Canadian Geoscience Council

The Geosciences in Canada, 1978

Annual Report including a study concerning the Geological Survey of Canada

Prepared by
The Canadian Geoscience Council

Edited by: E.C. Appleyard

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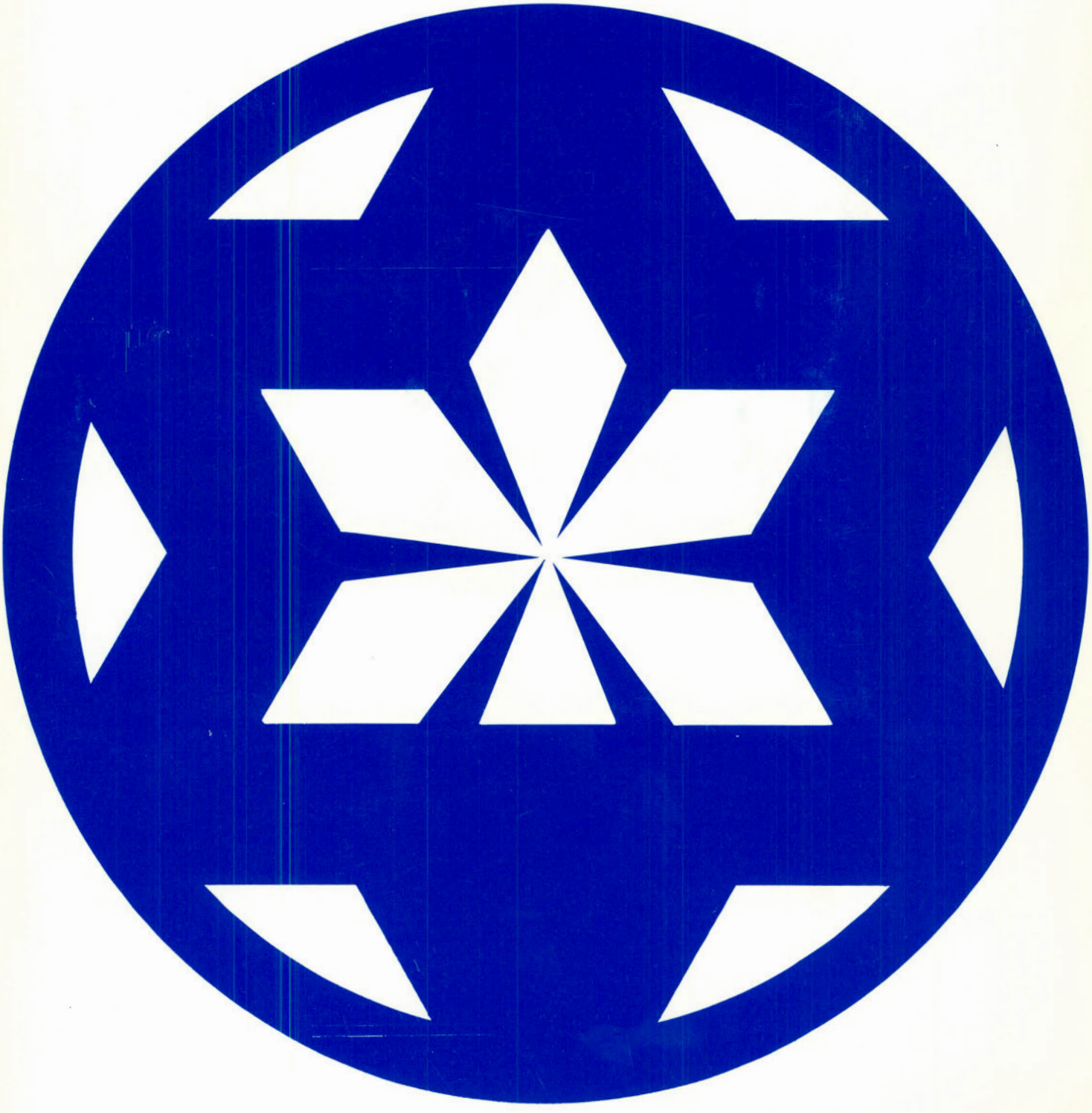

Energy, Mines and Resources Canada
Énergie, Mines et Ressources Canada

GEOLOGICAL SURVEY
PAPER 79-6

THE GEOSCIENCES IN CANADA, 1978

ANNUAL REPORT INCLUDING A STUDY CONCERNING THE GEOLOGICAL SURVEY OF CANADA

Prepared by
THE CANADIAN GEOSCIENCE COUNCIL

Edited by
E.C. APPLEYARD

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Preface

In its fifth annual report the Canadian Geoscience Council is pleased to present A Report Concerning the Geological Survey of Canada. This document was prepared by a unique Advisory Committee appointed by the Geoscience Council at the request of the Geological Survey of Canada. The Committee comprises distinguished representatives of a broad spectrum of the Canadian earth science community. Formed in 1976, the Committee's objective was to study and advise on the operations of the GSC. Visits were made to all GSC Divisions, and subgroups were formed to study the Uranium Reconnaissance, Radioactive Waste Disposal and Geochronology Programs.

Since 1976, the findings of the Advisory Committee have been presented in several detailed progress reports. It is noteworthy and highly commendable that the Survey has already taken steps towards implementing some of the recommendations of these early reports.

The picture which emerges from the Advisory Committee's report portrays the many problems faced by a large, complex organization which is evolving to meet the nation's changing requirements, and at the same time is making a determined effort to maintain its high level of competence and effectiveness. Careful reading of this report is recommended to all Canadian geoscientists.

In addition to the report on the Geological Survey of Canada, this volume includes the annual report of the Canadian Geoscience Council, and brief summaries of the activities of its member societies. Also included are four briefs presented during the year by the Geoscience Council, the Geological Association of Canada and the Canadian Geotechnical Society.

These briefs comprise representations made to various levels of government on behalf of the Canadian earth science community. Your attention to the contents of these briefs is warranted, as they document the attitudes and positions taken by your elected representatives, acting on your behalf.

January, 1979

G.W. Mannard
Past-President

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PART I

FOREWORD

The following report presents the conclusions, recommendations and explanatory discussion resulting from visits to the Geological Survey of Canada by an Advisory Committee appointed by the Canadian Geoscience Council at the request of the Survey. Detailed reports on each division visited were submitted to Survey management during 1976 and 1977. Additional reports for the use of Survey management were prepared concerning the Uranium Reconnaissance Program, the Radioactive Waste Disposal Program and the Geochronology program. Summaries of these last three reports are attached at the end of Part 2 of this report.

CONCLUSIONS

1. The people of Canada, the Minister of Energy, Mines and Resources and the Survey are facing a decision on whether the Survey is to remain a world class scientific body serving as an impartial source of information concerning the geology of Canada, or is to become a part of the regulatory and policy making functions of the federal government.
2. The Minister of Energy, Mines and Resources and the Survey are facing a decision regarding the implementation of co-operative sharing of earth science programs with provinces so that the Survey either remains a country-wide geological survey or becomes a regional geological survey restricted to the Yukon, Northwest Territories and British Columbia.
3. The Survey is facing a decision regarding organization into regional divisions or into functional divisions. The decision to decentralize has already been made so we conclude that proper locations and organization of the decentralized divisions are the problems to solve.
4. A very important decision has to be made regarding the percentage of effort applied to the core role and that applied to social and political objectives. While Survey scientists may see the need for a high percentage of effort on the core programs, they made need outside support from the Canadian Geoscience Council and the earth science community to support this role.
5. The Committee concludes that there must be wider recognition that the primary role of the Geological Survey of Canada is to gather, preserve, and publish information on the geology of Canada so that there will be a data base to aid resource discovery, development, conservation and exploitation, for the establishment of realistic environmental standards, and to guide urban development.
6. Decentralized divisions can be made to serve the earth science needs of Canada. The major geological and geographical regions of Canada can be served best by operating units similar to the Institute of Sedimentary and Petroleum Geology in Calgary or the Cordilleran Subdivision in Vancouver. In these institutes the benefits to be gained by teaming geologists with geophysicists, geochemists, and other earth scientists favour decentralization. Comments on this conclusion are contained in the body of the report.
7. The Committee endorses the concept of the Survey forming a marine geoscience research committee, one of whose directives would be to define and formulate objectives for the marine geoscience institute. The Committee suggests that marine geoscience studies in the Pacific have not received the attention which geology and mineralization would indicate as appropriate.
8. A final conclusion is to restate the belief of the Committee that the core activities and the support programs, must be the major "raison d'ètre" for the Survey's continued existence. These programs and activities permit the Survey to emphasize its position as one of the few divisions of government that can be part of the productive sector of the economy.

RECOMMENDATIONS

1. The Committee recommends to the Canadian Geoscience Council that it should rally support from the earth science community and industry for the Geological Survey of Canada to continue its primary role of core activities and related support programs.
2. The Committee recommends that the Geological Survey of Canada remain an objective scientific body and not involve itself directly in regulatory functions.
3. The Committee recommends that the Canadian Geoscience Council support the position that geological mapping and research remain as prime tasks for the Geological Survey of Canada. Reconnaissance mapping should be followed up by more detailed problem-oriented mapping in selected regions.
4. The Committee recommends that the Canadian Geoscience Council should help the Geological Survey of Canada in attempts to gain agreement with the provinces as to logical divisions of labour so that each would complement the other in the solution of earth science problems.
5. The Committee recommends that the Geological Survey of Canada seek the support of the earth science community and the resource industries of Canada so as to maintain programs of modern mapping, irrespective of socio-economic demands from the political level. The Canadian Geoscience Council should be the prime mover in gaining this support.
6. The Geological Survey of Canada should continue to do region-wide, problem-oriented, research on the geology of Canada.
7. To plan and evaluate results of its program, the Survey should be in contact with industrial users, provincial surveys and academic earth scientists.
8. The Committee recommends to the Canadian Geoscience Council that it help the Survey judge the relevance and adequacy of Survey programs by establishing a continuing committee that would assist communication with users and peers in the earth science and industrial sectors of the country.
9. The Survey should continue to set national standards of earth science data gathering, presentation and interpretation. It should preserve and publish data for future generations.
10. The Survey should continue to be a contact with international earth science research, ideas and methods and be a conduit for introducing international developments in earth science into Canada.
11. The Survey should continue to increase efforts to integrate all disciplines to the solving of earth science problems.

12. The Survey should continue to be alert to identify useful concepts in earth science and stimulate their development in Canada.

13. The policy of contracting out, as it affects the Survey, needs more study. Should the Survey feel that outside assistance would help, the Committee suggests the Survey ask the Canadian Geoscience Council for a specific review of this issue.

14. The Committee suggests for long-range consideration and planning a list of eleven recommendations that for brevity are not repeated here.

15. Should the Survey at some time request it, the Canadian Geoscience Council should be prepared to help the Survey in a detailed organization and cost effectiveness study.

16. With regard to individual mission-oriented programs, the Committee feels that each one should be examined as a special assignment from the Survey, with assistance, as requested, from the Canadian Geoscience Council.

J.A. Coope, Toronto D.W. Strangway, Toronto
J.D. Mollard, Regina A. Sutherland Brown, Victoria
J.D. Weir, Calgary (Chairman)

CGC Advisory Committee to the Geological Survey of Canada

RESPONSE

The following is a response by EMR to the recommendations made by the Advisory Committee on the Geological Survey of Canada to the ADM (Science and Technology)

Recommendations Nos. 1, 3, 4 and 8 – are noted.

Recommendation No. 2 – The Geological Survey of Canada is not now involved directly in regulatory functions nor does it intend to be in the future. As part of its departmental responsiblities, however, it does provide scientific advice to regulatory agencies and will continue to do so.

Recommendation No. 5 – The Geological Survey of Canada welcomes the support of the earth science community, resource industries of Canada and the Canadian Geoscience Council to enable it to maintain programs of modern mapping irrespective of other demands made upon the Survey.

Recommendation No. 6 – The Geological Survey of Canada will continue to do region-wide, problem-oriented, research-type studies of the geology of Canada.

Recommendation No. 7 –The Geological Survey of Canada will continue to be in contact with industrial users, provincial surveys and academic earth scientists to plan its program. The Advisory Committee to the Geological Survey, however, can help greatly with the evaluation of results of the GSC program by obtaining opinions from industrial users, provincial surveys and academic scientists on the quality and usefulness of its output. This could be the next task for the Advisory Committee.

Recommendation No. 9 – The Geological Survey will continue to set national standards for earth science data gathering, presentation and interpretation. It will continue to preserve and publish data for future generations.

Recommendation No. 10 – The Geological Survey will continue to maintain contact with international earth science research, ideas and methods and be a conduit for introducing international developments in earth science into Canada.

Recommendation No. 11 – The Geological Survey of Canada will increase its efforts to integrate all disciplines to solving of earth science problems. It has already acted on this recommendation with the establishement of three Integrated Multidisciplinary Pilot Projects, two in the Precambrian Shield and one in the Cordillera. It will continue other integrated multidisciplinary programs already being undertaken, for example, in offshore studies, radioactive waste disposal and in terrain geophysics.

Recommendation No. 12 – The Geological Survey of Canada will continue to be alert to identify useful concepts in earth science and stimulate their development in Canada. Examples are Canadian involvement in IAEA/NEA projects in uranium geology and participation in satellite-related laser ranging experiments.

Recommendation No. 13 – Contracting out is now a formal part of the Department's program forecast exercise. Thus GSC has to submit to Treasury Board its plans for research and data collection that may be contracted out during the program forecast period. Budget cuts over the last two years, however, have resulted in cuts of $2.65 million resulting in the cancellation of the contracted Uranium Reconnaissance Program and a reduction by half in contracted aeromagnetic surveys. As a result the GSC has little capacity for further contracting out without obtaining additional operating funds. Transfer of technology to industry will continue to be achieved, where possible, by contracting systematic operations, derived from successful technological development, e.g. as has been done in the past for aeromagnetic, radiometric and geochemical surveys.

Recommendation No. 14

Item 1 – Under planned reorganization the current Cordilleran and Pacific Margin Subdivision will become an independent Division.

Item 2 – ISPG will continue in Calgary.

Item 3 – The GSC Precambrian Institute is to be located in Thunder Bay. This is a political decision over which GSC has no control.

Item 4 – Future reorganization at an appropriate time will consolidate Atlantic Offshore and Appalachian geological responsibilities on land at Atlantic Geoscience Centre.

Item 5 – When the GSC considers that the time is appropriate regional and process studies staff in Terrain Sciences Division may be located in regional centres. This will take place only when teams will have had time to remain long enough in a region to develop regional expertise.

Item 6 – GSC considers that geophysical and geochemical technological and methodological development will continue to be centred in Ottawa in order to capitalize on the small, yet barely critical, mass of expertise necessary for successful innovation in the future. Airborne geophysical surveys, particularly radiometric, have to be carried out on a large enough scale to make them economic for the contractors and the Survey. This means that such surveys will inevitably collect data at a rate that will far outstrip the rate of bedrock and surficial geological mapping. Furthermore, contracted geophysical and geochemical surveys require a centralized cadre of scientists to provide specifications, control and inspection. Interpretation and integration of data from these surveys, however, are much better regionalized and integrated with the geological functions and activities of regional offices. Such integration will inevitably result in expanded use of instrumental field techniques, thus ultimately raising the general standard of geological knowledge. For these reasons, integration of various sorts of data now collected by the Geological Survey is a priority which has resulted in the establishement of integrated multidisciplinary projects.

Item 7 – GSC will increase its regional metallogenic expertise, as the opportunity arises, and, as appropriate, will eventually transfer this expertise to regional offices. Other mineral commodity specialists will continue to have national responsibilities and they, and their support functions, will continue to reside at Ottawa. There they will continue to be able to maintain liaison with the Mineral Policy Sector.

Item 8 – In the long term it is envisaged that Ottawa headquarters for GSC will retain the national responsibilities for mineral resource geology, Quaternary geochronology and paleoecology, engineering geology, geophysical and geochemical technological R&D and related survey implementation and inspection, eastern paleontology, and curation of types, analytical laboratories and related R&D, and GSC central managment and administration.

Item 9 – The Geological Survey will consider the use of staff specialists for co-ordination of disciplinary interests. it is noteworthy, however, that the GSC already has interdivisional disciplinary interests represented in palynology, micropaleontology, and structural geology. It is developing more formal interdivisional contacts in marine geology. Other interdivisional disciplinary interests need to be encouraged.

