLE AT CANADIAN UNIVERSITIES FOR ADVANCED TRAINING IN GEOLOGY

Answers to a questionnaire on this subject were received from all geology departments in the country, and the subcommittee wishes to sincerely thank all concerned for their co-operation.

On receiving the answers it was obvious that the questionnaire was in places ambiguous so that a certain plus and minus coefficient has to be applied to the information tabulated from it.

There seems little doubt that, owing to the rather adverse employment situation this year, more will be thinking of graduate work next (1958-59) session. It is perhaps unfortunate then, that this information was not available to departments of geology and their students prior to the end of the 1957-58 session.

The smaller departments, although anxious to give graduate work very wisely have concentrated their efforts, up to the present, on undergraduate courses. However, the geology departments of Brandon College, Mount Allison, Carleton, Ottawa, Ecole Polytechnique, University of Montreal and Memorial Universities will start giving advanced work shortly. They are, therefore, not included in the listing tabulated below.

A. Undergraduate Courses. This part of the table (p. 35) lists the various undergraduate courses now given by the different geology departments other than the Arts and Science course, which they all give. The dates at which these undergraduate courses were, or are to be, initiated is indicated by the year.

B. Advanced Training. This part of the table lists the various specialities that each department considers it is capable of handling. If the course was initiated for either Masters or Ph.D. training since 1950 the date is indicated. If no date was given or it was initiated prior to 1950 an "X" is used. If the "X" or the date is underlined it indicates that the training can now be taken to the doctorate level; if the "X" or date is not underlined it can now be taken only to the Master's level.

If an "C" instead of an "X" is used it signifies that this work can be done in, or with the aid of, another department of the same university.

Obviously, the fact that some departments have not specified certain subjects as one of their specialities does not mean that the graduate training they give is devoid of it.

It is interesting to note how the variety of courses offered by many departments has increased in the last few years.

C. Special Equipment. This part of the table lists the main pieces of equipment--usually expensive--that each department giving graduate work possess and are required for different phases of research work. It does not pretend to be complete. If the equipment is available for use but is present in another department the symbol "C" is used. No dates are listed expect "58" if this equipment is just being acquired and will be available for use next session.

It is obvious that nearly every type of special equipment is now available in one or more universities in Canada. It appears that if there is special research to be done there are places in Canada where it can be carried out.

FACILITIES AVAILABLE FOR ADVANCED TRAINING IN GEOLOGY

	British Columbia	Alberta	Saskatchewan	Manitoba	Western	McMaster	Toronto	Queen's	McGill	Montreal	Laval	New Brunswick	Acadia	St. Francis Xavier	Dalhousie
A. UNDERGRADUATE COURSES															
Geological Engineering or Applied Geology	21	56	35	50			37	44		57	46		54		
Geophysics - Arts	40	55	58		56	46	30	50	53				54		X
- Engineering			58				35	50							
Geol-Geophysics		57													
Geol-Civil Engineering								58							
B. ADVANCED TRAINING															
Mineralogy	X	58	58	52		57	X	X	X	57		55			X
Geochemistry	X	X		53		X	X	X	52			56			
High pressure-temp. studies			58	X		57	X	X	51		55				
Petrofabrics	X	56	54	X	58		X	50	X		X			57	X
Structure	X	56	X	X			X	50	X		52			55	
Deposits - metalliferous, etc.	X	X	X	53			X	X	X		51	X	56	56	X
- fossil fuels	X	X	X											56	X

B. ADVANCED TRAINING (cont'd)

	British Columbia	Alberta	Saskatchewan	Manitoba	Western	McMaster	Toronto	Queen's	McGill	Montreal	Laval	New Brunswick	Dalhousie	St. Francis Xavier	Nova Scotia	Memorial
Palaeontology - micro		50	58		58			57	X							
- macro	X	X	58	X		X	X	X	X			55				
- vertebrate							X		X							
Palaeobotony	57					0			X							
Stratigraphy - Precambrian	X		X				X	X								
- Palaeozoic	X	X	X	X			X	X				50	57	57		
- Meso. and Ceno.	X	X	X				X	X								
Pleistocene	50	52	56		52		X		56				51			
Sedimentation	X			58			X	X								
Photo interpretation	X	56	56	53			X		56				54			X
Geophysics - exploration	0	56			56		0	X	X							
- theoretical	0	55			56		0	X	0							
Geochemical exploration	X		53						53					57		
Nuclear geology		55				0	0									
Crystal structure analysis	X			51			X	X								
Trace metal distribution	X			53		X		X								
Paleomagnetism		58			57											

C. SPECIAL EQUIPMENT

	British	Alberta	Saskatchewan	Manitoba	Western	McMaster	Toronto	Queen's	McGill	Montreal	Laval	New Brunswick	Acadia	St. Francis Xavier	Dalhousie
Isodynamic separator	X	X	X	X		X	X	X	50						
Universal stage	X	X	X	X	X	X	X	X	X	X	X	X		X	X
Double variation apparatus	X					X	X	X							
X-ray diffractometer	X	X	58	X		X	X	X	50	X	0	X			X
Differential thermal equipment							X		52						
X-ray fluorescent spectrometer	X		58				X	X	50	X	0				
Optical spectroscope	X					X	0	X							
Flame photometer		X	X	X			X	X	50		X	0			
Mass spectrometer		58				0	0								
Radioactive measuring	X	X	X	X	X		X	X	50	X	X	X	X		X
High pressure-temperature	X	58	58	X	0	X	X	X	54		X				
Decrepitation equipment			X				X								
Aerial photo interpretation	X	X	X	X			X	X	56			0	X		X

THE NEED FOR GRADUATE SCHOLARSHIPS

A questionnaire on the need for scholarships for advanced work in geology was sent to the departments of geology that give graduate work. Answers from a little more than half of them were received, ranging in quality from thoughtful appraisals of the situation to rather unrealistic ones.

The information gained from the answers was very much in line with that already reported on this subject in the two previous reports of the Committee[1]. It is apparent that there are more than

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[1]National Advisory Committee on Research in the Geological Sciences, Sixth Annual report, 1955-56, p. 27 and Seventh Annual report, 1956-57, p. 45.

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enough scholarships for brilliant applicants, but not enough for a sizeable proportion of men of less ability but who are worthy of further advanced training. Also, it is evident that some of the smaller universities are under a distinct disadvantage because their brighter graduates usually obtain scholarships that allow them to go to the larger universities and thus they are not available to serve as instructors for junior classes or to provide the stimulus that good graduate students give to a faculty. Provincial Research Councils, Departments of Mines, or Universities could rectify this situation to some extent by providing scholarships tenable only at smaller universities and thereby help to stimulate their geology departments. Such a system is in operation in some of the provinces and its expansion would probably best look after the able but less brilliant men that should be trained for the national need. The matter is also worthy of consideration by industry.

The question comes up regarding the few brilliant men that are coming up to take advanced work. Is the field of geology receiving its proper share of these men? If not, what is the reason? These are interesting questions which are difficult to answer. Possibly the Awards Officer of the National Research Council might indicate the procedure by which data concerning them might be gathered.

REPORT OF THE SUBCOMMITTEE ON MINERALOGY, GEOCHEMISTRY AND PETROLOGY

Presented by J.W. Ambrose

Members of the Subcommittee

J.W. Ambrose (Chairman)	-	Queen's University, Kingston, Ontario.
L.G. Berry	-	Queen's University, Kingston, Ontario.
R. Beland	-	Universite Laval, Quebec, Quebec
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. Moorhouse	-	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 members of the Subcommittee on Mineralogy, Geochemistry, and Petrology wish to take this opportunity to express their warm appreciation to Dr. J.E. Hawley for his long and valuable service to the subcommittee, and of the part he played in establishing the National Advisory Committee. Dr. Hawley acted as chairman of a committee on geological research set up by the Canadian Institute of Mining and Metallurgy in 1946. A recommendation of this committee[1], "....that the endeavour be made to have formed a National

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[1]Hawley, J.E., Research in the Geological Sciences in Canada, Bull. Can. Inst. Min. Met., July, 1947, P. 359.

Advisory Committee on Research in the Geological Sciences", made to the Honourable J.A. Glen, the then Minister of Mines and Resources, was acted upon by the Privy Council, and in January, 1949 the National

Advisory Committee was established. Dr. Hawley served as a member of the Committee from its inception until last year (1957), his last two years as chairman of this subcommittee. Pressure of duties led to his decision to retire, but his interest in research and in the affairs of the National Advisory Committee in particular have in no way diminished. As incoming chairman of this subcommittee I propose to call upon him for advice and suggestions to the full extent of his good nature.

CURRENT RESEARCH

Elsewhere (p. 77) in this report are listed 136 research projects in mineralogy, geochemistry and petrology on which 133 people are engaged. Some of the projects overlap into two or even three fields, many involve two or more people, and some people are active in several projects, all of which make a useful statistical breakdown difficult. Tables 1, 2 and 3 are an attempt at this.

TABLE I

Level of Researcher

Subject	Bachelors or Masters Thesis	Doctorate Thesis	Thesis Level Unknown	Non Thesis	Total
Mineralogy	7	4	9	25	45
Geochemistry	7	12	20	30	69
Petrology	12	11	5	18	46
	26	27	34	72	160

(Number of researchers engaged - 136)

TABLE II

Level of Project

Mineralogy	5	4	16	33	38
Geochemistry	7	13	9	25	54
Petrology	12	10	4	15	41
	24	27	29	62	133

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	1	2	5
Research Council of Alberta	1	1	--	2
University of Alberta	--	1	2	2
University of Saskatchewan	--	--	2	2
University of Manitoba	1	1	2	4
Ontario Dept. of Mines	--	1	1	2
Ontario Research Foundation	1	--	--	1
McMaster University	3	4	--	7
University of Toronto	7 (1)	5	7	19
Quebec Dept. Mines	1			
Queen's University	4	7	4	15
Geological Survey of Canada	8	10	7	25
Mines Branch, Dept. Mines & Technical Surveys	6	7	1	14
McGill University	2	14	8	24
University of Montreal	2	--	1	3
Laval University	--	--	2	2
University of New Brunswick	--	1	1	2
Mount Allison	--	1	--	1
Memorial University	--	--	1	1
	38	54	41	133

Table I indicates the numbers of researchers, and their levels, engaged in the three fields. No duplication of personnel is shown in any one field, but since several people are working in more than one field, the apparent total number of people, 160, is larger than the actual total, 136.

Table II indicates the level of project in the subdivision of the projects among the several fields. Geochemistry is the most popular field but the difference between it and the others is not great and is probably not significant.

In mineralogy, four projects are concerned with radioactive minerals or mineral deposits, eleven with x-ray and crystal studies of specific minerals, ten with economic minerals or mineral deposits, and twelve with general mineralogic topics.

J.E. Hawley and R.L. Stanton, National Research Council post-doctorate Fellow, hope to complete this year a manuscript on the mineralogy of the Sudbury ores, on which considerable research has been completed. The manuscript will include a section on trace elements, including selenium, and one on the platinum group metals contained in these ores.

In geochemistry the diversity is so great that useful generalizations as to subjects of investigation are almost impossible. The projects include techniques for and applicability of geochemical prospecting, minor element studies of plutonic rocks, isotopic studies of sulphur from petroliferous deposits, ore deposits and rocks, minor elements in ore deposits,

and several other categories. J.E. Hawley, J.A. Grant, and Graham McDonald hope to complete their detailed geochemical studies of granitic rocks of both the Grenville and Algoman areas of Ontario, within another year.

Studies of igneous rocks account for 22 out of 41 projects. Of these, 12 deal with granites or granitization, five with ultrabasic rocks or complexes, and five with alkalic rocks of various sorts. Eight projects are concerned with sedimentary or metamorphosed sedimentary rocks and the remaining 11 include studies of pegmatite, of the Mystery-Moak Lake ore deposit, dating of intrusions by the Larsen method, two studies of gneisses, and general regional studies. K.R. Dawson has undertaken to obtain and maintain representative suites from all mapped areas of Canada for future petrological, geochemical and other scientific studies.

In connection with Table III, although the universities together are credited with eighty seven projects, the Geological Survey of Canada has the largest individual number (25), with McGill University a close second (24). With 19 institutions reporting, the Federal Government, McGill University, University of Toronto, and Queen's University together account for 97 out of 133 projects.

GENERAL PROJECTS

Survey of Physical and Chemical Methods of Analysis

Dr. W.W. Moorhouse is examining the possibility of compilation of a card index of analytical methods for rocks and minerals. A number of organizations have agreed to assist in the project, including Dept. of Mineralogy and Petrology, University of Cambridge (J.H. Scoon); Metallurgical Laboratories, Falconbridge Nickel Mines Ltd., (C.H. Lewis); Geophysical Laboratory (G.R. Tilton); Dept. of Mineralogy and Petrography, Harvard University, (Jun Ito); and Ontario Dept. of Mines, Assay Laboratories, (D.A. Moddle).

The project may be divided into two sub-projects: (a) a general review of modern methods of analysis, their accuracy, sensitivity, rapidity, together with names and addresses of laboratories which do analyses of various sorts on a custom basis and (b) a card file of the analytical methods. For the present at least Dr. Moorhouse intends to pursue the first of these sub-projects, and hopes to be able to report thereon before the next meeting of the National Advisory Committee.

Geochemistry of Canadian Rocks

Drs. Maxwell and Dawson have made substantial progress in this project. Dr. Maxwell's progress report is quoted here in full:

"In the tentative schedule proposed by Dr. K.R. Dawson and the writer (Dr. J.A. Maxwell) for the compilation of Canadian geochemical data, submitted to Dr. Hawley in February 1957, the first two steps were (a) to set up arrangements for the compilation of all geochemical data available in the files and publications of the Geological Survey of Canada, and (b) to begin the compilation of this data with the hope of completing it in one summer. These steps have been completed

and the following is a summary of this work, for the most part taken from a report prepared by Miss Margaret Tomilson.

"Preliminary Preparations. Dr. Dawson has had considerable experience in the statistical treatment of data, especially in the use of punched cards, and on his advice it was decided to use an 8" x 10 1/2" "Keysort" filing card. We also benefited from the experience and advice of those officers of the U.S. Geological Survey who are engaged in the revision of Professional Paper 99, kindly made available to us by Miss Marjorie Hooker.

"The Keysort Card is divided and printed to provide spaces for the recording of data under sample name, number, collector, locality, reference, field relationships, megascopic and microscopic description, nature of sample, purpose of analysis, chemical analysis, molecular equivalents, norm, trace elements, mode, specific gravity, and analyst. The back of the card is blank and additional data may be recorded on it. A small Keysort card, 5" x 8", is used to record the literature search and to tabulate the number of analyses found. A coding and cross-reference scheme has been worked out so that as much information as possible will be easily obtainable.

"Compilation Work, Summer, 1957. In her report Miss Tomilson gives a detailed description of the project which should facilitate the work of those who continue with the project.

"During the course of the summer of 1957 a complete search was made of the publications and files of the Geological Survey of Canada, from the first Report of Progress of 1843, to memoir, No. 287, published in March, 1957. The 500 publications examined contained 3,594 rock and mineral analyses, 2,199 fuel analyses, and 413 water analyses. Of the rock and mineral analyses, 514 have been transferred to Keysort cards, the supply of which was exhausted at this point; but 5,000 more cards are now on hand.

"Compilation Work, Summer, 1958. Our tentative plans call for a typist to work on the transference of the backlog of rock and mineral analyses to the Keysort cards, and a summer student-assistant to continue the search of the provincial publications.

"Visit to Washington, D.C. In October, 1957, the writer spent three days in Washington, D.C. Miss Marjorie Hooker showed the writer the files and discussed the methods that she is using in her revision of Professional Paper 99. She is pleased that we are undertaking this project for Canada and suggests that we publish our bibliography of analyses as part of the series she is publishing in Geochemica et Cosmochimica Acta. The U.S.G.S. is compiling analyses of igneous and metamorphic rocks only; sedimentary and mineral analyses are being noted for future reference. Miss Hooker made available to us the cards she had prepared for the Canadian literature search and asked that we provide her with a copy of our search in return."

Dr. Maxwell's report makes quite clear the very considerable size of this undertaking. It is gratifying to discover that the United States Geological Survey has a similar effort in hand and that liaison has been established between it and the Canadian group. As it progresses the results will become increasingly useful to all researchers in petrology.

We recommend that the project be given every possible support by the National Advisory Committee.

Nomenclature of Metamorphic Rocks, Facies and Phenomena.

The committee engaged in this project, consisting of Drs. D.F. Hewitt, H.W. Little, W.W. Moorhouse, and D.H. Williamson, and D.M. Shaw, Chairman, submitted its final report on July 29, 1957 to Dr. Hawley who forwarded it to Dr. Harrison, Chairman of the National Advisory Committee. The report has since been published in the Proceedings, Geological Association of Canada Volume 9, 1957, p. 69-81. The members of the committee deserve credit for bringing the project so rapidly to the publication stage.

Dr. M.V.N. Murthy suggested to Dr. Shaw that a set of rocks be prepared illustrating the nomenclature of metamorphic rocks as set out in this report. This suggestion is worthy of serious consideration but Dr. Shaw feels it would be premature to prepare such a set until there is evidence of general agreement on the proposed definitions. Action on this suggestion should perhaps be deferred until it is possible to judge the degree of acceptance of the proposed definitions.

Correlation of Age Determinations with Mineralogical and Petrological Data

Dr. S.C. Robinson reports that a paper embodying the results of Dr. M.V.N. Murthy's research on the zircons in the Parry Sound and Preissac granites is in preparation. Dr. Murthy has discovered in these granitic rocks two types of zircons, one of which occurs as rounded grains and is probably syngenetic and older than the other. Based on geochemical and crystallographic considerations, he concludes that crystallization of zircon occurs early in consolidation of granite[1].

[1]Murthy, M.V.N., On the Crystallization of Accessory Zircon in Granitic Rocks of Magmatic Origin; Canadian Mineralogist, Vol. 6, Pt. 2, p. 260-263 (1958)

Dr. Robinson further reports that methods of extraction of argon were revised during the year and argon extraction is now combined with addition of a 'spike' of known isotopic composition. It is hoped that first dates based on the K/A ratios will be determined in 1958. N.J. Snelling, a post-doctorate fellow from England and Australia has commenced studies of K/A dating and will evaluate results on specific suites from discrete plutonic groups. He is already assembling equipment to increase facilities for extraction of argon.

Other research projects reported by Dr. Robinson include examination of the Abee meteorite by K.R. Dawson; chemical, mineralogical, and possibly isotopic studies of the Mount Albert pluton by C.H. Smith, as a start of a study of the ultrabasic rocks of Canada; and detailed studies of granitic bodies in British Columbia by J.E. Reesor and H.H. Bostock. R.W. Boyle completed geochemical study of the Yellowknife camp, and with R.K. Wanless, completed study of sulphur isotopes in Yellowknife rocks and ores. Results of both studies are in preparation. Boyle completed field work for geochemical study of the Magnet Cove barite deposit and surrounding area and initiated work on geochemistry of copper-zinc deposits of the Bathurst region.

R.H.C. Holman continued a geochemical reconnaissance in Nova Scotia. He discovered numerous anomalies, many of them at the contact of the Horton and Windsor formations. Holman, in co-operation with Professor R. Beschel, Mount Allison University, has commenced a geochemical-biological study of a copper-rich swamp near Sackville, N.B.

R.K. Wanless and H.R. Belyea have completed preliminary study of variations in sulphur isotopes in sulphides and sulphates of petroliferous strata of the Golden Spike field, Alberta. Wanless and G.B. Leech have completed study of the isotopic composition of ore lead from a group of deposits in southwestern British Columbia.

G.S. MacKenzie, E.W. Hale and students at the University of New Brunswick are continuing and extending geochemical and petrologic investigations of Devonian intrusions in New Brunswick that are mainly granitic but include some earlier gabbros. They plan to make a geochemical study of Carboniferous volcanic rocks, including mid-Mississippian rhyolites and basalts. These rocks are relatively undeformed and may be genetically related to post-tectonic intrusions in the northeastern New England states.

NOTES AND SUGGESTIONS

Dr. F.G. Smith notes that, although it is less difficult than formerly to obtain costly special apparatus for research, it is still difficult to obtain funds for the purchase of consumable materials for laboratory maintenance and operation. He suggests that some of the money for grants-in-aid be retained for distribution during the academic year to directors of research to make such purchases.

The rate at which new research data in geology are accumulating poses some formidable problems. Much of this highly specialized information does not become useful until it is weighed, compared with other pertinent data (frequently from the most unlikely sources), and incorporated into some sort of general review or survey paper. This type of study, involving the assembling of data from a great variety of sources and the search for patterns therein, is an essential part of the scientific method and constitutes research just as much as does the production of new data. Postponement of such general reviews may result in needless duplication of effort and, more seriously, in the neglect of certain important gaps in our knowledge, the very existence of which only a general review study may reveal. Accordingly continued or extended support of compilations such as those of rock and mineral analyses by Dawson and Maxwell, of concentrated, co-operative studies of projects by teams, such as the comprehensive study of an orebody now under discussion (p. 1) or promotion and conduct of symposia on specific problems are all to be recommended.

G.S. MacKenzie notes that gravity traverses made by the Dominion Observatory in New Brunswick have proved very useful as aids in interpreting the forms and attitudes of granitic plutons. He suggests that additional gravity traverses, and possibly seismic work would help towards a better understanding of the shape of these masses. Informal conversations lead him to believe that the Dominion Observatory would be willing to co-operate in any overall program.

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, Ottawa, Ontario.
F.W. Beales	-	University of Toronto, Toronto, Ontario.
W.A. Bell	-	Nova Scotia Department of Mines, Stellarton, Nova Scotia.
Raymond V. Best	-	McMaster University, Hamilton, Ontario.
R.W. Landes	-	Imperial Oil Limited, 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, Quebec.
V.J. Okulitch	-	University of British Columbia, Vancouver, British Columbia.
L.S. Russell	-	National Museum of Canada, Ottawa, Ontario.
C.R. Stelck	-	University of Alberta, Edmonton, Alberta.

INTRODUCTION

The review of current research, (p. 77) shows roughly the same number of individual projects as last year. These projects deal directly with, or are related to stratigraphy, palaeontology, sedimentation and the fossil fuels, and, as in the previous year, they are distributed throughout the length and breadth of Canada and embrace almost every geological system from the Cambrian to the Tertiary. This research is being conducted in virtually every university in Canada, by federal and provincial geological surveys, and by research institutions such as the Alberta and Saskatchewan Research Councils, and the Ontario and Nova Scotia Research Foundations. Industry provides financial support for various research projects carried forward at several universities and through the medium of publication by professional associations is playing an ever increasing role in encouraging research and disseminating knowledge of fundamental importance and mutual concern to all engaged in the exploring, developing, and conserving Canada's natural resources.

The results of research in stratigraphy, palaeontology and sedimentation are perhaps applicable chiefly to the search for oil, gas, and coal. Three general regions of Canada are producing oil and gas, namely, Western Canada, Southwestern Ontario, and New Brunswick. At present, about 99 per cent of Canada's oil production and 92 per cent of the natural gas is from the western Canada sedimentary basin, comprising an area of about 700,000 square miles, all of which is considered as potentially productive. Within this region oil or gas or both have been found in about 30 reservoirs embracing seven geological systems and at depths ranging from 1,000 feet to more than 11,000 feet below the surface. At the time of the Leduc oil discovery in Alberta in 1947 there were about 13 oil fields in Western Canada producing an average of 19,000 barrels a day. Today, this region has more than 135 oil fields with an output averaging about 495,000 barrels a day, and a productive potential estimated at 900,000 barrels daily. Commercial fields are now scattered from the international boundary to Fort Norman, N.W.T., a distance of 1,400 miles and from Fort St. John, B.C. to southwestern Manitoba, a distance of about 1,000 miles.

In southwestern Ontario and New Brunswick production is from 4 geologic systems at depths of 400 to 3,500 feet.

As oil and gas are non-renewable resources, it follows that known reserves are depleted by the amount produced in any given period. It is therefore essential that exploration be continued in order to establish reserves sufficient to support the ever increasing demand for this form of energy. Oil and gas are becoming more difficult and costly to find as the more readily recognizable and accessible structures are exploited.

Research into geological processes and into the origin, age, history, correlation, structure etc., of sedimentary rocks provides data basic to exploration for the fossil fuels. The possible economic application of a given research project will continue for some time to be a decisive factor in determining whether that project will be undertaken.

Because of its pre-eminent position as a producer of oil and gas a large proportion of the total research effort has been directed to Western Canada. Palaeontological research in macro and micro fossils is adding to our knowledge of the age, correlation, and conditions of deposition of the formations that function as source and reservoir beds for oil and gas. Geological mapping is establishing the succession, thickness, lithologic character, distribution, origin, and structure of the various formations that constitute the sedimentary column, and in which the fossil fuels originate and accumulate as deposits of commercial significance. Studies involving the vast quantity of core and cuttings from wells are making possible the subsurface mapping of underground formations. From these data, cross-sections are made showing facies changes, correlation, and environmental conditions of deposition, all of which is necessary in evaluating the potentialities of a given region.

Petrographic studies of the micro features of reef and non-reef formations are being made to provide information on types of porosity and other characteristics required for a better understanding of the probable causes of accumulation of oil and gas. The most productive oil and gas reservoirs are either limestone or sandstone.

Investigation of conditions of deposition of limestone by comparison of ancient deposits with present day accumulation is going forward and petrographic studies of productive sandstones are being made. Detailed studies of various types of producing oil fields are furnishing information on the conditions of porosity, structure, sedimentation etc., under which these accumulations occur and are thus assisting in the exploration for further fields.

The usefulness of plant remains, both macro and micro (spores and pollen grains) in the stratigraphy of rocks of continential origin which normally contain but few animal fossils is being investigated. In this palaeobotany there is immediate need for an expanded program of collecting, cataloguing, classifying and describing the flora of each succeeding age with the ultimate goal of providing a practical scale for dealing with the coal-bearing rocks. Studies on the origin and constitution of coal are underway. These projects involve both micro-palaeobotany and petrography. What is the effect, for example, of the petrographic composition of various coals on the coking characteristics of those coals? Different parts of the same coal seam may have different coking qualities. Has the petrographic composition anything to do with this? Has petrographic composition an effect on the utilization of various coals?

Reference is made to the publication of a report by the Research Committee of the American Association of Petroleum Geologists entitled "Research Needs in Petroleum Geology". (Bull. Am. Assoc. Pet. Geol., vol. 41, no. 8; Aug. 1957, pp. 1854-1876). This paper treats the subject under nine major categories in each of which the present status of knowledge is summarized and is followed by a statement of current needs. This is a major contribution to directing research effort in petroleum geology into most needed channels.

The Alberta Society of Petroleum Geologists with a membership of more than 900, recently established a Research Committee. Dr. R.W. Landes is a member of that committee and through the good offices of the A.S.P.G. he is also on this subcommittee of the National Advisory Committee. The function and purpose of the A.S.P.G. Research Committee are as follows:

1. "To maintain liaison with the National Advisory Committee on Research in the Geological Sciences, the Alberta Research Council, the A.A.P.G. Research Committee, and other research organizations, to ensure co-ordination of research effort.

2. To determine areas of research associated with petroleum geology that should be encouraged, stimulated or supported.

3. To review periodically petroleum geology research activities in universities and other research organizations for the purpose of keeping the industry aware and informed of these activities.

4. To encourage the setting up of study groups to undertake various applied research problems such as preparation of correlation charts, regional cross-sections and regional mapping.

5. To suggest to universities or research organizations, areas of research and research projects of interest to the petroleum industry that might be undertaken by those organizations.

Suggestions for research pertaining to petroleum geology will be welcomed by the Committee. Research problems brought to the attention of the Committee will be reviewed and an effort will be made to arrange for support of worth-while projects".[1]

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[1]Jour. A.S.P.G., vol. 5, no. 11, p. 264, 1957

Although it has been in existence only a few months, the Alberta Society of Petroleum Geologists Research Committee has commenced a survey of information with respect to specific projects that might be carried out in Canada by various research institutions in line with the needs indicated by the general survey of the American Association of Petroleum Geologists.

Implementation of Suggestions

It is noted with satisfaction that some of the specific projects recommended by members of the Subcommittee are being implemented. The following such projects are from among those listed in the annual report for 1955-56[1].

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[1]National Advisory Committee on Research in the Geological Sciences, Sixth Annual Report, 1955-56, p. 45-46.

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1. Preparation of a lexicon of stratigraphic names for Ontario is currently being carried forward by Dr. C.G. Winder of the University of Western Ontario.

2. Study and correlation of the Palaeozoic outliers of the Canadian Shield is under investigation by Dr. B.A. Liberty of the Geological Survey of Canada and an interim account was presented at the joint meeting of the Canadian Institute of Mining and Metallurgy and Geological Association of Canada in Ottawa in 1957.

3. Sub-drift contour maps have been completed by Mr. B.V. Sanford of the Geological Survey of Canada, for much of the inter-lake area of southwestern Ontario where the drift has been penetrated by wells drilled for oil and gas. Additional maps are planned as this type of control becomes adequate.

4. Palaeontology and stratigraphy of the Silurian and Lower Devonian formations along the north side of the Restigouche river between Cascopedia and Matapedia rivers is receiving the attention of the Quebec Department of Mines as part of its program of field mapping in 1957 and 1958.

SUGGESTIONS

Dr. H.W. McGerrigle and F.F. Osborne submit the following suggestions:

A. Eastern Townships.

1. Investigation of the use of chemical analyses and trace elements to separate pre-Taconic and post-Taconic formations.

2. Critical examination of lithofacies changes versus thrust faults as an aid in explaining the stratigraphy of the Appalachians.

3. Fabric studies of St. Lawrence Lowlands sedimentary rocks to determine the source of the material.

B. Grenville Sub-Province.

1. A statistical study of the relative importance of the plagioclase-gneiss group and the quartzite-crystalline limestone group.