Item 10 – The report gives the impression that co-operation exists with few provinces. Although inevitably there are occasional areas of conflict with some provinces, good co-operation and a good working relationship between most provinces and the GSC are the general rule. The Geological Survey keeps provinces informed on what it is doing in their territory and ensures, at the technical level, that there is no duplication. Each province has different requirements and a different level of resources. Accordingly, GSC has developed a flexible approach to accommodate these various relationships. It is true, however, that agreements with all provinces have not been formalized and, therefore, a meeting between provincial geological surveys and GSC is desirable to explore this possibility.

Item 11 – The GSC appreciates that the Advisory Committee recognizes that decentralization requires a short-term increase in capital and some long-term increase in operating costs. The GSC has no choice but to stay "lean" as no additional positions are available from the federal government for GSC Precambrian Institute. Positions for this institute must come from within EMR, probably in part from GSC. All further strengthening of regionalization will be transfers, in some cases at the expense of reductions elsewhere in GSC.

Recommendation No. 15 – The GSC considers that the Canadian Geoscience Council does not have the expertise or the time to assist the GSC in detailed organization and cost effectiveness studies.

Recommendation No. 16 – The GSC, as necessary, will request the assistance of the Advisory Committee to examine the short-term programs (mission-oriented programs of the Advisory Committee in this report).

PART 2

A REPORT CONCERNING THE GEOLOGICAL SURVEY OF CANADA

by

J.D. Weir[1], J.A. Coope[2], J.D. Mollard[3], D.W. Strangway[4], and A. Sutherland Brown[5]

INTRODUCTION

This is the second report concerning the Geological Survey of Canada prepared by an Advisory Committee appointed by the Canadian Geoscience Council at the request of the Geological Survey of Canada. Committee members were chosen to represent a broad spectrum of the earth sciences in Canada including the Academic Sector, the Provincial Government Sector, the Mining industry, the Petroleum industry, Terrain Sciences and the Consulting Sector. During the first year Marine Geosciences were also represented. With the resignation of this representative an effort is under way to secure a francophone geologist to provide additional breadth to the Committee.

The Geological Survey of Canad does not operate in an ideal environment. It is subject to all the political, economic, geographical, cultural, and technological pressures which buffet our society today. It is to the credit of its scientists and management that it has continued to produce earth science studies of good quality which are of use to Canada. This Committee recognizes that there are many strengths within the Survey as it exists. However, it is our aim to look ahead for a decade and to see if the objectives, working conditions and scientific output of the Survey can be improved to meet the anticipated challenges of that time. It is in the interest of all earth scientists in Canada that the Geological Survey of Canada maintain its standards of scientific integrity, its stature in geological mapping and research and its independence as an impartial source of information concerning the geology of Canada.

Finally, it is important that the employers of the Geological Survey, namely the Canadian taxpayers, receive true value for their money.

The Committee has noted in a number of earlier comments, the inadequacy of funding of the GSC for all its assumed tasks. In a period when the government is spending far more than it has available from revenue, the government must reduce overall spending; however, it must be recognized that the Geological Survey differs from most branches of government in that it is part of the productive sector of the economy and thus is one of the elements that should be stimulated.

The Committee emphasizes that the recommendations of this report may require 10 years for implementation. Thus they are long-term recommendations. Short-term recommendations were included in the reports of visits to individual divisions and the Survey is already acting on some of these.

THE ROLES OF THE GEOLOGICAL SURVEY

The roles of the Geological Survey were considered at some length in the first annual report to the Survey management but are so central to the work of the Visiting Committee that we shall comment further on them.

Past Roles

That it has not been easy to define the roles of the Geological Survey may be judged from: (1) the numerous reorganizations of the government departments containing the Survey; The Mines Act of 1907, the Department of Mines and Resources of 1936, the Mines, Forests and Scientific Services Branch of 1947, the Department of Mines and Technical Surveys of 1950, the Department of Energy, Mines and Resources of 1966; (2) the creation of new departments with some earth sciences responsibility, such as the Department of the Environment and the Ministry of State for Science and Technology in 1970; and (3) the 1972 division of the Department of Energy, Mines and Resources into four units under four Assistant Deputy Ministers, so that the Geological Survey is now one of seven units under an Assistant Deputy Minister for Science and Technology. In many of these organizational shifts the Survey was not only the largest component of the Department but also one of the most important from all aspects. In EMR it is still the largest component but the present organization demonstrates that it is regarded as only one of many components. Thus the need to re-examine and emphasize the relevance of the Survey to Canada today is apparent.

Throughout all of these shuffles the constant role of the Geological Survey has been to gather, analyze, interpret and present data concerning the geology of Canada, both bedrock and surficial. It follows that the first and continuing task is to map the rock types and their unconsolidated cover. Associated with this mapping is the need to study processes forming the various rock types, processes modifying pre-existing rock types, processes concentrating various organic or inorganic minerals of value to man, and geological processes influencing distribution of soils and water. These functions we would call the core role of the Survey.

Whether the Survey has led the way or followed others, it has been its particular task to document observations on the geology of Canada and publish them as geological maps and reports so that all future workers would have a base on which to build. Since its inception, the justification for the Survey's role has been based on the need for this information to aid resource discovery, development, exploitation or conservation. The Committee believes that this, the primary role of the Geological Survey, is even more important today than in the past. However, provincial administration of resources, and the increasing work of provincial geological surveys require a new look at how this role may best be accomplished.

Present Roles

At present the Survey continues its core geological mapping and geoscience research role. To this role it has added new technology that has several aspects. In part, the new technology is used to strengthen and support the mapping and research role by the use of geochronology, palynology,

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organic geochemistry, etc.; partly it involves elaborate or sophisticated geochemical or geophysical onshore or offshore surveys that can be regarded as extensions of core mapping. These are in order when done in conjunction with geological surveys or to improve geological mapping or interpretation. The Survey recognizes that an effort must be made to keep the relationship between geology, geochemistry, and geophysics as close as possible and that data should not be collected faster than they can be interpreted. The use of new technology also appears designed to keep abreast of world geoscientific technology which in many ways is important, but which, without control all down the chain of command, easily passes into "technology for the sake of prestige."

Increasing population together with attitudinal changes have resulted in growing social and environmental concerns, which in combination with the needs for data for frontier energy development have increased the role of the Survey in mapping and evaluating unconsolidated sediments, particularly in the frontier regions of Canada. These relatively new demands have been placed almost entirely on one operating group, the Terrain Sciences Division. The core work of the Survey (geological mapping, geophysical and geochemical mapping, marine geoscience and terrain science each with its associated research) can still be recognized as directed towards gathering, analyzing, interpreting and presenting basic data on the geology of Canada. Since at least three of these roles apply to mapping the same land areas in different ways, a problem arises of proper organization to avoid duplication. The time is past when a single organization, located in Ottawa, could handle all the roles of the Survey. This will be discussed further in the section on organization.

Another class of Survey role which is increasing at present, is related to the desire of people within the government to manage economic and social development. Such emphasis, when imposed on the Survey, unfortunately diverts resources from the core programs described above and identified by the Committee as the primary task of the Survey. One such secondary role is the provision of earth science data to estimate location and amount of resources of oil, gas, coal, uranium, metallic minerals and construction materials that may, with exploration and development effort, turn into producible reserves of needed minerals and fuels. Another is to study geological processes that respond to man's disturbance of the physical environment and that may adversely affect man's construction of major transportation systems or man's disposal of wastes. This involves earth science advice on pipelines and other transportation routes, permafrost terrain, landslides, national park selection and nuclear waste disposal. It includes providing technical or professional advice based on earth science data to branches of government which, by political decrees, manage, direct and regulate resource and energy development, and major construction problems. A difficulty for the Survey in filling these roles is that they often find themselves giving advice to nontechnical administrators rather than providing a scientific data based. However, the misuse of the scientific data base is a concern of all earth scientists so the Survey has a responsibility in interpreting its findings.

It is important for the Survey, in fulfilling all of the above tasks, to maintain its policy of providing impartial, correct and informed basic data and the best scientific interpretation that it can. In line with this policy the Survey has elected not to take a regulatory or supervisory function, a decision which this Committee fully supports.

Future Roles

Perhaps the most important task of this Committee is to comment on the future roles which should be adopted by the Geological Survey. In order to assess what part the Survey should (or can) play in the future, answers are needed to certain questions such as:

1. What parts of Canada (or the world) should the Survey's efforts cover?
2. How will the Federal Survey work with the Provinces?
3. How many functions will (or should) be assigned to the Survey?
4. What share of the taxpayers' dollars will the Survey receive?

To be logical, the first three questions should be answered first and the resulting program funded to attain the chosen ends. Canaa would be well rewarded by funding the Survey in keeping with its importance in regard to resource development.

In the present situation, however, it is fairly obvious that there are three responses that the Survey can make to increased demands upon it from all sectors of society:

1. It can concentrate on core or basic geologic programs and turn aside or minimize new demands. This may lead to its decreased importance on the national scene.
2. It can accept the new demands and respond to them at the expense of core programs of geological mapping and research. This may lead to decreased stature in the scientific world.
3. It can accept the new demands or responsibilities with discrimination (seeking out important ones but rejecting costly or ill-conceived ones) and find ways of maintaining its service to the public at reduced cost by increasing efficiency, by pruning less relevant or less cost-effective programs, by internal retraining and by building shared co-operative programs with other agencies or institutions in the private, provincial, or federal domains.

It is the Committee's view that this third option should be chosen by the Survey and that the Canadian Geoscience Council should ask for support for this choice by the earth science community. This choice will place greatly increased demands upon departmental and Survey management.

In making the third choice it is important that the Survey should maintain its objectivity and not involve itself in defining regulations affecting the private sector or enter into prospecting in competition with that sector.

Of the core roles, geological mapping and research must be emphasized. The earlier reconnaissance coverage should be followed with more detailed, problem-oriented mapping in selected regions. The metallogenic and energy resource follow-up should include detailed geological mapping. Relationships with provinces must be clarified and shared programs or complementary programs attempted within a framework that allows different responses to varying needs. The GSC should seek the support of the geoscience community in Canada so as to be able to maintain these programs of modern mapping irrespective of changing socio-economic demands. The GSC should not just respond to varying demands from provinces but should attempt to obtain firm agreements concerning the type of surveys each should do so that they could complement each other in better solutions of earth science problems.

In addition the Survey must carry out and/or stimulate a certain amount of research related to its programs and play a part in on-the-job training and education of the next generation of Canadian geoscientists. (This training function is not as important as forty years ago, now that there are many industrial and academic organizations also involved. However, the Survey is still pre-eminent in classical field-oriented geology which should be a basic part of the training of all professional geologists.)

Contracting out is becoming a more common GSC activity. Because of manpower ceilings, difficult problems are imposed in meeting such controls as activities expand. However, the "contracting out" procedure can add manpower not otherwise permitted under the ceilings. In practice, however, the whole problem becomes very complex and takes time and effort of Survey management that would better be directed towards the core programs of the Survey. A policy of forced contracting out could seriously distort the core programs of the Survey. Contracting out will require the Survey to have (by employment or training) personnel who are able and willing to supervise and if necessary manage these contracted out programs.

The Geological Survey of Canada is extremely capable in conducting regional reconnaissance surveys and maintaining high standards of data collection, presentation and interpretation, along with asssociated research and technological development. The way in which programs of modern mapping are planned and presented to the public is important in securing user or public acceptance. For example, the Uranium Reconnaissance Program was launched by the argument that it would help define uranium resource areas (for political rather than for economic reasons) and this contributed to some confusion and objection by the private sector. The title "Uranium Reconnaissance Program" led some people to believe that the Geological Survey was becoming directly involved in uranium prospecting. Simple announcements that the GSC proposed to complete national radiometric, stream sediment and lake sediment surveys would have been more readily accepted and objections would have been directed towards the validity and value of the data rather than to political arguments.

Summary

The Geological Survey of Canada should set national standards of earth science data gathering, presentation and interpretation. It should preserve and publish data for future generations.

- The Survey should be a means of contact with international earth science research, ideas and methods and be a conduit for introducing international developments in earth science into Canada.
- The Survey should be able to identify useful concepts in earth science and stimulate their development.
- The Survey should do country-wide research-oriented geological studies. Examples of such studies might be establishment of criteria for recognition of ancient island arcs or volcanic piles, studies on the origin of massive sulphide deposits, the recognition and evaluation of source beds for hydrocarbons, studies of subsurface fluid migration, identification and interpretation of structural styles, recognition and interpretation of facies relationships, radiometric dating, etc. To plan and evaluate the results of such research the Survey should be in close and continuous contact with industrial users, provincial surveys and academic earth scientists.
- The Survey should be a local geological survey for the Northwest Territories, the Yukon and British Columbia, doing the required reconnaissance, detailed and problem-directed mapping.
- The Survey should recognize and encourage provincial surveys so as to strengthen them. Since the provinces own and administer natural resources, the allocation of objectives between provincial and federal surveys should follow some logical division of the earth science studies that are needed. The Survey should show itself to be receptive and objective in its approach to this sharing. The solution to this problem may be beyond the power of the federal and provincial surveys and lie in the political domain. The Geological Survey of Canada should seek help and advice from outside bodies such as the Provincial Mines Ministers Annual Conference, and/or meetings with Provincial Chief Geologists. A request to the Canadian Geoscience Council for advice and support from the Canadian geoscience community for help in determining proper sharing of earth science studies would also appear to be in order.
- The Survey should strive to maintain its reputation for providing impartial and informed basic data as a neutral scientific organization.
- Finally, the Geological Survey must emphasize a program of integrated geological mapping of all of Canada. This requires reaching agreement with the provinces. To do this, both the federal government and the provinces must accommodate to each other. To preserve its scientific integrity the Survey must retain its traditional "neutral" role. To maintain the technical quality of its work it must do research on problems related to geological mapping and geological processes, and to improve methodology. To be more effective within its budget it may have to face elimination of low priority programs and the personnel associated with them. To ensure its future the Survey must emphasize, not dimish, its position as one of the few divisions of government that can be part of the productive sector of the economy.

HOW THE SURVEY IS ORGANIZED

Over the years the Survey's organization has changed to meet changing needs. In the early years when the Survey's activities covered all of Canada, a central location in Ottawa was adequate. In the recent past the Survey's partially decentralized organization has been fairly effective. The main weaknesses detected by the Committee were: excessive rigidity across division boundaries in Ottawa and the combination of central laboratories and administration under one division.

The Committee recognizes decentralization to be an established policy of the Federal Government and a partially accomplished fact in the present Survey organization. Enforced further dispersal of the Survey brings about a need for reorganization that can be interpreted as fortunate. The Committee found that the Director-General and Deputy Director-General fought hard for a rational solution within the constraints of the decentralization policy. In effect the major geological and geographical regions of Canada will be served by fairly homogeneous and relatively autonomous institutes similar to the Institute of Sedimentary and Petroleum Geology in Calgary. The sizes, components and importance of the various institutes should not necessarily be equal. The institutes will, in effect, be regional geological surveys. The Committee wishes to emphasize the benefits to be gained by teaming geologists with geophysicists, geochemists and other geoscientists in the investigation of geological problems. Thus all related and needed disciplines

should be present in each regional institute. This would include research facilities and necessary laboratories. It is obvious that any decentralization has unavoidable costs in monies and communication. These should be minimized, duplication avoided as far as possible, and effective mechanisms of communication designed and used.

For the non-geologically trained administrator, the Committee wishes to emphasize that Canada consists of four onshore natural geological divisions: (1) The Cordilleran Region comprising most of British Columbia and the Yukon; (2) The sedimentary basins comprising southern Manitoba and southern Saskatchewan, most of Alberta, the Mackenzie Valley and the Arctic Islands; (3) The Precambrian Shield comprising the Northwest Territories east of the Mackenzie Valley, northern Saskatchewan, northern Manitoba and most of Ontario, Quebec and Labrador; and, finally, (4) The Appalachian and Maritime Region covering southern Quebec, the Maritime Provinces and Newfoundland. The offshore continental shelves, slopes and rises might be considered a fifth division. However, a better arrangement might be to group the offshore with the adjacent onshore orogen, e.g., the Atlantic shelf, slope and rise with the Appalachians; the Pacific offshore with the Cordilleran region.

Thus a natural organization of the Survey would consist of four operating divisions with assigned geographical responsibilities that would dictate the differing mix of geological and geophysical specialists needed for each division. It is believed that the need to do specialized and efficient geological work points strongly to this kind of organization. Such an organization would permit the preparation of unified maps (which the Committee believes Canada should have). Such an organization would encourage the study of geological problems or geological processes within natural geological divisions irrespective of political boundaries. Again, to attain this the federal government must find an accommodation with the provinces.