Dr. W.A. Bell and Mr. Richard Cote, a post graduate student at Acadia University, suggest field and laboratory study of a group of sediments and volcanics in western Cape Breton Island that underlie strata of the early Mississippian Horton group. The age of these rocks is not definitely known. Similar strata have been included with the Horton although with the suggestion that they may be of Lower Devonian age. Dr. Bell views this as an important problem in the geology of Nova Scotia and one sufficiently limited in scope to bring to completion in a single field season. He indicates the following:

Time:	In field, three months.
Laboratory:	Presumably a part of Ph.D. thesis work probably not requiring special funds.
Grant:	Field expenses, including car for travel and living expenses, for three months.
Personnel:	One man and assistant (?)

This problem is currently under consideration by the Geological Survey of Canada and plans for carrying out the work will be implemented at the first opportunity.

Dr. V.J. Okulitch stresses the need for continuing research on geological problems of the Canadian Cordillera. Although not submitting specific titles, he feels that the projects suggested in the annual report for 1956-57[1] continue to merit serious consideration.

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[1]Op. cit., p. 59.

Dr. F.W. Beales would like to see the following projects given some attention:

A. Sub-surface Stratigraphy

1. Detailed petrographic examination of all available cores in southwestern Ontario and publication of logs. This approach would provide information of value to the following problems.

   (a) Ordovician. Are the several metabentonite partings referred to in the literature valid and correlatable?

   (b) Reservoir porosity studies relating to possible underground storage of natural gas.

B. Palaeontology

1. Integration of James Bay Lowland and Arctic Islands palaeontology with that for the rest of the continent.

In this regard, it is noted that Operation Franklin carried out by the Geological Survey of Canada in 1955 yielded extensive collections of fossils from Arctic Canada and this material is being described, figured, and compared with known faunas elsewhere in North America. Also the type section of Williams Island Formation of the James Bay Lowland area has been systematically described for the first time (Madeleine A. Fritz; R.R.H. Lemon; and A.W. Norris; Proc. Geol. Assoc. Canada, vol. 9, pp. 21-47, Dec. 1957) with a composite stratigraphic section and description of the coral fauna found at the base of the Section.

C. Research leading to the publication of a popular illustrated book describing the fossils of given regions, e.g., natural parks, great lakes area, etc.

Dr. Beales makes a strong plea for more money for research. Worthwhile and pressing projects are so numerous and perhaps obvious that the real problem is finding money to finance them rather than one of searching for suggestions as to what specific projects merit attention if money were available. Given sufficient money there seems little doubt that many if not most of the suggestions made by members of this subcommittee would be implemented.

Dr. D.J. MacNeil, St. Francis Xavier University, Antigonish, N.S. writes in part, as follows:

> "The instructors and students that come annually to the M.I.T. Geological Summer School undertake assignments involving stratigraphy and palaeontology. Among the most significant in my opinion are the studies being made by Dr. N. McL. Sage, head of the Geology Department of New Hampshire University. He has charge of much of the instruction at the M.I.T. Summer School and he is directing his attention particularly to the stratigraphy of the Horton Series. He is also directing a project here in Nova Scotia which we hope will help to solve the many stratigraphic puzzles connected with the early Palaeozoic sedimentary and metamorphic rocks of this area".

General Comments

It seems reasonable to assume that the future will bring increased demand for electrical energy in Canada. In view of the fact that in some regions at least, hydro power sites have already been fully developed, a considerable part of the increased demand can be met only through development of generating plants utilizing coal, natural gas or perhaps nuclear power. Two thermal plants in Alberta are currently using 100,000 to 200,000 tons of coal annually. The Saskatchewan Power Commission is building a second thermal plant at Estevan that will use an estimated 1,000,000 tons of coal a year. In this connection there is a growing realization of the need for more geological information on

the possibility of finding large deposits of coal at depths permitting recovery by strip mining. Both the Geological Survey of Canada and the Alberta Research Council are aware of this problem and the latter organization has a special committee designed to deal with the general subject of energy in that province.

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.
W.H. Mathews	-	University of British Columbia, Vancouver, B.C.
C.P. Gravenor	-	Research Council of Alberta, Edmonton, Alberta.
W.C. Kupsch	-	University of Saskatchewan, Saskatoon, Saskatchewan.
Alexis Dreimanis	-	University of Western Ontario, London, Ontario.
R.E. Deane	-	University of Toronto, Toronto, Ontario.
A.K. Watt	-	Ontario Water Resources Commission, Toronto, Ontario.
Roland De Blois	-	Quebec Dept. of Mines, Quebec, Quebec.
J.A. Elson	-	McGill University, Montreal, Quebec.
R.H. MacNeill	-	Acadia University, Wolfville, Nova Scotia.

In addition to information supplied by the above subcommittee members, a short report was welcomed from P.F. Karrow, Ontario Dept. of Mines.

PLEISTOCENE RESEARCH FELLOWSHIPS

Subcommittee members stress the need for fundamental Pleistocene research in Canada. The subcommittee feels it is highly desirable that Pleistocene geology be included in the list of subjects for which post-doctorate fellowships are awarded in geology, and therefore does respectfully request the parent committee to give this matter due consideration. It is surely appropriate that Canada should lead the field in the study of most aspects of Pleistocene geology. Some of our universities now give considerable attention to Pleistocene, or at least glacial geology at the undergraduate level and a few at graduate level, but in the main, doctoral work is pursued in the United States where courses are well-established and suitable equipment is available. Establishment of a post-doctoral fellowship would bolster the Canadian record of achievement and broaden the scope of our work. If the fellowship were tenable at a university, it could also assist in the purchase of much-needed equipment. There are many problems of a fundamental nature that require research work to provide us with a firmer foundation on which to base our deductions in the fields of pure Pleistocene geology (including geomorphology), glaciology, engineering geology and groundwater geology.

GENERAL INFORMATION

The past year has been a very fruitful one as regards Pleistocene publications, work accomplished and general public attention. Workers in the field of Pleistocene geology proper have been active in most regions in Canada and there has been a truly national interest in Pleistocene history inasmuch as it has a direct bearing on work carried on in other disciplines such as biology, geography, archaeology, meteorology, geophysics and agronomy and others. Whether or not the requisite Pleistocene data are available, the work in these allied fields adds to the general interest in Pleistocene events and to our knowledge of them.

There has been increased work and interest in the migrations of plants and animals, including humans, which are directly related to Pleistocene events and in particular to the general recession of the Wisconsin ice-sheet. Studies of existing glaciers have been made by geologists, geographers and geophysicists with resulting important information on their behaviour. Terrain studies in northern Canada for defence research and northern development purposes have been made by geographers, and data on glacial features and events thereby obtained. Engineering projects in some places and ground-water requirements in many areas have necessitated detailed studies of surficial deposits. Hence, through both direct and allied work, the Pleistocene geology of Canada has been receiving more than passing attention.

On a country-wide basis two recent publications are worthy of special note: first, a third edition of Geology and Economic Minerals of Canada[1] which contains a chapter and maps pertaining to the Pleistocene geology of the country; and secondly the recent release of a Glacial Map of Canada[2]. These two publications will serve to stimulate widespread interest in Pleistocene geology both within and beyond our borders.

[1] Geology and Economic Minerals of Canada, Geol. Surv., Canada, Third Edition, Econ. Geol. Series no. 1, 1957.

[2] Glacial Map of Canada, Published by Geological Association of Canada, copies may be obtained from the Secretary, Geol. Assoc. Canada, P.O. Box 4029, Terminal A, Toronto, at $2.00 a copy.

The account of Pleistocene geology in Geology and Economic Minerals of Canada stresses the widespread occurrences of non-glacial deposits throughout Canada, and briefly outlines significant glacial features and events, points out some of the major chronological problems, and advances much new data. The Glacial Map of Canada which is an excellent multi-coloured lithographic map on scale 1 inch to 60 miles, gives a fine portrayal of ice-flow features and of eskers in northern Canada and of ice movements as indicated by striae in most parts of the country. The portrayal of the Cordilleran and Arctic present-day glaciers is the most detailed yet published for the entire country and fills a long-felt need. The Keewatin, Labrador and Cordilleran recessional ice-divide areas are indicated for the first time on one map. Contours showing the upper limit of known ice action in the Cordillera is also an innovation, and this, together with the recent concept of recessional ice-divides, is serving to stimulate discussion on glaciation in general.

The subject of Pleistocene chronology, which is the direct concern of Pleistocene geologists, but is also vital to the work of allied disciplines, has progressed well over the past year. Pleistocene palynological investigations are serving to point out the similarities or differences between widely separated non-glacial deposits on which detailed stratigraphic studies have been made, and elsewhere to give an indication of the changing climates as the Wisconsin glaciers receded and vegetation became established. These investigations, coupled with a few radiocarbon datings, are gradually putting the chronology on a sound footing. There has been a great need for radiocarbon analyses of Canadian samples. Lack of facilities in Canada has curbed much progress in the field of Pleistocene chronology. The research laboratory at Manitoba was inoperative in 1957 and that at Dalhousie was unmanned during most of the year. The unit in the chemistry department, University of Saskatchewan, converted to the acetylene method of analyses in 1956. It functioned satisfactorily and dated several western Canadian archaeological and some geological samples. Work on a radiocarbon laboratory in Ottawa finally got underway in 1957 in the Mines Branch, Department of Mines and Technical Surveys. The laboratory will probably be brought into operation in 1958 and function in the Mines Branch until the new Geological Survey of Canada building is completed. Great progress in Pleistocene chronology will result from the establishment of this much needed laboratory.

RECENT AND CONTINUING WORK

Very little information is available on Canadian work in the broad field of engineering geology. Work in some phases of this subject has been carried on by personnel of the Division of Building Research, N.R.C., and by geologists and others in some parts of the country. The projects listed (p. 88), record some of the work currently in progress.

Brief summaries of the Pleistocene and ground-water work in progress in various parts of the country follow.

British Columbia

Pleistocene mapping was carried out on the east-coastal lowland of Vancouver Island by the Geological Survey of Canada and in the Kettle River, Taseko River and Bear Pass areas by the British Columbia Department of Mines. Work has been directed largely to providing information relative to engineering, ground-water or soil studies. A ground-water program in the Lower Fraser valley was completed by the Geological Survey of Canada, and a comprehensive study was made of the character, origin, and economic importance of beach sands on Graham Island by the British Columbia Department of Mines. Glaciological studies were continued on Salmon Glacier, and sedimentation and allied phenomena were studied in the Tide Lake basin in the same general region. A radiocarbon dating of carbon from an aechaeological site in raised bar sands overlain by alluvial fan deposits, in the Fraser River Canyon, indicated about fifty feet of down-cutting over the past 8, 000 years.

In 1958 the Geological Survey of Canada expects to complete a reconnaissance of the northern and eastern shores of the Georgia Straits in an attempt to resolve the Pleistocene stratigraphical and chronological problems arising from recent work on Vancouver Island, in the Fraser Lowland and in the State of Washington.

Alberta

The Alberta Research Council carried out ground-water surveys in five areas involving surficial materials, and in the Milk River artesian basin involving the sandstone of that name. A program of establishing observation wells was begun, and seismic and resistivity work was carried out in selected areas to provide factual data relative to known ground-water conditions. Studies were made on artificial recharge of aquifers in one area, and the study of the chemistry of ground water in Alberta is continuing. Regulations have been made in regard to the use of ground water for injection into oil reservoirs. Research continues on the analysis of stagnant ice features including till fabric studies and studies on the weathering of till. Field mapping near Edmonton and in east central Alberta continues.

In 1958 ground-water surveys by the Alberta Research Council will be started in four or five additional areas, and will be continued in the Milk River artesian basin. Pleistocene mapping will be pursued in the Edmonton, Vermillion-Vegreville, Calgary and Medicine Hat districts. The last two are in connection with ground-water studies and irrigation problems respectively. In the laboratory, studies will be made of the role of electrical potentials in promoting the migration of ions and colloids in the soil profile, and on micro and macro methods of fabric determinations on the deposits of both dead and live ice glacial features. No field studies are being made by the Geological Survey of Canada but a report on the work of previous years is being prepared for early publication.

Saskatchewan

In Saskatchewan the Research Council is sponsoring the study of surficial deposits, in part in connection with the study of ground-water resources. Mapping of surficial deposits in the Swift Current area was completed. Willow wood from a post-glacial gyttja near Herbert was dated at the University of Saskatchewan at 10,050 ± 300 years. An interesting paper from the standpoint of both Pleistocene history and ground-water supplies appeared in 1957 entitled "The Pre-glacial Missouri River in Saskatchewan".[1]

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[1]Mineley, W.A., Christiansen, E., and Kupsch, W.O., Jour. Geol. vol. 65, no. 4, 1957.

In 1958 mapping by a research Council party will be started in Canora area in east-central Saskatchewan, and by the Geological Survey of Canada in the Elbow-Outlook area along the South Saskatchewan River. The Geological Survey will also field a ground-water party in the Souris River valley. Much remains to be done in southern Saskatchewan on the mapping of surficial deposits and the investigation of ground-water resources. A study of the aeolian deposits of the region is also warranted. In Saskatchewan all routine investigations of ground-water resources and administration of regulations are carried out by the Saskatchewan Department of Agriculture.

Manitoba

No parties were engaged exclusively in the mapping of Pleistocene deposits in Manitoba in 1957, but in the Seal River area in the northern part of the province a Geological Survey of Canada party mapping

the bedrock geology also studied the surficial deposits, and a paper on the surficial geology of the area is being prepared. Also, stemming from Pleistocene studies made for the Geological Survey between 1946 and 1955, in southwestern Manitoba and adjoining Saskatchewan, J.A. Elson has prepared several papers concerning the Pleistocene history of the area, its glacial lakes, washboard moraines, and striated boulder pavements. The influence of glacial Lake Agassiz on the migration of plants into western Canada has recently been revealed by botanical investigation at the University of Montreal.

No Pleistocene or ground-water surveys are scheduled for 1958.

Ontario

A Great Lakes Geophysical Research Program has been organized on a trial basis and work on many aspects of the limnology and geology of the waters and basin of Lake Ontario will begin in the summer of 1958. A Lake vessel has been loaned by the Royal Canadian Navy and comprehensive studies of the lake waters, lake bottom profile and bottom sediments will be made. It is expected that information on sedimentation phenomena and glacial history of direct interest to Pleistocene geologists will be gleaned, along with information of interest to meteorologists, hydrographers, etc. The program is largely the outcome of efforts by the Fisheries Branch, Ontario Department of Lands and Forests, and the Department of Geological Sciences, University of Toronto. In conjunction with the studies of the lake itself, geological investigations are being made on the land; core samples are being studied from numerous harbours and other work programs, and precise levelling of Lake Iroquois shore-lines is planned. The surficial geology of the Hamilton-Galt area and of the Trenton area are being undertaken by field parties of the Ontario Department of Mines and the Geological Survey of Canada respectively. It is hoped that the Great Lakes Research Geological Program will be carried on over a number of years, as it likely will be, if sufficient funds are available to operate and man the vessel for the lake studies. The need for Canadian geological and other studies of the Great Lakes and their basins is indeed very great.

The Geological Survey of Canada has been active in many phases of Pleistocene geological work in Ontario. Mapping of the surficial deposits was completed in the eastern half of the Kirkland Lake sheet with special attention being given to varve chronology. Surficial deposits were also being mapped in the Chalk River and Ottawa areas where the Champlain Sea deposits and the sequence of events are but little understood. A map of the Ottawa area showing the thickness of the overburden and bedrock-surface contours is being prepared. Palynological studies have been made over wide regions of southern Ontario to provide information on the sequence of deglacial events. Several papers on this subject are in press or in preparation for publication by the Geological Survey of Canada. Surficial mapping and palynological work will be continued in the western end of the St. Lawrence Lowlands in 1958.

The Ontario Department of Mines sponsored studies of the surficial deposits north of Lake Ontario in connection with sand and gravel resources, and reconnaissance mapping in the Newmarket and Markham areas. Several faunal localities were found in Lake Iroquois deposits, the study of which will provide better information on the depositional environment. The Ontario Research Foundation sponsored

mineralogical work on soil profiles in southern Ontario and continued clay-mineralogy investigations of Champlain Sea and glacial lake clays. The Ontario Water Resources Commission was active in ground-water work: 5,037 records of wells were filed and 582 well-driller's licenses were issued. Water level measurements are kept on 35 wells, 11 of which are taken by automatic recorders. These are providing vital data on ground-water conditions in key areas. In the nine months of its existence the ground-water branch of the Commission was called on to make forty-three appraisals of ground-water, and hence geological conditions, in the vicinity of municipalities desiring to install, or add to, water-work systems, and in connection with pollution problems. Ground-water data for the years 1953-54 are being prepared for publication in 1958. Information for the previous two years was published as a bulletin[1] in 1957,

[1]Ontario Dept. of Mines, Bull. 152, 1957.

also a report on the Pleistocene Geology and Ground-Water Resources of the township of North York, York County[2].

[2]Watt, A.K., Ont. Dept. Mines, Annual Rept. vol. 44, 1955, pt. 7.

In 1958 the Ground-Water Branch of the Commission will give increased attention to observation wells, and will no doubt be called upon to increase its work for municipalities experiencing ground-water problems. Detailed ground-water surveys may be made on a county basis.

International Water Supply did much research in the London area, on the applicability of electric logging and electrical resistivity determinations in locating ground-water supplies.

At the University of Western Ontario work continued on the Pleistocene stratigraphy of southwestern Ontario, and has been extended eastward to include part of the St. Lawrence Lowlands. Canadian Pleistocene studies, like American work to the south of the lakes, is indicating a significant glaciation and corresponding non-glacial interval between the Sangamon interglacial and the classical Wisconsin. The current trend is to regard this new glacial stage as an early stage of the major Wisconsin glaciation. There will long remain a need for detailed stratigraphical studies in the Great Lakes region. Prof. Dreimanis has both authored and co-authored several papers over the past year dealing with Pleistocene stratigraphy, depth of leaching, carbonate content of tills, ground-water etc., and several additional papers are either in press or being prepared for publication. In 1958 Prof. Dreimanis will continue his work on the Pleistocene stratigraphy of southern Ontario paying particular attention to the carbonate content of tills and to the factors governing the depth of leaching in various glacial deposits. His work on indicator trains will be continued and he hopes to complete work on a mastodon site at Wallaceburg and on glacial thrust features along Lake Erie.

At the University of Toronto work has continued on the Annotated Bibliography and Index of Pleistocene Geology of Canada. The study of heavy minerals as a means of differentiating a series of till sheets in southern Ontario will be the subject of a M.A. thesis. Also soil profile studies and the Great Lakes Geophysical Research Program, earlier mentioned have been in progress.

Quebec

A reconnaissance of the surficial geology of an area of 35,000 square miles in southwestern New Quebec was accomplished by attaching a Pleistocene geologist to the Geological Survey of Canada's helicopter operation 'Fort George'. An outcome of this study will be a paper on minor moraines that have long been regarded as raised beaches, and also new information on isostatic adjustments and the directions of ice movement in late Wisconsin time. A glacial map of the Province of Quebec, embodying the glacial observations made on the ground to date and also air photo interpretations, was recently published[1]. The Hydrology Division of the Quebec Department

[1]Sabourin, R. J.E., Glacial Map of Quebec, Universite Laval, Faculte des Sciences, Contribution no. 128, 1957.

of Mines had a very active year. Three geological engineers with special hydrological training deal with ground-water investigations and research. Usually the surficial deposits of the area under study are mapped and water-bearing horizons are located followed by tests to assess their potential capacity. In 1957 forty-one surveys of this type were made.

A comprehensive report on the glacial geology of the central Quebec-Labrador region is being prepared for publication as a Geological Survey bulletin. This paper is of special interest in that it includes discussion of the recession and disappearance of part of the Labrador ice-sheet at the southern or bottom part of the "U"-shaped ice-divide area.

Maritime Provinces

A Geological Survey of Canada report on the surficial geology of the Fredericton area was published last year[2] but no field

[2]Lee Hulbert, A., Geol. Surv. Canada, Paper 56-2, 1957

work was undertaken in New Brunswick. Work along the Saint John River valley will be resumed in 1958. In Nova Scotia the Nova Scotia Research Council continued its Pleistocene studies which included a preliminary study of Hants County and detailed studies of parts of the Annapolis Valley. Preliminary maps of a large section of south-western Nova Scotia have been completed and similar work will continue in 1958. Studies of the surficial geology of the eastern end of Prince Edward Island continued and the westerly movement of a glacier over this end of the island was confirmed. A late Wisconsin ice cap centered on the Cape Breton Highlands is believed to have been the source of this glacier. Studies of the surficial deposits in the north-eastern part of Prince Edward Island will be continued. The Geological Survey of Canada continued its investigation of surficial deposits in the Conception Bay map area of Newfoundland. Special attention was given to the occurrence and character of gravel deposits which are in short supply. In Labrador the study of the Pleistocene geology of the ice-divide region, already mentioned, is of great interest.

Yukon Territory

No specific areas were mapped in 1957, but in connection with the recently completed Geological Survey mapping of the bedrock north of Mayo, information was obtained on ice-marginal drainage channels and the upper limit of the last glacial advance. It has been shown that earlier glaciations were more extensive than the Wisconsin.

Northwest Territories

The largest Pleistocene mapping project in the Territories in 1957 was the reconnaissance of some 100,000 square miles of the Upper Mackenzie River Basin by a Pleistocene geologist attached to the Geological Survey of Canada's helicopter 'Operation Mackenzie'. The directions of ice movement were determined on both the plains and in the mountains, and data were gathered on the distribution of Laurentide and the Cordilleran drift. The Horn Mountains were found to have deflected the Laurentide glaciers to the north-northwest and to the southwest.

A study of the Pleistocene geology and physiography of the north-western part of Baffin Island and adjacent Melville Peninsula, based on ground observation and air photo interpretation was made in the course of mapping the bedrock of the region by the Geological Survey of Canada. On Ellesmere Island, the Defence Research Board sponsored studies of sedimentation in Lake Hazen. This work will continue during the summer of 1958. In 1957 a Geological Survey of Canada party on Meighan Island gave some attention to the surface deposits and Pleistocene history of the Island. A paper on the glacial features and late Pleistocene events of King William Island and adjacent parts of Adelaide Peninsula has been prepared by a member[1] of the Geographical Branch, Dept. of Mines and

[1]Fraser, J.K., Geographical Paper Series (in press)

Technical Surveys.

No strictly Pleistocene field studies are scheduled for the Northwest Territories in 1958 but work incidental to bedrock geological surveys and work by geographers should add further to our understanding of the northland and its glacial history.

ENGINEERING GEOLOGY

The geological fraternity in Canada should pay more attention to engineering geology as regards both practical and research work, rather than leave it to the engineering fraternity as is now the case. With this in mind the work of the Engineering Geology Division of the Committee on Teaching Aids (in the United States), appears relevant[2] This Committee has clearly

[2]Kiersch, G.A., Teaching Aids and Allied Materials in Engineering Geology, Geol. Soc. America, Pamphlet 36, p. 1957.

indicated that the field of engineering geology is a separate and specialized branch of applied geology. Specifically, it is the application of geology to

civil engineering and specialized branches thereof. The professional engineering geologist then is a "trained geologist with a general knowledge of engineering practice and possessing a practical bent".

Far too little attention is given to engineering geology in Canada. Though some universities list courses in engineering geology, they may be nothing more than introductory courses in geology (with some engineering applications) given to engineering students. The above Committee on Teaching Aids has recommended that such courses be termed geology for engineers, and that the term engineering geology be restricted to courses designed to acquaint the trained geologist with the professional practice of engineering geology.

Though the student who has graduated as a geological engineer, as distinct from a mechanical, mining, civil or other engineer, from a Canadian university, may be in a preferred position to apply and expand his knowledge by taking further courses in geology, other students of geology may likewise enter the engineering field by taking necessary basic engineering courses, followed by special courses in engineering geology. It is training in this latter field that is especially warranted in Canada. Post-graduate work is needed in either case.

It is recommended, therefore, that geologists, with a practical bent for engineering, be offered adequate course work in soil mechanics, strength of materials, etc., so that they may become conversant with engineering principles as applied to their work. Many engineering problems in soil mechanics are directly related to the geology of the deposits concerned; their solution depends on a basic knowledge of Pleistocene and glacial geology. There are many opportunities as regards both monetary and scientific [illegible] for those specializing in the engineering geology of the soils of Canada. It is hoped that future reports of the Pleistocene subcommittee will be broadened by the inclusion of research work in this specialized field.

SCOPE OF PLEISTOCENE SUBCOMMITTEE

Further to last year's decision to delegate the field of glaciology to the subcommittee on 'Physical Methods Applied to Geological Problems', and of geomorphology to the subcommittee on 'Structural Geology' (except insofar as these fields dealt specifically with Pleistocene matters), it is now felt that the linkage of these subjects with the field of Pleistocene geology is the more natural one. The Pleistocene subcommittee is more directly concerned than other subcommittees, and hence, these fields should be retained, per se, by the subcommittee.

In the case of glaciology, those studies involving physical methods (seismic etc.,) will automatically be dealt with by the subcommittee of that name. The study of glaciers, however, involves not only glacial geology itself, but also the fields of meteorology, climatology and snow and ice mechanics, and the Pleistocene geologist is more concerned with these fields than are other geologists. However, only those studies that are of direct concern to geologists will be dealt with by the Pleistocene subcommittee.

In the case of geomorphology, the Pleistocene geologist is again directly concerned because most geomorphological studies carried out in Canada pertain to the Pleistocene Epoch. The problem then is to inter-relate geomorphological studies with the broader fields of geology and geography. This has long been a rather controversial problem involving the full scope of these 'parent' fields. In North America, geomorphology (the use of physiographic forms in the study of geological events not otherwise recorded in the rocks) is regarded as an integral part of geology; it is an essential geological tool. As pointed out by Sheldon Judson (Transactions, New York Academy Science, February, 1958), it is one of the systematic elements of geology along with petrology, palaeontology, structural geology and geophysics. He believes that along with these systematic elements of geology, geography and history (the spatial and time factors) are essential parts of the 'mother science' of geology. It is in fact the time element "that gives perspective to the systematic and geographic aspects of geology. And it is time that distinguishes geology from most geographic investigations--and indeed most other sciences. Primarily, the description of land forms and the study of their distribution have fallen largely to the geomorphologist, and he is also interested in the processes that create land forms. The consideration of 'time' is always present, indicative of the geological nature of the subject. It is significant that most geomorphological studies pertain to the Pleistocene Epoch. Hence, as Horberg (1952) points out, the glacial geologist, the Pleistocene geologist, and the geomorphologist are virtually indistinguishable one from another".

From the foregoing it is obvious that the work of physical geographers and Pleistocene geologists overlaps. Nevertheless, it is noteworthy that the secretary of the National Advisory Committee does not include any current research projects by physical geographers anywhere in Canada in the compilation of current geological research (p. 77). Our Pleistocene subcommittee reports suffer for want of this data. Action should be taken to ensure its inclusion in the coming years' Pleistocene reports, through direct contacts with geographical institutions. It seems pertinent that we should recognize the work of physical geographers and benefit from their point of view.

SUGGESTED PROBLEMS

The numerous problems outlined in last year's Pleistocene report[1] are equally applicable at the present time. As pointed out by

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[1]National Advisory Committee on Research in the Geological Sciences, Seventh Annual Report, 1956-57, p. 71-72.

Gravenor, Mathews and Stalker, studies of the Cordilleran-Laurentide contact relations are in special need of attention. Gravenor, Kupsch and Mathews stress the need for study of aeolian deposits as regards age, wind direction, and distribution. Deane, Hughes and Mathews advocate research in the broad field of sedimentation in glacial and other lakes. The manner of the distribution of the sediment load over vast areas, and the control of temperature, density of sediment load, and pH of the waters are important considerations in such studies.

Mathews reports that H.W. Nasmith recommends a combined attack on the Pleistocene history of the Queen Charlotte Islands by geologists, botanists and zoologists in an effort to correlate the evidence

of glacial limits and of relict floras and faunas. Elson recommends a co-ordinated attack on the stratigraphy and palynology of western northern Ontario. Red clays of the Superior basin interfinger with grey Lake Agassiz clays in some areas and thus provide a starting point in this study.

De Blois and Watt have stressed the need for fundamental research on certain aspects of ground-water hydrology such as the porosity and permeability of different kinds of drift, and the rate of recharge of aquifers.

Karrow advocates an investigation of the application of aqualung operations to the study of both surficial and bedrock geology, using Lake Erie as a starting point. He further stresses the need for core sampling of Lake Ontario bottom sediments to solve critical problems relative to sea level and the lake basin in late Wisconsin time. Stratigraphic studies in Scarborough Township and along the Saugeen River are mentioned as suitable thesis problems.

APPENDIX I

GEOLOGICAL SURVEY OF CANADA RESEARCH GRANTS SUMMARY REPORTS ON PROJECTS

The Annual Reports for the past four years have contained 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 in the past year.

Project 1-51- Geological Age Determinations

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

A new argon extraction line of improved design has been set up and new methods developed for improved determinations of the age of biotites and feldspars. The apparatus is operating satisfactorily and arrangements have been made to collect specimens and emphasize geological applications.

In 1957, considerable progress was made in setting up equipment to make rubidium-strontium age determinations. It is hoped to resume this work in conjunction with the potassium-argon work.

Both mass spectrometers have been considerably modified and are now operating satisfactorily. One will carry out argon analyses and also more isotopic analyses of lead from large specimens such as lead ores. Microgram quantities of lead from minerals such as feldspar are now being extracted successfully and analysed with the other mass spectrometer. A mass spectrogram analysis of 10 micrograms of lead can now be accurately executed. The means are thus available to study the relations between lead ores and the lead in the surrounding rocks, and this study is being pursued vigorously on account of its interest and potential importance in theories of ore deposition.

Papers published in 1957 include:

Anomalous Leads from the Upper Great Lakes Region of Ontario; Farquhar, R.M. and Russell, R.D.; Trans. Am. Geophys. Union, Vol. 38, No. 4, August 1957.

Isotopic Constitutions and Origins of Lead Ores; Russell, R.D. and Farquhar, R.M.; Mining Engineering, May 1957, A.I.M.E. Transactions, Vol. 208, 556-559 (1957)

Dating the Proterozoic of Canada; Farquhar R.M. and Russell R.D.; Roy. Soc. Canada, Special Publication No. 2, 28-32, Univ. of Toronto Press, (1957)

Isotopic Analyses of Leads from Broken Hill, Australia; Russell, R.D., Farquhar, R.M., and Hawley, J.E.; Trans. Am. Geophys. Union. Vol. 38, No. 4 (August, 1957)

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

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

By January, 1956, a polythene twin calorimeter had been developed having an accuracy as good as that published for the best modern silicate calorimeters. Since then a large number of tests, design changes, and modifications have been made (1) to simplify the construction, maintenance and use of the apparatus and (2) to improve the accuracy of the apparatus. It is essential to achieve these objectives before an extensive program of mineral solution runs is initiated. A fragile and difficult to repair apparatus is wasteful of time and the small magnitude of the natural enthalpy changes to be distinguished requires an apparatus at least 10 times as accurate as the best modern apparatus.

The first objective has been achieved, while retaining the original accuracy. The present model permits calibration and mineral solution runs in about 5 per cent of the time required for runs with the 1956 apparatus. The second objective has not yet been achieved in that an apparatus with a markedly better accuracy than that of the 1956 calorimeter is not yet in operation. However the 1956 model utilized practically 100 per cent of the potential accuracy inherent in its design, while the best current model is considered to utilize considerably less than 10 per cent of its potential accuracy. An improved model is expected to be ready for testing by the summer of 1958.

Project 1-54- Silicate and Sulphide Phase Relationships

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

During the period April 1957 to April 1958 five separate investigations forming parts of the main project were in progress. These investigations were as follows, -

(1) Behaviour of Compressed Silicate and Sulphide Powders at High Temperature. This project has been completed and the results are embodied in Ph.D. thesis by J.F. McDougall, McGill University, October 1957.

(2) Hydrothermal Transportation of Sulphides. This work is designed to test the hydrothermal theory of ore deposition with respect to the sulphide minerals. The rate of transport of ore forming materials from a source to a point of deposition, the effect of heat, pressure, and different solutions on the concentration of the key materials in the transporting media, and the effect of different host materials and temperatures on the processes of deposition or replacement will be investigated experimentally.

(3) Solid Diffusion Experiments. The main purpose is to explore the potential of solid diffusion as an ore forming process.

(4) Melting of Geologic Materials. The objective is to study experimentally the melting of rocks under high pressure with particular reference to the behaviour of different mineral phases.

(5) Volatility of Certain Sulphides in Sulphur Vapour. Hsiao and Schlecten in 1952 classified the sulphides of copper, iron, nickel, cobalt, manganese, and molybdenum as "non-volatile," but recent work at McGill University suggests that sulphur vapour promotes the volatility and hence the transport of copper and iron sulphides. The present work involves a study of the volatility and transport of the "non-volatile" sulphides to resolve the conflicting evidence.

Project 2-54- Geochemical Studies

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

Within the last year the following projects have been completed:

(1) Correlation of Optics and Composition in the Scapolite Family. About 40 scapolites were analysed for Na, Ca, Ba, and Sr and their optics measured. The results are recorded in a thesis by R.H. Filby entitled Spectrographic Methods for the Determination of Na, Ca, Ba and Sr in Minerals, and their Application to some Scapolites, (M.Sc. thesis, McMaster University). Publication will follow some additional work.

(2) Lithium Distribution in the Preissac-Lacorne Region of Quebec. Numerous spectrographic analyses of rocks and minerals from this region were made. The results are fruitful in their bearing on the source of the spodumene deposits. They are recorded in a thesis by H.A. Siroonian entitled 'A Geochemical Study of Lithium Distribution in Batholithic Rocks of the Preissac-Lacorne Region', (M.Sc. thesis, McMaster University).

Continuing projects include geochemical study of trace elements in sillimanite, scapolites, pyroxenes and calcites, and study of minor elements in the White Mountain Magma Series of New Hampshire.

New projects include development of a method of spectrographic analysis in which the sample is burned in an argon-oxygen atmosphere, a statistical-analytical investigation of the problem of sampling coarse grained porphyritic rocks for analysis, and study of the geochemistry of greywackes.

The following papers arising directly or indirectly from this research project have been published in the last year:

Comments on the Geochemical Implications of Lead-isotope Dating of Galena Deposits; D.M. Shaw; Econ. Geology, vol. 52, 1957, p. 570-573.

Some Aspects of the Determination of Barium in Silicate Rocks; D.M. Shaw; Spectrochim. Acta, Vol. 10, 1957 p. 125-127.

The Geochemistry of Gallium, Indium, and Thallium - A Review; D.M. Shaw; Physics and Chemistry of the Earth, Vol. 2, Ch. 6, 164-211, Pergamon Press, 1957.

Project 33-54 - Mineralogy of the Sudbury Ores

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

The bulk of the laboratory investigations has been completed. Data have also been secured on the distribution of Cu, Ni, Fe in four deposits and is being analysed statistically. These suggest a fairly constant nickel or pentlandite content in single deposits, with chalcopyrite varying inversely with the pyrrhotite. Further study of heat effects on these minerals will continue in 1958-59.

A method was worked out using X-ray fluorescence for determination of selenium in the various sulphides present. Amounts found correspond in a general way with amounts recovered at Sudbury. Check analyses are being made by the United States Geological Survey (Chemistry Division).

Trace element studies have been carried out on concentrates of pyrite, pyrrhotite, pentlandite and chalcopyrite and show quantitative data on the partition of various elements in the different minerals.

In general the work supports the thesis that the ores have been deposited largely from a fluid closely akin to a sulphide melt, and to a lesser extent by fluids that had more of a hydrothermal character. The former is strongly supported by the fairly constant pentlandite composition of individual orebodies. Differences between orebodies on the north and south ranges may be explained by a limited amount of fractional crystallization of such fluids.

A related study entitled 'Trace Element Study of Contemporaneous Sulphides Pyrite, Pyrrhotite and Chalcopyrite' is the subject of an M.A. thesis by Mr. Ian Nichol (See abstract Can. Min. Journal, July 1958, p. 95). This compares both qualitatively and quantitatively the distribution of trace elements such as Co, Ni, Cr, U, Te, Ag, Sn and, in some, of Pb, Zn, and Se, in deposits ranging from the Sudbury nickeliferous sulphides, non nickeliferous copper sulphides of the hydrothermal type at Noranda, Quemont, Normetal, Chibougamau, Geco and Flin Flon, and gold deposits of the Porcupine. The general similarity is rather striking although some differences do appear regionally and in different deposits. This suggests a common deep-seated origin. Further work of this type is planned.

Related both to this and the Sudbury study is one on the distribution of trace elements in common sulphides near diabase dykes which, at Sudbury are considered as post-ore, but at Noranda have either a pre-ore or post-ore age. Elements such as Co and Ni are found to remain constant as the dyke-ore contact is approached in both cases, but changes are apparent, though of a minor nature, in Ag and Se and possibly Te. Thus both ore-dyke relations appear the same.

Results of these studies will be published in one or two papers.

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

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

Research on the geochemistry and origin of granites,

granitic gneisses, and other metamorphic rocks (amphibolites, scapolite and nepheline syenite) continues and includes the following investigations:

(1) The Westport Pluton and Granitic Rocks of the Adjacent Area. Further detailed mapping was completed in 1957 and 1958 for the Geological Survey of Canada and 18 new analyses of granite, monzonite, composite gneiss, paragneiss and pyroxene gneiss are near completion, along with 5 analyses of single minerals such as garnet, pyroxene and hornblende.

Some of the results of the work are included in a paper by H.R. Wynne-Edwards entitled 'Structure of the Westport Concordant Pluton in the Grenville, Ontario' in Journal of Geology, November, 1957.

(2) Geology of Centre Lake Uranium Deposits, Ontario. This Ph.D. thesis to be submitted by A.M. Evans includes 18 rock analyses.

(3) Other Granite and Gneiss Analyses, Grenville, Ont. In this master's thesis to be submitted by James A. Grant the analyses of some 75 rocks are studied and correlated with detailed petrography.

(4) Granitic Rocks of the Sudbury Area, Ont. This master's thesis by R.M. Ginn (for abstract of thesis see Can. Mining Journal, July, 1958, p. 96) compares the petrography, major constituents, and trace elements of the Murray, Creighton and Birch Lake granites. Decided differences are found in the three masses and some interesting conclusions are drawn including the correlation of part of the Murray granite with the granitic dykes that intrude the norite.

(5) Granitic Rocks of the Basement, Huronian Conglomerate Pebbles, and Killarney Granite of the District of Algoma, Ont. Forty-seven rock analyses will allow comparisons to be made between Pre-Huronian granites, Huronian pebbles, Killarney granites and granites of the Grenville province. This work will be incorporated in theses by J.A. Robertson and P.J. Pienaar which should be completed in 1958.

(6) Wolfe Lake Nepheline Belt, Bancroft, Ont. Analytical work on syenitic rocks of this area carrying nepheline and scapolite have been completed and will be used by E.C. Appleyard in a Master's thesis in 1958.

(7) Granitic Gneisses Around Clare River Syncline, Ont. More than 50 rock and mineral analyses have been made in the study of granitization by L.R. Pearson (For abstract of Ph.D. thesis see Can. Mining Journal, July 17, 1958, p. 95).

(8) Onwatin Slate Formation, Sudbury, Ont. This study which includes analyses of the underlying tuffs, the slate and the garnets, is incorporated in an M.Sc. thesis by J.F. Sadler (For abstract, see Can. Mining Journal, July 1958, p. 95).

Among other projects underway is a trace element study of concentrates from uranium rich horizons and associated rocks of the lower Mississagi formation, Algoma, including determination of some 13 elements among which are yttrium, ytterbium, zirconium, thorium and uranium.

Analyses have been made of 80 samples of chromite from orebodies in New Caledonia and experimental work has been carried out with various fusion techniques to prepare homogeneous samples for both X-ray and spectrographic analysis. X-ray analyses for Cr, total Fe, and Ni have been made. Spectrographic analyses have been completed for Mn, Ti, V, and Co and working curves established for Zr, Sn, and Sb. A magnetite base of high purity has been used to establish standard working curves. The results of this study will be used by R.D. Stevens and R.L. Stanton in comparing these with other chromites and establishing any trends.

Project 5-55- X-ray Spectrographic Analyses of Minerals and Rocks

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

The X-ray spectrograph has been used for the analysis of a wide range of minerals and rocks. When materials are of uniform composition, and if reliable standards are available, techniques are simple and straightforward. However, in most cases methods must be found to overcome the effects of variable matrix, and standards must be prepared from artificial materials of known purity or by addition to analysed natural materials. Fusion methods, the addition of an internal standard, and dilution of samples to produce a uniform matrix have all been used to control analyses. The use of background radiation and tube target radiation for reference has been investigated and used successfully in some cases.

Projects carried out during 1957-58, many of which form part of Projects 3-54 and 4-54 (p. 67), include:

(1) Analysis of 140 samples of sulphide minerals from Sudbury for selenium.

(2) Determination of Cr, Fe, and Ni in 82 samples of chromite.

(3) Determination of Sr and Rb in 16 samples and of iron in 20 samples from Blind River, Ont.

(4) Determination of Fe, K, Mn Al, Si, Ca in samples of rocks of several graduate students' researches.

(5) Determination of U and Th in a large number of samples from Blind River and Raglan Twp. Ontario.

Papers will be prepared for publication that will include some of these analytical results and describe some of the methods of analysis.

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

Under direction of Professors G.H. Reavely and A. Dreimanis, University of Western Ontario.

In 1957-58 work was concentrated on laboratory studies and evaluation of results, including results of previous years. The following papers, arising from this project were published in 1957-58:

Heavy Mineral Studies in the Tills of Ontario and Adjacent Areas; A. Dreimanis, G.H. Reavely, R.J.B. Cook, K.S. Knox and F.J. Moretti; Jour. Sediment. Petrol., Vol. 27, No. 2, p. 148-161, 1957.

Stratigraphy of the Wisconsin Glacial Stage Along the Northwestern Shore of Lake Erie; A. Dreimanis; Science, Vol. 126, No. 3265, p. 166-168, 1957.

Wisconsin Stratigraphy at Port Talbot on the North Shore of Lake Erie, Ont.; A. Dreimanis; Chio Jour. Science, Vol. 58, No. 2, 1958.

Beginning of the Nipissing Phase of Lake Huron; A. Dreimanis; Jour. Geol. Vol. 66, (in press), 1958.

Project 1-57- Problems in Nuclear Geochronology

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

The potassium-argon extraction line at the University of Alberta is now operational and results have been obtained for more than 20 samples. A spectrometer at the University of Minnesota has been used for the initial mass analyses but assembly of a spectrometer in the Department of Physics, University of Alberta is nearing completion. Five hundred Argon38 spikes have been prepared by Dr. Baadsgaard, research associate on the project during 1957-58.

At the present time work at the University of Alberta is concentrated on three critical problems: the accuracy of Holmes' time scale; the biotite potassium-argon ages of Cordilleran intrusions; and the biotite ages of the Precambrian basement of Western Canada.

Considerable progress was made in the past year resulting in the publication of one paper and the presentation of three others:

Crowsnest Volcanics and Cretaceous Geochronology: Folinsbee, R.E., Ritchie, W.D., and Stansbury, G.F.; Alberta Soc. Pet. Geol., Guide Book, 7th Field Conference, 1957, p. 20-26.

Late Cretaceous Geochronology; Folinsbee, R.E. and Ritchie, W.D.; Union Geod. Geophys. Internat., Toronto, 1957, p. 19 (Abstract)

Potassium Argon Age Dating of Sediments; Folinsbee, R.E., Baadsgaard, H., and Lipson, J.I.; Am. Assoc. Pet. Geol., 43 Annual Meeting, Research Committee Symposium, p. 17 (Abstract)

Petrology and Age Determination; Burwash, R.A.; Royal Soc. Canada, June Meeting, 1958, p. 23 (Abstract).

APPENDIX II

GEOLOGICAL SURVEY OF CANADA RESEARCH GRANTS TO CANADIAN UNIVERSITIES

1958-59

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 establishing an absolute time scale for post-Cambrian time by dating materials for which there is biostratigraphic control. In particular, he will study the volcanic ash beds in the sedimentary sequence using potassium-argon and strontium-rubidium methods for determining their ages. (See also p. 70).

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

Applicant - G.D. Garland — Amount $1,000.00

The flow of heat from the interior of the earth, and the regional variation in the quantity, remains one of the most uncertain, yet important of basic geophysical data. A series of determinations in abandoned oil wells in Western Canada, from as far east as possible in the Plains to the Foothills, will be made in order to find if there is any significant difference in heat flow between the interior of the continent and the mountains.

UNIVERSITY OF BRITISH COLUMBIA

3. **Isotope Geology**

Applicant - J.A. Jacobs — Amount $3,000.00

A National Research Council grant will cover the cost of building a mass spectrometer especially designed for research on geological problems. The first project, which the present grant will support, will be an investigation of the origin of sulphide ore deposits and the use of isotope ratios of lead in rock minerals to determine the relationships among different rock masses.

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

Applicant - H.V. Warren — Amount $3,850.00

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.

ECOLE POLYTECHNIQUE

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

Applicant - Guy Perrault — Amount $1,000.00

The alkaline rocks of the Oka district of Quebec are of particular interest because of the 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.

UNIVERSITY OF MANITOBA

6. Distribution of Nickel, Copper, Cobalt and Iron In Silicate and Sulphide Phases

Applicant - H.D.B. Wilson — Amount $2,600.00

This project has grown out of two projects recently completed, namely, a study of trace metal contents and major elements in fifty North American ores, and a statistical study of several thousand assays from some Canadian base metal mines. These studies are thought to indicate some of the controls that determine the metal ratios in the ores at various mines. The present project, involving determination of the distribution coefficients in silicate and sulphide phases by making melts at various temperatures (and possibly pressures), will test these conclusions experimentally in the laboratory.

MCGILL UNIVERSITY

7. Studies of Terrestrial Thermal Gradient in the St. Lawrence Lowlands of Quebec.

Applicants - T.H. Clark and V.A. Saull — Amount $2,180.00

The objectives of the proposed research are to determine depth-temperature curves for a number of bore holes recently drilled in the vicinity of Montreal and the lithology and thermal properties of the strata penetrated by the holes, by examination and testing of the drill cores; and to study the results with particular reference to terrestrial heat flow, artesian water flow, and local and regional rock structure.

8. Silicate and Sulphide Phase Relationships

Applicants - J.E. Gill, E.H. Kranck, V.A. Saull — Amount $5,000.00

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 work involves (1) experiments on the hydrothermal transportation of sulphides (2) experiments to test the efficacy of solid diffusion as an ore forming process (3) experiments on the melting of rock materials and (4) experiments on the volatility of certain sulphides in sulphur vapour. (See also p.65).

9. Geochemical Study of Anorthosite

Applicant - E.H. Kranck Amount $400.00

The purpose of this project is to obtain information on the physico-chemical conditions under which anorthosites formed. It will include a study of the cation ratios and the rare diadoke constituents of the major minerals, and of the distribution of the less common accessory minerals in the rock series. It is hoped that these studies will contribute to a better understanding of the distribution of anorthosites in the Grenville province, and of the conditions under which they were formed.

10. Enthalpy Changes in Metamorphic Reactions and their Geologic Significance

Applicant - V.A. Saull Amount $2, 240.00

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. These data will be used to determine heats of reactions, surface and strain energy of geologic materials. (See also p.65)

11 Mineralogical and Chemical Investigation of the Relation Between Pyrochlore and Betafite.

Applicant - John S. Stevenson Amount $800.00

The relationship of chemical composition with the physical and crystallographic properties of pyrochlore and betafite has not been studied systematically and is in doubt. This study will attempt to supply X-ray, density and differential thermal analysis data on pure materials and correlate them with chemical composition, thus solving the relationship of the two minerals.

MCMASTER UNIVERSITY

12. Geochemical Studies

Applicant - Denis M. Shaw Amount $4, 000.00

A program of spectrochemical research on the distribution of minor elements in minerals has been supported at McMaster for the past seven years. Investigations currently underway include geochemical studies of the sillimanite group, of scapolites, of pyroxenes and of calcites. In addition, experimental work on spectrographic analysis in an argon-oxygen atmosphere is in progress, and a stastical-analytical study of the sampling of coarse grained porphyritic rocks will be made. (See also p. 66)

UNIVERSITY OF NEW BRUNSWICK

13. Trace Element Distribution in the Rocks and Ores of The Bathurst District, N.B.

Applicant - W.E. Hale — Amount $1,100.00

The purpose of this project is to find out whether particular trace elements are common to the ores and any specific rocks of the area. It is possible such a study will reveal some unique similarities between the ores and a specific rock type. This information, in conjunction with petrographic and structural evidence may clarify the problem of the origin of the large base metal deposits of the district.

Petrology and Structure of Southern New Brunswick Granites

14. Applicant - G.S. MacKenzie — Amount $700.00

A study will be made of the nature, form and structural relations of granite bodies of this area. In addition to petrographic examination, chemical analyses will be made and the heavy minerals of the granites will be studied and compared with those in adjacent intruded rocks. This project will complement the study by Dr. Hale above (No. 13)

QUEEN'S UNIVERSITY

15. Publication of "Canadian Mineralogist".

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

The Mineralogical Association of Canada, which was organized in 1954, will publish the "Canadian Mineralogist" annually (the second number was published in September, 1958). 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 for the first few years. This will be on a diminishing scale as circulation, particularly outside Canada, is built up. (See also p. 3)

16. X-Ray Spectrographic Analyses of Minerals and Rocks

Applicant - L.G. Berry — Amount $3,300.00

The purpose of this work is to establish methods of quantitative analytical determination of elements in minerals and geological materials by X-ray fluorescent analysis. The following specific projects will be undertaken during the coming year (1) analysis of garnets from a wide variety of sources (2) determination of selenium content of sulphide minerals (3) analysis of sphalerite as part of a study of the Sullivan ores (4) analysis of limestones by X-ray fluorescence and (5) analysis of magnesium, iron, silicon and other elements in ultrabasic rocks and chromites. 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 also p. 69)

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

Applicant - Dr. J.E. Hawley — Amount $4,200.00

This project which has been supported for the past six years embraces a wide range of studies. Included in the projects

proposed for 1958-59 are (1) geochemical studies on granitic rocks of the Grenville province and comparison with Killarney types and those of part of the Algoma district (2) further studies of trace elements in copper and gold ores and selenium distribution in Canadian sulphide deposits (3) study of limestones in the Kingston area (4) further studies of results of heat treatment of sulphides in ores, in sulphur and H_2S atmospheres (5) geochemical study of chromite and ultrabasic rocks in Quebec (6) geochemical study of Sullivan ore minerals (7) and continuation of study of high- and low-iron sphalerites etc., to find out reasons for variation in ore types of Blue Bell lead zinc deposit, B.C. and possible temperatures of formation. (See also p. 67-68)

18. Investigation of Internal Structures and Wall Composition of Certain Microfossils

Applicant - Alan McGugan Amount $700.00

Taxonomic descriptions and illustrations of microfossils are limited in general to external morphology. This work will supplement study of obvious external characters with study of detailed internal and wall structure, including the pore distribution in perforate forms. With improved knowledge of the microfaunas, improved correlations of strata will be possible, particularly in interfingering micro-biofacies

UNIVERSITY OF TORONTO

19. Annotated Bibliography and Index of Pleistocene Geology of Canada

Applicant - R.E. Deane Amount $500.00

No comprehensive bibliography exists and a sound program of Pleistocene geology cannot be undertaken without knowledge of what has been done. The bibliography will supplement the recently published Pleistocene map of Canada and the two will summarize our knowledge of Canada Pleistocene geology and provide a framework for the detailed information that is accumulating.

20. Lead Isotope Abundance Variations in Lead Minerals from Southern Ontario

Applicant - R.M. Farquhar Amount $800.00

This project includes an investigation of possible lead isotope variations in the Grenville geological province and sedimentary rocks of southern Ontario by means of the mass spectrometer and chemical analyses of the leads, and determination of the age relationships among certain suites of rocks from the Grenville geological province by the potassium-argon method.

21. Solubility of Metallic Sulphides in Water at Elevated Temperatures and Pressures

Applicant - F.G. Smith Amount $1,770.00

This project involves direct measurement of the solubility of metallic sulphides to obtain thermodynamical constants, and extrapolation of the data to conditions of geological interest.

22. Geological Age Determinations

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

This project has been supported for the past seven years. A new argon line has been set up and new methods for improved determination of the age of biotite, feldspar and similar minerals by the potassium-argon method have been developed. Arrangements have been made to collect specimens and future work will emphasize geological applications.

Microgram quantities of lead from minerals such as feldspar are being successfully extracted and analysed. The means are thus available to study the relations between lead ores and the lead in surrounding rock bodies, and this is being vigorously pursued because of its interest and potential importance in theories of ore deposition (See also p. 64).

UNIVERSITY OF WESTERN ONTARIO

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

Applicant - A. Dreimanis — Amount $260.00

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 will include lithologic investigation of tills, and studies of leaching of soils.

24. Scale Model Experiments c Electromagnetic Prospecting

Applicant - Robt. J. Uffen — Amount $350.00

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

This project, which was 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. Work will continue on both phase and amplitude measurements on aggregates of conducting particles.

25. Methods of Operations Research Applied to Prospecting

Applicant - Robt. 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 programed for solution with a high speed computor thus permitting rapid evaluation or re-evaluation when new data becomes available.

CURRENT RESEARCH IN THE GEOLOGICAL SCIENCES IN CANADA, JUNE, 1957 - MAY, 1958

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 1957 to April 1958 and the bibliography records research in progress for about the period June 1957 to May 1958.

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 co-operation, 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, Victoria Museum, 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.

AREAL GEOLOGY

Alberta

1. Godfrey, John D., Research Council of Alberta:
   Mapping of Precambrian in Northeastern Alberta, 1957-
   Includes detailed petrologic study of geology and mineral deposits.

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

3. Price, R.A., Geol. Surv., Canada (part time):
   Flathead North Map-area, B.C. and Alberta, 1 inch to 1 mile, 1956-57; Ph.D. thesis
   Includes evaluation of the oil, gas, and coal potentialities of the area.

4. Stalker, A.M., Geol. Surv., Canada:
   Surficial Deposits of the McLeod Map-area, (West Half), 1 inch to 4 miles, 1956-57.

British Columbia

5. Brown, A. Sutherland, B.C. Dept. of Mines:
   Geological Reconnaissance of the Cariboo Mountains, 1954-58.
   Fieldwork in 1957 included carrying the reconnaissance to the Rocky Mountain Trench, giving a section across the Mountains and adding information on the Cariboo group.

6. Gabrielse, H., Geol. Surv., Canada:
   Kechika and Rabbit River Map-areas, 1 inch to 4 miles, 1957-58.

7. Hughes, J.E., McGill Univ.:
   Geology of Pine Point Area, 1954-59;
   Ph.D. thesis.

8. Irish, E.J.W., Geol. Surv., Canada:
   Charlie Lake Map-area, 1 inch to 4 miles, 1955-57.
   Geological mapping with special emphasis on the oil and gas potentialities of the area.

9. Leech, G.B., Geol. Surv., Canada:
   Fernie Map-area, 1 inch to 4 miles, 1956-57.

10. Lee, Randolph, University of British Columbia:
    Geology of Newman Creek to Sunset Creek, Eastern Shore of Howe Sound, 1956-58;
    M.Sc. thesis.
    A study of some phenomena of the Coast Range batholith.

11. Price, R.A., Geol. Surv., Canada (part time):
    Flathead North Map-area, British Columbia and Alberta, 1 inch to 1 mile, 1956-57;
    Ph.D. thesis.
    Includes evaluation of the oil, gas, and coal potentialities of the area.

12. Reesor, J.E., Geol. Surv., Canada:
Lardeau Map-area (East Half), 1 inch to 4 miles, 1953-57.
See Geol. Surv., Canada Paper 53-34, 1957.

13. Roots, E.F., Gabrielse, H., Souther, J.G., Geol. Surv., Canada:
"Operation Stikine", 1 inch to 4 miles, 1956-58
Geological study and mapping of part of Northwestern British Columbia including the use of helicopters to appraise their usefulness in future geological surveys in the Cordillera.

14. Tipper, H.W., Geol. Surv., Canada:
Quesnel Map-area, 1 inch to 4 miles, 1957-61.
Anahim Lake Map-area, 1 inch to 4 miles, 1954-57.
See Geol. Surv., Canada, Map 10, 1957.

15. Eastwood, G.E.P. and Fyles, J.T., B.C. Dept. Mines:
Structural and Stratigraphic Study of a Strip Along Lardeau River and Gainer Creek, Including Lardeau Series, Badshot Formation and Hamil Series.

Manitoba

16. Allen, C.M., Manitoba Mines Branch (part time): Mount Allison University:
Geology of Oxford Lake, 1/2 inch to 1 mile, 1955-

17. Milligan, G.C., Manitoba Mines Branch:
Geology of Lynn Lake District, 1954-58.
A study of the structure and geological history of the district largely based on field work of Manitoba Mines Branch geologists.

18. Taylor, F.C., Geol. Surv., Canada:
Seal River Map-area, 1 inch to 4 miles, 1957.

New Brunswick

19. Anderson, F.D., Geol. Surv., Canada:
Big Bald Mountain Map-area, 1 inch to 1 mile, 1956-57.
See Geol. Surv., Canada Map 1, 1957.

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

21. Petruck, William, McGill University:
A Study of An Area Along Clearwater River, Including Copper-Zinc-Lead Deposits, 1956-58; Ph.D. thesis.
The chlorites around the ore deposit will be studied using X-ray diffraction to find out if there is evidence of zoning.

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

23. Smith, C.H., Geol. Surv., Canada:
California Lake Map-area, 1 inch to 1 mile, 1955-57.

24. Stockwell, C.H., Geol. Surv., Canada:
Bathurst District, 1955-57.
Detailed mapping with emphasis on the geology of the sulphide deposits.

25. Williamson, D.H., Mount Allison University:
Geology of Hampstead, 1957
Geological mapping and investigation of electromagnetic conductors with reference to possible deposits of base metals.

Newfoundland and Labrador

26. Baird, D.M., Newfoundland Dept. Mines and Resources:
Carboniferous Rocks of the Canche-Northern Grey Island Area, Newfoundland, 1953.

27. Duffell, S., Geol. Surv., Canada:
Geological Study and Mapping of the Iron Range and West Half of Mount Wright Map-area, Southwest Labrador and New Quebec, 1 inch to 4 miles, 1956-57.
Geological mapping and study of developments and geological problems of the Iron Range.

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

29. Jenness, S.E., Geol. Surv., Canada:
Terra Nova Area, Newfoundland, 1 inch to 4 miles, 1955-57.

30. McCartney, W.D., Geol. Surv., Canada:
Dildo Map-area, Newfoundland, 1 inch to 1 mile, 1954-57.
See Geol. Surv., Canada Map 13, 1956.
Western Avalon Peninsula (West Half), Newfoundland, 1 inch to 4 miles, 1955-57
Geological mapping with special efforts to find and outline deposits of gravel suitable for construction purposes.

31. Mann, E.L., McGill University:
Seal Lake Area, Central Labrador, 1956-58; Ph.D. thesis.

32. Mumtazuddin, M., McGill University:
Geology of the Area Between Wabush Lake and Carol Lake, Labrador, 1957-58; M.Sc. thesis.

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

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

Northwest Territories

35. Blackadar, R.G., Geol. Surv., Canada:
Northwest Baffin Island, 1956-57.
Reconnaissance mapping with special attention to detailed stratigraphic sections from the Late Precambrian and Early Palaeozoic strata, and Pleistocene geology and physiography.

36. Christie, R.L., Geol. Surv., Canada:
Hazen Lake, District of Franklin, 1957-58.
Geological reconnaissance of Hazen Lake and vicinity, northern Ellesmere Island.

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

38. Douglas, R.J.W. (in charge), Norris, D.K., Brady, W.B., McLaren, D.J., Harker, P., Norris, A.W., Pelletier, B.R., Stott, D.F., and Craig, B.G.
Geol. Surv., Canada:
Upper Mackenzie River Basin ("Operation Mackenzie"), 1 inch to 8 miles, 1957.
Geological mapping, with support of conventional aircraft and helicopter, of an area of 100,000 square miles with special emphasis on stratigraphy and faunal content of the Palaeozoic, Mesozoic and Tertiary formations, and including reconnaissance mapping of the surficial deposits.