In the reorganization, many parts fall naturally into place and some are accomplished facts. Thus the Cordilleran Section in Vancouver becomes the Cordilleran and Pacific Institute, the Institute of Sedimentary and Petroleum Geology is already functioning in Calgary, the Precambrian Institute is beginning to form, and an Appalachian and Maritime Institute, including the Atlantic Geoscience Centre, needs consideration.

Three questions remain to be examined:

1. What should be the organization and location of the Terrain Sciences Division?
2. How should research and development related to new methodology be located and organized?
3. What Survey functions and organization should remain in Ottawa?

From our observations and discussions to date we would recommend for long range consideration and planning:

1. A Cordilleran Institute in Vancouver in association with a marine section.
2. Continuation of the Institute of Sedimentary and Petroleum Geology in Calgary.
3. A Precambrian Institute in some location with mining industry and academic association.
4. An Appalachian and Atlantic Institute probably at the location of the present Atlantic Geoscience Centre.
5. Decentralization of a number of staff associated with regional projects in the Terrain Sciences to the four institutes, keeping a staff in Ottawa headquarters for specialist group assignments (process studies, engineering, etc.) and for national compilation and syntheses. Work of the Terrain Sciences Division falls logically into Arctic, Cordilleran, Boreal Forest, and Southern Regions rather than into the natural bedrock geology divisions mentioned above.
6. Long term decentralization of personnel in geophysical, geochemical, laboratory and research work to the four operating institutes so that in each institute there could be a team approach by geologists, geophysicists and geochemists to earth science problems.
7. Over the long term, plan to phase economic geologists and Resource Geophysics and Geochemistry groups into the core mapping groups in the institutes for one-location communication with industrial users within those regions.
8. Retain in Ottawa the residual staff in Terrain Sciences and those personnel responsible for management functions, program planning, financial resource allocations and control of budgets and spending targets.
9. Develop a system of staff specialists for co-ordination of methods, communication of ideas, results and discoveries, and to guide transfers of personnel for training or transfer of technology. Such specialists, located in Ottawa and reporting to the Deputy Director General, should tackle the problems of communication between regions and specialized branches of earth science. Rather than have various sub-disciplines develop in competition, as they have in the past, the Survey should develop co-operative attacks on earth science problems.
10. Develop a basis for working with the provinces so that the Survey is in fact the Geological Survey of Canada. Examples of co-operation exist with British Columbia and Newfoundland. Again, the Committee recommends that the Survey ask the Canadian Geoscience Council for help on this specific problem. From our observations to date, a workable relationship exists where the Survey does the regional geological mapping and establishes the geological framework while the province does the detailed geology related to mineral or fuel deposits. In defining the role and organization of the Survey this point of shared but complementary effort needs to be clarified and accepted. If, instead, the federal government asks the Geological Survey to provide technical and professional advice (using provincial data) to the branches of the federal government that manage, regulate and direct the development of natural resources, there is unlikely to be much agreement. In this case, the Geological Survey of the future will be responsible for the Cordilleran region, the Northwest Territories and some studies in terrain sciences and marine geology. A much smaller Survey and fewer institutes could handle this assignment. The end result of such a trend could be a take-over by provincial surveys of all geological and resource assessment projects.
11. The Committee recognizes that extra money and staff are involved in decentralization. It is not possible to both decentralize and reduce costs immediately. Thus a short term increase in capital costs and some long term increase in operating costs are involved if decentralization is the policy followed. However, the Committee wishes to stress that the Survey should stay as "lean" as possible and that increases in staff in the institutes should be offset by elimination of positions in Ottawa wherever possible. Revised future planning and the changes in long term planning that decentralization and changing roles demand will, or should, permit economies that can be gained in personnel and other costs.

COMMENTS ON ACTIVITIES

Comments concerning activities of the Survey have been made in confidential reports of visits to the various divisions and institutes. In a sense, the activities of the Survey have also been discussed in the preceding sections concerning the role and the organization of the Survey. However, activities are so numerous and so widespread that perhaps an attempt should be made to summarize them from the point of view of the Visiting Committee. One such summary would be:

1. Core Activities
2. Support Programs
3. Mission-Oriented Programs
4. Overseas Programs
5. Co-operative Programs

Without trying to identify all the present activities of the Survey, a partial list is still impressive:

1. ***Core Activities***

   A. **Regional Mapping**
   Precambrian sedimentary, metamorphic and igneous geology
   Paleozoic, Mesozoic and Tertiary sedimentary and igneous geology
   Offshore geology

   B. **Special Problems**
   Structual problems
   Stratigraphic problems including facies relationships
   Tectonic history
   Economic geology
   –mineral deposits including uranium
   –fuels, including oil and gas, and coal

   C. **Correlation**
   Paleontology
   Palynology
   Geochronology

   D. **Quaternary Geology**
   Pleistocene and Recent deposits
   Landslides and other natural hazards
   Sedimentary and erosional (geomorphic) processes
   Permafrost studies and ground ice distribution
   Geological framework studies for engineering purposes

   E. **Marine Geology**
   Offshore gravity, magnetics and seismic surveying
   Offshore surficial mapping, bedrock sampling and structural studies

2. ***Support Programs***

   A. **Geophysical Surveys**
   Magnetic
   Gravity
   Electromagnetic
   Radiometric
   Seismic
   Remote sensing

   B. **Geochemical Surveys**
   Lake and stream sediment
   Hydrogeochemistry
   Rock and soil geochemistry
   Biogeochemistry
   Geobotany
   Gas and particulate geochemistry
   Organic geochemistry

   C. **Central Laboratories**

   D. **Information Publications**

3. ***Mission-Oriented Programs***
   Uranium Reconnaissance Program
   Resource Evaluation
   Environmental Studies of Pipeline Routes
   Waste Disposal
   Geothermal Resources

4. ***Overseas Programs***
   Support of CIDA
   International conferences

5. ***Co-operative Programs***
   Research with universities and industry
   Joint programs with provinces

In the same way that reviews of division operations suggested that certain divisions are over-extended, so this summary of Survey activities suggests that the Survey as a whole is over-extended.

In order to judge the relevance and adequacy of the Survey's programs, a method is needed to get the judgment of users and peers in the country's earth science establishment. The present voluntary committee is not large enough, nor has it had enough time to provide an adequate answer.

Core Activities

Viewed in the long term, the single most important activity of the Survey is the core program outlined under 1, above. This core program has normally been pursued vigorously and should continue to be what it is at present, the largest single activity performed by the Survey. The level of activity should be set on a long term basis, as it is, and should not be subject to sudden truncations and surges. The long-standing justification of mapping and related research by its importance to resources is now taken as a truism, but it must be realized how true it is. Exploration in areas of the world without an adequate geoscience data base is very costly per discovery. Without such a data base results rely greatly on chance in areas that must be selected with a minimum of informed thought. In such places one discovery does not lead to a chain of discoveries, as there is no geological basis for an extension of reasoning other than proximity. In addition, data gathered by the discoveries is usually confidential. In contrast in an area with a geoscience framework which has been published, exploration can be carefully planned and is increasingly effective as information is added. The story of multiple uranium discoveries in Saskatchewan is a good example. Another one is the rapid output of B.C.'s interpretive map set of Mineral Deposit/Land Use maps, which was only possible because of the relatively complete and good quality four-mile mapping of the Survey and the advanced state of mineral inventory in B.C. This map set, in turn, is having a major impact on planning in the province, not only of exploration but particularly park locations and transportation.

There is no doubt that the mapping, and the related research, needs constant revision to incorporate advancing concepts. It also needs to be increasingly detailed because the important factors for mineral and fuel resources are normally on the scale of facies, not formations. The difficult questions for Survey management are – what constitutes relevant research? and what is to be the balance of effort between mapping and compilation, and related research? Recent Survey practice seems to handle this problem adequately. Also the standard and quality of work done by the Survey is being maintained by Survey management. Increased effort on integration of disciplines is one area that needs attention.

Support Programs

Support programs should have a geological reason. If, as was suggested in the section on organization, these programs are decentralized to the proposed institutes, this will no doubt be the case. If support programs are placed in an operating division remote from the institutes (such as in Ottawa) there is likely to be friction, difficulty of relating programs to geological mapping, and conflict over funds. Regional or systematic geophysical and geochemical surveys should be carried out in areas where experience indicates they will provide helpful and meaningful information. Proper integration of disciplines in regional institutes should serve to identify areas and problems within these regions worthy of geochemical and geophysical research effort in co-ordination with geological mapping and research studies, terrain science and Pleistocene studies, metallogenic studies and, possibly, urban planning.

Such geophysical and geochemical surveys, as are justified, are prime subjects for contracting out, as the Survey has done for some time. However, the Survey can justify research in geophysics and geochemistry so as to be able to properly control the contract surveys. The Survey properly does little research on instrument development as this is costly and has many chances of failure. However, the Survey should be deeply involved in the development of methods and techniques as they apply to the geoscientific problems of Canada. The cautious use of this policy will keep the cost of instrumentation from taking too much of the Survey's limited resources, while keeping their scientific capacity at a high level.

Comments on regional mapping and related research made with regard to the land areas of Canada apply also to the marine offshore areas of Canada. It must be recognized that the GSC and Canada are rather latecomers to marine geoscience. However, the continental shelves and slopes of Canada are an integral part of the geological framework of Canada. These active and passive margins contain outstanding examples of spreading centres, transform faults and quiet zones. The Committee agrees that the study of these should be a part of the core programs of the Survey. They do contain potential for development of natural resources. A well defined program of marine geoscientific research should be directed towards solving problems relevant to the Canadian landmass and its mineral and energy resources. We could even recommend marine geoscience research in Pacific Island arcs and other areas of the world provided it was relevant to Canadian earth science problems.

We endorse the GSC concept of forming a marine geoscience research committee, one of whose directives would be to define and formulate objectives for the marine geoscience institute.

Mission-Oriented Programs

The Committee has attempted to get user opinion of the Uranium Reconnaissance Program and is presently examining the Waste Disposal Program. It had been our plan to examine the program of studies of pipeline routes but time has not permitted this. We believe that this Committee or its successor should spend more time evaluating the mission-oriented programs of the Survey.

Overseas Programs

We suspect that the Survey is slightly uncertain of its role and obligations in regard to CIDA. This is a problem for higher levels in government than Survey management. Most nations of the Western World and many of the Soviet Block carry out overseas programs in the Third World for a variety of motives. Canada has its share. Regardless of the motives of Canada, the mechanism of initiating and carrying out this overseas role in earth sciences in co-operation with CIDA is uncertain and not well codified.

Co-operative Programs

We have already referred to the need for co-operative programs, particularly with provincial surveys. As a start, we suggest meetings of senior scientists representing the different governments to determine what might be done. Eventually some recommendations from these meetings may survive and achieve approval and financing. At any rate, there would be an exchange of views which would focus on the geological needs in the different regions of Canada. Again, the Canadian Geoscience Council might be asked for help by proffering informed advice on how earth science effort should be shared between the federal and provincial governments.

That the work of the Survey is already skewed to certain parts of Canada may be seen by examining the 1350 studies written up in the Reports of Activities for the period 1970 to 1977. For Regional and Economic Geology, the areas of B.C., Yukon, NWT, Newfoundland and Labrador have 204 reports. All other provinces (Alberta, Saskatchewan, Manitoba, Ontario, Quebec, New Brunswick, Nova Scotia and PEI) have 85. For the Institute of Sedimentary and Petroleum Geology, B.C., Yukon, NWT, Newfoundland and Labrador have 135 reports; all others have 14. For Resource Geophysics and Geochemistry, B.C., Yukon, NWT, Newfoundland and Labrador have 63 reports; all others have 55. For Terrain Sciences, B.C., Yukon, NWT, Newfoundland and Labrador have 260 reports; all others have 111. Work in the past has been subject to certain priorities. There is concern whether this distribution should be continued.

Examination of Output

The Advisory Committee will have a continuing role with respect to the examination of the output of the GSC. However, the GSC would get more direct input from industry and other estates if it were to organize well-planned seminars or open-houses on specific topics in different cities across the country. Such open-houses sessions have served the provincial surveys well. At this point we might comment that the Advisory Committee's Uranium Reconnaissance Program Questionnaire seems to have been favourably received and industry and academia would probably be receptive to similar questionnaires on other subjects. It is important to realize that these questionnaires will only

succeed if the respondents are provided with a summary report on the responses. The Survey and the Visiting Committee recognize the difficulties inherent in using questionnaires and also recognize that effort at seminars will be at the expense of other work or in competition with meetings of earth science societies. However, the continuing need for appraisal of the output of the Survey suggests that these methods must be considered. If the Canadian Geoscience Council supports the continuation of a Visiting Committee, one of the continuing assignments of such a committee will be the review of Survey output. This should be done in greater depth than the present committee has had time to do.

PROBLEMS OF THE SURVEY

A. Internal Problems

1. Communication

Internal communications were identified in earlier confidential reports to the Survey Management as being unsatisfactory in varying degrees. They were noticeably bad in many cases between divisions, even when work was closely related, such as between geologists and geophysicists, or uranium resource evaluation physicists and geochemists and regional geologists. Clearly this concerns Survey management and remedial efforts are being instituted. It is too soon to say if these are suitably effective. Internal communications appeared to be less of a problem within the Cordilleran Division, the Institute of Sedimentary and Petroleum Geology, and the Atlantic Geoscience Centre. As already mentioned under the sections on Organization and Activities, the ongoing reorganization of the Survey offers an opportunity to improve communications.

A great deal of responsibility for internal communication rests upon middle management. Broadly trained and professionally experienced scientists used as staff specialists to help middle management can improve interdisciplinary communication.

2. Decentralization

Although decentralization creates certain problems of communication, these must be overcome to meet the challenges that lie ahead. The Cabinet decision to move the Precambrian Subdivision and several smaller units out of Ottawa pre-empted in-depth consideration by the Committee of the problems of decentralization. However, if decentralization is inevitable, the system of fully integrated decentralized institutes, recommended in this report appears to the Committee to result in the best environment for the GSC personnel.

3. Integration of Disciplines

Integration of earth science disciplines to solve geological problems is needed in the Survey. Such integration could flourish in regional institutes. It could be helped by putting members of different disciplines, assigned to the same problem, into the same office or neighboring offices where day-to-day discussions can take place. Difficulties of integrating disciplines also occur in industrial and academic organizations, particularly where more senior, traditional people are insecure about young colleagues who possess technical training quite beyond them. The solution appears to lie with managers who are able to define goals that use the strengths and experience of each professional assigned to the team effort.

4. Contracting Out

Adaptation of the policy of "contracting out" is another problem which Survey management may have to solve by trial and error. Some of the concerns about contracting out have been resolved in the past year and the Survey must now wait to see how the rules are applied in practice. Such contracting out could strengthen the Survey's position by requiring survey people to compete intellectually, and perhaps even contractually, with outside people thus increasing quantity and quality of output both inside and outside the Survey. The Committee wishes to emphasize that supervision of contracted work requires professionals with supervisory skills who, while maintaining geological competence, are not desirous of submerging themselves in their own field of research.

5. Management Training

This raises a question which the Committee has not explored, namely, the numerous management courses available to Survey personnel. We have neither examined how these courses are used to help scientists learn management methods nor have we examined how managers are chosen. However, in many large organizations using earth scientists there is a tendency to choose a person for his merit as a scientist and then give him management training. If the training is not adequate or the scientist is not temperamentally suited for management, this results in the loss of a good scientist and creation of an indifferent manager. One is reminded here of one of the recommendations made by the Public Accounts Committee of Parliament concerning its investigations of Atomic Energy of Canada Limited: "The government should ensure that . . . senior management be qualified for the tasks assigned."

6. Allocation of Manpower and Money

The allocation of manpower and money is another problem for Survey management. It is made more difficult as salaries rise in a fixed total budget so that operations become under-funded. The Committee's view of this problem is divergent as shown by statements from individual members:

"The present allocation of manpower and money shows a fair balance given the inertia inherent with any desire to change."

"The allocation of manpower and money as practiced in the Survey is difficult . . . to understand. In industry a dollar is a dollar, irrespective of whether it is spent on salaries or services. Arguments could be developed to the effect that, if there is not a balanced allocation of money for personnel, and money for any program the GSC might undertake, such activity would be inefficient and a waste of taxpayers' money."

"I believe they do remarkably well with what they have."