39. Fraser, J.A., Geol. Surv., Canada:
Fort Enterprise Map-area, 1 inch to 4 miles, 1957.

40. Ross, J.V., Univ. of British Columbia:
Geology of the Central Part of the District of Mackenzie, 1957.

41. Sheng, C., Univ. of British Columbia:
Geology of Anco Lake and Wreck Lake Area, Copper Mine River Area, 1957-58;
M.Sc. thesis.

42. Thorsteinsson, R. and Tozer, E.T., Geol. Surv., Canada:
Eureka Sound, Nansen Sound, and Greely and Canyon Fiords, 1956-57.
Reconnaissance geological mapping with special attention to surficial deposits, extent of recent marine submergence, physiography, state of sea ice, and other factors that effect the economic development of the area.

43. Tozer, E.T., Geol. Surv., Canada:
Cornwall, Exmouth, Table and Ekins Islands, 1957.
Geological reconnaissance and stratigraphic palaeontological studies, with special emphasis on the Triassic formations.

Nova Scotia

44. Cote, R.P., Acadia University:
Geology of Whycocomagh Area, Cape Breton, 1957-58, M.Sc. thesis.

45. Smitheringale, W.G., Geol. Surv., Canada (part time):
Nictaux and Torbrook Map-areas, 1 inch to 1 mile, 1956-57; Ph.D. thesis.

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

Ontario

47. Evans, A.M., Ontario Dept. Mines:
Denbigh Township, Lennox and Addington County, 1 inch to 1/2 mile, 1957.

48. Ferguson, S.A., Ontario Dept. Mines:
Tisdale Township, District of Cochrane, 1 inch to 1320 ft., 1956-57.

49. Frarey, M.F., Geol. Surv., Canada:
Huronian Rocks North of Lake Huron Commencing in Echo River Map-area, 1 inch to 1 mile, 1956-57.

50. Ginn, R.M., Ontario Dept. Mines:
Porter Township, District of Sudbury, 1 inch to 1,000 ft., 1956-57.

51. Grant, J.A., Ontario Dept. Mines:
Neelon Township, District of Sudbury, 1 inch to 1/2 mile, 1957-58.

52. Hewitt, D.F., Ontario Dept. Mines:
Bigwood Township, District of Sudbury, 1 inch to 1/2 mile, 1957.
Methuen Township, Peterborough County, 1 inch to 1/2 mile, 1956-57.

53. Johnston, W.G., Ontario Dept., Mines:
Caviar Lake Area, District of Kenora, 1 inch to 1/2 mile, 1956-57.

54. Langford, F.F., Ontario Dept. Mines:
Levack Township, District of Sudbury, 1 inch to 1/2 mile, 1956-57.

55. Liberty, B.A., Geol. Surv., Canada:
Manitoulin Island, St. Joseph Island, and Sault Ste. Marie Area, 1 inch to 4 miles, 1954-57.
Geological mapping with particular reference to the possible occurrence of oil and natural gas.

56. Robertson, James A., Queens University:
Geology of Townships 144 and 163, Blind River Area, with special reference to the Granitic Rocks, 1956-58; M.A. thesis.

57. Roscoe, S.M. and Pienaar, P.J., Geol. Surv., Canada:
Radioactive Deposits Between Sault Ste. Marie and Cobalt, Including the Blind River Camp, 1954-57.
Detailed mapping with particular reference to those deposits associated with conglomerate and other sedimentary strata. See Geol. Surv., Canada Paper 56-7.

58. Thomson, J.E., Ontario Dept. Mines:
MacLennan Township, District of Sudbury, 1 inch to 1/2 mile, 1957.

59. Usher, J.L., Queen's University:
Geology of the Rocky Mountains in Southern Alberta, 1956-58.

60. Wynne-Edwards, H.R., Geol. Surv., Canada (part time):
Westport Map-area, 1 inch to 1 mile, 1957; Ph.D. thesis, Queen's University.

Prince Edward Island

61. Prest, V.K., Crowl, C.H. and Frankel, L., Geol. Surv., Canada:
Geology of Prince Edward Island, 1 inch to 1 mile, 1953-59.
Includes mapping and study of surficial and bedrock formations.

Quebec

62. Behr, S.H., Quebec Dept. Mines (part time):
Part of Western Duprat Township, Rouyn-Noranda County, 1 inch to 1,000 feet, 1957-58; M.Sc. thesis, McGill University.

63. Beland, Jacques, Quebec Dept. Mines:
Oak Bay Area, Bonaventure and Matapedia Counties, Gaspe, 1957-58.

64. Benoit, Fernand W., Quebec Dept. Mines:
St. Sylvestre-St. Joseph Area, Beauce, Dorchester, and Megantic Counties, 1956-58; Ph.D. thesis.
See "Un Essai d'Interpretation d'une Section de l'Axe Sutton pres de la Riviere, Chaudiere"; paper presented at 25th Congress l'Association Canadienne-Francaise pour l'Advancement des Sciences, Quebec, Nov. 1957.

65. Berard, Jean, Quebec Dept. Mines:
Finger Lake Area (East Half), Fort Chimo Region, Quebec, 1 inch to 1 mile, 1957-59; Ph.D. thesis, Universite Laval See "Bones Lake Area, New Quebec".
Prel. Rept. Quebec Dept. Mines, P.R. 342, 1957.

66. Bergeron, Robert, Quebec Dept. Mines:
Cape Smith-Wakeham Bay Belt, New Quebec, 1957-60.
Reconnaissance in 1957 resulted in a geological map on scale of 1 inch to 8 miles. Future reconnaissance is expected to result in maps on scale of 1 inch to 4 miles.

67. Bergeron, Robert and Beall, G.H., Quebec Dept. Mines:
Bochart-Louvigny Area, Roberval County, 1957-58.
The continuation of geological mapping along the Chibougamau highway.

68. Clark, T.H., Quebec Dept. Mines (part time), McGill University:
Geology of the St. Lawrence Lowlands, 1938-
A continuing investigation of the geology and oil and gas possibilities of the lowland region between Quebec City and the Quebec-New York State boundary.

69. Davison, W.L., Geol. Surv., Canada:
Reconnaissance Geological Mapping in Northwestern New Quebec, 1957.

70. de Romer, Henry, Quebec Dept. Mines (part time):
Mount Orford Area, Eastern Townships, 1 inch to 1,000 feet, 1957-58.

71. Duffell, S., Geol. Surv., Canada:
Geological Study and Mapping of the Iron Range and West Half of the Mount Wright Map-area, Southwest Labrador and New Quebec, 1 inch to 4 miles, 1956-57.
Geological mapping, and study of the developments and geological problems of the Iron Range.

72. Dugas, Jean, Quebec Dept. Mines:
Compilation of Geology of the Rouyn-Noranda District, 1 inch to 1,000 feet; a continuing program.

73. Eade, K.E., Lee, H.A., and Heywood, W.W.
Southwestern New Quebec (Operation Fort George), 1 inch to 8 miles, 1957.
Geological mapping of an area of 35,000 sq. miles with helicopter, including the surficial formations.

74. Gaucher, Edwin, Quebec Dept. Mines (part time):
Southeast Quarter Roy Township, Chibougamau District, 1 inch to 1,000 ft.; Ph.D. thesis, Yale University.

75. Gelinas, Leopold, Quebec Dept. Mines (part time):
Fort Chino-Thevenet Lake Area, New Quebec, 1 inch to 1 mile, 1956-59; Ph.D. thesis, Princeton University.

76. Greiner, H.R., Quebec Dept. Mines:
Cabano Area, Temiscouata County, 1957-58.
Mapping of the Palaeozoic rocks in the Appalachians of southeastern Quebec.

77. Jackson, Garth D., McGill University:
Geology of an Area West of Wabush Lake, 1955-58; Ph.D. thesis.

78. Jenkins, J.T., McGill University:
Manitou Lake and Manitou River areas, Saguenay County, 1956-58;
Ph.D. thesis.
See "Manitou Lake Area" Quebec Dept. Mines, Prel. Rept. 349, 1956.

79. Klugman, M.A., Quebec Dept. Mines:
Boucher Carrignan Area, Laviolette County, 1 inch to 1 mile, 1957-58.

80. Kretz, R.A., Quebec Dept. Mines (part time):
Pontefract-Gillies Area, Pontiac County, 1 inch to 1 mile, 1957-58; Ph.D. thesis
See "Litchfield-Huddersfield Area, Pontiac County", Quebec Dept. Mines Prel. Rept. 338, 1957.

81. Latulippe, M., Quebec Dept. Mines:
Compilation of Geology of Val d'Or District, 1 inch to 1,000 ft.; a continuing program.

82. Laurin, Andre, Quebec Dept. Mines:
Houdet-Lorrain Area, Pontiac County, 1 inch to 1 mile, 1957-59.

83. Lyall, H.B. Universite Laval:
Geology of Hainaut-Champagne Area, Pontiac County, 1956-58; D.Sc. thesis.
A study of the gneisses of the main gneiss belt of the northwestern part of the Grenville sub-province, and the origin of some copper-nickel deposits.

84. Marleau, R.A., Quebec Dept. Mines (part time):
Woburn-Megantic-Armstrong Area, Frontenac and Beauce Counties, 1956-58, 1 inch to 1 mile, 1956-58; Ph.D. thesis Laval University.
See "Woburn Area, Frontenac County", Quebec Dept. Mines, Prel. Rept. 336, 1957.

85. Mattinson, Cyril, McGill University:
Mount Logan Area, Gaspe, 1 inch to 1 mile, 1955-58; Ph.D. thesis.

86. McPhee, D.S., Quebec Dept. Mines:
Eric Lake Area, Saguenay Electoral District, 1 inch to 1 mile, 1957-58; Ph.D. thesis.
This area completes the mapping by the Quebec Dept. Mines of the areas bordering the North Shore and Labrador Railway between Sept. Isles and the Labrador-Quebec boundary.

87. Nunes, A., Universite Laval:
Geology of Island of Orleans, 1955-58;
Ph.D. thesis
See abstract in Can. Mining Journal, July, 1958, P. 97.

88. Phillips, L.S., Quebec Dept. Mines:
Tuttle Lake Area, New Quebec, 1 inch to 1 mile, 1957-59: Ph.D. thesis.

89. Pollitt, E.I.K., Geol. Surv., Canada:
Groundwater Survey of Parts of the St. Jean and Lachine Map-areas, 1955-57.

90. Remick, J.H., Quebec Dept. Mines:
Marin-Picquet Area, Abitibi East County, 1957-58; Ph.D. thesis.

91. Sater, G.S., Quebec Dept. Mines (part time):
McOuat-Gauvin Area, Mistassini Territory and Roberval County, 1957-59.
See "McOuat-Gauvin Area", Quebec Dept. Mines, Prel. Rept. 356, 1957.

92. Sauve, Pierre, Quebec Dept. Mines (part time):
De Freneuse Lake Area (East Half), Fort Chimo Region, New Quebec, 1 inch to 1 mile, 1957-58; Ph.D. thesis.
See Quebec Dept. Mines Prel. Rept. 332, 1956.

93. Skidmore, W.B., Quebec Dept. Mines (part time):
Honorat Area, Bonaventure County, Gaspe, 1957-58.

Saskatchewan

94. Bell, C.K., Geol. Surv., Canada:
Milliken Lake Map-area, Athabasca Lake, 1 inch to 1,000 ft., 1954-59.
Detailed mapping with special reference to radioactive mineral deposits.

95. Byers, A.R., Univ. of Saskatchewan:
Hanson Lake Area, 1954-57.
See Sask. Dept. Mineral Resources, Rept. No. 30, 1957.
Flin Flon Area, 1952-58.

96. Cheesman, R.L., Saskatchewan Dept. Mineral Resources:
Wapus Bay Area, Reindeer Lake, 1 inch to 1 mile, 1956-58.

97. Kirkland, S.J.T., Saskatchewan Dept. Mineral Resources:
Deschambault Lake Area (East Half), 1 inch to 1 mile, 1957-58.

98. Mawdsley, J.B., Univ. of Saskatchewan:
Charlebois Lake Area; Sask. Dept. Mineral Resources, Map 24A, 1957.
Middle Foster Lake Area, Northern Saskatchewan; Sask. Dept. Mineral Resources, Rept. 26, 1957.

99. Tremblay, L.P., Geol. Surv., Canada:
Beaverlodge Area, Athabasca Lake, 1 inch to 1,000 ft., 1952-57.
Detailed geological mapping with special reference to radioactive mineral deposits. See Geol. Surv., Canada Papers 54-15, 55-28 and Map 18, 1956.

Yukon Territory

100. Green, L.H., Geol. Surv., Canada:
Scougale Creek Map-area, 1 inch to 1 mile, 1954-57.
See Geol. Surv., Canada Map 5, 1956
McQuesten Lakes Map-area, 1 inch to 1 mile, 1955-57.

101. Muller, J.E., Geol. Surv., Canada:
Teepee Lake Area, 1 inch to 4 miles, 1953-57.

102. Wheeler, J.O. Geol. Surv., Canada:
Quiet Lake Map-area, 1 inch to 4 miles, 1956-58.

ENGINEERING GEOLOGY

103. Bostock, J.M., Geol. Surv., Canada:
Compilation of Drift Thickness Map in the City of Ottawa, 1957-58.
To make an isopach (drift thickness) map of the overburden, and a bedrock surface map of the area.

104. Bozozuk, M., Div. of Building Research, National Research Council.
Swelling and Shrinkage of Clays, 1954-58.
There has been extensive damage to houses due to swelling and shrinkage of clays. An area in central Ottawa has been observed for three years for (a) relation, if any, between damage and soil types, (b) observation of ground movements and correlation of climatic data and (c) laboratory study of swelling and shrinking of clays. See "Seasonal Movement in some Canadian Clays". Proc. 4th Int. Conference on Soil Mechanics and Foundation Engineering, London, 1957.

105. Brown, R.J.E., Div. Building Research, National Research Council:
Permafrost Boundary in Canada, 1953-

106. Burn, K.N., Crawford, C.B., Eden, W.J., and Hamilton, J.J., Div. of Building Research, National Research Council:
Geotechnical Properties of Eastern Marine Clay, 1951-
In conjunction with other investigations, geotechnical data from several borings in the Ottawa area, from Beauharnois, and Hawkesbury are being collected and correlated. Investigations in the laboratory are being made on the sensitivity of Leda Clay. Field measurements on the settlement of a heavy fill east of Ottawa are under way to compare with settlement predictions based on laboratory tests.

See "Geotechnical Properties of Leda Clay in the Ottawa Area", Proc. Int. Conference on Soil Mechanics and Foundation Engineering, Vol. 1; pp. 22-27, London, 1957.

107. Holland, S.S., B.C. Department of Mines:
Study of Fraser Valley at Moran, B.C., 1956-58.
Detailed study of the river valley including data available from drilling, regarding present and previous channels and of the alteration of rock on the west side. The study was undertaken to assist in evaluating the feasibility of constructing a high dam.

108. Holland, S.S. and Nasmith, H.W., B.C. Dept. of Mines:
Study of Proposed Damsties and Tunnel Routes, Taseko Lake-Chilko Lake-Bishop River, B.C., 1957-58.

109. Pearce, D.C., Penner, E., Leggett, R.F., and Crawford, C.B., Div. of Building Research, National Research Council:
Ground Temperatures and Frost Action, 1948-
Increased emphasis is being placed on theoretical considerations, and preliminary studies indicate that this approach, combined with the empirical approach, will result in a reasonable understanding of problems associated with ground temperatures and frost action.

110. Legget, Robert F., Div. of Building Research, National Research 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 textbook "Geology and Engineering" which it is hoped may be completed by 1959.

111. Meneley, M.A., Univ. of Saskatchewan:
Microfabrics and Soil Mechanics Study of Glacial Deposits; M.Sc., thesis, 1958.

112. Pihlainen, J.A., and Johnston, G.H., Div. of Building Research, National Research Council:
Aklavik Relocation Project, 1954-
Soil temperature measurements are being continued and rate of annual thaw observations were carried out at selected areas during July, August, and September, 1957. In addition, observations were continued on physical changes to the terrain caused by melting of permafrost due to construction or occupation.

113. Taylor, R.S., Univ. of Alberta:
Differential Rates of Heaving in Freezing Soils, 1956-57.
A brief investigation of the rates of frost heaving of buried objects of different shapes and materials.

114. Legget, R.F., and Eden, W.J., Div. of Building Research, National Research Council:
Varved Clays at Steep Rock Lake, Ontario, 1948-
The performance of several large slopes cut in varved clays during stripping operations are being observed in cooperation with the mine authorities. A paper summarizing the engineering work on the clays is being prepared. See "Laboratory Study of Varved Clay from Steep Rock Lake, Ontario". Amer. Jour. Sci. Vol. 253, pp. 659-674, Nov. 1955.

115. MacFarlane, I.C., Div. 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 "Correlation Palaeobotanical and Engineering Studies of Muskeg (Peat) in Canada". Proc. 4th Conference, Int. Soc. of Soil Mechanics and Foundation Engineering, Vol. 1, London, 1957.

116. McTaggart, K.C., and Trettin, H.P., B.C. Dept. Mines (part time):
Detailed study of a Strip along the Fraser River extending upstream from Lillooet, B.C.

GEOCHEMISTRY

117. Anderson, G.M., Univ. of Toronto:
Semi-Quantitative Evaluation of the Solubility of PbS in Dilute H_2S Solutions at Elevated Temperatures and Pressures, and Its Geological Implications, 1957-59; Ph.D. thesis.

118. Azzaria, L.M., Univ. of Toronto:
Distribution of Heavy Metals in the Minerals of an Igneous Granite, 1956-58; Ph.D. thesis.

119. 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 (1) in correlation and dating of strata at and near petroleum-bearing horizons and (2) in determining the source rock from which petroleum in various fields was originally derived.

Berrange, Jean, McGill University:
Dispersion in Humus and Moss of Zinc, Nickel, Copper and Lead from Mineralized Zones in a Glaciated Precambrian Terrain, 1956-58; M.Sc. thesis.

121. Boyle, R.W., Geol. Surv., Canada:
Geochemistry of the Bathurst-Newcastle District, New Brunswick, 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.

122. Boyle, R.W., Wanless, R.K., and Lowden, J.A., Geol. Surv., Canada;
Isotope Chemistry of Sulphur in Rocks and Ore Deposits, 1955-57.
The determination, with the mass spectrometer, of the ratios of sulphur isotopes in sulphide and sulphate minerals collected from and in the vicinity of ore deposits, and the use of this data in establishing the genesis of ore deposits.

123. Boyle, R.W., Geol. Surv., Canada:
Geochemical Study of the Barymin Barite Deposit, Walton, Nova Scotia, 1957.
To obtain and interpret data concerning the geochemistry of barium in the deposit and adjacent strata and thereby afford useful information concerning the origin of the deposit, its possible extension, and the possible occurrence elsewhere of commercial barite deposits.

124. Bright, N.F.H., Mines Branch, Dept. Mines and Technical Surveys:
High Temperature Phase Equilibrium of Titania Slag Constituents - the System Fe-Ti-O, 1954-58.
The ranges of stability with temperature, and the extend of solid solutions are being studied for $_2FeO.TiO_2$, $FeO.TiO_2$ (Ilmenite) and $FeO.2TiO_2$.

125. Clark, Lloyd, A., McGill Univ:
Subsolidus Relations in the System FeS_2 - FeAsS, 1955-58; Ph.D. thesis.

126. Cumberlidge, John T., McGill Univ.:
Surface and Strain Energy in Minerals, 1954-58; Ph.D. thesis.
Colorimetry to determine heat of solution of mineral silicates in hydrofluoric acid.

127. Davies, J. Leslie, Univ. of New Brunswick:
Trace Elements in the Bathurst Ores, N.B., 1957-59.
The project will be concerned primarily with the minor elements associated with the sulphide ores of the Bathurst-Newcastle district. Trace elements will be studied also in granitic, volcanic, and basic intrusive rocks of the district with a view to learning something of the origin of the ores. All analyses will be by spectrochemical semi-quantitative methods.

128. Davies, John, and Wilson, H.D.B., Univ. of Manitoba:
A Study of the Major and Minor Constituents of the Basic Intrusions in the Kenora Area, Ontario, 1956-59.

129. Dawson, K.R., and Maxwell, J.A., Geol. Surv., Canada:
Compilation of Canadian Rock and Mineral Analyses, 1957-
To collect and evaluate all Geological Survey Canadian rock and mineral analyses; and if and when practicable, to expand the project to include all similar data from other sources.

130. Dean, R.S., McGill Univ.
A Compositional Study of Calcareous Lorraine Sedimentary Rocks, 1956-58; M.Sc. thesis.

131. deRomer, Henry, McGill Univ:
Geology of Eastman Area, Quebec, 1956-59; Ph.D. thesis.
Stress will be put on trace elements in the lavas of the region, the C^{12} to C^{13} ratio in shales and graphite schists, and the behaviour of the greywackes under temperature and pressure.

132. Deuters, B.E., and Shaw, D.M., McMaster University:
Geochemical Study of the White Magma Series in New Hampshire, 1956-58.
Minor elements are being determined spectrographically in a suite of rocks collected from several of the ring-dyke complexes from New Hampshire. The data will be used to study the mode of evolution of these mildly alkalic rocks and to give fundamental geochemical information.

133. Fairbairn, H.W., Ontario Department Mines (part time), Massacheusetts Institute of Technology:
Age Determinations from Precambrian Rocks of Northern Ontario Using Argon and Strontium Methods, 1957.

134. Folinsbee, R.E., Baadsgaard, H. and Lipson, J., Univ. of Alberta:
Problems in Nuclear Geochronology, 1954-
An argon extraction line and rare-gas mass spectrometer suitable for the determination of the potassium argon age of young potassic minerals are being set up in the departments of geology and physics. See "Late Cretaceous Geochronology", Assoc. Inter. de Volcanologie, XI General Assembly, I.U.G.G., Toronto September 1957, p. 19; "The Crowsnest Volcanics and Cretaceous Geochronology", Seventh Annual Field Conference, Alberta Society Petroleum Geologists, Waterton, September 1957, pp. 20-26 (Guidebook).

135. Gleeson, Christopher, McGill Univ.:
Operation Muskeg, 1957-59; Ph.D. thesis.
An investigation into the physico-chemical conditions of the muskeg environment with particular reference to the distribution of metals therein; Ph.D. thesis.

136. Gorman, W. Alan, Queen's University:
Geochemical Sampling of Pleistocene Soils, 1957-59.

137. Guy-Bray, John V., McGill Univ:
Transfer of Metals as Gases, 1957-58; M.Sc. thesis.
Experiments will be made on the volatility of the sulphides of iron, manganese, cobalt, nickel, copper and molybdenum in sulphur vapour.

138. Hansuld, John A., McGill Univ.:
Electrochemical Aspects of Sulphide Ore deposition, 1957-59; Ph.D. thesis.
A laboratory investigation, including study of dispersion of heavy metals around uranium mineralization (Labrador, Blind River).

139. Hawley, J.E. and Westervelt, R.D., Queen's Univ:
Geochemical Study of Lead-Zinc Deposit in Southeast British Columbia, 1957-58.
A study in cooperation with Prof. F.G. Smith, University of Toronto, of the variations in composition of sphalerite and other sulphides with temperature of formation.

140. Hawley, J.E., and Nichol, Ian, Queen's Univ.:
Partition of Trace Elements in Contemporaneous Sulphides of Copper-Iron Sulphide Bodies, 1956-58.
Trace elements are being determined particularly in pyrite, pyrrhotite and chalcopyrite which have been concentrated from single ore specimens. Elements being determined include Co, Ni, Pb, Zn, Sn, Cr, Ti, U and Se.
See abstract, Can. Mining Jour., July 1958, p. 95.

141. Hawley, J.E., and Grant, J.A., Queen's Univ.:
Geochemical Studies of Granitic Rocks in Eastern Ontario, 1955-58.
Complete analyses of 65 granitic rocks of both magmatic and metasomatic origin are being assembled, including the trace elements. Some 60 others have been completed for local areas, the Claire River syncline and Westport areas. These appear to fall into four distinct groups on the basis of certain ratios and trace elements. A comparison will be made with similar rock analyses recently published by A.F. Buddington for the Adirondacks.

142. Hawley, J.E., and Stanton, R.L., Queen's Univ.:
Mineralogy and Geochemistry of the Sudbury Nickel Ores, 1956-58.
Involves detailed mineralographic study of some hundreds of ore specimens combined with detailed spectrographic and X-ray studies of the minerals for Co/Ni ratios, selenium content and precious metals (platinum group). See "Intergrowths of Pentlandite and Pyrrhotite", Econ. Geol. V. 52, 1957, p. 132-139.

143. Holman, R.H.C., Geol. Surv., Canada:
Geochemical Exploration in Nova Scotia, 1957-58.
To explore by geochemical means the northwestern part of Nova Scotia in an effort to locate and outline areas likely to contain valuable deposits of base or other metals.

144. Jones, R.E., Univ. of Toronto:
A critical study of Phase Relations at the Pegmatite Stage, 1957-58; Ph.D. thesis.
The physical chemical conditions of the formation of pegmatites are reviewed and new diagrams showing hypothetical phase relationships in water silicate systems are proposed. Application of the diagrams to explain associations in natural systems is discussed and the phase relations found in some experimental silicate-water systems are examined.

145. Jongejan, A., and Bright, N.F.H., Mines Branch, Dept. Mines and Technical Surveys:
Magnesia-Ferric Oxide-Allumina Spinels, 1957-58.
Relates to the constitution of dolomitic magnesite refractory clinkers.

146. Jongejan, A., Mines Branch, Dept. Mines and Technical Surveys:
Iron Bearing Gehlenites, 1957-58.
Relates to contribution of dolomitic magnesite refractory clinkers.

147. Lapkowsky, W., Moxham, R., and Shaw, D.M., McMaster Univ.:
Geochemical Study of Skarn Minerals from the Grenville Province, 1955-58.
Major and minor element determinations are being made by chemical and spectrographic methods on three mineral series--calcite, pyroxene and scapolite. Information thus obtained will be correlated with optical properties and used in a study of the genesis of these minerals in numerous deposits from the Grenville province. Preliminary work, now completed, includes detailed optical measurements on about 40 scapolites, together with determinations for sodium potassium, calcium, barium and strontium. In addition, determinations of minor elements in the scapolites is nearly complete and similiar determinations on the pyroxenes and scapolites are well advanced.

148. Le Breton, G., Research Council of Alberta:
Chemistry of Alberta Groundwaters, 1957-58.

149. Maxwell, J.A. and Courville, S., Geol. Surv., Canada:
Analyses of Rocks and Minerals and Investigation of New Methods of Analysis.

150. Meikle, B.K.M., McGill Univ.:
Diffusion of Metallic Sulphides, 1957-58; Ph.D. thesis.

151. Mloszewski, M.J., Univ. of Toronto:
Semi-Quantitative Evaluation of the Solubility of Zinc Sulphide in Aqueous Hydrogen Sulphide Solution under Elevated Temperature and Pressure, 1956-58; Ph.D. thesis.

152. Montgomery, D.S., and Goodspeed, F., Mines Branch, Dept. Mines and Technical Surveys:
The Infra-red Adsorption Spectra of Bituminous Substances, 1957-

153. Moorhouse, W.W., Univ. of Toronto:
Studies of Precambrian Sediments, 1950-
A continuing study of their petrology and geochemistry with particular reference at present to iron formations of the Port Arthur region.

154. Papezik, Vladmir S., McGill Univ.:
A Study of Trace Elements in Anorthosites, 1957-59; Ph.D. thesis.
A study of their distribution in rocks of different ages, environments and phases.

155. Patterson, J., Manitoba Dept. Mines and Univ. of Manitoba:
Metamorphism and Nickel Sulphide Mineralization in the Mystery-Moak Lake Area, Manitoba, 1958- ; Ph.D. thesis.
A co-operative project to investigate the relationship between metamorphism and the concentration of nickel sulphides and/or the conversion of the nickel silicates to sulphides.

156. Prince, A.T., and Rao, R.M., Mines Branch, Dept. Mines and Technical Surveys:
High Temperature Phase Equilibrium Studies in the System Mg O-TiO_2-Fe_2O_3-SiO_2, 1955-.
This study is related to basic refractory materials, particularly to the effect of TiO_2 on forsterite and on magnesite clinker.

157. Prince, A.T. and Bright, N.F.H., Mines Branch, Dept. Mines and Technical Surveys:
High Temperature Phase Equilibrium Studies in the System CaO-Nb_2O_3-SiO_2, 1956-58.
The quench technique for silica equilibria studies is being used to find the fields of primary crystallization in a substantial portion of the ternary system. A phase having X-ray properties similiar to natural niocalite occurs in this system.

158. Russell, R.D., Farquhar, R.M., and Mair, J.A., Univ. of Toronto:
Isotopic Constitution of Common Leads, 1952-
The use of isotopic ratios of lead in rocks and in lead minerals to study the processes of lead mineralization and their relation to major orogenic processes. See "Isotopic Analyses of Leads from Broken Hill, Australia", Trans. Amer. Geophysical Union, 38, 557 (1957).

159. Russell, R.D. and Ozima, M., Univ. of Toronto:
The Potassium-Argon Method of Geological Age Determinations, 1957-

160. Raychaudhuri, S., McGill Univ.:
Trace Elements in Sulphide Deposits of Chibougamau District, Quebec, 1957-58; Ph.D. thesis.
Studies of minor element distribution in this group of minerals are being continued with a view to finding information relevant to their manner of formation.

161. Shaw, D.M., McMaster Univ.:
Geochemical Studies in the Sillimanite Group, 1954-58.
Studies on minor element distribution in the group of minerals are being continued, with a view to finding information relevant to their manner of formation.

162. Shaw, D.M., McMaster Univ.:
Geochemical Studies in the Sillimanite Group, 1954-58.
Studies on minor element distribution in this group of minerals are being continued, with a view to finding information relevant to their manner of formation.