7. Summary

We have discussed under future roles the responsibilities that are, or should be, given to the Survey and under organization the geographic areas that may be assigned to it. These should determine the Survey's share of the taxpayers' dollar and in spite of the size of the nonscientific element in Ottawa we still believe there should be some greater allocation of resources to the Survey. We emphasize that the number of economic geologists is presently low,

considering the economic justification of Survey work and the need for regional metallogeny, commodity geology and mineral deposit geology. Also the distribution is strongly skewed to uranium. Attempts are being made to correct this within the present framework but it is obviously still not right.

The levels of research have decreased in some areas because scientists have been transferred to special operations. Research should be kept in balance with geological problems under study and in balance with data gathering and processing. In the future the national role of the Survey may be related to research on fundamental geological problems that have wide application. Such research may fall into the category of "mission-oriented" research or problem-oriented research. The design and/or execution of such research would benefit by consultation with academic and industrial earth scientists. If such consultation and co-operation can be established, a clear mandate and support for such research is likely to evolve.

B. External Problems

The Survey has many sensitive interfaces with external organizations within the Federal Government, with Provincial Governments, with universities and with industry. It is a task far beyond this volunteer committee as presently constituted to examine and comment on these problems. The Committee leaves it up to the Survey whether or not to ask the Canadian Geoscience Council for additional help in involving Canada's earth science establishment in a survey and review of this set of problems. The purpose for such a survey could be to reduce overlap, to improve co-operative effort, to increase efficiency, to reduce cost, to improve organization, and to clearly define and assign objectives.

1. Federal Relationships

In its more than two years of operation, the Committee notes that there are sensitive relationships within the Department, such as overlap of missions with Earth Physics Branch and CANMET, sensitive relationships with Atomic Energy of Canada Limited and Atomic Energy Control Board regarding waste disposal, input to the resource assessment program and the relation to Eldorado Nuclear. These are high level problems, partly or wholly beyond the influence of Survey management.

In relations with other ministries there is possible overlap with the Department of Fisheries and Environment. Relationship to the Department of Agriculture needs to be defined.

Relationships to Department of Regional Economic Expansion and Canadian International Development Agency would appear to be the most politically influenced. Foreign governments seeking technical aid are said to prefer an approach through a government organization but earth science questions do not come directly to the GSC. The role of the Survey is to respond to requests from CIDA. The Committee feels that with the funds CIDA controls it should have the capacity to steer these approaches directly to Canadian contractors without involvement of the Survey. At the level of our knowledge the relationship of the GSC to DREE is dificult to understand. Relationships to the Department of Indian and Northern Affairs (DINA) seem fitful and still developing. There is need for further study of overlap and competition between the GSC and DINA divisions.

2. University Relationships

Relationships with universities relate to research projects formalized through research agreements. There are also relationships developed on a person-to-person basis, such as a Survey geologist with a graduate student and/or his professor. These latter relationships are often excellent. A problem does exist in mobilizing effectively the available talent in universities and involving it in the country-wide research program that we believe will be a future role of the Survey.

3. Provincial Relationships

Relationships with provincial governments apparently vary, from good to almost non-existent. This is a major problem, or 10 problems, but successful solutions should be possible. The constant frustrations and delays caused to the Survey and to federal/provincial relations by administration of contracts by the Department of Supply and Services are a nagging problem. The examples are legion. One, particularly galling to B.C., is the very late letting of contracts yearly for URP, for example letting a contract in May 1977 for that summer's program.

Although greater co-ordination and co-operation between provincial geoscientists and GSC geoscientists is advocated, the federal branch must be extremely careful in any agreements to ensure that the political aims of a province will not undermine the GSC's neutrality and impartiality. For example, past involvements with the governments in the Provinces of Manitoba and Saskatchewan have resulted in suspicion being levelled at the GSC because these provinces have entered the exploration field and have, in some cases, had access to URP data before general release to the public. In such instances, the GSC could find itself violating its preferred neutral stance.

Nevertheless, there is promise that effective and integrated co-operation can be reached. Most Provincial Ministries of Mines have extensive cadres of economic geologists, whereas the GSC is short of these specialists and may have an attitude that regards this discipline as unimportant to regional mapping. It is very noticeable when examining modern GSC reports on areal geology that scant attention is paid to mineral resources or their potential (cf. Cordilleran reports in Current Research Part A – Paper 78-1A). Perhaps a start on this problem could be made at a technical level with an approach to Provincial Chief Geologists asking for their suggestions and opinions. This might be followed by a joint meeting to discuss the results and see if a program based on scientific problems and mutual contributions could be accepted by political levels.

4. Industry Relationships

Relationships with industry do not seem to be a major problem. In areas where institutes are located in industrial centres the relationships appear to work out reasonably. As long as the Survey's programs are directed to important geological problems they receive industry support. Where Survey officers have contact with industry representatives they have an opportunity to assess industry needs and plan their programs accordingly. With such a large program as the Uranium Reconnaissance Program there is a large diversity of industry opinion. There are those who object to the program as an intrusion or invasion into the mineral exploration field. There are others who question the scientific basis for the program since radiometric measurements are seriously affected by surface conditions (overburden and water). On the other hand, geochemical surveys might be seen to infringe more on mineral exploration than

radiometric surveys, but because they are reconnaissance and offer data on many metals they are accepted, as is aeromagnetic mapping, as adjuncts to the regional geological mapping functions of the Survey.

As a final point, the Committee would urge the Survey to consider a series of seminars or open house meetings in various cities across the country which would allow GSC personnel to meet face-to-face with industry personnel, enabling an exchange of views. The GSC should also seriously consider discussions with industry representatives prior to implementation of any special programs and also take into account the opinions of industry in planning mapping and research programs. Provincial government representatives could also be invited to certain of these planning dicusssions and this relationship could lead to expanded co-operation between the two levels of government. Having observed, at various institutes and divisions of the Survey, that programs tend to grow from senior personnel deciding what they want to do, we recommend that such senior personnel take advantage of contacts with peer scientists as they formulate their work. This Committee, and we believe the Canadian Geoscience Council, have a job to do to make known to the Geological Survey that there is a competent community of earth scientists outside, as well as inside, the federal government. These earth scientists can not only respond to initiatives by the Survey but, given the right relationship can help to set the directions and contribute to needed solutions of earth science problems.

APPENDIX TO ADVISORY COMMITTEE REPORT

INTRODUCTION

The Advisory Committee made detailed studies of three separate topics to augment its general review of the Geological Survey of Canada. The committee felt it would be pointless to pursue topics in detail that on our overall appraisal appeared either excellently conducted, satisfactory, or not subject to controversy. Therefore, the committee's attention was applied to topics that had elements that seemed to have some of the reverse characteristics.

The three topics examined were the Uranium Reconnaissance Program, Geochronology and Nuclear Waste Disposal. Each topic was investigated in a manner thought to be appropriate to the subject but different from each other.

The *Uranium Reconnaissance Program* was studied by the committee in a preliminary way and then it was decided to study the output by a survey of the opinion of users of the data. This was done in the latter part of 1977. In a general way there was strong support for the program. However, one quarter of the large or well established energy or mining companies responding opposed the program. Most of these objecting respondents were companies who themselves have the capacity to conduct comparable studies and see URP as an unwelcome government intrusion into the mineral exploration field. The vast majority of the smaller companies surveyed supported the program and felt that it was indeed valuable. Several consulting or service companies voiced their objections to the program but a majority of these organizations considered URP to be a source of information to be used for entrepreneurial activities.

In general, however, the results of the survey show quite clearly that the private sector does not want government involved in any direct exploration activities. This means that URP must be seen as another means to provide basic data and not as a means for the government to involve itself in direct exploration. Confusion on this point is so widespread that the GSC must direct a greater effort towards the effective presentation of similar programs to the public.

It was felt important to get the results to the respondents of the survey rapidly so that a summary was submitted to the "Northern Miner" and published on the 3rd August 1978. A full report forms part of this Appendix.

A postscript to the study is that the URP program was cancelled in the fall of 1978 by Federal Cabinet order. It is apparent from the response of many companies and Provincial agencies that the termination is looked on with dismay.

Geochronology was studied in a different manner. The committee's preliminary study confirmed this was an area that needed a thorough review but felt expert advice was necessary. Hence they asked R.L. Armstrong of the University of British Columbia to visit the Geochronology Section and prepare a report. This he did by visiting the laboratory in Ottawa for one week in late August 1977, and submitting a report to the committee and the Survey management in September 1977. Some aspects of the report are summarized in this appendix, largely abstracted from the original report. Since receipt of corrective measures to permit and encourage the laboratory to be more efficient. The Survey also intends to invite Professor Armstrong to return for a further review of the laboratories.

Nuclear Waste Disposal. The Geological Survey involvement in this program was studied in yet another different manner. A subcommittee of outside experts was created, which was chaired by D.W. Strangway of the Advisory Committee. In addition to the Chairman, the subcommittee consisted of the following: R. Azuma, a nuclear physicist from the University of Toronto; J. Cherry, hydrogeologist from the University of Waterloo; W. Fyle, geochemist, University of Western Ontario; P.Y. Robin, petrologist from the University of Toronto. The subject of this topic crossed many boundaries within Energy, Mines and Resources, and some outside. All parties approached consented to support the review and co-operated fully. The subcommittee met in Ottawa on February 16 and 17, 1978 at which time presentations were made by personnel responsible for most aspects of the existing program. Time was taken by the subcommittee to visit staff scientists and a plenary session for questions and comments was scheduled. A final report was submitted by the subcommittee to management of the Survey, Earth Physics Branch, CANMET, Environment Canada, and Atomic Energy Canada Limited.

The Canadian Geoscience Council itself has been concerned about this topic and organized a Forum at the Joint Annual Meeting of GAC/MAC/GSA in Toronto on October 24, 1978. The papers and comment presented at this Forum form a part of the report of the Canadian Geoscience Council for 1978. Some of the material presented to the subcommittee is similar to that presented at the Forum. A brief summary of the subcommittee's report forms part of this appendix. The concern of the Council and the enquiry of the subcommittee have been that Atomic Energy Canada Limited asked the Council to suggest names from the geoscience community for a Technical Advisory Committee to Atomic Energy Canada Limited.

GEOCHRONOLOGY

The Geochronology Section of the Survey at the time of the visit produced scientifically useful but expensive information. The Section has a generous endowment of major equipment that is to some degree under-utilized. Effort should be concentrated on making procedures more efficient and productive rather than in multiplying the number of mass spectrometers in operation. Complete spectrometer automation and multiple-sample capability are needed to improve the existing equipment. This will free large amounts of operator time, improve the quality of data produced, and ultimately reduce the number of spectrometers needed to maintain expanded data production. There are many ways by which the K-Ar and Rb-Sr technical operations could be streamlined and made more productive. None involve great expense but the changes may involve some stress as traditional procedures are modified or discarded and expectations increased. Zircon date production could be doubled with automation of mass spectrometry and a moderate investment in chemical processing facilities and mineral preparation equipment.

There should be a steady adoption of technological improvements – adopting the best procedures in use in labs throughout the world. Those directly responsible for procedural details and innovation should regularly visit other laboratories to learn new techniques and propagate their own good ideas.

Data processing and communication, within the section and with geologists, will remain a major problem, regardless of technical proficiency. The leaders of the Geochronology Section do not have time to do this job properly, and they do not have the luxury of focusing attention on single problems or areas but must satisfy demand for services from coast to coast. Decentralization of the Survey may aggravate the problem of communication. An immediate need is for secretarial and data cataloguing assistance. Rapid reporting

of all data produced by the section should be encouraged. This requires releasing time now devoted to tedious chores in the lab, simplifying the reporting procedures, and putting pressure on geologists to put their information and thoughts on samples and results down on paper. A major improvement in communication and scientific accomplishment will require more interchange between geologists and senior laboratory personnel, and a deliberate encouragement of research visitors in the laboratory. The accomplishments of such exchanges far exceed costs of added confusion, crowding, and demand on lab equipment. The equipment spends most of the 24-hour day in an unused state so that work of visitors, or even employees, on odd time shifts would further increase productivity, at no cost other than for a few expendable items, electricity, and greater administrative flexibility. A portion of the Survey demand for geochronometric data can be flexibly met by contract arrangements with university laboratories. The Geochronology Section should be kept informed of and at times directly involved in, such arrangements so that duplication is avoided and analytical quality control maintained.

NUCLEAR WASTE DISPOSAL

The subcommittee concerned itself principally with activities directed to location and evaluation of sites for waste repository and to a lesser degree with the "pathway analysis" program – a numerical simulation of migration and dispersion of radioactive materials. They considered that the program, although five years old, was still in its infancy as it had received a low level of funding ($180 000 in 1975/76 and $327 000 in 1976/77). The inquiry by the subcommittee was made difficult in the fact that the whole program was said to be in process of reorganization, the shape of which was unknown.

Almost all the Canadian effort toward a waste repository has been directed toward selecting plutonic sites. The effort in regard to a repository in salt was limited to review of available documentation. An elaborate series of geological, geophysical, hydrogeological and rock mechanic studies are initiated for a possible plutonic site but many are at an early stage of planning or implementation. Many await pilot site selection before they can usefully be started.

The subcommittee found a certain lack of definition of objectives and need for greater interdisciplinary and intra-disciplinary communication. They felt the "salt option" should receive more serious attention in Canada than it has. The program so far appears to be designed primarily to exploit methods and techniques already extant without reaching out to novel solutions. They felt the interagency organization lacked some elements of leadership but felt the talent of personnel involved was considerable. Nevertheless, experts outside the present program should be involved. The level of funding should clearly be related to the seriousness of the problems involved and the cost of the overall nuclear power program.

URANIUM RECONNAISSANCE PROGRAM: A SURVEY OF OPINION OF DATA USERS

Introduction

The Federal/Provincial Uranium Reconnaissance Program (URP) was established in 1975 to provide industry with high quality reconnaissance exploration data to indicate those areas of Canada having the greatest probability for the location for new uranium deposits, and to provide the government with national systematic data to serve as a basis for uranium resource appraisal. The Program involves the performance of combinations of airborne gamma ray spectrometry and regional geochemical sampling surveys to provide relevant information under the great variety of topographical, geological and geomorphological conditions existing in different parts of the country. Analysis of stream or lake sediment samples for a range of elements provides data on the distribution of many metals of economic interest in addition to uranium.

In order to get a measure of the public response to the Uranium Reconnaissance Program (URP), the Advisory Committee to the Geological Survey of Canada in November 1977 contacted users of the information (particularly, mining and oil companies, consultants and service groups, Provincial Geological Departments and selected individuals). The intention was to obtain opinions, comments and recommendations which would indicate the reaction of these groups to these surveys and also provide information which could have a direct bearing on the ongoing Uranium Reconnaissance Program and on decisions concerning similar programs which may be conceived in the future.

As part of this survey, ninety questionnaires were distributed from Toronto and Calgary to users in Alberta, Saskatchewan, Manitoba and Ontario. Fifty-two (58%) of these questionnaires were returned and these responses are analyzed in this report. In addition, twenty-four other users based in Vancouver and active in the Cordilleran Region were polled by telephone. These responses are also evaluated in this report.

It should be recorded that all questionnaires were directed to the senior exploration officer of the various organizations polled. Answers were received directly from these persons, from other individuals delegated to complete the questionnaire and from committee groups within an organization which were directed to review the questions and answers.

It is difficult to break down respondents meaningfully into categories such as "Major Mining," "Intermediate Mining," "Small Mining," "Major Oil" etc., because such a classification is not always a reflection of dollars spent in exploration in Canada, nor does it always relate to the individual philosophies of the persons completing the questionnaire. In the following classification, the three respondents described as "Small Mining or Oil Companies" are not widely known across Canada. "Oil (Energy) Companies" and "Mining Companies" are well known and long established corporations.

Classification of Respondents

Mining Companies	27	52%
Oil (Energy) Companies	7	13%
Small Mining or Oil Companies	3	6%
Exploration Consulting/ Service Companies	8	15%
Provincial Government Departments	3	6%
Individuals	1	2%
Source Unknown	3	6%

Location of Respondents

Toronto	29	56%
Calgary	9	17%
Ottawa	3	6%
Edmonton, Winnipeg, Vancouver	2 each	4% each
Flin Flon, Bathurst, Yellowknife Regina and Unknown	1 each	2% each

The Questionnaire

The following were the questions posed in the written questionnaire:

1. Do you believe the URP is a proper pursuit of Federal/Provincial governments?
2. How does the availability of URP data affect your exploration planning?

   (a) Has not been used
   (b) Reviewed on release
   (c) Used to guide exploration
   (d) Used to identify areas for staking and land acquisition
3. Of the geochemical and radiometric data which do you find most useful?
4. What do you believe URP data, as presented, is indicating and what do you expect to find?
5. Do you consider URP data, as released, satisfactory?
6. Do you believe the data could be presented more satisfactorily?
7. Is the choice of elements in the URP geochemical data complete enough?
8. Do you prefer geochemical data presented as coded symbols or by numbers (ppm values)?
9. Is microfiche presentation satisfactory?
10. Have you used the radiometric and geochemical tapes that are made available?
11. Do you consider a sample density of 1 per 5 square miles for routine URP geochemical data collection to be satisfactory?
12. Do you consider the flight line interval of 5 km for routine radiometric surveys to be satisfactory?
13. To what extent should Geological Survey of Canada scientists follow-up on URP data following its release to public?
14. In your opinion, how does the usefulness and value of the data provided by URP surveys compare with the usefulness and value of data provided by the Geological Survey of Canada Aeromagnetic coverage?
15. Can you suggest additional procedures other than through the present Advisory Committee to the Geological Survey of Canada whereby the Geological Survey of Canada can gain feedback on URP and its other activities – so enabling the Geological Survey of Canada to improve its service to its customers?
16. Do you intend to make use of the radiometric calibration facilities provided by the Geological Survey of Canada?
17. Further comment on the URP.

General Comment and Summary of Responses

The response to the questionnaire (58%) indicates that it was well received and the nature of many of the responses indicates a high level of interest in the current program.

Question 1 Thirty-eight respondents (73%) believe that the URP is a proper pursuit of the Federal/Provincial Governments. A very important minority of thirteen (25%), strongly believe that such a program should not be within the terms of reference of government organizations. Eight per cent of the total number of respondents qualified an affirmative answer to this question by stating that government involvement should be on a reconnaissance scale only. The majority (10) of those objecting to government involvement in the URP are large or well established energy or mining companies. The remaining three are consultants or independent persons. It is emphasized that a significant number of major oil and mining companies approve, albeit some of them conditionally, of the URP.

Question 2 Forty-six (88%) of the respondents have used URP data to date and thirty-two (62%) have used URP data to identify areas for staking and land acquisition. Thirty-nine (75%) reviewed the data on release and twenty-six (50%) used the data to guide their exploration.

Question 3 Fifteen (29%) consider both the geochemical and radiometric data to be useful without singling out any one set of data to be more useful than the other. Of the other respondents, twenty-one (40%) find the geochemical data, and eleven (21%) the radiometric data to be the most useful. The balance did not answer the question directly.

Question 4 Responses to this question were numerous and diverse. In general, the majority have an understanding of what can be expected by data gathering defined by the parameters of the URP reconnaissance. Some responses were obviously related to frustrating experiences of those expecting to find significant mineralization coincident with the strongest results.

Question 5 A significant majority (67%) consider the URP data, as released, to be satisfactory. Fourteen (27%) stated the release procedures could be improved. Those objecting to the release procedures that have been followed to date state that the information should be released at all Geological Survey of Canada outlets across the country and also in other major centres where there are important concentrations of exploration personnel, such as Toronto, Edmonton, Yellowknife, etc., and the data should be released simultaneously to industry, government and paragovernment organizations. Several expressed dissatisfaction because maps could not be ordered for delivery on the release date. Commercial duplicators and distributors of the data are not able to quote prices until after the official publication date and, consequently, those requesting copies by mail do not receive the information until several days after the release date.

Question 6 Twenty-six respondents (50%) do not believe that the data could be presented more satisfactorily. Eighteen (35%) considered the presentation could be improved. A number who are mathematically inclined suggested that the data be treated statistically to remove certain sampling biases and that data could be normalized to reflect the anomalies. On the other hand, those who preferred to do their own interpretation stated that the geochemical maps should show ppm values and sample numbers. It was also suggested that URP data be made available on translucent overlays, preferably on the same scale as available geological maps, to facilitate comparisons of data and interpretation.

Question 7 Forty-four (85%) believe that the choice of elements in the Uranium Reconnaissance Program geochemical data is complete enough.

Question 8 A majority of twenty-nine (56%) preferred geochemical data to be presented as numbered values, i.e., ppm values. Eighteen (35%) of the respondents preferred coded symbols.

Question 9 Microfiche presentation is considered satisfactory by twenty-five (48%) of those replying. Sixteen (31%) indicated microfiche was not satisfactory, and eleven (21%) stated they have not used this type of presentation, or did not answer the question.

Question 10 A minority of nineteen (37%) have used the radiometric and geochemical tapes that are made available by the Geological Survey of Canada. Thirty-two (62%) have not.

Question 11 A sample density of 1 per 5 square miles (1 per 13 km^2) for routine Uranium Reconnaissance Program geochemical data collection is considered satisfactory by a strong majority of thirty-nine (75%). The majority of the negative comment stimulated by this question stated that the spacing was too great to identify certain deposits of interest. Suggestions included closer spacing within known mineral belts and in areas of extensive overburden. A general comment was that sampling density should be determined according to the characteristics of each field area.

Question 12 The flight line interval of 5 km for routine radiometric surveys is considered satisfactory by a smaller majority of thirty-one (60%). Most of the 33% replying negatively state that the 5 km traverse interval is far too great to indicate individual orebodies and conclude that radiometric surveys have little exploration use. One respondent stated that radiometrics are unsatisfactory for blanket coverage. Others disagreed with the philosophy of the radiometric program entirely. Those answering affirmatively apparently accept the limiting factors of water and overburden cover and also appreciate the necessary integration of geological information in the interpretation of the radiometric data.

Question 13 Only eight (15%) of the respondents agree that Geological Survey of Canada scientists should follow-up on the results of the initial Uranium Reconnaissance Program surveys. Another thirteen (25%) qualify their reply by stating that Geological Survey of Canada should not follow-up on Uranium Reconnaissance Program data or prospect but should direct their attention to other pursuits. The balance of respondents did not answer the question. Of the respondents who qualified their affirmative answers, several noted that it was important that industry be given guidelines on how to interpret and how to follow-up on the Uranium Reconnaissance Program results and any follow-up work by the Geological Survey of Canada should be directed only to answering these questions. Others in this group would endorse follow-up only to examine the validity of the Uranium Reconnaissance Program data and investigate basic scientific research questions. Those approving Geological Survey of Canada follow-up activity without qualification state that it is important for the Geological Survey of Canada to know what the Uranium Reconnaissance Program data is reflecting and what the results mean (allowing a more meaningful interpretation to be made of data from similar geological environments).

Question 14 Tweny-one (40%) of the respondents consider the Geological Survey of Canada Aeromagnetic surveys and the Geological Survey of Canada Uranium Reconnaissance Program surveys to be comparable, compatible, or "both useful." Of the remainder, nineteen (37%) consider Uranium Reconnaissance Program surveys to be less useful than the Aeromagnetic surveys and two (4%) consider Aeromagnetic surveys to be less useful than the Uranium Reconnaissance Program surveys. The balance did not answer the question.

Question 15 When queried about how the Geological Survey of Canada can gain feedback on its activities from users of data, nine (17%) remarked that the Advisory Committee is a satisfactory communication link between industry and government personnel. Another nine (17%) cited personal contact between the Geological Survey of Canada and industry personnel. From the phrasing of question 15, the sixteen respondents who did not give specific answers (31%) could be interpreted as favoring communication through the Advisory Committee. Fourteen (28%) suggested a variety of means including open houses, seminars, committees, meetings and more questionnaires.

Question 16 Twenty-nine (56%) intend to make use of the radiometric calibration facilities provided by the Geological Survey of Canada in the Ottawa area. Seventeen (33%) answered negatively, and the balance did not respond to the question at all. Several of the respondents stated that consideration should be given to establishing similar facilities in Western Canada, either in the Calgary or the Vancouver area.

Question 17 Only 50% of all the respondents to the questionnaire took this opportunity to add further comment. The greater majority of the remarks support or duplicate the responses contained in the balance of the questionnaire. There is reflection of the support and opposition to the Program correlatable with different philosophies, and there are the comments of those who expected the Uranium Reconnaissance Program data to pinpoint specific mineral deposits. The concern of the public with respect to the apparent de-emphasis of the traditional geological mapping role of the Survey is also quite prominent.

SURVEY OF CORDILLERAN USES (THE CORDILLERAN SURVEY)

In mid 1977, Dr. A. Sutherland Brown conducted a telephone survey of users of Uranium Reconnaissance Program data in the Cordilleran Region. The Vancouver offices of a total of 24 companies were contacted. They were subdivided into 5 Major Oil companies, 12 Major Mining companies, and 7 Minor companies and Individuals.

The questions asked in the Cordilleran Survey were not exactly the same as those in the Uranium Reconnaissance Program Questionnaire which has been described (the Main Survey). However, several questions can be compared and the following comments refer to these specific questions.

The Uranium Reconnaissance Program in British Columbia has consisted entirely of geochemical surveying.

The minority of 17% of those polled in the Cordilleran Survey did not believe that the Uranium Reconnaissance Program is a proper pursuit of government survey departments. This minority is smaller than that determined by the Main Survey (see Question 1). No specific objections were expressed by Cordilleran respondents to government involvement in Uranium Reconnaissance Program surveying, although some replied that money would be better spent on perceptive geological mapping. Twenty (83%) indicated that they are in favour of the Uranium Reconnaissance Program. When questioned about the relative helpfulness of radiometric and geochemical data, 22 (92%) indicated that the geochemical data was the most useful.

Twenty-two (92%) of the Cordilleran respondents approved of the choice of elements in the Uranium Reconnaissance Program geochemical surveys. Up to 33% of these respondents suggested additional analysis be made for tungsten and arsenic.

A similar major percentage (92%) approved of the style of presentation of the Uranium Reconnaissance Program data in releases. This is in contrast to a 50% approval of presentation by respondents in the Main Survey.

Geochemical data presented as numbers is preferred by 50% of the Cordilleran respondents. This figure compares with the 56% replying similarly to the Main Survey.

The percentage who consider microfiche presentation to be acceptable from the Cordilleran Survey (46%) is almost exactly the same as the response from the Main Survey (48%). A larger proportion of the category "Small companies and Individuals" state that microfiche is not satisfactory, presumably because of the unavailability of microfiche readers.

Only 3 (12%) of the Cordilleran users polled have used the geochemical and radiometric tapes of data made available by the Geological Survey of Canada.

The 1 per 5 square miles (1 per 13 km^2) density of geochemical sampling is considered satisfactory by 19 (79%) of the Cordilleran respondents. Two (8%) recommended an increase in this density and three (12%) noted that the optimum sample interval is dependent upon the geological relationships in the field areas.

One question in the Cordilleran Survey correlated with question 13 of the Major Survey which asked "To what extent should Geological Survey of Canada scientists follow up on Uranium Reconnaissance Program data following its release to the public?" Emphatic opposition to such activity by the Geological Survey of Canada is much less in British Columbia (17%) than elsewhere in Canada (25%). The Cordilleran Survey results indicate that only two (8%) are in favour of the Geological Survey of Canada doing more detailed surveys but none of the respondents feel that this follow-up should be a major effort. The 18 respondents (75%) who would prefer the Geological Survey of Canada do scientific follow-up work only, reflect similar views to those expressed by those polled in the Main Survey.

A majority of the respondents in the Cordilleran Survey (58%) use the data to guide their exploration programming.

CONCLUSIONS AND RECOMMENDATIONS

The survey directly reports responses received from 76 mining, oil and service companies, Provincial Government departments and individuals. Comments by respondents have been rigorously summarized but more expansive reporting has been passed on to the Geological Survey of Canada for their information.

Many conclusions which are obvious from the summarized responses in the appendix are not listed below. The following conclusions and recommendations, regarded as significant, are based on a general review of the responses as a whole.

1. The majority of the respondents to the questionnaire understand what the radiometric and geochemical surveys included in the Uranium Reconnaissance Program are capable of indicating. Several critics stated that the regional parameters for the data collection are too broad to indicate mineral occurrences of interest and, because of this, considered the data to be of limited or no value. A number of others have obviously been frustrated in their follow-up of anomalous Uranium Reconnaissance Program indications, expecting them to be directly related to mineralization of significance. At least one case history is on record of a private company discovering uranium mineralization by detailed follow-up of indications from Uranium Reconnaissance Program data and there are unconfirmed reports of discoveries of other types of mineral showings. large numbers of claims have been staked by users of the data.

2. Approximately three-quarters of the respondents believe that the Uranium Reconnaissance Program surveys are a proper pursuit of the Federal/Provincial Governments. However, it is clear from the questionnaire responses that there is a strong minority opposition to Uranium Reconnaissance Programs in general and a much stronger opposition (50% of the respondents) to Geological Survey of Canada follow-up on the reconnaissance data collected during the programs.

   The principal objection cited is that the Uranium Reconnaissance Program is an unwelcome government incursion into the mineral exploration field, and follow-up by the Geological Survey of Canada would place government in direct competition with industry. As noted in Item 1, others object to Uranium Reconnaissance Programs on technical grounds.

   The majority of respondents favouring Geological Survey of Canada follow-up on Uranium Reconnaissance Program data qualified their position by stating that follow-up should only be of a research scientific nature directed towards a better understanding and interpretation of Uranium Reconnaissance Program reconnaissance data. The Geological Survey of Canada should not prospect. It is recommended that the Geological Survey of Canada adopt these as proper parameters and, in future, the Geological Survey of Canada should clearly identify and, whenever possible, discuss with industry the nature of any follow-up work that is contemplated.

3. The radiometric and geochemical surveys included in the Uranium Reconnaissance Program are reconnaissance surveys and, in this sense, are comparable with the aeromagnetic surveys initiated by the Geological Survey of Canada several decades ago. Aeromagnetic surveys today are considered to be an important contribution by governments to the knowledge of the geological framework of Canada and are a valuable reference for private concerns involved in mineral exploration.

   The name "Uranium Reconnaissance Program" reflects the Federal Government's desire to provide data leading to the identification of uraniferous areas but, in the political atmosphere of the times, is interpreted by private enterprise as a move towards a greater involvement by government in the mineral exploration field in Canada.

   It is apparent to the Committee that a considerable proportion of the opposition to Uranium Reconnaissance Program is directly related to this interpretation by the private sector. The selection of a more appropriate name or names (e.g., "National Radiometric Reconnaissance Program" and "National Geochemical Reconnaissance Program") for the program would have allayed much of this opposition and, because of this clarification and better understanding, would have aided scientific communication between the government and the private sector, so avoiding to some degree the critical responses noted in Items 1 and 2 of these conclusions and recommendations.

4. Generally, the majority of respondents considered the release procedures and style of presentations of Uranium Reconnaissance Program data being practiced at the time of the questionnaire survey to be satisfactory. A distinct preference for numbered geochemical values, instead of coded symbols, was indicated. Several suggestions received from respondents relevant to these matters merit consideration, and the Geological Survey of Canada has already incorporated some of the suggested improvements.

5. The overall response to the questionnaire, together with replies to Question 15, clearly indicate that a majority of industry respresentatives wish to communicate with government with respect to the Uranium Reconnaissance Program and other geoscientific programs. It is recommended that the Geological Survey of Canada give serious consideration to the suggestions received from respondents which are included in the responses to this survey.

6. In a large number of responses there was frequent reference to core roles of the Geological Survey of Canada – i.e., geological mapping and research in geological, geochemical and geophysical fields. These references indicate that these core roles are the ones that industry expects the Geological Survey of Canada to pursue as actively as possible, and that the record of the Geological Survey of Canada in these roles is well-respected and well-regarded.

7. One respondent makes the important point that the Uranium Reconnaissance Program provides useful baseline data for many aspects of urban planning and the avoidance of potential or unforeseen hazards. Considerable environmental information is present in Uranium Reconnaissance Program data and sampled media. Consideration should be given to long term storage of stable sample materials for future reference and analysis.

8. When asked to compare the usefulness of the Uranium Reconnaissance Program data with the usefulness of aeromagnetic data (Question 14) a number of respondents stated specifically that Uranium Reconnaissance Program data had value, although they gained more information from the aeromagnetic data because of their greater knowledge of aeromagnetic responses and interpretation. This is an indication of familiarity with data and it can reasonably be concluded that the appreciation and, therefore, the use of Uranium Reconnaissance Program data will increase with time.

PART 3

CANADIAN GEOSCIENCE COUNCIL 1978 ANNUAL REPORT

REPORT OF THE PRESIDENT

Canada is notable for the breadth, richness and diversity of its geological endowment. It is not surprising that a remarkably large and complex community of diversely oriented geoscientists has evolved in response to this situation. The Canadian Geoscience Council is a co-ordinating body whose aims are to improve co-operation and communication between Canadian earth science professionals, and to stimulate the development of the geosciences in the best interests of the Canadian nation as a whole. 1978 was a year of progress towards achieving these objectives.