163. Smith, C.H., Geol. Surv., Canada:
Study of Mineralogical, Petrographical and Chemical Variations in the Mount Albert Ultrabasic Intrusion, Quebec, 1957-58.
The object will be to test the chemical homogeneity of the intrusion and to set up techniques for future study of other ultrabasic bodies.

164. Smith, F.G., Univ. of Toronto:
Solubility of Metallic Sulphides in Dilute Aqueous Solutions of Hydrogen Sulphide at High Temperatures and Pressures, 1956-66.

165. Soles, J.A., McGill Univ.:
Study of the Solution and Transportation of Sulphides, 1957-58; Ph.D. thesis.
An experimental study of methods of transportation of sulphide minerals and the effects of changing conditions in areas of deposition.

166. Soles, J.A., MacDougall, J.F., Meikle, B.K.M., Guy-Bray, J.V., McGill Univ.:
Behaviour of Sulphides at Elevated Temperatures and Pressures, 1953-

167. Sims, W.A., Mount Allison Univ.:
Adsorption of Base Metals on Clays, 1955-

168. Stanton, R.L., N.R.C. Post doctorate Fellow, Queen's University:
Abundances of Major Elements in Some "Conformable" Sulphide Orebodies, 1954-58.
The investigation deals with the general trends and variability of abundance of the individual metals with their correlation as pairs, and their mutual behaviour as a group of three. Several persistent features, apparently of principal rather than province, have appeared so far. It is hoped that these may guide physical-chemical and perhaps biological investigations into the possible mode of emplacement of ores.

169. Thomas, J.F.J., Mines Branch, Dept. of Mines and Technical Surveys:
Survey of Surface Waters for Heavy Minerals, Particularly Zn and Cu, 1955-
Research on Sensitive Test Methods for Pb, Zn, and Cu in Water which are also suitable for geochemical prospecting, 1955-

170. 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 the concentrations for specific elements and make chemical concentrations of specific elements for isotope analyses. By means of the mass spectrometer to make analyses of the above and to compute the age of the minerals and enclosing rocks. See "Nature", August, 1956.

171. Wanless, R.K., Maxwell, J.A., Smith, C.H., Geol. Surv., Canada:
Magnesium Isotopes, 1957-58.
A survey of the variations in abundance of magnesium isotopes from different geological environments to determine if fractionation of isotopes takes place and whether distinctive abundances are indicative of distinctive environment; and to use the results to elucidate various geological processes.

172. Wanless, R.K., and Lowdon, J.A., Geol. Surv., Canada:
Isotopic Study of Canadian Cre Leads, 1956-
To determine the lead (and possibly the sulphur) isotope distribution in lead ores, the possible isotope variations with geological environment, 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.

173. Warren, H.V., Delevault, R.E., and Boyle, S., Univ. of British Columbia:
Trace Elements in Plants, Soils and Rocks, 1945-
This project is concerned with improvement of geochemical techniques and in obtaining fundamental data on trace elements in rocks, and corresponding relationships with soils, stream silts, and vegetation. See "Soils in Geochemical Prospecting". Western Miner and Oil Review, Vol. 29, No. 12, 1956, pp. 36-42.

174. Webber, G. Roger, McGill Univ.:
An Investigation into Applications of Instrumental Methods to the Quantitative Chemical Analysis of Geological Materials, 1955-59.
See "Applications of X-Ray Emission Spectrometry to Rock and Ore Analysis". Can. Inst. Mining and Metallurgy, Transactions, Vol. LX, 1957, pp. 138-143.

175. Wickremasinghe, C. and Shaw, D.M., McMaster Univ.:
Development of Methods of Spectrographical Analysis of Silicates, 1957-
The air jet method of spectrochemical analysis is being used extensively for minor element determination. The disadvantage is the relatively high CN-band emission. To improve sensitivity, attempts are being made to develop a jet in which the gas surrounding the burning electrode will be argon or other inert gas rather than air. Results to date seem encouraging.

176. Wright, C.M., and Jolliffe, A.W., Queen's Univ.:
Origin of the Sulphurous Zones at Steeprock Lake, 1957-58.

GEOPHYSICS

Electrical

177. Blanchard, J.E., Nova Scotia Research Foundation:
Theoretical Studies of Electromagnetic Methods Geophysical Prospecting, 1956-
An attempt is being made to determine the effect of overburden on the resolving power of the various types of electro-magnetic prospecting equipment presently being used.

178. Groundwater Division, Research Council of Alberta:
Earth Resistivity and Its Relation to Shallow Aquifers, 1956-59.

179. Uffen, Robert and Surkin, Alvin, Univ. of Western Ontario:
Scale Model Experiments of Airborne Electro-magnetic Prospecting, 1954-60.
Scale model measurements are being made of the electromagnetic response of typical geological structures for airborne prospecting techniques.

180. West, Gordon, F., Univ. of Toronto:
Studies of Electromagnetic Prospecting and Electrical Conduction in Rocks and Ores, 1957-59; Ph.D. thesis.
Present work involves theoretical and model studies of the fields of uniformly conducting bodies, particularly a semi-infinite sheet. Further work will be done to study the mechanisms of electrical conduction in rocks, minerals, and ores.

Gravity

181. Blanchard, J.E., Nova Scotia Research Foundation:
Gravity and Magnetic Studies of the Sedimentary Basins of Nova Scotia, 1952-
Because of the 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.

182. Bancroft, A.M., Dominion Observatory:
Gravity Measurements in the Prairie Provinces, 1955-58.
The object is to prepare up-to-date gravity data in sufficient detail for geodetic and large scale structural studies and at the same time suitable for control of detailed gravity surveys conducted by the oil exploration industry. The current work which is part of the I G Y program, is being carried on in cooperation with major oil companies who have agreed to contribute a considerable amount of gravity data.

183. Garland, G.D., Univ. of Alberta and Tanner, J.G., Dominion Observatory:
Gravity Measurements in Southern British Columbia, 1954-57.
See "Investigations of Gravity and Isostasy in the Southern Canadian Cordillera", Pub. Dom. Cbs. Vol. XIX, No. 5 (in press).

184. Innes, M.J.S., Dominion Cbservatory:
Gravity Investigations of the Area of the North Shore of Lake Huron, 1957.
Approximately 600 stations were observed in the vicinity of Manitoulin Island in sufficient detail to proceed with the preparation of a gravity map of the area. A study is in progress to determine if certain gravitational features observed on Manitoulin Island are due to relief or to lithological changes of the Precambrain basement rocks.
Study of Large Scale Gravitational Features in Canada, 1957-59.
The purpose is to compile a gravity map of Canada on a scale of 1 inch to 100 miles, and interpret the large scale gravitational features. The map which includes all measurements to the end of 1956 has been completed.

Gravity Investigations in Northern Quebec, 1954-
Approximately 400 stations have been established in the area. In 1958 the regional gravity mapping will be continued throughout a wide area to the east of Hudson Bay.

185. Loncarevic, Bosko D., Univ. of Toronto:
Micromeasurements of Gravity, 1957-58;
M.A. thesis.

186. Tanner, J.G., Dominion Observatory and Uffen, R.J., University of Western Ontario:
Geological Interpretation of Gravity Anomalies in the Gaspe Peninsula, 1954-58.
Approximately 600 gravity stations have been established. Analysis of the results including a geological interpretation and isostatic study is in progress. See "Gravity Measurements in Quebec", Pub. Dom. Observatory, Vol. 19, No. 4 (in press).

187. Thompson, L.D.G. and Miller, A.H., Dominion Observatory:
Gravity Measurements in Southern Cntario, 1951-57.
See "Gravity Measurements in Southern Ontario", Pub. Dom. Obs., Vol. XIX, no. 9 (in press).

188. Thompson, L.D.G., and Garland, G.D., Dominion Observatory:
Gravity Measurements in Quebec south of Latitude 52° North, 1951-57.
See "Gravity Measurements in Quebec, South of Latitude 52° North", Pub. Dom. Obs., Vol. XIX, No. 4 (in press).

Magnetic

189. Blanchard, J.E., Nova Scotia Research Foundation:
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.

190. Cameron, H.L., Nova Scotia Research Foundation:
Correlation of Structures in the Meguma In Relation to Aeromagnetic Maps, 1957-58.
Investigation in particular covers southwestern Nova Scotia.

191. Cook, Anne B., Dominion Observatory:
Earth Currents (Short Period Magneto-Telluric Phenomena), 1955-

192. DuBois, P.M., and Larochelle, A., Geol. Surv., Canada:
Paleomagnetic Studies, 1955-
Involves the collection and preparation of rock samples to measure the direction of remanent magnetism and the accumulation of data expected to reveal the direction of the earth's magnetic field during geologic history; this may throw light on age and structural relationships of rock formations.

193. DuBois, P.M., Geol. Surv., Canada:
Construction of Anisotropic Susceptibility Meter, 1958.
A meter to measure the anisotropic component of the magnetic susceptibility of weakly magnetized rocks. It is hoped that such measurements will help determine the mode of magnetizations found in rocks, and show whether there is any correlation between the direction of remanent magnetism and the direction of the principal axes of anisotropic susceptibility.

194. Fitzpatrick, M.M., Queen's Univ.:
Pole Strength and Magnetic Interpretation, 1956-58.
The development of a method for calculating pole strength of bodies containing magnetic materials from the results of airborne and ground magnetic surveys.

195. Hood, P.J., University of Toronto:
Rock Magnetism, 1956-58; Ph.D. thesis.
A number of oriented rock specimens from the Bancroft and Sudbury areas of Ontario have been collected. Work is continuing on the measurement of the directions of the remanent magnetism in these rocks.

196. Larochelle, A., Geol. Surv., Canada:
Construction of Curie-point Meter, 1957.
To obtain an instrument capable of accurately measuring the Curie point of ferromagnetic minerals.
An Investigation Into the Cause of Reversed Magnetic Polarization of Rocks from Yamaska and Brome Mountains, Que., 1955-58; Ph.D. thesis, McGill University.

197. Sargent, H. McCammon, J.W., Brown, A. Sutherland, and McKechnie, N.D., B.C. Dept. Mines:
Airborne Magnetometer Investigations, 1956-
Airborne surveys have been made on Texada Island, Quadra Island, and areas on Vancouver Island near Campbell River, and from Neurotsis Inlet to Head Bay. Surveys have been made with fixed wing aircraft and with helicopter, and the usefulness of the two methods in areas of strong relief compared. Areas of magnetic highs on Texada Island, Quadra Island and near Campbell River have been investigated on the ground.

198. MacLaren, A.S. and Larochelle, A., Geol. Surv., Can.:
Relations of Bedrock Geology to Aeromagnetic Anomalies, Eastern Towsnhips, Quebec, 1955-57.
The objective is to enhance ability to make geological interpretations of aeromagnetic maps, explain aeromagnetic anomalies, and to associate and correlate aeromagnetic anomalies with economic geology.

199. Morley, L.W., MacLaren, A.S., Bower, M.E. and Langlois, R., Geol. Surv., Canada:
Interpretation of Aeromagnetic Data for Operation MacKenzie, 1956-57.
To aid Operation Mackenzie (item 38) by interpreting available aeromagnetic data for depths to basement rocks and for position of geological boundaries in basement rocks.

200. Morley, L.W., and Bower, M.E., Geol. Surv., Canada:
Compilation and Evaluation of results of an Aeromagnetic Test Survey in New Brunswick, 1958-59.
Various methods of depth determination will be tried out using data obtained in 1955 from high altitude test survey over a granite batholith.

201. Morley, L.W. and Bower, M.E., Geol. Surv., Canada:
Interpretation of Aeromagnetic Maps of Alberta with view to Determining Depth and Contour of Basement, 1958-59.

202. Owens, K.H., Geol. Surv., Canada:
Airborne Magnetometer and Scintillation Counter Survey, Northern Manitoba, National Topographical Index, Map Sheets 54M, and 64F, K, N, O and P.
To aid geological mapping and prospecting and serve as temporary substitutes for geological maps.

203. Potter, R.R., Univ. of New Brunswick:
Correlation of Aeromagnetic Anomalies and Geology in New Brunswick, 1956-57; M.Sc. thesis.

204. Roy, J.L., Dominion Observatory:
Rock Magnetism, 1955-
Study of palaeomagnetic history of the earth's magnetic field, and magnetic analyses of drill cores from suspected meteor craters.

205. Serson, P.H., and Hannaford, W.W.L., Dominion Observatory:
Three component Airborne Magnetometer Survey of Canada, East of the 95th Meridian, 1957.
The continuation of a magnetic survey of Canada employing the Dominion Observatory magnetometer measuring declination, horizontal intensity, and vertical intensity.

206. Strongway, D., Univ. of Toronto:
Magnetic Properties of Rocks, 1957-58; M.A. thesis.
An apparatus for the determination of the temperature variation of the susceptibility of rocks is being constructed. It is hoped to reach temperatures of about 700°C.

207. Uffen, Robert, Carmichael, Charles and Agarwal, R., Univ. of Western Ontario:
Palaeomagnetism, 1957-60.
A remanent magnetometer is under construction for the measurement of the direction of magnetization of old rocks as a means of investigating possible reversals of the earth's magnetic field throughout geologic time. A suite of specimens from the inversely magnetized Allard Lake ilmenite body has been collected.

Radioactive

208. Burwash, R.A., Univ. of Alberta:
Precambrian Basement of Western Canada, 1950-60.
Current work consists of studies of regional rock assemblages, relation of rock type to geophysical maps, and potassium argon dating of core samples. See "Reconnaissance of Subsurface Precambrian of Alberta", Bull. Assoc. Petrol., Geol., Vol. 41, 1957, pp. 70-103.

209. Folinsbee, R.E., Baadsgaard, H., and Lipson, J., Univ. of Alberta:
Problems in Nuclear Geochronology, 1954-
An argon extraction line and rare-gas mass spectrometer suitable for the determination of the potassium-argon age of young potassic minerals are being set up in the Departments of Geology and Physics. See "Late Cretaceous Geochronology", Assoc. Inter de Volcanologies, XI General Assembly, I.U.G.G., Toronto, Sept. 1957, p. 19; "The Crowsnest Volcanics and Cretaceous Geochronology", Seventh Annual Field Conference Alberta Society of Petroleum Geologists, Waterton, September, 1957, pp. 20-26 (guide book).

210. Fairbairn, H.W., Cnt. Dept. Mines (part time), Massachusetts Institute of Technology:
Age Determinations from Precambrian Rocks of Northern Ontario Using Argon and Strontium Methods, 1957.

211. MacCallum, D.S.L., Geol. Surv., Canada:
Compilation of Gamma Radiation Maps, 1954-
The compilation of airborne scintillation records into gamma radiation maps to compare (1) the radioactivity of various rock types and (2) the general background activity of various geological provinces.

212. Pollock, Gerald, Brownell, G.M., and Wilson, H.D.B., Univ. of Manitoba:
Dating of Intrusions in the Kenora, District, Ontario, using the Larsen Method, 1956-
The alpha counting equipment has been built and analyses of test specimens and three granites completed. Samples collected in 1957 are being processed for zircon recovery.

213. Ross, D.B. and Blanchard, J.E., Dalhousie Univ. and Nova Scotia Research Council:
Carbon 14 Dating Using Proportional Counter, 1957-58.

214. Russell, R.D. and Ozima, M., Univ. of Toronto:
The Potassium-Argon Method of Geological Age Determinations, 1951-

215. Russell, R.D., Farquhar, R.M., and Mair, J.A., Univ. of Toronto:
Isotopic Constitution of Common Leads, 1952-
The use of the isotopic ratios of lead in rocks and in lead minerals to study the processes of lead mineralization and their relation to major orogenic processes. See "Isotopic Analyses of Leads from Broken Hill, Australia", Trans. Amer. Geophysical Union, 38, 557 (1957).

216. Sikka, Desh B., McGill University:
Radioactivity Associated with Oilfields, 1955-59; Ph.D. thesis.
A radiometric survey of Redwater Area, Alberta made in 1955 suggested the possibility of a partial halo 1 1/2 miles west of the producing zone. At present, surface samples are being studied including analysis for K^{40}, uranium and thorium families, nickel, vanadium, zinc, etc.

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 the concentrations for specific elements and make chemical concentrations of specific elements for isotope analyses. By means of the mass spectrometer to make analyses of the above and to compute the age of the minerals and enclosing rocks. See "Nature", August, 1956.

218. Uffen, Robert, McConnel, D. and Murty, R., Univ. of Western Ontario:
Multiple scattering of Gamma Rays and Neutrons in Rocks, 1955-59.
Experiments are being carried out to determine the effects of multiple scattering on the energy spectrum from radiation from a source of gamma rays and/or neutrons embedded in rock. See "Effects of Multiple Scattering on the Energy Spectrum of a Buried Gamma Ray Source" (Abstract), A.I.M.E. Annual Meeting, 1957.

Seismic

219. Beck, A., N.R.C. Post-Doctoral Fellow, Uffen, R.J., and Zelenka, F., University of Western Ontario.
Attenuation of Seismic Waves, 1957-59.
A study of the attenuation of the various frequency components of seismic waves in situ, particularly in shallow Pleistocene sediments, by utilizing a "thumper" as an energy source.

220. Blanchard, J.E., Nova Scotia Research Foundation:
Application of Seismic Methods of Geophysical Exploration to Geological Problems in Nova Scotia, 1956-
Geophysical Studies of the Sedimentary Basins of Nova Scotia, 1952-
Gravity, magnetic and seismic studies are being conducted in the basins to help in the interpretation of the geology.
A Study of Energy Released by "Bumps" in the Springhill Coal Mines Area, Nova Scotia, 1956-58.
In co-operation with the Dominion Observatory and the Mines Branch of the Dept. Mines and Technical Surveys, Ottawa, records of the micro-seismic activity were obtained using a Willmore seismograph. The number and time of the micro-seisms 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 in co-operation with the Nova Scotia Research Foundation.

221. Hodgson, E.A., Smith, W.E.T., Dominion Observatory:
Seismicity of Eastern Canada, 1925-1960.
Dr. Hodgson has compiled a complete history of the seismicity of Eastern Canada by searching old manuscripts. The Seismological Service of Canada has provided records of all Canadian earthquakes since 1925. This material has not been published in a comprehensive catalogue. Mr. Smith is preparing such a catalogue using the data provided by Hodgson. The first paper will cover the period to 1928, and is expected to be available early in 1958. For subsequent papers Smith will determine all epicentres, using modern techniques.

222. Hodgson, J.H., Stevens, Anne, Dominion Observatory:
Fault Plane Project, 1949-
By studying the direction of first motion in earthquake records, it is possible to determine the strike and dip of the fault and the direction of slipping in the fault which causes the earthquake. The Seismological Division attempts fault plane solutions for all major earthquakes. See "Nature of Faulting in Large earthquakes", Bull. Geol. Soc. Am., 68, 611-643 (1957).

223. Milne, W.G., and White, W.R.H., Dominion Observatory:
Seismicity of Western Canada, 1951-
See "Seismic Activity in Canada, West of 113th Meridian, 1841-1951" Pub. Dominion Observatory, 18, 117-146, 1956.

224. Seismological Division, Dominion Observatory:
Seismological Service of Canada, 1904-
The Seismological Division maintains a network of 11 seismograph stations across Canada. Records from these stations are reported in regular quarterly bulletins. These records are available for loan to any seismologist and form a basis for the seismological research work of the Division.

225. Willmore, P.L., Milne, W.G., and White, W.R.H., Dominion Observatory:
Study of Crustal Structure-Ripple Rock, B.C., 1954-58.
When the Dept. of Public Works blows up Ripple Rock, a network of seismograph stations will be operated along the main line of the Canadian Pacific Railroad as far east as Banff. Commercial geophysicists will operate stations in the Prairie Provinces. The work will be under supervision of Dr. Willmore. In preparation for this event, and in order to determine local structure, Milne and White, with co-operation of the Pacific Naval Laboratories and the Royal Canadian Navy, have recorded the explosions from precisely timed and located depth charges. Before Ripple Rock is blown up detailed knowledge of the local structure will be available. From the combined work it should be possible to define seismic velocities in British Columbia, and to determine whether the mountains have roots or not.

226. Willmore, P.L., and Britton, W.G.B., Dominion Observatory:
Directionally Sensitive Seismic Recording, 1957-60.
It is proposed to record earthquakes on magnetic tape or photographic film in such a way that the records can be analysed for the direction of approach of particular rays; this technique is already successfully used in seismic prospecting, but extension to earthquake recording presents severe problems. It is hoped that if an approximate recorder can be built, it will be possible to settle such questions as to whether shear waves traverse the core or whether longitudinal waves traverse the inner core. The possibilities of the technique are extremely interesting, but the initial problem-the design of the equipment-will take about two years.

General Problems

227. Beck, A., N.R.C. Post-Doctoral Fellow, Misener, A.D., and Manuel, P., Univ. of Western Cntario:
Measurement of the Thermal Conductivity of Rocks, 1957-58.
An improved divided bar apparatus is under construction for the measurement of the thermal conductivity of rocks in the laboratory and improved thermal conductivity probes are under construction and test, for measurements in bore holes. See "Measurement of the Thermal Conductivity of Rocks by Observations in Bore Holes", Australian Journal of Physics, Vol. 9, pp. 286-296, 1956.

228. Beck, A.E., and Misener, A.D., Univ. of Western Cntario:
Determination of Geothermal Gradient and Heat Flow in Southwestern Cntario, 1957-60.
Arrangements have been made to use suitable drill holes provided by the Union Gas Company, Imperial Cil Ltd. and other companies. An attempt will be made to obtain a reliable coverage of the area rather than accepting evaluations from a few isolated places.
Measurement of Thermal Conductivity of Rock Samples, 1957-
An improved divided bar apparatus has been designed and constructed. It will be used to determine the thermal conductivity of selected types of rocks such as the high density peridotites from Gaspe region. It will also be used to find the thermal conductivity of core samples in conjunction with the measurement of temperature gradients for heat flow determinations.

229. Blackwell, J.H., Univ. of Western Cntario:
Development of Cylindrical Probe for Conductivity and Diffusivity Measurements, 1955-58.
Laboratory tests have confirmed Dr. Blackwell's theory regarding axial flow corrections. Work is proceeding on the investigation of the effect of a considerable water layer around the pole. A pressure tight and water tight probe is being constructed.

230. Grant, F.S., Univ. of Toronto:
Mathematical Analysis of Geophysical Data, 1954-
See "A Problem in the Analysis of Geophysical Data", Geophysics, Vol. 17, pp. 309-344, 1957.

231. Innes, M.J.S., Dominion Observatory, and Pearson, W., Saskatchewan Dept. of Mineral Resources:
Geophysical Investigations of Fossil Craters; 1953-
Geophysical Investigations have been carried out over circular topographic features near Brent, Ontario, Holleford, Ontario, Franktown, Ontario, Macamic, Quebec, and Reindeer Lake, Saskatchewan.
See "Possible Meteorite Crater" at Deep Bay, Saskatchewan," Jour. Roy. Astron. Soc. Canada, Vol. L1, No. 4, 1957.

232. Uffen, Robert, Blackwell, J.H. and Ellis, Robert, Univ. of Western Ontario:
Determination of Optimum Prospecting Plans, 1957-58.
Slichter's Method of determining the completeness of search, the discovery hole economy, and the optimum prospecting profit ratio, is being extended to include targets at variable depth.

MINERALOGY

X-ray, Crystal Structure, Specific Minerals

233. Berry, L.G., McKelvie, D. and Chrisholm, I., Queen's Univ.:
Crystal Structure Studies and Chemical Studies on Cobalt-Nickel-Iron Arsenides, 1950-
This project includes (1) the crystal structure study of pararaurmelsbergite and safflorite and (2) the relation of chemical composition to variation in X-ray data for the safflorites and glaucodot.

234. Brackenridge, A. and Burley, B.J., McMaster Univ.:
Investigation of Cell Dimension Variation of Analcite Within Its Stability Field, 1957-58.
The stability field is being investigated within a range of pressures of 5,000 to 30,000 p.s.i., cell dimensions measured by powder method using a diffractometer.

235. Burley, B.J., McMaster Univ.:
Study of Zeolite Stabilities, 1957-
Stabilities will be studied within range of 5 to 30,000 p.s.i. and temperatures of 100 to 500°C.
Determination of Centrosymmetry in Scapolite by X-ray Methods, 1957.
Wilson's statistical method based on intensities obtained from Weissenburg photographs will be used.

236. Ferguson, R.B. and Davies John, Univ. of Manitoba:
Crystal Structure of the Feldspars, 1950-

237. Freemen, E.B., and Burley, B.J., McMaster Univ.:
Investigation of Cell Dimension Variation of Nepheline Within its Stability Field, 1957-58.
The stability field is being investigated within a range of pressures of 5,000 to 30,000 p.s.i. and cell dimensions measured by powder method using a diffractometer.

238. Dawson, K.A. and Maxwell, J.A., Geol. Surv., Canada:
Loss of Na and K in Plagioclase Feldspar Glasses Prepared for Identification Purposes. 1958.

239. Hogarth, Donald D., McGill Univ.:
Certain Minerals of the Pyrochlore and Betafite Groups, 1957-58; Ph.D. thesis.

240. Hughson, M.R., Mines Branch, Dept. Mines and Technical Surveys:
Composition of Britholite from Cka, Quebec, 1957-58.

241. Kaiman, S., Mines Branch, Dept. Mines and Technical Surveys:
The Ideal Composition of Brannerite, 1956-58.
An attempt to prepare a synthetic compound from oxides.

242. Nickel, E.H., Mines Branch, Dept. Mines and Technical Surveys:
Study of a Native Nickel-Iron Alloy in Serpentenized Rock from Eastern Townships of Quebec, 1957-59.

243. 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, 1957-58.
This lithium-bearing amphibole has been reported only from Sweden. The present investigation of the first Canadian occurrence includes geological and mineralogical studies and chemical and X-ray diffraction analysis.

244. Nuffield, E.W., Univ. of Toronto:
An X-Ray Study of Lung Tissue Affected by Silicosis, 1956-
This is part of a large study under the direction of Dr. A.M. Fisher, Connaught Medical Research Laboratories.

245. Perrault, Guy, Univ. of Montreal:
Structure of the Potash Feldspars, 1957-60.
See "La Structure Atomique des Feldspaths", L'Ingeneeur, 1957-58.

246. Robinson, S.C. and Sabina, A.P., Geol. Surv., Canada:
Variation on Lattice Parameter of Specimens of Pitchblende and Uraninite from Various Localities, 1949-
The purpose is to ascertain whether the variations can be attributed to (1) different mineralogical provinces, (2) age of the deposits, (3) degree of alteration, (4) variations in solid solution series. See data on uraninite and thorianite on Grenville Rocks in American Mineralogist, July-August, 1955.

247. Traill, R.J., and Sabina, A.P., Geol. Sur., Canada:
Reference Collection of X-Ray Powder Photographs of Minerals, 1949-
Involves collection of photographs of material identified accurately by chemical or other means, and the development of new techniques in powder photography.

248. Van Loan, P. and Nuffield, E.W., Univ. of Toronto:
An X-Ray Study of Triclinic Minerals, 1957-58.

General Problems

249. Benson, David G., McGill Univ.:
Mineralogy of New Brunswick Sulphide Ore Deposits, 1957-59; Ph.D. thesis.
The study is concerned with temperature zoning of the deposits.

250. Buchanan, R.M., Mines Branch, Dept. of Mines and Technical Surveys:
Mineralogical Study of Canadian Clays and Shales with Special Reference to Those of Interest in the Ceramic and Construction Industries, 1957-

251. Champ, W.H., White, W.F., and Malone, J.P., Geol. Surv., Canada:
Spectrographic Analysis of Minerals, Rocks and Ores, 1953-
Involves the calibration and standardization necessary to permit quantitative spectrographic analyses of minerals, rocks and ores.

252. Cumming, K.H., Univ. of Toronto:
Mineralogy of the Bernic Lake Lithium-Bearing Pegmatite, 1957-58; M.A.Sc. thesis.

253. Dell, Carol I., Univ. of Toronto:
Mineralogical Analysis of Some Pleistocene Sands of Southern Ontario, 1957-58; M.A. thesis.

254. Dell, Carol I., and Mirynech, E., Cntario Research Foundation:
Mineralogical Composition of Sand in Some Cntario Tills and Sediments, 1956-59.
See abstract, Can. Mining Jour., July, 1958, p. 97.

254-A. Girault, J.P., Quebec Dept. Mines:
Identification of Minerals in Polished Sections by Means of Curves Showing Reflectivity and Wave Length, 1957-
Using a recording spectrophotometer, scannings are made from 4,000A to 7,000A, and relative reflectivity values obtained continuously. Relative reflectivities are plotted on a graph against wave lengths. The graphs so far obtained for a limited number of minerals appear to be unique, although they exhibit some differences for different specimens of a given mineral. The influence of the quality of the surface, crystallographic orientation and variations in chemical composition will be investigated. Slits of appropriate size and shape allow study of very small areas, which might otherwise be unidentifiable.

255. Gorman, D.H., and Deane, R.E. Univ. of Toronto:
Study of Formation of Clay Minerals in Weathering of Minerals and Rocks, 1956-61.

256. Halferdahl, L.B., Research Council of Alberta:
Heavy Minerals in River Sands of Alberta, 1957.

257. Hawley, J.E. and Maycock, Ian D.
Stratigraphy and Mineralogy of Ordovician Limestones near Kingston, Cntario, 1957-59.
This project is being carried out with the cooperation of the Building Research Division, National Research Council and is designed to throw some light on variations in composition of the limestones of this area and their behaviour in concrete aggregates.

258. Hawley, J.E. and Stanton, R.L., Queen's Univ.:
Mineralogy and Geochemistry of the Sudbury Nickel Ores, 1956-58.
Involves detailed mineralographic study of some hundreds of ore specimens combined with detailed spectrographic and X-ray studies of the minerals for Co/Ni ratios, selenium content, and precious metals (platinum group). See "Intergrowth of Pentlandite and Pyrrhotite", Econ. Geol. 52, 1957, p. 132-139.

259. Haycock, M.H., Mines Branch, Dept. Mines and Technical Surveys:
Development of Apparatus for Determining the Spectral Reflectivity of Ore Minerals, 1955-58.
This is the first step in a project designed to exploit the application of electronics to the field of mineralogy.

260. 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.

261. Mirynech, E., Univ. of Toronto:
Mineralogical Study of Some Drift Soil Profiles of Southern Ontario, 1957-58; M.A. thesis.

262. Patchett, J.E. and Milne, V.G., Univ. of Toronto:
Accessory Minerals in the Uranium Bearing Conglomerate, Blind River Area, Ontario, 1956-58; Ph.D. and M.A. theses.
Patchett is investigating the radioactive minerals present to determine the relative abundance and importance of the minerals, and Milne, working with the same material, will investigate the proportions and nature of the other accessory minerals.

263. Pienaar, P.J., Queen's Univ.:
Stratigraphy and Mineralogy of the Elliot Group in the Quirke-Elliot Lake Syncline, Blind River Area, Ontario, 1956-58; Ph.D. thesis.
Will include study of the sedimentary structure and lithological variations in the Elliot Group, including the radioactive oligomictic conglomerates, with emphasis on the distribution of radioactivity and sedimentary environment.

264. Morse, S. Anthony, McGill Univ.:
Chemical Variations in Metamorphic Rocks, 1956-58; M.Sc. thesis.
A study of the iron-magnesium ratios in garnet and chlorite, also biotite and hornblende to some extent.

265. Perrault, Guy, Ecole Polytechnique, Univ. of Montreal:
Mineralogy and Petrography of the Cka Alkaline Intrusives, 1957-60.
Results of study of certain amphiboles will be published shortly; work will continue on other minerals including pyroxenes, pyrochlore, betafite, nepheline etc.
Fusion Method in X-Ray Spectrographic Analysis, 1957-58.
An investigation of the effect of extreme variations in groundmass in the fusion method of x-ray spectrographic analysis.

266. Rose, E.R., Geol. Surv., Canada:
Mineralogical Investigation of Gordon Lake-Werner Lake Nickel-Copper-Cobalt Deposits, Ontario, 1956-57.
Mineralogical Investigation of Timagami Island Copper-Nickel-Cobalt Deposits, Cntario, 1957.

267. Sabourin, R.J.E., Universite Laval:
Mineralogy and Geology of Meach Lake Complex, Quebec, 1958.

268. Shepherd, N., Univ. of Toronto:
Petrology and Mineralogy of the Cross Lake Area, Ungava Quebec, 1957-59; Ph.D. thesis.

269. Thompson, R.M., Univ. of British Columbia:
Mineragraphic Studies of Cres--a continuing project.
Cres presently under investigation include Giant Yellowknife, Craigmont Copper Mines, and French Gold Mines Ltd., (Hedley Area, B.C.)
Mineralogical Study of Some Beach Sands from Queen Charlotte Island, 1957.

270. Traill, R.J., Geol. Surv., Canada:
Mineralogy of the Blind River Uranium Deposits, 1956-58.

MINERAL DEPOSITS

Base Metals

271. Assad, Robert J., McGill Univ.:
Geology of the East Sullivan Copper-Zinc Deposit, Quebec, 1955-57; Ph.D. thesis.

272. Bannatyne, Barry, Univ. of Manitoba:
Economic Geology and Metal Distribution in the Rankin Inlet (N.W.T.) Copper Nickel Deposit, 1957-58; M.Sc. thesis.

273. Benson, David G., McGill Univ.:
Mineralogy of New Brunswick Sulphide Ore Deposits, 1957-59; Ph.D. thesis.
The study is concerned with temperature zoning of the deposits.

274. Berrange, Jean, McGill Univ.:
Dispersion in Humus and Moss of Zinc, Nickel, Copper and Lead from Mineralized Zones in a Glaciated Precambrian Terrain, 1956-58; M.Sc. thesis.

275. Boyle, R.W., Geol. Surv., Canada:
Geochemistry of the Bathurst-Newcastle District, New Brunswick, 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.

276. Carr, J.M., B.C. Dept. Mines:
Study of Guichon Batholith with Particular Reference to Mineralization in Highland Valley, B.C., 1957-59.

277. Coates, Colin, Queen's Univ.:
Copper-sulphide Mineralization in a Dioritic Dyke, Uchi Lake Area, Cnt., 1957-58; M.A. thesis.
The study of the mineralization and wall rock alteration of a copper-iron sulphide zone.

278. Hawkins, William M., McGill Univ.:
Geology of Goshen Prospect, Goshen, N.B., 1956-58; M.Sc. thesis.
Evaluation, description and postulated origin of a copper carbonate deposit in sedimentary rocks.

279. Halferdahl, L.B., Research Council of Alberta:
Heavy Minerals in River Sands of Alberta, 1957.

280. Hawley, J.E., and Westervelt, R.D.:
Geochemical Study of Lead Zinc Deposit in Southeast British Columbia, 1957-58.
A study (in cooperation with Prof. F.G. Smith, Univ. of Toronto) of the variations in composition of sphalerite and other sulphides with temperature of formation.

281. Hawley, J.E. and Stanton, R.L., Queen's Univ.:
Mineralogy and Geochemistry of the Sudbury Nickel Ores, 1956-58.
Involves detailed mineralographic study of some hundreds of ore specimens combined with detailed spectrographic and X-ray studies of the minerals for Co/Ni ratios selenium content, and precious metals (platinum group). See "Intergrowths of Pentlandite and Pyrrhotite," Econ. Geol. 52-1957, p. 132-139.

282. Hawley, J.E. and Nichol, Ian, Queen's Univ.:
Partition of Trace Elements in Contemporaneous Sulphides of Copper-Iron Sulphide Bodies, 1956-58.
Trace elements are being determined particularly in pyrite, pyrrhotite, and chalcopyrite which have been concentrated from single ore specimens. Elements include Co, Ni, Pb, Zn, Sn, Cr, Te, V, and Se.
See abstract, Can. Mining Journal, July, 1958, p. 95.

283. Jeffrey, Gordon W., McGill Univ.:
Geology of Campbell Chibougamau Mine, Que., 1956-58; Ph.D. thesis.

284. Jones, Richard A., Univ. of New Brunswick:
Genesis of Massive Sulphide Bodies in the Bathurst District, N.B., 1957-59; M.Sc. thesis.

285. Turner, William R., McGill Univ.:
Geology of Vandome Mine, Piedmont Township, Quebec, 1957-58; M.Sc. thesis.

286. Lyall, H.B., Universite Laval:
Geology of Hainaut-Champagne Area, Pontiac County, Quebec, 1956-58; D. Sc. thesis.
A study of the gneisses of the main gneiss belt of the northwestern part of the Grenville sub-province. The origin of some copper-nickel deposits will be considered.

287. 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.

288. Patterson, J., Manitoba Dept. Mines and Natural Resources:
Metamorphism and Nickel Sulphide Mineralization in the Mystery-Moak Lake Area, 1958- , Ph.D. thesis, Univ. of Manitoba.
A co-operative project with the Univ. of Manitoba to investigate the relationship between metamorphism and the concentration of nickel sulphides and/or the conversion of the nickel silicates to sulphides.

289. Petruk, William, McGill Univ.:
A Study of an Area Along Clearwater River, New Brunswick Including Copper-Zinc-Lead Deposits, 1956-58; Ph.D. thesis.
Using X-ray diffraction methods, the chlorites around the deposits will be studied to find out if there is evidence of zoning.

290. Raychaudhrui, S., McGill Univ.:
Trace Elements in the Sulphide Deposits of Chibougamau District, Quebec, 1957-58; Ph.D. thesis.

291. Relly, Bruce H., McGill Univ.:
Geological History and Control of Mineralization at Buchans, Newfoundland, 1956-58; Ph.D. thesis.

292. Rose, E.R., Geol. Surv., Canada:
Mineralogical Investigation of Gordon Lake-Werner Lake Nickel-Copper-Cobalt Deposits, Cntario, 1956-57.
Mineralogical Investigation of Temagami Island Copper-Nickel-Cobalt Deposits, Cntario, 1957.

293. Russell, R.D. Farquhar, R.M., and Mair, J.A., Univ. of Toronto:
Isotopic Constitution of Common Leads, 1952-
The use of isotopic ratios in rocks and in lead minerals to study the processes of lead mineralization and their relation to major orogenic processes. See "Isotopic Analyses of Leads from Broken Hill, Australia", Trans. Amer. Geophys. Union, 38, 557 (1957)

294. Stockwell, C.H., Geol. Surv., Canada:
Bathurst District, N.B., 1955-57.
Detailed mapping with emphasis on sulphide deposits.

295. Sims, W.A., Mount Allison Univ.:
Adsorption of Base Metals on clays, 1955-

296. Stanton, R.L., (N.R.C. Post-doctorate Fellow) Queen's Univ.:
Abundances of Major Elements in Some "Conformable" Sulphides Orebodies, 1954-58.
The investigation deals with the general trends and variability of abundance of the individual metals, with their correlation as pairs, and their mutual behaviour as a group of three. Several persistent features, apparently of principal rather than province, have appeared so far. It is hoped that these may guide physical-chemical and perhaps biological investigations into the possible mode of emplacement of ores.

297. White, W.H., Univ. of British Columbia:
Economic Geology of Highland Valley Area, B.C.
See "Geology and Mineral Deposits of Highland Valley, B.C.", Can. Inst. Min. Met., Bull., August, 1957.

Ferrous

298. Auger, P.E. and Beland, Rene,
Universite Laval:
Structural Features of the Iron Formation of Ungava, 1957-58.

299. Giblin, P.E., Univ. of Toronto:
A Study of the Magnetite Deposits of Mayo Township, Ontario, 1957-58; Ph.D. thesis.

300. 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.

301. Holland, S.S., B.C. Dept. of Mines:
Investigation of Beach Sands, Mainly for Iron and Titanium Content, 1957-58.
Ocean beach sands at Wreck Bay, Cape Caution and Graham Island were examined and sampled, and laboratory study will follow. In connection with the Graham Island study, observations on the glacial history of the area were made by H.W. Nasmith.

302. Mawdsley, J.B., Univ. of Saskatchewan:
Iron Occurrences in Northwestern Saskatchewan, 1956-58.

303. Stirling, R.J., Univ. of Toronto:
A Study of the Iron Deposits of Mount Reed, Quebec, 1957-58; M.A. Sc. thesis.

304. Wright, C.M. and Jolliffe, A.W., Queen's Univ.:
Origin of the Sulphurous Zones at Steeprock Lake, 1957-58.

Other Metals

305. Johnston, Frederick J., Univ. of New Brunswick:
Geology of the Stratmat Ore Body, Pine Lake Area, Northumberland County, N.B., 1957-58; M.Sc. thesis.
A petrographic study of ore and wall rock from drill core samples.

306. Quinn, H.A., Geol. Surv., Canada:
Investigation of Chromite Deposits of Canada, 1951-57.
To supplement the compilation of all available data on chromite occurrences in Canada.

307. Rowe, R.B. and Mulligan, R., Geol. Surv., Canada:
Geological Study of the Lithium-Beryllium Pegmatites of Canada, 1953-57.
See G.S.C. Papers, 54-5, 55-26, and 57-3.

308. Sinclair, A.J., Univ. of Toronto:
An Evaluation of the Erzberg Molybdenum Deposit, Greenland; 1957-58;
M.A. Sc. thesis.
See abstract Can. Mining Jour., July 1958, p. 96.

309. Stevenson, John S., McGill Univ.:
Detailed Study of Bridge River Gold Camp, B.C., 1948-58.

Radioactive Deposits

310. Bell, C.K., Geol. Surv., Canada:
Milliken Lake Map-area, Sask., 1954-59.
Detailed mapping with special reference to radioactive mineral deposits.

311. 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.

312. Lang, A.H. and Griffith, J.W., Geol. Surv., Canada:
Field Studies of Uranium Deposits, 1958.

313. Lang, A.H., and Steacy, H.R., and Staff, Geol. Surv., Canada.
Laboratory Investigation of Samples of Radioactive Substances, 1945-
To maintain a complete inventory of all occurrences of uranium and thorium deposits in Canada; field examinations of radioactive deposits; and the laboratory examination of samples of radioactive minerals and ores.

315. Morrison, Euen R., McGill Univ.:
Geology of Uranium Bearing Precambrian Allik Series, Central Labrador;
1957-59; Ph.D. thesis.

316. Patchett, J.E. and Milne, V.G., Univ. of Toronto:
Accessory Minerals in the Uranium Bearing Conglomerate, Blind River area, Ontario, 1956-58; Ph.D. and M.A. theses.
Patchett is investigating the radioactive minerals present to determine their relative abundance and importance, and Milne, working on the same material, will investigate the proportions and nature of the other accessory minerals.

317. Pienaar, P.J. Queen's Univ.:
Stratigraphy and Mineralogy of the Elliot Group in the Quirke Elliot Lake Syncline, Blind River, Ontario, 1956-58; Ph.D. thesis.
Will include study of the sedimentary structures and lithological variations in the group including the radioactive oligomictic conglomerates, with emphasis on the distribution of radioactivity and sedimentary environment.

318. Roscoe, S.M. and Pienaar P.J., Geol. Surv., Canada:
Radioactive Deposits Between Sault Ste. Marie and Cobalt, Including Blind River Camp, 1954-57.
Detailed mapping with particular reference to those deposits associated with conglomerate and other sedimentary strata; See Geol. Surv., Canada Paper 56-7.

319. Steacy, H.R., Griffith, J.W. and Traill, R.J., Geol. Surv., Canada:
Laboratory Investigation of Uraninite in Greywacke from Creelman Township, Sudbury District, Cnt., 1958.
To describe the occurrence, mineralogy, age and other geological features of this unusual radioactive deposit and demonstrate (or otherwise) the presumably detrital origin of the uraninite found in greywacke interlayered with Gowganda conglomerate.

320. Traill, R.J., Geol. Surv., Canada:
Mineralogy of the Blind River Uranium Deposits, 1956-58.

321. Tremblay, L.P., Geol. Surv., Canada:
Beaverlodge Area, Lake Athabasca, Sask., 1952-1957.
Detailed mapping with special reference to radioactive mineral deposits. See Geol. Surv., Canada Papers 54-15, 55-28, and Map 18-1956.

322. Underwood, E.O., Univ. of New Brunswick:
Occurrences of Radioactive Minerals in New Brunswick, 1957-58, M.Sc. thesis.

Industrial Minerals

323. Baird, D.M. and McKillop, J.H., Newfoundland Dept. Mines and Resources:
Gypsum Deposits at Flat Bay, Newfoundland, 1956-58.

324. Baird, D.M., Newfoundland Dept. Mines and Resources:
Relations of Gypsum-Anhydrite-Limestone in Lower Carboniferous of Western Newfoundland, 1954-58.

325. Boyle, R.W., Geol. Surv., Canada:
Geochemical Study of the Barymin Barite Deposit, Walton, Nova Scotia, 1957.
To obtain and interpret data covering the geochemistry of barium in the deposit, and adjacent strata and thereby afford useful information concerning the origin of the deposit, its possible extension, and the possible occurrence elsewhere of commercial barite deposits.

326. Buchanan, R.M., Mines Branch, Dept. Mines and Technical Surveys:
Mineralogical Study of Canadian Clays and Shales with Special Reference to Those of Interest in the Ceramic and Construction Industries, 1957-

327. Burret, P.E., Quebec Dept. 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.

328. Cumming, K.H., Univ. of Toronto:
Mineralogy of the Bernic Lake Lithium-Bearing Pegmatite, 1957-58; M.A. Sc. thesis.

329. Haw, V.A. and Bayne, R.L., Mines Branch, Dept. Mines and Technical Surveys:
Properties of Rocks Related to their Use as Construction Materials, 1956-
See "Concrete Aggregate Production", Can. Inst. Min. Metallurgy, Trans., Vol. LX, 1957, pp. 336-342.

330. Hogg, William A., McGill Univ.:
Building Stones of Eastern Canada, 1954-58; Ph.D. thesis.
Investigation includes moisture effects on building stones and elasticity and flexibility problems and their relation to pore space.

331. Edmunds, F.H., Univ. of Saskatchewan:
Study of Stratigraphy Including Sedimentary Petrology of Strata Penetrated by Shaft of Potash Company of America, 15 miles East of Saskatoon.

332. Hawley, J.E., and Maycock, Ian D., Queen's Univ.:
Stratigraphy and Mineralogy of Ordovician Limestones near Kingston, Ontario, 1957-59.
This project is being carried out with the cooperation of Building Research Division, National Research Council and is designed to throw some light on variations in composition of the limestones of this area and their behaviour in concrete aggregates.

333. McCammon, J.W., B.C. Dept. Mines:
Investigation of Clay, Shale and Limestone Occurrences Prince George Area, John Hart Highway, and Peace River areas, 1957.

334. Nickel, E.H., Mines Branch, Dept. Mines and Technical Surveys:
Mineralogical and Geological Investigation of a Canadian Occurrence of Holmquistite, 1957-58.
This lithium bearing amphibole has been reported only from Sweden. The present investigation of the first Canadian occurrence includes geological and mineralogical studies and chemical and X-ray diffraction analysis.

335. Rose, E.R., Geol. Surv., Canada:
Heavy "Rare Earths" (Gadolium, etc.) in the Grenville Region, 1957.
To provide information on possible sources of the heavier "rare earths" and data useful in prospecting, evaluating, and exploring such deposits.

336. Shea, Frank F., Dalhousie Univ.:
Observations on Geology of Barite Deposit at Walton, N.S. 1957-58; M.Sc. thesis.
See abstract, Can. Mining Jour., July 1958, p. 97.

Petroleum

337. Belyea, H.R., Geol. Surv., Canada:
Sub-surface Studies of the Devonian System of the Alberta Plains, 1951-57.
The preparation of cross-sections from data from cores, samples, and electric and radioactivity logs to show correlation 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.
See Geol. Surv., Canada Papers 53-3, 55-38.
Petrographic Study of the Upper Devonian Reef-bearing Woodland Group of Central Alberta, 1953-57.
A study of the micro features of reef and non-reef deposits to provide information on types of porosity and the characteristics required for better understanding of the causes of accumulation of oil and gas.

338. 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 (1) in correlation and dating of strata at and near petroleum-bearing horizons and (2) in determining the source rock from which petroleum in various fields was derived originally.

339. Brady, W.B., Geol. Surv., Canada:
Carboniferous Stratigraphy in the Central Foothills, Alberta between Nordegg and Banff, 1954-1958.
To obtain data related to the detailed correlation of the strata, their lateral variations, their potentialities as possible sources of petroleum and natural gas, and their suitability as reservoir rocks for these fuels.

340. Caley, J.F. and Sanford, B.V., Geol. Surv., Canada:
Drift Thickness and Bedrock Topography in Southern Ontario, 1948-
The objective is to determine the pre-Pleistocene bedrock topography and the drift thickness from bore hole data and to deduce the pre-glacial drainage and the probable location of reservoirs of groundwater. Because the pre-Pleistocene topography may reflect the underlying structure of the bedrock, this knowledge assists in the search for oil and gas.
See Geol. Surv., Canada Paper 55-20.

341. Clark, T.H., Quebec Dept. Mines (part time), McGill Univ.:
Geology of the St. Lawrence Lowlands, 1938-
A continuing investigation of the geology and oil and gas possibilities of the lowland region between Quebec City and the Quebec-New York State boundary.

342. Edmunds, F.H., Univ. of Saskatchewan:
Stratigraphy and Characteristics of Lloydminster Oil Field.

343. Irish, E.J.W., Geol. Surv., Canada:
Charlie Lake Map-area, British Columbia, 1 inch to 4 miles, 1955-57.
Geological mapping with special emphasis on oil and gas potentialities of the area.

344. Kent, D.M., Univ.: of Saskatchewan:
Lloydminster Oil Field, Alberta: M.Sc. thesis.

345. Kupsch, W.O., Univ.: of Saskatchewan:
Geomorphic Expression of Bedrock Structures in Drift Covered Areas of Southern Saskatchewan, 1956-
See "Lineaments in the Avonlea Area, Sask" Bull. Amer. Assoc. Petrol. Geol., January, 1958.

346. Liberty, B.A., Geol. Surv., Canada:
Manitoulin Island, St. Joseph Island, and Sault Ste. Marie Area, Ont., 1 inch to 4 miles, 1954-57.
Geological mapping with particular reference to the possible occurrence of oil and gas.

347. Price, L.L., Geol. Surv., Canada:
Subsurface Study of the Lower Cretaceous Formations of Southern Saskatchewan, 1954-57.
To describe and illustrate the character, distribution, structure, and correlation of the principal Lower Cretaceous formations by study of electric logs and samples from oil and gas wells, and thereby assist exploration for oil and gas.

348. Price, R.A., Geol. Surv., Canada (part time):
Flathead North Map-area, B.C. and Alberta, 1 inch to 1 mile, 1956-57; Ph.D. thesis.
Includes evaluation of the oil, gas and coal potentialities of the area.

349. Pugh, D.C., Geol. Surv., Canada:
Subsurface Study of Pennsylvanian and/or Permian, Triassic, and Jurassic Formations in Northeastern British Columbia, 1954-57.
The determination, description and correlation of facies changes by study of samples, cores, and electric and radioactivity logs of oil and gas wells.

350. Rogan, A.D., Univ. of Saskatchewan:
Study of the Reservoir Characteristics of the Viking Sand in the Smiley-Dewar Field, Saskatchewan; M.Sc. thesis, 1958.

351. Sanford, B.V., Geol. Surv., Canada:
Establishment of the Elevations of Wells Drilled for Oil and Gas in South-Western Ontario, 1951-
To assist interpretation of the structure and stratigraphy of the productive oil and gas formations.
Oil and Gas Fields of Southwestern Ontario, 1952-
The preparation of maps and reports giving data and conclusions pertaining to the oil and gas fields of this region. See Geol. Surv., Canada Memoir 278.

352. Sawatsky, L.H., Univ. of Saskatchewan:
Lloydminster Oil Field, Saskatchewan; M.Sc. thesis.

353. Sikka, Desh B., McGill Univ.:
Radioactivity Associated with Oilfields, 1955-59; Ph.D. thesis.
A radiometric survey of Redwater area, Alberta made in 1955 suggested the possibility of a partial halo 1 1/2 miles west of the producing zone. Soil profile samples are being studied including analysis for K^{40}, uranium and thorium families, nickel, vanadium, zinc, and mechanical chemical uranium, and gamma ray isotopic analysis.

Coal

354. Blanchard, J.E., Nova Scotia Research Foundation:
A Study of Energy Released by "Bumps" in the Springhill Coal Area, N.S., 1956-58.
A co-operative project with the Dominion Observatory and Mines Branch, Dept. Mines and Technical Surveys. Records of the micro-seismic activity in the Springhill area were obtained using a Willmore seismograph. The number and time of micro-seisms 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, Dept. Mines and Technical Surveys in co-operation with the Nova Scotia Research Foundation.

355. Hacquebard, P.A., Geol. Surv., Canada:
Petrography and Spore Analysis of Coal, 1948-
Involves investigation of the character and correlation of the various coal seams in Nova Scotia and Western Canada coal fields. See G.S.C. Bull. 19, and papers in Economic Geology Vol. 49, No. 8; Vol. 50, No. 8.

356. Latour, B.A., Geol. Surv., Canada:
Coal Reserves of Canada, 1950-
Collection of data necessary for estimation of Canada's coal reserves, including collection of samples for qualitative spectrographic analysis.

357. Montgomery, D.S., and Goodspeed, F., Mines Branch, Dept. Mines and Technical Surveys:
The Infra-red Adsorption Spectra of Bituminous Substances, 1951-

358. Swartzman, E. and Burrough, E., Mines Branch, in co-operation with Coal Research Laboratory, Geol. Surv., Canada:
Study of Coking Characteristics on Laboratory and Plant Scales of Coal Seam Sections in Relation to Petrographic Constituents, 1956-

General Problems

359. Anderson, Donald, T. and Wilson, H.D.B., Univ. of Manitoba:
Distribution of Metals in Ore Deposits, 1957-
Statistical distribution studies using large quantities of assays.

360. Anderson, G.M., Univ. of Toronto:
Semi-Quantitative Evaluation of the Solubility of PbS in Dilute H_2S Solutions at Elevated Temperatures and Pressures, and Its Geological Implications, 1957-59; Ph.D. thesis.

361. Archibald, Gary M., Quebec Dept. Mines (part time):
Examination of Mining Properties in Chibougamau District, 1957-58; M.Sc. thesis, Univ. of Michigan.

362. Boyle, R.W., Wanless, R.K. and Lowden, J.A., Geol. Surv., Canada:
Isotope Chemistry of Sulphur in Rocks and Ore Deposits, 1955-57.
The determination, with the mass spectrometer, of the ratios of sulphur isotopes in sulphide and sulphate minerals collected from and in the vicinity of ore deposits and the use of these data in establishing the genesis of ore deposits.

363. Brett, S.E., Univ. of Toronto:
Relation Between Mineral Districts and the Orogenic Pattern of the Earth, 1957-58; M.A. thesis.

364. Brown, A., Mines Branch, Dept. Mines and Technical Surveys co-operating with Geol. Surv., Canada:
Investigation of Sudden Release of Stress in Coal Mines, and Ore Extraction Problems in Metal Mines, 1950-
See "Structural Conditions at the Wabana Iron Mines, Newfoundland", Bull. Can. Inst. Min. Metallurgy, Sept. 1957.

365. Brown, W.G., Univ. of Toronto:
Structural Patterns in Ore Deposits, 1956-58; M.A. Sc. thesis.

366. Byers, A.R., Univ. of Saskatchewan:
Study of Certain Base Metal Deposits in Northern Saskatchewan, 1956-.

367. Clark, T.H., McGill University:
Structure, Stratigraphy, and Economic Resources of the St. Lawrence Lowland of Quebec, 1939-

368. Deland, Andre, Quebec Dept. Mines:
Examination of Mining Properties and Development in the Montreal District.
A continuing program of investigation of mining properties and development work being carried out from year to year in the Montreal district.

369. Dreimanis, A., Univ. of Western Ontario:
Tracing of Ore Boulders as a Prospecting Method in Canada, 1953-57.
See "Steep Rock Iron Ore Boulder Train", Proc. Geol. Assoc. Can. Vol. 8, Pt. I, p. 27-70, 1956.

370. Dugas, Jean, Quebec Dept. Mines:
Examination of Mining Properties and Development in Rouyn-Noranda District, Quebec.
A continuing program of investigation of mining properties and development work being carried out from year to year in the district.

371. Gleeson, Christopher F., McGill Univ.:
Studies of the Distribution of Metals in Muskegs and Lakes, 1957-59; Ph.D. thesis.

372. Grenier, P.E., Quebec Dept. Mines:
Examination of Mining Properties and Development in Quebec District.
A continuing program of investigation of mining properties and development work being carried out from year to year in the district.

373. Guy-Bray, John V., McGill Univ.:
Transfer of Metals as Gases, 1957-58; M.Sc. thesis.
Experiments will be made on the volatility of the sulphides of iron, manganese, cobalt, nickel, copper, and molybdenum in sulphur vapour.

374. Hansuld, John A., McGill Univ.:
Electrochemical Aspects of Sulphide Ore Deposition, 1957-59; Ph.D. thesis.
A laboratory investigation including study of dispersion of heavy metals around uranium mineralization (Labrador, Blind River).

375. Innes, G.M., Univ. of Toronto:
A Study of Zoning of Mineral Deposits, 1957-58; M.A. Sc. thesis.

376. Johnston, G.A., Geol. Surv., Canada:
Economic Geology Files, 1940.
The objective is to file all published authentic geological information on all Canadian occurrences of economic metals or minerals; to cross index these files so that the information is readily accessible; and to assist in preparing for publication maps and reports showing the distribution and mode of occurrence of specific metals or minerals.

377. Jolliffe, A.W., Queen's Univ.:
Evolution of the Atmosphere and Hydrosphere, 1956-
This problem has a bearing on conditions in earliest geological time, and in turn on types of rocks and economic mineral deposits formed in the early Precambrian.

378. Lang, A.H. and Staff, Geol. Surv., Canada:
Preparation of a Series of Metallogenic Maps of Canada, 1957-62.
The compilation of maps of Canada showing occurrences of selected minerals to aid in elucidating metallogenic provinces and supply information useful in selecting areas for prospecting.

379. Latulippe, M., Quebec Dept. Mines:
Examination of Mining Properties and Development in Val d'Or District.
A continuing program of investigation of mining properties and development work being carried out from year to year in the Val d'Or district.

380. McKechnie, N.D., B.C. Dept. Mines:
Study of Lineaments in Air Photo Mosaics and of the Distribution of Mineral Occurrences in Certain Areas, 1956-
Air Photo mosaics that have become available have been studied to detect linear features. Study of published geological maps, and of the distribution of mineral occurrences indicates parallelism or coincidence of lineaments and aligned mineral occurrences.

381. McLeod, C.R., Geol. Surv., Canada:
Heavy Minerals of Beach Deposits in Canada, 1957-59.
To provide data concerning the the occurrence in beaches, beach placers, and similiar deposits of minerals of commercial or possible commercial importance; and to test and improve techniques for detecting and evaluating such occurrences. Initially the work will be mainly in New Brunswick, Nova Scotia, and Prince Edward Island.

382. Meikle, Brian, B.K.M., McGill Univ.:
Diffusion of Metallic Sulphides, 1957-58; Ph.D. thesis.

383. Mloszewski, M.J., Univ. of Toronto:
Semi-Quantitative Evaluation of the Solubility of Zinc Sulphide in Aqueous Hydrogen Sulphide Solution under Elevated Temperature and Pressure, 1956-58; Ph.D. thesis.

384. Smith, F.G., Univ. of Toronto:
Solubility of Metallic Sulphides in Dilute Aqueous Solutions of Hydrogen Sulphide at High Temperatures and Pressures, 1956-1966.

385. Soles, James A., McGill Univ.:
Study of the Solution and Transportation of Sulphides, 1957-58; Ph.D. thesis.
An experimental study of methods of transportation of sulphide minerals and the effects of changing conditions on areas of deposition.