Full meetings of Council were held in Calgary, Toronto and Ottawa. The first two of these coincided with meetings of major member societies, in accordance with a policy adopted two years ago to improve contact with regional groups of geoscientists. The meetings were well attended by representatives of eleven Member societies and five organizations participating as Associate Members or Observers. This year we were strengthened by the induction of the Canadian Association of Geographers as an Associate Member and by the advancement of the Standing Committee of Provincial Geologists from Observer to Associate Member status.

Any scientific organization becomes known and evaluated largely by its publications. The Council is particularly proud of its report *The Geosciences in Canada, 1977*, which was published in mid-1978 as GSC Paper 78-6. The report features a detailed review of the many aspects of soil science in Canada, contributed by members of the Canadian Society of Soil Science. The Council hopes that this timely and important report will help to focus attention on Canada's most vital – and often most neglected – mineral resource, our soil.

Also of note in the 1977 annual report are a Geological Association of Canada Brief on *Geosciences in the Provinces*, and a report from the Committee of Chairmen of Canadian Earth Science Departments entitled *Graduation Statistics and Patterns of Employment*.

The Geoscience Council is accepted as representing the Canadian earth science community at its interface with all levels of government. In this capacity members of Council made or maintained contacts with several government or quasi-government organizations during 1978. Most prominent was the continued activity of the Advisory Committee to the Geological Survey of Canada, chaired by J.D. Weir. This unique committee has been most effective in providing external advice to the Geological Survey, and the Survey has demonstrated a remarkable degree of responsiveness to constructive criticism. The Advisory Committee's first major report is a feature item of this volume. It is accompanied by a useful subcommittee report on the Uranium Reconnaissance Program, compiled by J.A. Coope.

A meeting and substantial correspondence with officers of Atomic Energy of Canada Limited resulted in important progress towards the establishment of an outside committee of geoscientists and engineers who will act in an advisory capacity to AECL.

Two meetings were held with the Executive of the Canadian Environmental Advisory Council to explore means by which the Canadian Geoscience Council might contribute to the amount and quality of earth science input into the decision-making processes of the federal Department of Fisheries and the Environment. A basis for future co-operation was established in principle during these meetings.

As part of a continuing effort to secure more equitable funding for geoscience research in Canadian universities, a brief was presented to the Provincial Ministers of Mines at their Toronto meeting in September. The text of this presentation is included elsewhere in this volume. In collaboration with our affiliated group, the Chairmen of Canadian University Departments of Earth Science, a meeting was arranged with the Hon. Alastair Gillespie, Federal Minister of Energy, Mines and Resources, who has recently had the portfolio of Science and Technology added to his responsibilities. D.W. Strangway, W.S. Fyfe, R.D. Russell and G.W. Mannard represented the Council. The discussion was based largely on Strangway's brief, entitled *Earth Sciences and Natural Resources – The Next Decade*. During the cordial one-hour meeting, a strong cae was presented for increased federal funding of geoscience research in the Canadian Universities. Although the response was not overwhelmingly positive, it was felt that progress had been made, some misconceptions removed, and a bridgehead for further contact established.

During 1978, the joint Federal-Provincial Uranium Reconnaissance Program became a victim of budget-cutting. The Canadian Geoscience Council considers that the elimination of this program was an ill-advised move, which was apparently made without recourse to technological advice.

The Council views the program as having had a significant stimulating effect on the national economy and on the potential for future discovery of uranium and other valuable mineral deposits. Furthermore, the Council feels that the termination of the Uranium Reconnaissance Program runs counter to the recently announced Federal policy of stimulating research and development. A letter embodying these views was sent to the Prime Minister and appropriate members of his Cabinet.

Important work in the fields of geoscience education and international geoscientific co-operation were continued by committees of Council chaired by C.G. Winder and E.R.W. Neale, whose reports are included in this volume. C.R. Barnes organized a highly successful forum on *Disposal of high-level radioactive waste: the Canadian geoscience program*. The forum was presented during the joint G.A.C.-M.A.C.-G.S.A. Meeting held in Toronto during September. It was well-attended despite competition by concurrent technical sessions. The papers presented by an imposing panel of Canadian and foreign experts, together with discussion and an overview by the Geoscience Council, will be published under separate cover during 1979. The organization of this forum represents an attempt by the Canadian Geoscience Council to bring the full spectrum of earth science expertise to bear on specific problems which are of great importance to all Canadians.

It would be misleading to suggest that all of our endeavours of 1978 were crowned with instant and unqualified success. Little progress was made towards the establishment of a committee on Marine Geoscience, an area in which an important contribution can be made. Response by member societies to a questionnaire designed to provide basic data for a new careers booklet was disappointingly weak. The first year of a two-year study of the status of geoscience teaching and research in Canadian universities encountered both expected and unexpected problems which

will necessitate some changes in the scope and methodology of the project. These problem areas constitute a challenge to the determination and ability of the incoming Council and Executive. I have every confidence that they can meet this challenge.

In closing I wish to thank all of the members of Council, its Executive and its associated committees for their co-operation. During my year as President, I have been impressed by the willingness of most Council members to state their opinions forcefully and frankly, and at the same time to give fair consideration to the views of members of other sectors in the geoscience community. These qualities are essential if we are to attain our dual objective of improving communication within the earth science community and enhancing our joint contribution to society.

G.W. Mannard

President
December, 1978

REPORT OF THE SECRETARY-TREASURER

There were eleven Member Societies in the Council in 1978. Table 3.4 lists the Member Societies along with their objectives and activities. Invitations to all Council meetings are extended to the following organizations as Associate Members or Observers:

- Associate Committee on Geotechnical Research
- Canadian Association of Geographers
- Committee of Chairman of Canadian University Departments of Earth Sciences
- Committee of Provincial Geologists
- Earth Physics Branch (EMR)
- Earth Science Division of the Royal Society of Canada
- Geological Survey of Canada (EMR)

Funds for the Council activities are obtained from three main sources: a sustaining grant and contract from Energy, Mines and Resources; fees paid by Member Societies; and grants from the Canadian Geological Foundation to assist with the activities of the Education Committee. Income from the investments in short term funds has risen due mainly to the rise in interest rates in that market. Somewhat higher meeting costs chiefly reflect higher costs of accommodation. The main expenditures of the Council are in support of the Education and the Editorial Committee activities. The Council pays membership fees to SCITEC, the Association of Geoscientists for International Development, and the Youth Science Foundation.

The Council held three meetings during 1978; the 27th in Calgary, in June; the 28th in Toronto, in October; and the 29th in Ottawa, in December. After the last session a special meeting was held with senior officials of Energy, Mines and Resources.

Included in a wide ranging agenda was the presentation of the report on the Status of Geosciences for 1978.

The Executive Committee of the Council in 1978 comprised:

President – G.W. Mannard

Vice-President – C.R. Barnes

Past-President – P.J. Savage

Secretary-Treasurer – K.A. Morgan

Executive Member – A. Sutherland Brown

Foreign Secretary – E.R.W. Neale
Executive Director – E.C. Appleyard

Member societies and representatives at year end 1978.

Association of Exploration Geochemists – L.A. Clark

Canadian Exploration Geophysical Society – E.O. Andersen, K.A. Morgan

Canadian Geophysical Union – D.W. Strangway

Canadian Geotechnical Society – D.F. VanDine, O.L. White

Canadian Institute of Mining and Metallurgy – L.J. Cabri, A.E. Soregaroli, R.J.M. Miller

Canadian Society of Exploration Geophysicists – E.F. Mahaffy, R.D.J. McCaffrey, W.D. Evans, J.R. Pullen

Canadian Society of Petroleum Geologists – D.W. Organ, J. Andriuk, R.H. Erickson, N.J. McMillan

Canadian Society of Soil Science – G.C. Topp, D.F. Acton

Canadian Well Logging Society – W.D.M. Smith, J.A. Ellis

Geological Association of Canada – D.W. Strangway, A. Sutherland Brown, W.G.E. Caldwell, R.G. Roberts

Mineralogical Association of Canada – R. St. J. Lambert, A.C. Brown

K.A. Morgan

Secretary-Treasurer
December, 1978

REPORT OF THE FOREIGN SECRETARY

The position of Foreign Secretary was created in 1976 to respond to a need which developed when the Geological Survey of Canada divested itself of the role of National Committee for Geology and transferred this to the Canadian Geoscience Council. The Council set up a Standing Committee on International Scientific Relations in April, 1977 with terms of reference drawn up by its first Foreign Secretary, W.W. Hutchison. These terms appear as Appendix 8 of the minutes of that meeting and are available upon request from the Executive Director.

The Committee is chaired by the Foreign Secretary and consists of J.M. Harrison and R.A. Price, chairmen respectively of the national committees for the International Geological Correlation Program (IGCP) and the International Geodynamics Project (IGP), W.J. Eden as representative of the Associate Committee on Geotechnical Research, T.E. Bolton – the secretary of the adhering body of the International Union of Geological Sciences (IUGS), J.M. Moore a representative of the Association of Geoscientists for International Development (AGID) and J.M. Duke a representative of the Canadian adhering body to the International Mineralogical Association (IMA).

Briefly, the purpose of the Committee is to provide advice and guidance to Council and to provide a forum for discussion of Canadian activities in internaitonal geoscience. Thus it acts as a clearing house for reports of our national committees, proposes responses to new international initiatives, ensures that Council is adequately represented in international non-governmental programs, projects and meetings.

Annual meeting of the Standing Committee

The second annual meeting of the Committee was held in Ottawa, March 2 and 3, 1978. The full minutes of this meeting are available upon request from the Foreign Secretary or the Executive Director of the Council. In addition to regular members, special observers included W.W. Hutchison (secretary-general of IUGS), D.J. McLaren (chairman of the board of IGCP), K. Whitham (representing the International Union of Geodesy and Geophysics (IUGG)) and the secretaries of the national committee for IGCP and IGP.

IGCP: In a brief summary of the entire program D.J. McLaren pointed out that a comprehensive review by Reinemund and Watson would appear in the publication 'Geological Correlation' available from E.T. Tozer, GSC, Ottawa. A shorter version would appear in the popular IUGS newsletter *Episodes* (1978, no. 2).

It was noted that the IGCP special volume on the Caledonides of the Atlantic Region had just gone to press. It has since been published (as GSC Paper 78-13).

During discussions of project financing a new system of financial accountability was devised and adopted. Also, it was decided that expenses incurred in connection with international project group meetings held in Canada would be limited to expenxes incurred in Canada.

IGP: The International Geodynamics Program is drawing to a close so the Canadian Subcommittee decided that a final summary report on activities in Canada should be prepared and published. NRC agreed to make a special issue of the Canadian Journal of Earth Sciences available in March, 1979 which would be dedicated to J. Tuzo Wilson. It will include all reports which can be prepared and submitted by an October, 1978 deadline. R.A. Price will co-ordinate the projects and all reports will be subject to the Journal's normal refereeing procedure.

The Subcommittee expressed concern at the continued lack of Canadian participation in deep oceanic drilling, particularly now that IPOD is considering a program on the passive margins of the North Atlantic. The Canadian Geoscience Council was charged with carrying this message to appropriate cabinet ministers.

The IUGS and IUGG, sponsors of the Geodynamics program, are now looking for a successor program.

AGID: This Association for International Development which was formed in St. John's, Newfoundland in 1974 under the sponsorship of our Council has now grown to 1100 members representing 94 different countries. It publishes a regular newsletter, holds workshops, seminars and training courses in various parts of the world. The headquarters of AGID is now moving from St. John's to Caracas, Venezuela. A tribute was paid to its Canadian leaders, A.R. Berger and R.A. Blais, and the hope expressed that it would still maintain its permanent seat on our Committee.

Canadian Commission for UNESCO

The 20th annual meeting of this group took place in Vancouver, April 19-21, 1978. Chiefly it was concerned with education, status of women, social science, status of the artist, racial prejudice, the International Year of Children, physical education and cultural heritage. Your Foregin Secretary was asked to act as animateur of a special panel on Science and Environment in Developing Countries. It is advised that we continue to send a representative to this meeting to keep people informed of progress in our science. This will not be necessary in the immediate future as the new president of C.C. Unesco is J.M. Harrison, one of the country's best known geoscientists.

International Council of Scientific Unions (ICSU)

The national committee for ICSU met in Ottawa, May 1 and we were represented by our former Foreign Secretary, W.W. Hutchison. Full minutes of this meeting are available upon request. The meeting was concerned chiefly with reports from various national committees, major ICSU programs, the universality of science (and attempts to politicize it) and a committee on the management of radioactive wastes. Dr. Hutchison noted a lack of familiarity by some committee members with activities and organization of Canadian geoscience – it is wise that we continue to send an informed representative to ICSU meetings.

Meeting with American Geological Institute (AGI)

Our president and our president-elect met with representatives of the AGI in Toronto, October 25, 1978. This was the third exploratory meeting seeking possible joint action on common problems. It seems unlikely that we shall ever undertake joint ventures because our present goals and methods of operation are very different. However, we do have common interests – e.g. in geoscience education where we have much to learn from AGI successes. We shall probably continue our informal annual exchanges.

It is also planned to initiate meetings with the U.S. National Committee for Geology which comes under the National Academy of Science and bears closer resemblance to our Council in its goals and methods of operation.

E.R.W. Neale
Foreign Secretary
January, 1979

REPORT OF THE EDUCATION COMMITTEE

The Canadian Geoscience Council's Resource Document for Teachers was assembled in 1975. During this past year, the last copy of existing inventory was dispatched. A total of about 900 copies was printed of which the bulk was distributed by the Canadian Institute of Mining and Metallurgy, Montreal. There is no plan to re-issue this document as the Education Committee of the Geological Association of Canada has compiled a comparable publication.

The EdGEO program – week-end workshops for pre-university teachers – was held at three locations as follows:

1. Dr. George Lammers, Manitoba Museum of Man, Winnipeg, organized a three day session at the Star Lake Field Station with 25 participants, May 25-28. The program was a "hands-on" session of teaching methods followed by field observations. Members of the faculty of the University of Manitoba assisted with the instruction.
2. Mr. D.B. Ferguson, a teacher from Vincent Massey school, Saskatoon, conducted a field trip into the Cypress Hills, Saskatchewan, May 5-7, using a field guide assembled by W.O. Kupsch, University of Saskatchewan. There were 18 participants and three other teachers acting as assistants.
3. Dr. Norman Lyttle, Department of Geology, Dalhousie University, Halifax, organized a session, November 3-5 with the assistance of four geology faculty. Special speakers, films and a field trip were included. The group consisted of 56 teachers and 14 spouses. This session had the co-operation of the Nova Scotia Department of Education.

A trend toward greater time in the field seems to be developing which probably should be encouraged. This approach also seems to require less financing.

In April, 1979 an EdGEO program is planned for Edmonton. The Chairman of the Education Committee will provide information to professionals in other areas who may wish to make a contribution to the professional development of teachers and, subsequently, their students.

C.G. Winder
Chairman, Education Committee
January, 1979

BRIEFS PREPARED BY THE CANADIAN GEOSCIENCE COUNCIL AND MEMBER SOCIETIES, 1978

Earth Sciences and the Natural Resources: The Next Decade

(Early in 1977, an ad hoc Committee on University/Energy, Mines and Resources Relations was formed comprising the Executive Committee of the Council of Chairmen of Earth Science Departments in Canada and several senior members of Energy, Mines and Resources. This group prepared the first draft of the following brief. The brief was widely distributed for comments amongst Canadian geoscientists and after several revisions was adopted by the Canadian Geoscience Council in October, 1977 as a brief of Council and an audience was sought with the Hon. Alastair Gillespie (Energy, Mines and Resources). The brief was presented to the Minister on December 12, 1978.)

"It will be a test of our geological surveys whether they succeed in mobilizing our limited national expertise from all sectors for this work, and thus show true national leadership, or become merely one of a rising babel on the world scene."

Smith, 1974

Introduction

The Canadian nation faces a variety of important issues that require a better knowledge and understanding of our land-mass and its limited resources. In this time of re-evaluation of our potential, we must have a knowledge of the geology of our country. This is the critical basis for the decisions that must be made in a number of important areas such as:

- Energy: oil, gas, coal, uranium, geothermal – what is our potential and how can we assess our capacity?
- Minerals: where do our important minerals occur and how do we exploit them?
- Oceans: we have a major resource to be evaluated and managed and to date only a small start has been made. Systematic exploration and drilling needs to be done.
- Geological Hazards: in planning our cities, towns, parks, pipelines and construction projects we must have knowledge of potential earthquakes, of landslides and of the permafrost regime.
- Waste Disposal: we are calling upon the geological environment and our coastal waters (Ocean Dumping Act) to dispose of spoils chemical, sewage and radio active wastes in ever increasing amounts.

Statement of the problem

In 1975, the Canadian mineral industry contributed 13.4 billion dollars to our economy. This represents 8.7% of our gross national product. Some have estimated that this is reflected through as much as 20% of our gross national product. At the same time, exploration for minerals has been decreasing rapidly.

Expenditures on the study of the earth can be viewed in a number of ways. There is work at the Geological Survey of Canada, the Earth Physics Branch, CANMET, Department of Fisheries and the Environment, and Department of Indian and Northern Affairs. The information on the budgets of these organizations is given in Table 3.1. Federal government expenditures total about $34 million on in-house programs of data gathering and research in the earth sciences. Excluding salaries, the federal government spends about $10.5 million per year in operating costs.

The figures for the provincial governments are not so certain, but it appears that they spend about $30 million ($3.2 of this from the federal government). It is estimated that the corresponding operating costs for the provincial sector are about $9 million per year. This also includes data gathering and some research. It is difficult to get the true operating costs for the many universities in Canada. As a rough estimate, it is probable that the total expenditure nationally is about $20 million (we are currently compiling this information more accurately).

Table 3.1

COSTS OF FEDERAL, PROVINCIAL AND UNIVERSITY EARTH SCIENCE PROGRAMS IN CANADA IN 1975/76

	(millions of $)	
	Total	Approximate Operating Funds (excluding Federal salaries)
Federal		
Geological Survey of Canada	24.30	9.720
Earth Physics Branch	5.90	2.500
CANMET	0.30	0.300
Department of the Environment (glaciology and geohydrology)	2.50	0.875
Department of Indian and Northern Affairs	0.96	0.410
	33.96	13.535
(less approximately $3 million for contacts for routine surveys		-3.000
		10.535
Provincial		
Provincial surveys (these are rough estimates)	26.00	9.000
Federal-Provincial Programs		
Federal Share	3.20	
Provincial Share	1.40	
	30.60	9.000
Universities		
Operating Budgets (subject to confirmation)	20.000	
National Research Council	4.500	4.500
Research Agreements (EMR, DOE, etc)	.823	.823
OVERALL TOTAL	$90. Million	24.858 Million

It may be concluded from Table 3.1 that nationally, we invest 2/3 of 1% of the net mineral production in studying the source of this production. We do know the operating costs of research programs. The National Research Council is the main source of funds at $4.5 million (1974/75) and various agencies including EMR put a small amount of money into research agreement programs.

Projected costs of mineral exploration

In the coming years, expenditures on exploration will increase dramatically. Estimates have been made about the level of investment that will have to be made in the remainder of this century if our energy and mineral demands are to be met and if we are to maintain our present share of the world market.

These are:

- Costs to discover and develop new oil and gas resources $15–40 billion (1)
- Costs to define and develop new coal reserves 3.2 billion (1)
- Metallic minerals – to retain our present share of the world market – discovery of 100 medium sized or 25 large mines required 4.9 billion (2)

(1) An Energy Strategy for Canada, EMR (1976), p. 108, 133.

(2) Mineral Area Planning Study, EMR (1975), p. 33.

This amount of investment is about ten times greater than our present rates of investment. In the mineral sector, for example, this is three times our present rate. These figures suggest that a national effort of enormous proportions is required. The magnitude of the problems is enormous and we must develop the expertise to tackle these problems. Naturally, not all of this investment will be in the earth science sector, but in the end, these resources must be discovered from the terrain.

How to tackle the problem

It is significant to consider the implications of such expenditures. These investments are comparable to the total cost to date of the complete U.S. national space effort or of the currently projected costs of the James Bay project. We are entering an era in which new ideas, new technologies and above all, good people must become more involved than ever in achieving these national goals. Our landmass has been largely explored by the conventional geophysical and geochemical tools and we are in need of new ideas and new thinking. We have barely started to explore our continental shelf regions. We need to devise schemes to stimulate activity in these critical fields in the service of the country.

In the immediate future we must, therefore, do everything in our power to trigger a new scientific era and to encourage our best people to participate. We must ensure that our institutions can rise to the challenge ahead of us in a sensibly co-ordinated effort that involves the best people whether they be in industry or government.

What is needed, is a revitalization of those fields of earth science research which are indicated by national needs. At present, the technical capability of the Geological Survey of Canada and the Earth Physics Branch are under severe and increasing pressure with demands to respond rapidly to assessments and evaluations. These agencies are committed to high quality and relevant, mission-oriented research, but in the present time of a) manpower freezes, b) increasing need to know about the landmass and c) rapidly changing sophistication in science and technology, it is becoming increasingly difficult to maintain the required breadth of capabilities. This document therefore, considers mechanisms by which the Department of Energy, Mines and Resources can maintain its necessary base in the new approaches to science and technology as they become developed and needed in our assessment of the landmass. The renewed program should be guided by thinking at three levels.

1. Where in Canada are the centres of excellence able to carry out the mission-oriented research proposed here?
2. What are the necessary programs in earth science neede to fulfill national goals?
3. How can we use our scientific and financial research resources most effectively to achieve the goals?

Proposed program

The program we are proposing involves financial support to four major elements of our existing institutions where scientific excellence is concentrated.

A. *Universities*

There are about 440 university professors in earth sciences in Canada; many are looking for ways to accomplish more research but they can only achieve this if they are provided with tools and manpower support. At least 50 could be expected to become involved in the type of mission-oriented research proposed here. There is no doubt that the proposed program would involve excellent people who would produce useful and important results relevant to the national needs.

B. *High technology sector*

Canada's expertise in development of high technology instruments and methods for the exploration of mineral resources, and for the measurement of the physical properties of the earth is particularly well known. The companies in this field however, find it particularly difficult to operate in the Canadian environment; the fact that they do so well demonstrates exceptional ability which should be encouraged. These companies have a great deal to do with the successful implementation of techniques to utilize the instrumentation.

C. *Resource industries*

It has always been difficult to interact effectively with the resource-based industries in the sense of obtaining research having general value in the public domain. It is clear these companies operate of necessity in a competititve manner. As a result, their research programs, although highly effective, tend to be strongly mission-oriented in very narrow fields. At the same time, the university sector and indeed the public sector do not have access to the wealth of information available in the private sector. We are therefore proposing that a category of research funding be made available to resource industries in the private sector. It is our hope that funding in this sector would permit these companies to release key people to put some of their research results in the public domain.

D. *Marine geoscience studies*

Canada faces an important issue in its oceanography programs. The enormous coast line and the large continental shelf adds an immense area to Canada's landmass. Our knowledge of the seafloor beneath it is very limited. We

have a few excellent institutions which have developed superior abilities in some areas of specialization, but these organizations are sccarcely able to rise to the challenges ahead.

E. *Fields of investigation*

Scientific Investigations The list is long, and a total funding level of about 3.5 millin per year may be required to provide the information we need to make critical decisions in the years ahead concerning problems of energy, minerals, geological hazards, and waste disposal. Many important and relevant studies are needed such as:

- The migration of fluids in the crust,
- The movement of toxic and natural materials,
- Seismicity and the siting of nuclear power plants,
- The mechanisms of ore formation,
- Dating techniques for geological materials including petroleum deposits,
- Methods for the detection and mapping of permafrost,
- Shoreline processes,
- Exploration for minerals at depth.

Many of these investigations are of the type that can be best handled in the universities sector.

High Technology Developments High technology skills can be best applied to specific projects for development of instrumentation and techniques, such as the development of marine seismic methods (an excellent example of this is in progress now at the Atlantic Geoscience Centre with Huntec ('70) Ltd); permafrost sounding techniuqe; major crustal seismic sounding; development and installation of geotechnical monitoring devices and instrumentation for exploration techniques. For successful operation we have estimated that it would cost about $250 000 per project per year. We would envision about four such projects per year and funded as needed on a continuing basis. Some aspects of this work and related studies might be handled by the resource industries, which, under our proposal, would permit some of the excellent science which is done within company framework to be made available for the public domain.

Marine geoscience The areas of greatest interest for oceanographic studies are those in which our oceanographic institutions have specialized. At least one million dollars per year would be required to form CORE grants for these institutions.

It is our contention that these issues are all within the mission of the Department of Energy, Mines and Resources and that the Department should fund this program by a special submission to the Treasury Board.

It is also our contention that this funding is urgently needed as a base for the major thrusts that have to be made in the coming decade. These funds are for new, well directed research in the national interest. In no sense do they represent just an increase to expand our current efforts.

Summary of Needs

(thousands $)	
Scientific investigations	3500
High technology and resource industries	1550
Marine geoscience	1000
Total	6050/year

A possible approach

"Again in 1855 the same problem was encountered. Logan was obliged to drum up support from all sides – the Governor General, scientists at the University of Toronto, the Anglican bishop and John A. MacDonald."

Blackadar, 1976

It is the central and most important theme of this document that the most talented people in Canada, wherever they are, be focused on the critical problems.

Our proposed procedural mechanism is to form a Senior Committee of EMR personnel and outside authorities to set guidelines and to screen proposals solicited from the community for both relevance and quality. These proposals would originate at the scientific working level and collectively would represent a new level of endeavour.

The Lamontagne Senate Committee recommended that the "foundations (NRC, etc) concern themselves for the most part with basic research in the universities with the *support of applied research being left to departments in pursuit of their mission.*" The Senate Committee also made a strong recommendation for contracting our research and this is now becoming government policy.

We concur with these recommendations and recommend in this report a mechanism to achieve this most effectively. This involves the Senior Committee to set guidelines and general fields of national significance. This committee will then be responsible for advising on the quality and relevance of proposals submitted.

It is also the sense of this proposal that there be a strong peer group assessment of projects. This should consist of a review of each proposal by the best people in the field and be coordinated by a committee consisting of senior EMR, university, and industry research personnel. The recommendations of this committee will be made to EMR, who in turn, would have the authority to take action on those proposals which were assessed to be of high quality and of general relevance to the national priorities in EMR's mandate.

In view of the clear need to stimulate work on our landmass, both from the point of view of short term and of longer term needs, it appears that we need to trigger a variety of new scientific and technological efforts on the part of industry, government, and the university. The industry incentives must include a favourable, stable, economic and political climate that encourages exploration. The university community can and should be used to tackle the important issues with the mechanisms which are appropriate to them.

The projects require peer-group assessment, with support of the highest quality programs, and the requirement to publish results in the open literature. These requirements have been shown in a number of instances to be entirely compatable with mission-oriented requirements. It remains only for EMR to tap this resource of people and to develop the great potential for expertise in Canada.

Recommendation

In view of the rapidly increasing demands being placed on our landmass to provide energy and mineral resources and to be used for major construction and urban projects and to act as a receptacle for our wastes, we recognize the need to substantially increase our base of scientific and technical expertise in the earth sciences. We recommend that the Department of Energy, Mines and Resources expand and modify its present research agreements to a peer-group assessed, mission-oriented program.

In the earth sciences alone we believe that such a program funded at a level of 6.05 million dollars per year (1976 dollars) for the next five years is required so that university and industry can rise to the challenge ahead.

Critical readings

The Geosciences in Canada – 1974 (1975) Geological Survey of Canada, Paper 75-6.

Towards a Mineral Policy for Canada – Opportunities for Choice, 1974, published by the Department of Energy, Mines and Resources.

Geological Surveys in the Public Service, C.H. Smith, U.S. Geological Survey, p. 921, 1975.

The need for increased provincial funding of applied Geoscience Research in the universities

(A submission by the Canadian Geoscience Council to the 35th Annual Provincial Mines Ministers Conference, Toronto, September, 1978. The brief was prepared by the President of the Council, G.W. Mannard).

Introduction

The Canadian Geoscience Council welcomes the opportunity to address the Provincial Ministers of Mines on the occasion of their Annual Meeting, Toronto, September 1978.

The Council is a forum of representatives of eleven major Canadian earth science societies, working together to encourage the development of the geosciences in the best interests of the nation. The member societies have an aggregate active Canadian enrollment of more than 12 000 geoscientists.

Foremost among the objectives of the Canadian Geoscience Council are the provision of advice to governments on science policy, the promotion of science education, and the provision of informed opinions on matters of public concern relating to the earth sciences.

Background

Few Canadians realize the importance of geoscience to the Canadian economy. As a producer of minerals, Canada ranked third in the world in 1977, with total production valued at $18.1 billion. The minerals and fuel industry directly employs 148 000 Canadians, and indirectly creates jobs for so many others that the total employment impact of the industry affects roughly nine per cent of Canada's labour force.

Mineral exports account for 30 per cent of the value of all Canadian exports each year. In fact, the export earnings potential of the Canadian mineral industry has been in the past, and can be in the future, our strongest trump card in a highly competitive trading world.

Unfortunately, all mines or oilfields sooner or later become depleted. Therefore, the prime requisite of a healthy mineral industry is a continuing, vigorous and successful campaign of exploration and development, in order that new deposits may be available to replace those which have been exhausted.

Mineral deposits are becoming more and more difficult to find, and those engaged in mineral exploration are calling for help in the form of improvements in the geoscience data base, the formulation of effective exploration concepts, and the development of increasingly sophisticated exploration concepts, and the development of increasingly sophisticated exploration techniques and equipment. Whereas there is little doubt of the technical ability of Canadian geoscientists to provide the essential aids to mineral discovery, it is less certain that the magnitude of the problem will be recognized in time, and the necessary financial support given to research and development.

A step in the right direction – The Ontario Geoscience Research Grant Program

The Canadian Geoscience Council has addressed itself to the task of convincing the public and governments of the need for increased and more effective funding of *all* earth science research. One of its associated groups, the Council of Chairmen of University Geoscience Departments, has directed its attention to a specific aspect of the problem – the solicitation of funding for intermediate-range, mission-oriented research subject to a peer review system. This approach achieved a major success in November, 1977, when the Province of Ontario annouced the establishement of its Geoscience Research Grant Program. This program is designed to foster the expansion and improvement of applied geoscience research carried out in Ontario universities, with the following specific objecties:

- Definition of the parameters of geological environments favourable to the occurrence of valuable mineral resources, and devising methodologies to aid in discovering these resources.
- Provision of geoscience information to assist and improve the existing Ministry of Natural Resources earth resources program.

The program is *not* intended to support or supplement basic geoscience research of the type normally eligible for funding by national agencies. Its support can be readily directed towards solving those problems of specific concern to Ontario. The program provides funding of $500 000 per year for an initial five-year period. Applications are reviewed by a committee which includes representatives from industry, the universities and the Ontario Geological Survey. Data obtained from funded projects must be made available to the public within twelve months of the termination of the research.

The Ontario program has been implemented with commendable speed. By May, 1978, twenty-four grants totalling over $400 000 had been made to 10 Ontario universities. Although it is much too early to assess the effectiveness of the program, it is remarkable that the creation of this fund has, at a single stroke, doubled the amount of money available to support research on exploration-oriented geoscience projects in the Ontario universities. The Canadian Geoscience Council is gratified to have been involved, in an advisory capacity, in the selection of industry representives to the committee which administers the new fund.

Recommendation

Several provinces have in recent years added substantially to their staffs of geoscientists because of their increasing involvement in highly specialized earth science activities. We feel that this trend will continue, and that the provinces will gradually assume more and more responsibility in the many fields of applied geoscience.

The Canadian Geoscience Council is well aware that some provinces are already supporting various forms of earth science research in their geological surveys, research councils, museums and universities. However, we feel strongly that there is a need for the provinces to increase their level of research funding, and that this can be done

most effectively through sponsoring programs similar in scope and structure to the Ontario Geoscience Research Program. Our studies of the status of the geosciences in Canada have pointed clearly to the need for increased research funding, and have also indicated clearly that with a few exceptions, only the universities possess the combination of specialized scientists and expensive facilities needed to carry out effective geoscience research.

Accordingly, we recommend that the Ministers of Mines give serious consideration to increasing the funding of mission-oriented geoscience research in the universities of their provinces. Such research, when funded by the provinces, can be directed most effectively towards solving their individual problems in critical resource areas.

The Canadian Geoscience Council stands ready to advise and assist in the formulation and administration of provincial geoscience funding organizations.