386. Soles, J.A., McDougall, J.F., Meikle, B.K., and Guy-Bray, J.V. McGill Univ.:
Behaviour of Sulphides at Elevated Temperatures and Pressures, 1953-

387. Uffen, Robert, Blackwell, J.H., and Ellis, Robert, Univ. of Western Ontario:
Determination of Optimum Prospecting Plans, 1957-58.
Slichter's method of determining the completeness of search, the discovery hole economy, and the optimum prospecting profit ratio, is being extended to include targets at variable depths.

388. Reesor, J.E., Geol. Surv., Canada:
Granitic Bodies of Canada, 1957-
Includes detailed mapping of representative granitic bodies to provide comprehensive geological information concerning their scientific and economic aspects. The initial studies are in southern British Columbia but eventually will be broadened to include study of bodies in the Canadian Shield and Appalachian regions.

389. Smith, C.H., Geol. Surv., Canada:
Ultrabasic Intrusions of Canada, 1957-
The detailed mapping of representative ultrabasic intrusions with special emphasis on their scientific and economic features. The intrusions to be studied include those of Tulameen, B.C., Bird River, Manitoba, Thetford, Quebec and Bay of Islands, Newfoundland.

390. Thompson, R.M., Univ. of British Columbia:
Mineragraphic Studies of Ores--a continuing project.
Ores presently under investigation include Giant Yellowknife, Craigmont Copper Mines, and French Gold Mines Ltd., (Hedley Area).
Mineralogical Study of Some Beach Sands from Queen Charlotte Islands, 1957.

391. Warren, H.V. Delevault, R.E., and Boyle, S., Univ. of British Columbia:
Trace Elements in Plants, Soils, and Rocks, 1945-
This project is concerned with improvement of geochemical techniques and in obtaining fundamental data on trace elements in rocks and corresponding relationships with soils, stream silts, and vegetation. See "Soils in Geochemical Prospecting" Western Miner and Oil Review, Vol. 29, No. 12, 1956, pp. 36-42.

392. West, Gordon F., Univ.: of Toronto:
Studies of Electromagnetic Prospecting and Electrical Conduction in Rocks and Ores, 1957-59; Ph.D. thesis.
Present work involves theoretical and model studies of the fields of uniformly conducting bodies, particularly a semi-infinite sheet. Further work will be done to study the mechanisms of electrical conduction in rocks, minerals, and ores.

393. Williamson, D.H., Mount Allison Univ.:
Geology of Hampstead, N.B., 1957.
Geological mapping and investigation of E.M. conductors with reference to possible deposits of base metals.

394. Wilson, J.T. and Dence, M., Univ. of Toronto:
Studies of Continental Growth and Structure and the Relation of Orebodies to Them.
See "Origin of Earth's Crust", Nature, vol. 199, Feb., 1957, pp. 228-230.

395. Winter, L.D.S., Univ. of Toronto:
A Formulation of the Optimum Rate of Production in Relation to Size and Grade of Ore bodies, 1957-58; M.A. Sc. thesis.

MINERAL INVENTORIES

396. Dawson, K.R., Geol. Surv., Canada:
Meteorite Collection, 1957-
To catalogue, study and describe the Geological Survey of Canada meteorite collection.

397. Johnston, G.A., Geol. Surv., Canada:
Economic Geology Files, 1940-
The objective is to file all published authentic geological information on all Canadian occurrences of economic metals and minerals; to cross index these files so that the information is readily accessible; and to assist in preparing for publication maps and reports showing the distribution and mode of occurence of specific metals or minerals.

398. Lang, A.H., Steacy, H.R., and Staff, Geol. Surv., Canada:
Laboratory Investigation of Samples of Radioactive Substances, 1945-
To maintain a complete inventory of all occurrences of uranium and thorium deposits in Canada; field examination of radioactive deposits; and the laboratory examination of samples of radioactive minerals and ores.

399. Winder, C. Gordon, Univ. of Western Ontario:
Lexicon of Palaeozoic Formation Names in Southern Ontario, 1956-58.
This project will include the Devonian, Silurian, and Ordovician, and is designed for persons unfamiliar with the stratigraphy.

PALAEONTOLOGY

400. Best, R.V., McMaster Univ.:
Revision of Clenellid Trilobites, 1956-58.

401. Brindle, J.E., Saskatchewan Dept. Mineral Resources:
Carboniferous Faunas of Southern Saskatchewan, 1957-58.
This research is planned to test the validity of non-palaeontological paratime rock subdivisions of the Mississippian rocks in the northern part of the Williston Basin, and to facilitate faunal correlation with the Alberta, Manitoba and United States successions.

402. Carter, George, F.E., McGill Univ.:
Ordovician Ostracoda from the St. Lawrence Lowlands of Quebec, 1955-57; Ph.D. thesis.

403. Frebold, H., Geol. Surv., Canada:
Jurassic Rocks of the Canadian Arctic Islands, 1957-58.
Jurassic Rocks of the Nelson and Salmo-Map-areas, B.C., 1957-58.

404. Fritz, M.A., Univ. of Toronto:
Mississippian Bryozoa from Montana, 1956-57.

405. Fritz, M.A., Lemon, R.R.H. and Cranswick, J.S. (deceased) Univ. of Toronto:
Corals of the Upper Abitibi River Limestone, 1950-59.

406. Fritz, Madeline A., Lemon, R.R.H., and Norris, A.W., Univ. of Toronto:
Corals of the Williams Island Formation, Abitibi River, Ontario, 1952-57.

407. Fry, W.L., Geol. Surv., Canada:
Tertiary of Southern British Columbia between Flood and Gulf of Georgia, 1954-57.
A stratigraphic-palaeontological study of the Tertiary flora.

408. Green, Robert, Research Council of Alberta:
Mississippian Micropalaeontology of Alberta, 1956-60.
A study of ostracods of the Banff formation and ostracods and foraminifera of the Rundle group. This project is concerned firstly with sections in the Bow Valley; it is hoped to extend any zonation scheme to the subsurface of the Plains and along the Mountains.

409. Stelck, C.R. and Wall, J.H., Univ. of Alberta:
Lower Cretaceous Microfossils, 1947-60.
See "Middle Albian Foraminifera from Athabasca and Peace River Drainage Areas of Western Canada", Research Council of Alberta, Rept. 75, 1956.

410. Langston, Wann., National Museum of Canada:
Vertebrate Fauna of the Lower St. Mary River Beds at Scabby Butte, Alberta, 1957-59.
A description of the dinosaurs and other vertebrate fossils, and discussion of the faunal association.
Vertebrate Faunas of the Formost and Oldman Formations of Southeastern Alberta, 1957-60.

411. Lemon, R.R.H., Royal Ontario Museum:
A Lower Devonian Flora from Sextant Rapids, Northern Ontario, 1951-58.
Proterozoic and Early Palaeozoic Sediments of the Admiralty Inlet Region, Baffin Island, 1954-58.

412. McCammon, Helen, Manitoba Dept. Mines and Natural Resources:
Fauna of the Manitoba Group (Devonian), 1956-58; Ph.D. thesis, Univ. of Indiana.
A study of the fossils, especially the corals and brachiopods of the Devonian rocks of this group.

413. McGugan, Alan, Queen's Univ.:
General Micropalaeontology Including Study of Local Microfaunas, Upper Cretaceous Foraminifera from Northern Ireland, and Mechanical Aids and Devices in Micropalaeontology, 1957-
Studies of the Triassic foraminifera of Northern Ireland, Silurian and Devonian Microfauna of Ontario, and Upper Cretaceous Microfauna of Vancouver Island may be initiated in the future.

414. McLearn, F.H., Geol. Surv., Canada:
Ammonoidea of the Upper Triassic Pardonet Beds of Peace River Foothills, British Columbia, 1952-57.
The revision, consolidation and completion of previous interim studies and publications pertaining to the stratigraphy and ammonoid fauna.

415. McLaren, D.J., Geol. Surv., Canada:
Revision of the Type Species of the Genus Synatophyllum Simpson, 1957.
To describe thoroughly and accurately this important Devonian genus from recently available material.

416. Nelson, S.J., Univ. of Alberta:
Brachiopod Zones of the Upper Rundle, Rocky Mts., Alberta, 1955-57.
Colonial Corals of the Banff Rundle formations, Rocky Mts., Alberta, 1955-57.

417. Wall, J.H., Research Council of Alberta:
Jurassic Microfaunas of Saskatchewan, 1953-58; Ph.D. thesis, Univ. of Missouri.
A study of ostracods and foraminifera from wells in Saskatchewan.

418. Winder, C. Gordon, Univ. of Western Cntario:
Microfauna of the Kettle Point and Port Lambton Shales, 1957-59.
An attempt to date these beds more precisely by study of the conodont fauna primarily; probably the "Marcellus" black shales of Norfolk county will also be included in the study.

419. Rice, H.M.A., Geol. Surv., Canada:
Study of Geological Survey Collection of Fossil Insects, 1955-
Includes organization and arrangement of collection, identification of orders, genera, and species, figuring and description of specimens, and consideration of stratigraphic significance of collections.

420. Rouse, G.E., Univ. of British Columbia:
Plant Microfossil Analyses of Tertiary and Cretaceous Strata, 1956-
The objective is the reconstruction of floras and climatic conditions, and correlation and dating of strata, employing plant spores and pollen grains recovered from Tertiary and Cretaceous beds. Of immediate interest is the separation of the Upper Cretaceous-Tertiary boundary in the coastal-international boundary region.

421. Russell, L.S., National Museum of Canada:
Tertiary Mammalian Faunas of Southern Saskatchewan, 1948-59.
Description of the mammalian faunas of Upper Eocene, Lower Oligocene and Miocene of Southern Saskatchewan.
A Horse Astralagus from the Hand Hills Conglomerate of Alberta, 1955-57.
A description of a fossil indicating a late Pliocene age for the Hand Hills Conglomerate.

422. Stearn, C.W., McGill Univ.:
A Study of the Stromatoporoid Fauna of the Devonian of Alberta, 1955-58.
See "Stromatoporoid Fauna from the Devonian of the Canadian Rocky Mountains", Geol. Soc. Amer. Bull. vol. 63 (1957) Dec. (Abstract).

PETROLOGY AND PETROGRAPHY

British Columbia, Alberta, Saskatchewan and Manitoba

423. Carr, J.M., B.C. Dept. of Mines:
Study of Guichon Batholith with Particular Reference to Mineralization in Highland Valley, B.C., 1957-58.

424. Edmunds, F.H., Univ. of Saskatchewan:
Study of Stratigraphy Including Sedimentary Petrology of Strata Penetrated by Shaft of Potash Company of America, 15 Miles East of Saskatoon.

425. Lee, Randolph, Univ. of British Columbia:
Geology of Newman Creek to Sunset Creek on East Shore of Howe Sound, B.C., 1956-58; M.Sc. thesis.
A study of some phenomena of the Coast Range batholith.

426. Lerbekmo, J.F., Univ. of Alberta:
Petrology of Some Upper Cretaceous Continental Sandstones in Alberta, 1957-59.

427. McTaggart, K.C., Univ. of British Columbia:
Petrology of the Custer Gneiss, Chilliwack, B.C., 1957-

428. Patterson, J., Manitoba Mines Branch (part time):
Possible Relation of Mystery-Moak Lake Nickel Deposits of Northern Manitoba to Metamorphism, 1957-60; Ph.D. thesis, Univ. of Manitoba.
This problem will involve a two year field mapping program by Manitoba Mines Branch in the nickel belt. Particular attention will be paid to regional metamorphism. Laboratory investigations will concern the effects of sulphur metasomatism on the nickel bearing silicate minerals.

429. Pyke, M.W., Univ. of Saskatchewan:
Metamorphic Rocks of the Forbes Lake Area, Northern Saskatchewan; M.Sc. thesis.

Ontario

430. Appleyard, E.C., Queen's Univ.:
Wolf River Nepheline Belt, Ont., 1956-58; M.A. thesis.
A project in cooperation with Dr. D.F. Hewitt, Ont. Dept. Mines.

431. Davies, John and Wilson, H.D.B., Univ. of Manitoba:
A Study of the Major and Minor Constituents of the Basic Intrusions in the Kenora Area, 1956-59.

432. Ginn, R.M., Univ. of Toronto:
The Granites Between Sudbury and Blind River and their Relationship to the Bruce Series, 1956-58.

433. McDowell, J.P., Ont. Dept. Mines:
Sedimentary Petrology of the Mississagi Quartzite in Blind River Area, District of Algoma, 1956-57.
See "Sedimentary Petrology of the Mississagi Quartzite in the Blind River Area", Geol. Circular No. 6, Ont. Dept. Mines, 1957.

434. Pearson, G.R., and Ambrose, J.W., Queen's Univ.:
Metamorphic Petrology and Granitization in the Clare River Folds, Ontario, 1955-58.
To investigate further the problems of structure and petrology. See abstract, Can. Mining Jour., July, 1958, p. 95.

435. Pollock, Gerald, Brownell, G.M., and Wilson, H.D.B., Univ. of Manitoba:
Dating of Intrusions in the Kenora District, Using the Larsen Method, 1956-
The alpha counting equipment has been built and analyses of test specimens and three granites completed. Samples collected in 1957 are being processed for zircon recovery.

436. Robertson, James A., Queen's Univ.:
Geology of Townships 144 and 163, Blind River Area, Ont., with Special Reference to the Granitic Rocks, 1956-58; M.A. thesis.
This project is aimed at elucidating problems of regional geology correlation.

437. Saha, A.K., Univ. of Toronto:
Studies of the Mode of Emplacement of Some Granitic Plutons in Hastings County, 1955-57; Ph.D. thesis.
See abstract, Can., Mining Jour., July 1958, p. 96.

438. Wynne-Edwards, H.R., Queen's Univ.:
Structure and Petrology of Part of the Frontenac Axis, Westport, Ont., 1956-59; Ph.D. thesis.
A stratigraphic and structural study that includes investigation of possible tectonic control of granitoid rocks. See "Structure of Westport Concordant Pluton in the Grenville", Jour. Geol., Vol. 65, p. 639, 1957.

Quebec

439. Black, Earnest D., McGill Univ.:
Petrographic Study of Metamorphosed Sediments at Little Manicouagau Lake, Quebec, 1957-58; M.Sc. thesis.

440. Ferguson, John, McGill Univ.,
Study of Metamorphosed Strata Near Fort Chimo, 1956-58; M.Sc. thesis.

441. Findlay, David Christopher, McGill Univ.:
Ultrabasic Rocks in Labrador and Northern Quebec, 1957-58; M.Sc. thesis.

442. Godard, John D., McGill Univ.:
A Study of the Igneous Rocks of Mt. St. Hilaire, 1956-58; Ph.D. thesis.

443. Lyall, H.B., Universite Laval:
Geology of Hainaut-Champagne Area, Pontiac County, 1956-58; D.Sc. thesis.
A study of the gneisses of the main gneiss belt of the northwestern part of the Grenville sub-province. The origin of some copper-nickel deposits will be considered.
See abstract, Can. Mining Jour., July, 1958, p. 97.

444. Perrault, Guy, Ecole Polytechnique, Univ. of Montreal:
Mineralogy and Petrography of the Oka Alkaline Intrusives, 1957-60.
Results of a study of certain amphiboles will be published shortly; work will continue on other minerals including pyroxenes, pyrochlore, betafite, nepheline, etc.

445. Sabourin, R.J.E., Universite Laval:
Mineralogy and Geology of Meach Lake Complex, Quebec, 1958.

446. Sauve, Pierre, Quebec Dept. Mines:
Metamorphism and Structure of the Labrador Trough at 58°N. Latitude.
Paper presented to "La Scoiete Geologique de Quebec", Quebec, December, 1957.

447. Shepherd, N., Univ. of Toronto:
Petrology and Mineralogy of the Cross Lake Area, Ungava, 1957-59; Ph.D. thesis.

448. Smith, C.H., Geol. Surv., Canada:
Study of Mineralogical, Petrographical and Chemical Variations in the Mount Albert Ultrabasic Intrusion, 1957-58.
To test the chemical homogeneity of the intrusion and set up techniques for the study of other ultrabasic bodies planned for the future.

New Brunswick and Newfoundland

449. Hutchinson, W.W., Univ. of Toronto:
A Petrographic Study of the "Quartz Monzonite" Associated with the Holyrood Granite, Newfoundland, 1957-58; M.A. thesis.

450. Sharpe, John I., Univ. of New Brunswick:
Petrography and Origin of the Neripis Syenite, Granite, Granophyre Pluton, 1956-58; M.Sc. thesis.

451. Williams, Harold, Newfoundland Dept. Mines and Resources:
Petrology of the Tilting Igneous Complex, Fogo District, Newfoundland, 1956-57; M.Sc. thesis, Memorial University of Newfoundland. See abstract, Can. Mining Journal, July 1958, p. 97.

General Problems

452. Azzaria, L.M., Univ. of Toronto:
Distribution of Heavy Metals in the Minerals of an Igneous Granite, 1956-58; Ph.D. thesis.

453. Belyea, H.R., Geol. Surv., Canada:
Petrographic Study of the Upper Devonian Reef-bearing Woodbend Group of Central Alberta, 1953-57.
A study of the micro features of reef and non-reef deposits to provide information on types of porosity and other characteristics required for better understanding of the causes of accumulation of oil and gas.

454. Bostock, H.H., Geol. Surv. Canada (part time)
Shingle Creek Granitic Stock, Penticton, B.C., 1957; Ph.D. thesis, Univ. of Wisconsin.
Detailed mapping of the stock, and forming part of the Geological Survey's continuing study of granitic rocks in Canada.

455. Dawson, K.R., Geol. Surv., Canada:
Petrological Collections, 1957-
To obtain and maintain representative suites of rocks from all mapped areas of Canada for future petrological, geochemical and other scientific studies.

456. Deuters, B.E., and Shaw, D.M., McMaster Univ.:
Geochemical Study of the White Magma Series in New Hampshire, 1956-58.
Minor elements are being determined spectrochemically in a suite of rocks collected from several of the ring-dyke complexes in New Hampshire. The data will be used to study the mode of evolution of these mildly alkalic rocks and to give fundamental geochemical information.

457. Gold, David, P., McGill Univ.:
Carbonatites of Eastern Canada; 1958-59; Ph.D. thesis.

458. Kranck, E.H., McGill Univ.:
Anatexis, Gneiss Structures
See "Rock Structure and Frabric in the Zone of Plastic Deformation"; paper presented at XXth Int. Geol. Congress, Mexico City, 1956.

459. Loudon, J.R., Moorhouse, W.W., Univ. of Toronto:
Origin of Some Porphyritic Rocks, 1954-58.
A study of the origin of certain porphyritic rocks in New Brunswick and in certain Precambrian areas.

460. Moorhouse, W.W., Univ. of Toronto:
Studies of Precambrian Sediments, 1950-
A continuing study of their petrology and geochemistry with particular reference at present to iron formations of the Port Arthur region.

461. Morse, S. Anthony, McGill Univ.:
Chemical Variations in Metamorphic Rocks, 1956-58; M.Sc. thesis.
A study of the iron-magnesium ratios in garnet and chlorite, also biotite and hornblende to some extent.

462. Minnes, D.G., Univ. of Toronto:
Petrographic Character of the Rocks of the Coppermine Series, Coppermine River District, N.W.T., 1957-58; M.A. thesis.

463. Cja, Reino, McGill University:
Experimental Study of Anatexis, 1957-59;
Ph.D. thesis.

464. Reesor, J.E., Geol. Surv., Canada:
Granitic Bodies of Canada, 1957-
Includes detailed mapping of representative granitic bodies to provide comprehensive geological information concerning their scientific and economic aspects. The initial studies are in southern British Columbia but eventually will be broadened to include study of bodies in the Canadian Shield and Appalachian regions.

465. Rowe, R.B., and Mulligan, R., Geol. Surv., Canada;
Geological Study of the Lithium-Beryllium Pegmatites of Canada, 1953-57
See Geol. Surv., Canada Papers 54-5, 55-26, and 57-3.

466. Smith, C.H., Geol. Surv., Canada
Ultrabasic Intrusions of Canada, 1957-
The detailed mapping of representative ultrabasic intrusions with special emphasis on their scientific and economic features. The intrusions to be studied include those of Tulameen, B.C., Bird River, Manitoba, Thetford, Quebec, and Bay of Islands, Newfoundland.

467. Swartzman, E. and Burrough, E., Mines Branch, in co-operation with Coal Research Laboratory, Geol. Surv., Canada:
Study of Coking Characteristics on Laboratory and Plant Scales of Coal Seam Sections in Relation to Petrographic Constituents; 1956-

PLEISTOCENE AND GROUNDWATER

Alberta

468. Bayrock, L.A., Research Council of Alberta:
Pleistocene Mapping in Alberta, 1954-
The Edmonton area will be mapped in 1958. See "Stream Trench Systems in East Central Alberta", Res. Council of Alta., Prel. Rept. 56-4.
Research on Weathering of Till, 1957-
Research on Deposition of Till, 1958-

469. Farvolden, R.N., Meneley, W., and Lennox, D.H., Research Council of Alta.:
Preglacial Drainage in Alberta, 1956-59.

470. Gravenor, C.P., Research Council of Alberta:
Analysis of Stagnant Ice Features in Alberta, 1957-59.
The first stage in this study is fabric determinations on till crevasse fillings and examination of recent fossils in stagnant ice deposits. A paper (with W.C. Kupsch) on ice disintegration features in Western Canada is in press.

471. LeBreton, G., Research Council of Alberta:
Chemistry of Alberta Groundwaters, 1957-58.

472. Mathews, W.H., Univ. of British Columbia:
Hydrology and Sediment Transport of a Glacial Stream (Sunwapta River, Alta.), 1956-57.
Field investigations are completed, data on stream discharge, sediment loads, chemical analyses are on hand; mechanical analyses are partly completed; tabulation and computation of sediment transport has been started.

473. Meneley, W., Research Council of Alberta:
The Milk River Sandstone, 1957-59.

474. Stalker, A.M., Geol. Surv., Canada:
Surficial Formations of the McLeod Map-area (West Half), Alberta, 1 inch to four miles, 1956-57.

475. Stalker, A.M., Geol. Surv., Canada:
Dead-ice Plateaux of Alberta, 1955-58.
By combining past field data with current study of air photos, the location, composition, formation, and significance, of many of the larger dead-ice plateaux of the moraine areas of Alberta will be studied.

British Columbia

476. Armstrong, J.E. Geol. Surv., Canada:
Geology and Groundwater of Vancouver Area, 1 inch to 1 mile, 1953-58. See Geological Survey of Canada Paper 57-5.

477. Fyles, J.G., Geol. Surv., Canada:
East Coast of Vancouver Island, 1 inch to 1 mile, 1956-57 mapping of surfical formations with special attention to groundwater supply.

478. Halstead, E.C., Geol. Surv., Canada:
Groundwater of Lower Fraser Valley, B.C. Including Surrey Langeley and Matsqui Municipalities, 1954-57.
See G.S.C. Water Supply Papers 322, 327.

479. Holland, S.S., B.C. Dept. Mines:
Investigation of Beach Sands, Mainly for Iron and Titanium Content, 1957-58.
Ocean beach sands at Wreck Bay, Cape Caution and Graham Island were examined and sampled, and laboratory study of the samples will follow. In connection with the Graham Island study, observations on the glacial history of the area were made by H.W. Nasmith.

480. Mathews, W.H., Univ. of British Columbia:
History of Tide Lake, B.C. and its Glaciolacustrine Sediments, 1957-
Reconnaissance field work has been undertaken, and a preliminary report drawn up; laboratory study yet will follow.
Vertical Distribution of Velocity in Salmon Glacier, B.C., 1955-58.
See progress report in Proceedings, 10th Canadian Soil Mechanics Conference, pp. 79-80.

481. Nasmith, H.W., B.C. Department of Mines:
Studies of Glacial Geology and Unconsolidated Materials, 1957.
Areas studied include (1) Kettle River, to assist in soil surveying by B.C. Dept. of Agriculture (b) Taseko River and Bear Pass in connection with problems of engineering geology (C) Graham Island in connection with beach sand studies. The Graham Island studies included use of air photographs and scruitinizing logs of churn drill holes.

482. Ostic, R., Kellerhaus, R., and Falconer, George, Univ. of Toronto:
Glacialogical Study of Salmon Glacier, B.C., 1956-58.
An investigation in co-operation with geophysicists of Mass. Inst. Technology, Univ. of Alberta, and Cambridge Univ. of the Salmon and Leduc glaciers adjacent to the Granduc Mining property. See "Geophysical Determinations of Thickness of Glacier Surrounding the Granduc Deposit, B.C.", Can. Mining Jour., Vol. 78, No. 4, April, 1957.

Manitoba

483. Elson, J.A., McGill Univ.:
Surficial Geology of Brandon-Virden Areas, Southwestern Manitoba and Saskatchewan, 1950-58.
See "Lake Agassiz and the Mankato-Valders Problem", Science, vol. 126, pp. 999-1002 (1957)

New Brunswick, Nova Scotia, Prince Edward Island and Newfoundland

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

485. Lee, H.A., Geol. Surv., of Canada:
Surficial Deposits of St. John River Valley, Edmunston to Fredericton, 1 inch to 1 mile, 1953-58.
See G.S.C. Paper 56-2 and Map 2-1956.

486. Prest, V.K., Crowl, C.H., and Frankel, L., Geol. Surv., Canada:
Geology of Prince Edward Island, 1 inch to 1 mile, 1953-60.
Includes mapping and study of surficial and bedrock formations.

487. McCartney, W.D., Geol. Surv., Canada:
Western Avalon Peninsula (West Half), Nfld., 1 inch to 4 miles, 1955-57.
Geological mapping with special efforts to find and outline deposits of gravel suitable for construction purposes.

Northwest Territories

488. Blackadar, R.G., Geol. Surv., Canada:
Northwest Baffin Island, N.W.T., 1956-57.
Reconnaissance mapping with special attention to detailed stratigraphic sections from the Late Precambrian and Early Palaeozoic strata, and Pleistocene geology and physiography.

489. Douglas, R.J.W. (in charge), Harris, D.K., Brady, W.B., McLaren, D.J., Harker, P., Norris, A.W., Pelletier, B.R., Stott, D.F., and Craig, B.G., Geol. Surv., Canada:
Upper Mackenzie River Basin, Northwest Territories, (Operation Mackenzie), 1 inch to 8 miles, 1957.
Geological mapping of an area of 100,000 sq. miles with special emphasis on stratigraphy and faunal content of the Palaeozoic, Mesozoic, and Tertiary formations, and including reconnaissance mapping of the surficial formations of the area.

490. Grant, F.S., Sandstrom, H., and Arnold K., Univ. of Toronto:
Investigation of Glaciers and Snowfields West of Hazen Lake, Ellesmere Island, 1957-58.
A project sponsored by the Defence Research Board.

491. Thorsteinsson, R., and Tozer, E.T., Geol. Surv., Canada:
Eureka Sound, Nansen Sound, and Greely and Canyon Fiords, N.W.T., 1956-57.
Reconnaissance geological mapping with special attention to surficial deposits, extent of recent marine submergence, physiography, state of sea ice, and other factors that affect the economic development of the area.

Ontario

492. Bostock, J.M., Geol. Surv., Canada:
Compilation of Drift Thickness Map in the City of Ottawa, 1957-58.
To make an isopach (drift thickness) map of the overburden, and a bedrock surface map of the same area.

493. Caley, J.F. and Sanford, B.V., Geol. Surv., Canada:
Drift Thickness and Bedrock Topography in Southern Ontario, 1948-
The objective is to determine the pre-Pleistocene bedrock topography and the drift thickness from bore hole data; and to deduce the pre-glacial drainage and the probable location of reservoirs of groundwater. Because the pre-Pleistocene topography may reflect the underlying structure of the bedrock, the knowledge assists in the search for oil and gas. See G.S.C., Paper 55-20.

494. Dell, Carol I., Univ. of Toronto:
Mineralogical Analysis of Some Pleistocene Sands of Southern Ontario, 1957-58; M.A. thesis.

495. Dell, Carol I., and Mirynech, E., Ontario Research Foundation:
Mineralogical Composition of Sand in Some Ontario Tills and Sediments, 1956-59.

496. Dreimanis, A., Reavely, G.H., and graduate students, Univ. of Western Ontario:
Pleistocene Stratigraphy Along Lakes Erie and Huron, 1952-60.
Certain lithologic differences have been recognized between the Huron and Erie glacial lobes and between different ice flows feeding these lobes. One or two cool and long interstadial intervals separated the classic or main Wisconsin from an early Wisconsin glaciation which post-dated the Sangamon interglacial.

Another shorter interstadial interval, older than the Two Creeks, separated the main Wisconsin in two glacial substages in the Lake Erie area. See "Heavy Mineral Studies of Tills of Ontario and Adjacent Areas", Jour. Sed. Petrol., Vol. 27, p. 148-161, 1957.

497. Dreimanis, A., Univ: of Western Ontario:
Wisconsin Stratigraphy in the Region between Lake Huron and the St. Lawrence Lowland, 1953-60.
This study was started by lithologic investigations of tills in scattered areas in this region. Correlation of these and other areas will be attempted. See "Stratigraphy of the Wisconsin Glacial Stage along Northwestern Shore of Lake Erie" Science, V. 126, p. 166-168, 1957.

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

499. Karrow, P.F., Ont. Dept. of Mines:
Sand and Gravel Deposits, North of Lake Ontario, 1957.

500. Mirynech, E., Univ. of Toronto:
Mineralogical Study of Some Drift Soil Profiles of Southern Ontario, 1957-58; M.A. thesis.

501. Terasmae, J., Geol. Surv., Canada:
Palynological Study of the Pleistocene Toronto Formation, 1957.
The objective is to establish the chronologic position of this formation by palynological study, supported by stratigraphical observations and thereby further the general understanding of Pleistocene chronology in eastern North America.

502. Terasmae, J., and Hughes, O., Geol. Surv., Canada:
Interglacial Deposits Along the Missinabi River, Ontario.
A palynological study of the deposits and combination of the results with C-14 determinations already available to establish their stratigraphic position.

Quebec

503. Lee, H.A., Geol. Surv., Canada:
Beach Moraines Along the East Coast of Hudson Bay and James Bay, 1958.
To describe them, present an adequate theory for their origin, and relate their origin to the glacial and post-glacial history of the east coast of Hudson and James Bay.

504. Eade, K.E., Lee, H.A., and Heywood, W.W., Geol. Surv., Canada:
Southwestern New Quebec (Operation Fort George), 1 inch to 8 miles, 1957.
Geological mapping of an area of 35,000 square miles with helicopter, including the surficial formations.

General Problems

505. Brown, R.J.E., Div. of Building Research, National Research Council:
Permafrost Boundary in Canada, 1953-

506. Deane, R.E., Univ. of Toronto:
Annotated Bibliography of the Pleistocene of Canada, 1956-59.

507. Dreimanis, A., Univ. of Western Ontario:
Depth of Leaching in Glacial Deposits As a Criterion in Pleistocene Chronology, 1953-60.
A formula has been developed for comparison of the probable actual depths of leaching in glacial deposits with great variations in carbonate content. Influence of the dolomite/calcite ratios to depth of leaching is also being studied and a rapid method for determination of this ratio is being tested. See "Depths of Leaching in Glacial Deposits", Science, V. 126, p. 403-404, 1957.
Tracing of Ore Boulders as a Prospecting Method in Canada, 1953-57.
See "Steep Rock Iron Ore Boulder Train", Proc. Geol. Assoc. Can., Vol. 8 Pt. I, P. 27-70, 1956.

508. Falconer, George, Falconer, Jessie, and Wilson, J.T., Univ. of Toronto:
Glacial Map of Canada, 1956-58.
A glacial map of Canada in eleven colours on scale of 1 inch to 60 miles with inset showing proportion of drift to outcrop over the Canadian Shield has been published in 1958 by the Geological Association of Canada with help from sources across Canada.

509. Farvolden, R.N., Research Council of Alberta, and Maggs, P.J., and Balshaw, F.E., Calgary Power Co., Ltd.:
Artifical Recharge in Gravels, 1956-58.

510. Gorman, W. Alan, Queen's Univ.:
Geochemical Sampling of Pleistocene Soil, 1957-59.

511. Grant, F.S. and Kellerhals, R., Univ. of Toronto:
Inventory of Canadian Glaciers, 1957-58.
Preparation of catalogue and description of all glaciers in Canada for I.G.Y.

512. Groundwater Division, Research Council of Alberta:
Earth Resistivity and Its Relation to Shallow Aquifers, 1956-59.

513. Lee, H.A., Geol. Surv., Canada:
Pleistocene Ice Dome in Hudson Bay, 1958.
An evaluation of the evidence pointing to the former existence of a Pleistocene Ice Dome in Hudson Bay.

514. Meneley, M.A., Univ. of Saskatchewan:
Microfabrics and Soil Mechanics Study of Glacial Deposits; M.Sc. thesis, 1958.

515. Taylor, R.S., Univ. of Alberta:
Differential Rates of Heaving in Freezing Soil, 1956-57.
A brief investigation of the rates of frost heaving of buried objects of different shapes and materials.

516. Terasmae, J., Geol. Surv., Canada:
Post Glacial Deposits in the St. Lawrence Lowland, 1957-
To establish the end of the Champlain Sea interval in the lowland, provide information on the age of the major marine, estuarine, and river terraces, and certain glacial and post-glacial features north of the St. Lawrence River, and to date by the radio-carbon method certain recognizable levels in the standard pollen diagram for this region.
Study of Pleistocene Pollens of Canada, 1956-
The continuing study of Pleistocene palynology from samples of bog and lake deposits as an aid in determining the glacial history and correlating glacial deposits.

517. Terasmae, J. and Gadd, N.R., Geol. Surv., Canada:
Interglacial Deposits in the St. Lawrence Lowland, 1954-57.
A palynological and palaeobotanical study of the above deposits to establish the climate during that interval and the stratigraphic position of these deposits.

SEDIMENTATION

518. Beales, F.W., Univ. of Toronto:
Limestone Research - Sedimentation and Diagenesis, 1948-
The study of conditions of deposition of limestones by comparison of ancient deposits with modern accumulations including study of the time-rock relationships and interpretation. See "The significance of Bahamites in Oil Exploration", Jour. Alberta Petrol. Geol., Nov. 1957.

519. Belyea, H.R., Geol, Surv., Canada:
Petrographic Study of the Upper Devonian Reef-Bearing Woodbend Group of Central Alberta, 1953-57.
A study of the micro features of reef and non-reef deposits to provide information on types of porosity and other characteristics required for better understanding of the causes of accumulation of oil and gas.
Sub-surface Studies of the Devonian System of the Alberta Plains, 1951-57.
The preparation of cross-sections from data from cores, samples, and electric and radioactivity logs 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. See Geol. Surv., Canada Papers 53-3, 55-38.

520. Brady, W.B., Geol. Surv., Canada:
Carboniferous Stratigraphy in the Central Foothills, Alberta between Nordegg and Banff, 1954-58.
To obtain data relative to the detailed correlation of the strata, their lateral variations, their potentialities as possible sources of petroleum and natural gas, and their suitability as reservoir rocks for these fuels.

521. Dean, R.S., McGill Univ.:
A Compositional Study of Calcareous Lorraine Sedimentary Rocks, 1956-58; M.Sc. thesis.

522. Lerbekmo, J.F., Univ. of Alberta:
Petrology of Some Upper Cretaceous Continental Sandstones in Alberta, 1957-59.

523. McDowell, J.P., Cntario Dept. of Mines:
Sedimentary Petrology of the Mississagi Quartzite in Blind River Area, District of Algoma, 1956-57.
See "Sedimentary Petrology of the Mississagi Quartzite in the Blind River Area", Geol. Circular No. 6, Ont. Dept. Mines, 1957.

524. Middleton, G.V., McMaster Univ.:
Diagenesis of the Lowermost Devonian at Hagersville, Cntario, 1956-58.
Greywackes of the Northern Appalachians, 1957-59.

525. Mellon, G.B., Research Council of Alberta:
Sedimentation Study of the Blairmore Formation, 1955-58.

526. Moorhouse, W.W., Univ. of Toronto:
Studies of Precambrian Sediments, 1950-
A continuing study of the petrology and geochemistry of Precambrian sediments, at present with particular reference to iron formations of the Port Arthur region.

527. Pienaar, P.J., Queen's Univ.:
Stratigraphy and Mineralogy of the Elliot Group in the Quirke-Elliot Lake Syncline Blind River Area, Ontario, 1956-58; Ph.D. thesis.
Will include study of the sedimentary structures and lithological variations in the group including the radioactive oligomictic conglomerates, with emphasis on the distribution of radioactivity and sedimentary environment.

528. Price, L.L. Geol. Surv., Canada:
Subsurface Study of the Lower Cretaceous Formations of Southern Saskatchewan, 1954-57.
To describe and illustrate the character, distribution, structure, and correlation of the principal Lower Cretaceous formations by study of electric logs and samples from oil and gas wells, and thereby assist exploration for oil and gas.

529. Pugh, D.C., Geol. Surv., Canada:
Subsurface Study of Pennsylvanian and/or Permian, Triassic and Jurassic Formations in Northeastern British Columbia, 1954-57.
The determination, description and correlation of facies changes by study of samples, cores and electric and radioactivity logs of oil and gas wells.

STRATIGRAPHY AND PALAEONTOLOGY

Precambrian

530. Morrison, Euen, R., McGill Univ.:
Geology of Uranium-Bearing Precambrian Allik Series, Central Labrador; 1957-59; Ph.D. thesis.

531. Ginn, R.M., Univ. of Toronto:
The Granites Between Sudbury and Blind River and their Relationship to the Bruce Series, 1956-58.

532. Pienaar, P.J., Queen's Univ.:
Stratigraphy and Mineralogy of the Elliot Group in the Quirke-Elliot Lake Syncline, Blind River Area, Ontario, 1956-58; Ph.D. thesis.
Will include study of the sedimentary structures and lithological variations in the group including the radioactive oligomictic conglomerates, with emphasis on the distribution of radioactivity and sedimentary environment.

533. Burwash, R.A., Univ. of Alberta:
Precambrian Basement of Western Canada, 1950-60.
Current work consists of studies of regional rock assemblages, relations of rock type to geophysical maps, and potassium-argon dating of core samples. See "Reconnaissance of Subsurface Precambrian of Alberta", Bull. Assoc. Petrol. Geol., Vol. 41, 1957, pp. 70-73.

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

Cambrian to Silurian

535. Bolton, T.E., Geol. Surv., Canada:
Stratigraphic Palaeontological Study of the Ordovician and Silurian Formations of Anticosti Island, Quebec, 1957.

536. Byrne, Anthony, W., McGill Univ.:
The Beekmantown Group in the St. Lawrence Lowlands of Quebec, 1955-57; Ph.D. thesis.

537. Chernoff, C.N., Univ. of Saskatchewan:
The Subdivision of the Silurian of Saskatchewan, 1958; M.Sc. thesis.

538. Cumming, L.M., Geol. Surv., Canada:
Silurian of New Brunswick, 1953-1957.

539. Frey, J.F., Univ. of Saskatchewan:
Silurian of Western Canada; M.Sc. thesis.

540. Greggs, Robert G., Univ. of British Columbia:
Palaeontology and Stratigraphy of the Ordovician and Cambrian of the Rocky Mountains in Vicinity of Banff, Alberta, 1957-59; Ph.D. thesis.

541. Hawley, J.E., and Maycock, Ian D., Queen's Univ.:
Stratigraphy and Mineralogy of Ordovician Limestones near Kingston, Ontario, 1957-59.
This project is being carried out with the cooperation of the Building Research Division, National Research Council, and is designed to throw some light on variations in composition of the limestones of this area and their behaviour in concrete aggregates.

542. Okulitch, V.J., Univ. of British Columbia:
Cambrian Stratigraphy and Faunas in Western Canada--a continuing project.
See "Archaeocyatha from the Lower Cambrian of the Yukon", Jour. Palaeontology, Vol. 31, No. 5, pp. 913-930.

543. Sinclair, G.W., Geol. Surv., Canada:
Stratigraphic Palaeontological Study of the Ordovician Formations of Southern Manitoba 1957.

544. Rickard, Michael John, N.R.C. Postdoctorate Fellow, McGill Univ.:
Structural and Stratigraphical Considerations of the Relationships between the Oak Hill Series and the Sutton Schists, Southern Quebec, 1957-59.
Detailed geological mapping at 4 inches to 1 mile is being undertaken with special attention to the minor structural elements. It is hoped to establish the relation between these rock groups and the nature of their junction. The structural style and geometry with relation to the Appalachian fold belt will be compared with that of similar rocks in Vermont and other parts of Quebec.

Devonian to Permian

545. Baird, D.M., Newfoundland Dept. Mines and Resources:
Relations of Gypsum-Anhydrite-Limestone in Lower Carboniferous of Western Newfoundland, 1954-58.
Carboniferous Rocks of Newfoundland, 1956-58.
This will be a compilation of all work on the Carboniferous of Newfoundland in which Dr. Baird has worked intermittently since 1948.
Carboniferous Rocks of the Canche-Northern Grey Island Area, 1957.

546. Bancroft, M.F., Acadia Univ.:
Bore Holes, Mt. Denson, Hants County, N.S., 1957.
Columnar sections of two drill holes with details of formations encountered in exploration for salt in the Windsor Basin.

547. Belyea, H.R., Geol. Surv., Canada:
Petrographic Study of the Upper Devonian Reef-bearing Woodbend Group of Central Alberta, 1953-57.
A study of the micro features of reef and non-reef deposits to provide information on types of porosity and other characteristics required for better understanding of the causes of accumulation of oil and gas.
Sub-surface Studies of the Devonian System of the Alberta Plains, 1951-57.
The preparation of cross-sections from study of cores, samples and electric and radioactivity logs 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. See Geol. Surv., Canada Papers 53-3, 55-38.

548. Brady, W.B., Geol. Surv., Canada:
Carboniferous Stratigraphy in the Central Foothills, Alberta between Nordegg and Banff, 1954-58.
To obtain data relative to the detailed correlation of the strata, their lateral variations, their potentialities as possible sources of petroleum and natural gas, and their suitability as reservoir rocks for these fuels.

549. Brunt, Gordon W., Saskatchewan Dept. of Mineral Resources:
Bakken Formation in Western Saskatchewan, 1957-58.

550. Cote, R.P., Acadia Univ.:
Geology of the Whycocomagh Area, Cape Breton, N.S., 1957-58; M.Sc. thesis.
With particular reference to the sedimentation and stratigraphy of the Horton formation.

551. Harker, P., and Thorsteinsson, R., Geol. Surv., Canada:
Stratigraphy and Fauna of the Permian Section at Grinnel Peninsula, Devon Island, District of Franklin, Northwest Territories.
To prepare from material collected by Dr. Thorsteinsson, a report on the stratigraphic palaeontology of the Grinnel Peninsula.

552. McCabe, Hugh R., Manitoba Dept. Mines and Natural Resources:
Mississippian Stratigraphy of Southwestern Manitoba, 1954-58; Ph.D. thesis, Northwestern University.
A regional stratigraphic analysis of Mississippian stratigraphy including a series of isopach and lithofacies maps of the various units, lithologic descriptions, and interpretive palaeogeography and palaeotectonics. The relation of the Manitoba section to the overall depositional picture of the Williston Basin will be shown.

553. McCamis, J.G., Univ. of Saskatchewan:
Anhydritization in the Souris Valley Beds of the Broadview Area, Sask; M.Sc. thesis.

554. Meneley, R.A., Univ. of Sask.:
Regional Study of the Upper Devonian "Nisku" Formation in Saskatchewan; M.Sc. thesis, 1958.

555. Middleton, G.V., McMaster Univ.:
Diagenesis of the Lowermost Devonian at Hagersville, Ontario, 1956-58.

556. Sanford, B.V., Geol. Surv., Canada:
Devonian of Southwestern Ontario, 1951-
A stratigraphic palaeontological study of the formations.

557. Usher, J.L., Muirhead, M., Grunder, A.N., Balkwill, H., Queen's Univ.:
Devonian Lithofacies in Alberta, 1957-58.
The Rocky Mt. Group in Alberta, 1957-58.
Ordovician Stratigraphy of the Kingston Area, Ontario, 1957-58.

Triassic to Tertiary

558. Copeland, M., Geol. Surv., Canada:
Jurassic Microfaunas, 1957-58.
Stratigraphic palaeontological studies in the Prairies and Foothills with special emphasis on Jurassic ostracod occurrences.

559. Crowther, M. Anne, Sask. Dept. of Min. Resources:
The significance of the Thick Viking Formation in Southeastern Saskatchewan, 1957-58.

560. Edwards, R.G., Univ. of Saskatchewan:
Stratigraphic Study of the Spinney Hill Formation (Cretaceous) of Saskatchewan; M.Sc. thesis, 1958.

561. Frebold, H., Geol. Surv., Canada:
Jurassic of British Columbia, 1955-57.
A stratigraphic palaeontological study of the Ashcroft, Lillooet, Harrison Lake and other areas.

562. Frebold, H., Mountjoy, E.W., Geol. Surv., Canada and Reed, H., Shell Oil Co.:
Fauna and Stratigraphy of the Oxfordian Green Beds in Western Canada, 1957-58.

563. Fry, W.L., Geol. Surv., Canada:
Tertiary of Southern British Columbia Between Flood and Bulf of Georgia, 1954-57.
A stratigraphic palaeontological study of the Tertiary flora.

564. Jeletzky, J.A., Geol. Surv., Canada:
Cretaceous Marine Zones of the Western Interior of Canada, 1956-
A comprehensive description of the palaeontology and stratigraphy of the marine Cretaceous strata.
Cretaceous and Jurassic Strata Southwest of the Mackenzie River Delta Between Rat and Babbage Rivers, N.W.T., 1955-58.

565. Meneley, W., Research Council of Alberta:
The Milk River Sandstone, 1957-59.

566. Mellon, G.B., Research Council of Alberta:
Sedimentation Study of the Blairmore Formation, 1955-58.

567. Price, L.L., Geol. Surv., Canada:
Subsurface Study of the Lower Cretaceous Formations of Southern Saskatchewan, 1954-57.
To describe and illustrate the character, distribution, structure and correlation of the principal Lower Cretaceous formations by a study of electric logs and samples from oil and gas wells, and thereby assist exploration for oil and gas.

568. Pugh, D.C., Geol. Surv., Canada:
Subsurface Study of Pennsylvanian and/or Permian, Triassic and Jurassic Formations in Northeastern British Columbia, 1954-57.
The determination, description, and correlation of facies changes by study of samples, cores, and electric and radioactivity logs of oil and gas wells.

569. Rouse, G.E., Univ. of British Columbia:
Plant Microfossil Analyses of Tertiary and Cretaceous Strata, 1956-
The objective is a reconstruction of floras and climatic conditions, and correlation and dating of strata employing plant spores and pollen grains recovered from Tertiary and Cretaceous beds. Of immediate interest is the separation of the Upper Cretaceous-Tertiary boundary in the coastal international boundary region.

570. Tozer, E.T., Geol. Surv., Canada:
Triassic of Southern Yukon and Southwestern British Columbia, 1954-57.
To describe and evaluate the stratigraphic significance of the pelecypod and ammonite faunas.

571. Westermann, G.E.G., McMaster Univ.:
Middle Jurassic of Germany, 1956-1958.
Zonal Stratigraphy of the Canadian Jurassic, 1958-59.

General Problems

572. Blackadar, R.G., Geol. Surv., Canada:
Northwest Baffin Island, N.W.T., 1956-57.
Reconnaissance mapping with special attention to detailed stratigraphic sections from the late Precambrian and Early Palaeozoic strata, and Pleistocene geology and physiography.

573. Clark, T.H., McGill Univ.:
Structure, Stratigraphy, and Economic Resources of the St. Lawrence Lowland of Quebec, 1939-

574. Douglas, R.J.W., (in charge), Norris, D.K., Brady, W.B., McLaren, D.J., Harker, P., Norris, A.W., Pelletier, B.R., Stott, D.F., and Craig, B.G., Geol. Surv., Canada:
Upper Mackenzie River Basin, Northwest Territories (Operation Mackenzie), 1957, 1 inch to 8 miles.
Geological mapping of an area of 100,000 miles with special emphasis on stratigraphy and faunal content of the Palaeozoic, Mesozoic and Tertiary formations and including reconnaissance mapping of the surficial formations of the area.

575. Edmunds, F.H., Univ. of Saskatchewan:
Study of Stratigraphy, Including Sedimentary Petrology, of Strata Being Sunk Through by Shaft of Potash Company of America, 15 miles East of Saskatoon.
Stratigraphy and Characteristics of Lloydminster Oil Field.

576. Danner, Wilbert R., Univ. of British Columbia:
Palaeozoic Stratigraphy of Southwest British Columbia, 1956-

577. Eastwood, G.E.P., and Fyles, J.T., B.C. Dept. Mines:
Structural and Stratigraphic Study of a Strip Along Lardeau River, and Gainer Creek, Including Lardeau Series, Badshot Formation and Hamil Series, 1953-57.

578. Fuller, J.G.C.M., Saskatchewan Dept. of Mineral Resources:
Lower Palaeozoic Stratigraphy of Southern Saskatchewan, 1957-
This project takes advantage of some new bore-holes through the Lower Palaeozoic rocks in the deeper parts of the Williston Basin in Canada. Encouraging oil showings prompt the establishment of a regional stratigraphy to employ in further exploration.

579. Hughes, John E., B.C. Dept. Mines:
Stratigraphic and Structural Studies of Post-Palaeozoic Rocks Along the John Hart Highway, 1954-
Field workon Lower Cretaceous rocks extending east to Little Prairie is essentially complete; some further work may be done in Triassic and Jurassic rocks.

580. Lesperance, Pierre J., McGill Univ.:
Mont-Wissich Group and Related Strata, Quebec, 1957-59, Ph.D. thesis.

581. Lemon, R.R.H., Royal Cntario Museum:
Proterozoic and Early Palaeozoic Sediments of the Admiralty Inlet Region, Baffin Island, 1954-58.

582. Liberty, B.A., Geol. Surv., Canada:
Palaeozoic Outliers of the Canadian Shield, 1957-
The compilation of all available data on their distribution and geology, and evaluation of their palaeogeographical significance.

583. Mountjoy, E.W., Univ. of Toronto:
Structure and Stratigraphy of the Miette Area, Alberta, 1956-58; Ph.D. thesis.

584. Cllerenshaw, N.C., Univ. of Toronto:
Diamond Drill Core Study of the Palaeozoic Section in Southwestern Cntario, 1957-58; M.A. thesis.

585. Sanford, B.V., Geol. Surv., Canada:
Establishment of Elevations of Wells Drilled for Cil and Gas in Southwestern Cntario, 1951-
To assist interpretations of the structure and stratigraphy of the productive oil and gas formations.

586. Tozer, E.T., Geol. Surv., Canada:
Cornwall Exmouth, Table, and Ekins Islands, N.W.T., 1957.
Geological reconnaissance and stratigraphic palaeontological studies with special reference to the Triassic formations.

587. Warren, P.S. and Stelck, C.R., Univ. of Alberta:
Palaeogeography of Western Canada, 1955-59.
See "Pacific Floodings of the Canadian Rocky Mountain Area", Ninth Pacific Science Congress (in press)

588. Winder, C. Gordon, Univ. of Western Cntario:
Lexicon of Palaeozoic Formation Names in Southern Cntario, 1956-58.
This project will include the Devonian, Silurian and Crdovician and is designed for persons unfamiliar with the stratigraphy.

STRUCTURAL

Alberta, Saskatchewan and Manitoba

589. Kupsch, W.C., Univ. of Saskatchewan:
Geomorphic Expression of Bedrock Structures in Drift Covered Areas of Southern Saskatchewan, 1956-
See "Lineaments in the Avonlea Area, Sask." Bull. Amer. Assoc. Petro. Geol., January, 1958.

590. Milligan, G.C., Manitoba Dept. Mines and Natural Resources:
Geology of Lynn Lake District, Manitoba, 1954-58.
A study of the structure and geological history of the district, largely based on field work of Manitoba Mines Branch geologists. See Canadian Mining Journal, Vol. 78, No. 7, 1957, p. 75-79.

591. Mountjoy, E.W., Univ. of Toronto:
Structure and Stratigraphy of the Miette Area, Alberta, 1956-58; Ph.D. thesis.

592. Wild, J., Univ. of Saskatchewan:
Physiographic Expression of Structural Elements of Southern Saskatchewan; M.Sc. thesis, 1958.

British Columbia

593. Eastwood, G.E.P., and Fyles, J.T., B.C. Dept. Mines:
Structural and Stratigraphic Study of a Strip Along Lardeau River and Gainer Creek, Including Lardeau Series, Badshot Formation and Hamil Series, 1953-57.

594. Hovdebo, H.R., Univ. of Saskatchewan:
Structural Geology of Part of the Elk River Area, British Columbia; M.Sc. thesis, 1958.

595. Hughes, John E., B.C. Dept. Mines:
Stratigraphic and Structural Studies of Post-Palaeozoic Rocks Along the John Hart Highway, 1954-
Field work on Lower Cretaceous rocks extending east to Little Prairie is essentially complete; some further work may be done on Triassic and Jurassic rocks.

596. White, W.H., Univ. of British Columbia:
Tectonics of British Columbia, a continuing study.

597. Willmore, P.L., Milne, W.G., and White, W.R.H., Dominion Observatory:
Study of Crustal Structure - Ripple Rock, B.C. 1954-58.

When the Department of Public Works blew up Ripple Rock, a network of seismograph stations were operated along the main line of the Canadian Pacific Railroad as far east as Banff. Commercial geophysicists operated stations in the prairie provinces. The work was under the supervision of Dr. Willmore.

In preparation for this event, and in order to determine local structure, Milne and White, with co-operation of the Pacific Naval Laboratories and the Royal Canadian Navy, have recorded the explosions from precisely timed and located depth charges.

From the combined work it should be possible to define seismic velocities in British Columbia, and to determine whether the mountains have roots or not.

Nova Scotia

598. Cameron, H.L., Nova Scotia Research Foundation: Correlation of Structures in the Meguma Series In Relation to Aeromagnetic Maps, 1957-58.

Investigation covers southwestern Nova Scotia in particular.

Ontario

599. Clarke, P.J., and Ambrose, J.W., Queen's Univ.: Joint Systems in the Kingston Area, 1957-58.

Joint sets in Precambrian and overlying Ordovician rocks have similar but not identical attitudes, and one set in Ordovician rocks seems to be missing in Precambrian rocks. This investigation will determine the number, character, and average attitudes of joint sets in each rock series within a few miles radius of Kingston, to establish relationships between the sets, to examine mechanics of their origin and their relations to features of Precambrian (i.e. sub-Ordovician) topography.

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To investigate further the problems of structure and petrology. See abstract, Can. Mining Jour., July, 1958, p. 95.

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AUTHOR INDEX

APPENDIX

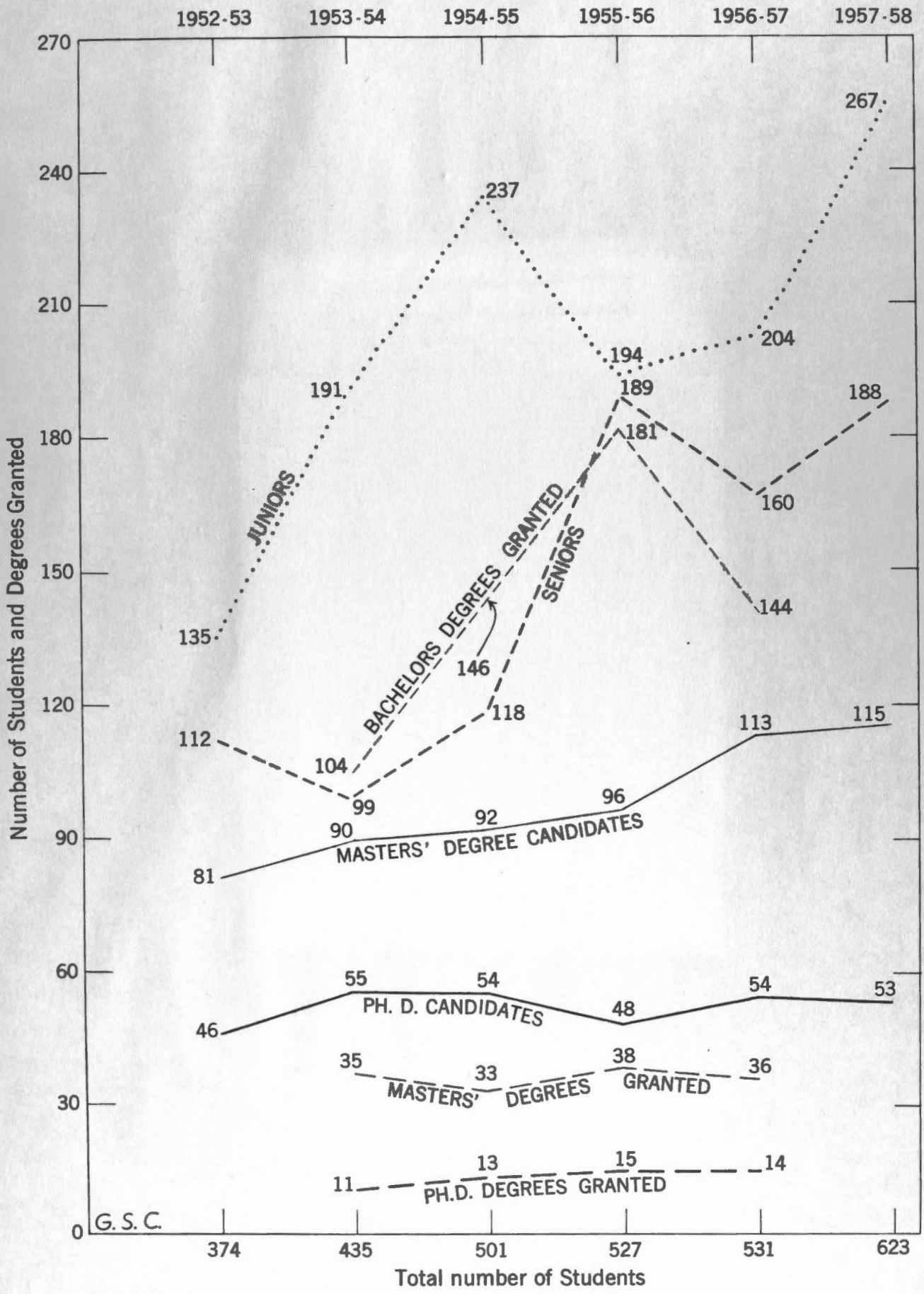
UNIVERSITY STUDENTS SPECIALIZING IN GEOLOGY IN CANADA

1952 - 1958

Since 1952, the Annual Reports of the National Advisory Committee have contained each year a tabulation of the numbers of graduate and undergraduate students attending Canadian universities. The American Geological Institute recently initiated a similar survey of universities in the United States and Canada and publishes the results in yearly reports[1]. It is, therefore, unnecessary for the National Advisory Committee to continue its survey and subsequent reports will not contain data on numbers of geological students in Canada.

[1]Survey of Geology - Geophysics Students in Colleges and Universities in the United States and Canada, 1956-57; Amer. Geol. Institute, Report No. 12, 1957 Edition.

The accompanying graph presents in summary the results of the annual surveys of the past six years. It is of interest in indicating the marked increase in the number of students specializing in geology over this period.


UNIVERSITY STUDENTS SPECIALIZING IN GEOLOGY
IN CANADA 1952-1958
1952-53
1953-54
1954-55
1955-56
1956-57
1957-58
270
240
210
180
150
120
90
60
30
0
Number of Students and Degrees Granted
JUNIORS
SENIORS
BACHELORS DEGREES GRANTED
MASTERS' DEGREE CANDIDATES
PH. D. CANDIDATES
MASTERS' DEGREES GRANTED
PH.D. DEGREES GRANTED
135
191
237
194
204
267
112
104
99
118
189
181
160
188
144
146
81
90
92
96
113
115
46
55
54
48
54
53
35
33
38
36
11
13
15
14
G. S. C.
374
435
501
527
531
623
Total number of Students