Research and Technological Developments in the provinces

(A submission by the Geological Association of Canada to the 35th Annual Provincial Mines Ministers Conference, Toronto, September, 1978. The brief was prepared by D.W. Strangway, President, and does not necessarily represent the views of the membership).

In 1977, a brief was prepared for the Geological Association of Canada and presented and distributed at the Provincial Mines Ministers Conference in Quebec City. A short version of that brief has subsequently been published in the annual report of the Canadian Geoscience Council entitled "The Geosciences in Canada, 1977".

The GAC is an organization of 2700 members from all across Canada and it is one of the member societies of Canadian Geoscience Council. It has a deep interest in the health of the earth sciences in Canada both because it is one of the basic scientific disciplines and because knowledge of the earth is essential in almost every aspect of Canadian endeavours.

The past two decades have seen truly remarkable changes in the study of the earth and its behaviour. The great revolution of plate tectonics and the pattern of moving continents and seafloor has brought new life and new momentum. This revolution has been likened to that of the discovery of the circulation of blood in humans. Following that fundamental discovery, there were obvious changes that occurred in the practical aspects of the delivery of health care. In the past two decades we have returned materials from the moon and we are now seriously planning for the return of samples from Mars, asteroids and comets. The analytical tools that have been applied to geological problem solving have opened new frontiers.

We have new models, new theories, new data, new tools and an expanding information base on which to build a new generation of endeavour in the practical problem of the exploration for minerals.

In the late 1940s and early 1950s airborne magnetometers were widely applied to mapping and exploration. In the late 1950s airborne electromagnetic methods were widely adopted and at about the same time airborne gamma ray spectrometers were brought into wide use. These developments represented a new dimension to the total endeavour of geological mapping and knowledge of our country.

The next generation of the earth sciences now has a solid foundation and there seems to be little doubt that many scientists are willing and anxious to make contributions to the practical problems of resources.

We have a small base of scientists at our universities. We have a small but aggressive technology development sector. We have the need to develop new methods and new ideas for exploration, for mapping and for land utilization. One of the questions which faces mines ministers is how to develop and exploit our human resources to continue to provide the solid geological base necessary to our Canadian way of life.

One aspect of this is to provide economic incentives and rewards for those who have the courage to explore. I will not address this issue since there are many other groups at this meeting who are surely speaking to this issue in detail. It is however, also necessary to provide incentives to the technological community to ensure that we know as much as possible about how economic concentrations of minerals are formed and to have methods and techniques available for deep exploration.

Somehow in the suspicious society in which we live, it is thought that the people of science and technology are primarily looking after themselves. How often have I heard federal economists and bureaucrats express the view that this community is "self-serving". I find this attitude particularly upsetting because I really believe that many of us feel that we have something essential to contribute to our national fibre. I continually fail to understand why the attitude is not one in which the system seeks to exploit and to strengthen what we have in the area of science and technology.

In this regard we must congratulate the Province of Ontario, our hosts at this occasion. They have had the foresight to establish a research fund to develop the provincial capacity in three areas:

- the nature and origin of ore deposits,
- methods and techniques for deep exploration,
- the utilization of the earth for construction materials and for the disposal of wastes.

This program has now started and the response from the universities demonstrates a keen interest in doing this type of research. Perhaps one of the keys was the incentive of quality assessment by peer group review as well as the criterion of relevance.

Discussions are now under way in Ontario to establish an Earth Science Technology Development Fund for development of new instrumentation. There are no details as yet, but it is clear that the scale of technial skills that are needed has multiplied and anyone who wishes to explore in already heavily explored areas will need access to such tools. Mechanisms to provide incentives and contracts to the entrepreneurial, but small technology sector are urgently required. We hope at next year's conference that this province will announce that it has moved to provide a firmer base for these technology-oriented companies and to help keep our industries at home. Canada has been a leader in these disciplines in the past but we need more activity in the development of methods such as cryogenic magnetometers, chemical analytical methods for rock geochemistry and drillhole methods for deep exploration.

It is interesting to consider for a moment that our economy and in particular our mineral sector has as its first element, science and technology. Without this we would have no industry and certainly there would be little capacity to generate wealth. In the final few minutes I should like to call your attention to a noteworthy comparison in the federal budget.

The foreign aid program of this country is directly based on our capacity to produce. The federal foreign aid budget is 1.2 billion dollars and represents 0.51 per cent of the gross national product. While there are logical and

humanitarian reasons for these expenditures, they assume that we have a healthy economic base. The total federal budget for research and development is 0.92 billion dollars. This is about 0.4% of the gross national product and is lower than that of Australia, France, Germany, Japan, the Netherlands, Sweden, Britain and the United States. This is the investment we are making at the front end to ensure that we have a healthy scientific and technological base and it is even less than we put into foreign aid.

Gentlemen, I conclude by stating that those of us involved in the science and technology of the earth should not be embarrassed if we appear to be self-seeking. Instead, we should stand up and demand a system that capitalizes and exploits our services, for without us the eventual health of the mineral industry in Canada will be seriously weakened. I consider it a challenge to the provincial mines ministers to ensure that they are investing enough in the productive and potentially productive sectors of our society and recommend that mechanisms to stimulate research and technological developments in the provinces be put into place.

The role of the Canadian Geotechnical Society in Canada's Resource Development

(A submission by the Canadian Geotechnical Society to the 35th Annual Provincial Mines Ministers Conference, Toronto, September, 1978. The brief was prepared by J.I. Adams, Vice-President, Technical Operations).

We were pleased to receive an invitation to submit a brief to the above Conference on our concerns in the field of mining in Canada. In submitting this brief our purpose is to describe the role of the Canadian Geotechnical Society in Canada's Resource Development indicating some areas where the Provincial Ministries could provide useful input or interaction in future geotechnical and geological studies.

The scope of geotechnical activites in our Society includes the study of the properties of soil, rock, peat, snow and ice, the influence of environmental factors on such properties and the application of this knowledge.

Table 3.2

Confirmed significant hydrocarbon discoveries 1976-1978

Region/Area	Well Name	Discovery Year	Formation/Type	Operator/Participants
Mackenzie Delta	Kamik D-48 68°57'12.59"N, 133°27'29.86"W	1976	Cretaceous/oil	Gulf/Mobil
Mackenzie Delta	Garry P-04 69°30'N, 135°30'W	1976	Tertiary/oil, gas	Sun/SOBC/Bow Valley
Willston Basin	Minton 11-2-3-21W2	1976	Winnipegosis/Ord./oil	Dome, Tenneco et al
Alberta Basin	Pass Creek 7-13-61-18W5	1976	Beaverhill Lake/gas	Chevron/Gulf
Alberta Basin	Gulf Pacific Fina Hamelin 11-8-47-17W5	1976	Swan Hills/gas	Gulf/Pacific/Fina
Alberta Basin	Gulf et al. Erith 6-31-47-17W5	1976	Swan Hills/Cambrian	Gulf et al.
Alberta Basin	Elmsworth 11-15-70-11W6	1976	Cretaceous/gas	Canadian Hunter/Texcan
Alberta Basin	Karr 11-36-64-2W6	1976	Cretaceous/gas	Canadian Hunter/GIM
Willston Basin	Torquay 15-12-4-12W2	1977	Mississippian/oil	Shell Canada
Alberta Basin	Blackie 10-16-20-27W4	1977	Mississippian/oil	Ipex et al.
Alberta Basin	Pembina A-11-22-49-12W5	1977	Devonian/oil	Nairb (Chevron)
Northern Foothills	Kotaneelee YT H-38 60°07'11"N, 129°06'03"W	1977	Miss./Dev./gas	Columbia Gas et al.
Beaufort Basin	Ukalerk C-50 70°09'07"N, 132°43'52.5"W	1977	Tertiary/gas	Come, Gulf et al.
Beaufort Basin	Nektoralik K-59 70°28'36"N, 136°16'59"W	1977	Tertiary/oil/gas	Dome, Hunt
Alberta Basin	Branard 11-2-74-12W6	1977	Triassic/gas	Chieftan/Texcan
Alberta Basin	Wapiti 7-5-69-9W6	1977	Cretaceous/gas	Canadian Hunter/Sulpetro
Labrador Shelf	Hopedale E-33 55-52-24.08N, 58-50-51.08W	1978	Not released/gas, condensat	Chevron et al.
Alberta Basin (N.E., B.C.)	Stoddart 6-35-85-20W6	1978	Pennsylvanian/oil	General American
Alberta Basin	Hythe 10-30-73-9W6	1978	Triassic/oil	Total, PanCanadian

Table 3.3

Significant Metallic Mineral Discoveries 1976-1978

Among its accomplishments in the 1976-1978 period, Canada's mining exploration community lists the following significant mineral discoveries. This list is an update of a similar list published in 1978 covering the 1975-1977 period

Name and year of Discovery	Responsible Companies	Location	Type of Deposit	Grade and Reserves*
X-25 Orebody (1976)	Western Mines and Dupont of Canada	Pine Point, N.W.T.	Pb-Zn sulphides in Devonian carbonate rocks	2.8 million tons @ 4.1% Pb, 11.9% Zn. Strong indications of other orebodies in the vicinity.
Deilman Orebody (1976)	Inexco Oil & Gas; Uranerz; Sask. Govt.	Key Lake, Saskatchewan	Uranium adjacent to Athabasca Sandstone	12 million lbs U_3O_8, 8 million lbs Ni.
DY Prospect (1977)	Cyprus Anvil	Anvil District, Y.T.	Massive Sulphides	(not available).
West Bear (1977)	Gulf; Noranda; Sask. Govt.	Rabbit Lake area, Sask.	Uranium in or near Athabasca Sandstone	(not available).
Maurice Bay (1977)	Uranerz; Inexco Oil & Gas; Sask. Govt.	Lake Athabasca	Uranium	10 million lbs U_3O_8.
Hydraulic Lake (1976)	Tyee Lake Resources; optioned to Placer	Kelowna area, B.C.	Uranium in Tertiary channel deposits	1.5 million lbs U_3O_8.
Blizzard (1977)	Norcen et alia; (Lacana option)	Kelowna area, B.C.	Uranium in Tertiary channel deposits	2 million tons @ 5 lbs U_3O_8.
Cape Kay (1977)	Riocanex	NE of Port aux Basques, Nfld.	Gold veins in Proterozoic volcanic rocks	500,000 tons @ 0.29 oz Au/ton in three zones.
Nadaleen River (1977)	McIntyre	80 mi E of Keno Hill, Y.T.	Pb-Zn-Ag in Proterozoic carbonate rocks	1 million tons @ 22% combined Pb-Zn and 3 oz/ton Silver.
Dismal Lakes (1977)	Esso Resources	S of Dismal Lakes, N.W.T.	Uranium in Proterozoic Sandstones	(not available).
Midwest Lake (1978)	Esso Resources; Numac; Bow Valley	Rabbit Lake area, Sask.	Uranium in and below Athabasca Sandstone	1,424,000 tons @ 3.4% U_3O_8 (97 million lbs U_3O_8).
Trout Lake, B.C. (1978)	Newmont; Esso Resources	Revelstoke area, B.C.	Molybdenum porphyry	(not available).
Chu Chua Prospect, (1978)	Craigmont Mines	Barrier Lake, area B.C.	Copper in metasedimentary rocks	2 million tonnes of 2.0% Cu.
Trout Lake, Manitoba (discovered earlier; reported in 1978)	Granges	Flin Flon area, Manitoba	Massive sulphides in Precambrian volcanics	3.5 million tonnes @ 2.6% Cu and 4.3% Zn.
Lone Gull (discovered in 1977; reported in 1978)	Urangesellshaft	Baker Lake area	Uranium	Single drill intersection of 100 ft. @ 1% U_3O_8 reported.
Collins "B" (found in 1977, reported 1978)	Gulf	Rabbit Lake, Sask	Uranium near Athabasca Sandstone	(not available).

* Best available published reserves. Mostly "drill indicated", undiluted, but may include other categories. Best taken as order-of-magnitude estimates.

Our Society was formed in 1972 after a background of some 25 years operating informally under the umbrella of the National Research Council, Associate Committee on Geotechnical Research. We have approximately 900 members. Our Board of Directors is composed of elected directors and ex-officio members. We have 8 elected directors who represent the local sections across the country. We have one Division known as the Engineering Geology Division with 675 members. We are responsible for the Canadian Geotechnical Journal published by the National Research Council. This journal, as you probably are aware, has gained high international recognition. We are a Constituent Society of the Engineering Institute of Canada.

The Canadian Geotechnical Society sponsors and participates in the Annual Conference which is held in various parts of the country on a rotating basis, being organized by a local section of the Society. The annual conference is usually 2 days, papers usually prepared in accordance with a theme. This year the 31st Annual Conference will be held in Winnipeg in October, the theme, *Groundwater – A Geotechnical Consideration*. Typically the attendance varies between 200 and 300 people with fair representation from outside the country. We would welcome your attendance or representation at these meetings.

The local Sections are organized with their own executive and these Sections run active programs each year largely consisting of technical lectures and seminars. At the national level the Society has organized a number of technical committees which have been given specific assignments in their respective fields. These committees are as follows:

1. Foundations
2. Tunnels
3. Slopes
4. Embankments

We also have two Task Groups, one on Standards and Metric Conversion and the other on Computer Applications. The Foundations Committee has recently revised and prepared for publication the Foundation Manual. This manual was prepared originally under the NRC National Building Code Revision Committee and was turned over to the Society for publication. This document was intended to provide guidance and standardization for the design of building foundations in Canada. It has been well accepted and has recently been put on the market for wide distribution. The Tunnel Committee was recently formed and has proposed a very active program which will include the preparation of monographs on urban tunnelling, underground storage, tunnelling in frozen ground, tunnelling in tar sands, groundwater control, and the use of boring machines. The other committees are formulating programs aimed at identifying problems peculiar to Canada which they will address in due course.

We feel the activities of the Canadian Geotechnical Society will be of interest and value to those engaged in mining activities. We acknowledge the traditional geological activities of the provincial ministries in support of both metal and industrial mineral deposits. We note particularly the recent work on aggregate resources and geotechnical studies recently carried out by the Quebec and Ontario ministries. We also look with pride on the input provided by the major geotechnical consultants in Canada's mining activities particularly in slope stability studies in open pit mines, the tar sands projects, the siting of mining facilities and townsites and the design of tailings dams.

However, we feel there is a need to integrate more closely the service provided by the ministries and their agents with the work and needs of the geotechnical community. As an example we would like to identify the following topics for discussion:

Compilation of geological and geotechnical data

There are large masses of geotechnical data being compiled by consultants and governmental agencies across the country. If this data were assembled, condensed and made available in map or computerized form for general use for engineers and geologists it would be of great value in assisting the development of mineral resources as well as the overall development of our resources. This has been attempted in the past for urban areas, but for one reason or another was never completed. It is suggested that the Provincial Ministries consider the development or the extension of existing data systems for the dissemination of geotechnical and geological data for both urban and non-urban areas.

Waste disposal sites

The management or disposal of waste material is a major concern in mining. It is also a common problem across the nation in respect to the disposal of domestic, industrial and hazardous materials. Although the problem is a multi-disciplinary one with a great deal of input from many sources, the geological and geotechnical input is extremely important, particularly in the preliminary stages. We feel that more basic geological information is needed, particularly in developed or urbanized areas.

Land subsidence

Surface subsidence results from the subsurface removal of either solids or liquids. It is a common problem in removal of solids by conventional mining but also by solution mining and natural dissolution. Also, the removal of liquids, including groundwater, by pumping has serious long term ramifications. For both industrial and residential development a better knowledge of such occurrences is needed.

For the latter two topics we would suggest that more engineering geology studies including remote sensing surveys are required in both urban and non-urban areas and areas which may be generally classified as hazard areas. While we do not suggest such work should necessarily be done in-house, we feel the ministries should have a responsibility here to administer such work by the capable consultants which are available in the various fields. The Canadian Geotechnical Society would be pleased to confer with and discuss such activities with the ministries and assist in whatever activities may be generated.

We hope in this short brief that we have provided a good description of our structure, activities and future plans and conveyed to you some food for thought in respect to future input to geological and geotechnical studies by the provincial mines ministries.

SIGNIFICANT HYDROCARBON AND METALLIC MINERAL DISCOVERIES: 1976-1978

As a service to those attempting to keep abreast of Canada's resource discovery/consumption balance, lists of significant discoveries made during the previous three-year period have been published in the Canadian Geoscience Council's Annual Reports since 1976.

Hydrocarbon discoveries for the period 1976-1978 are listed in Table 3.2 and for metallic minerals in Table 3.3.