GEOGRAM

Dr. Kathryn Sullivan, a mission specialist on NASA's space shuttle flight 41G in 1984, is shown presenting Mike Keen, Director of AGC, with a souvenir to mark her association with AGC. (p. 15)

Mme Kathryn Sullivan, astronaute de la NASA ex-membre d'une mission de la navette spatiale 41G en 1984, présente à M. Mike Keen, directeur du CGA, un souvenir pour commémorer son association avec ce centre de recherches. (p. 15)

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Canada

FROM THE DIRECTOR GENERAL

The December issue of Geogram provides a convenient vantage point from which to review the past year and try to anticipate what lies ahead.

During 1984, there has been a great deal of effort in the GSC on the planning and implementation of a series of special new programs which extend and augment the fundamental work of the GSC's A-base (core) program. These deserve some comment.

New federal-provincial co-operative mineral development agreements were signed during the first half of the year with Manitoba, Saskatchewan, Newfoundland, Nova Scotia and New Brunswick. The geoscience components of these programs are intended to stimulate and facilitate mineral exploration in specific regions by private industry. The further development of these new programs will require much additional effort during the coming year; and there is the possibility that more federal-provincial mineral development agreements will be established during 1985.

Another new special program involves studies, in collaboration with the Earth Physics Branch and the Department of Fisheries and Oceans, in offshore boundary areas on Canada's Atlantic, Pacific, and Arctic Coasts. These follow the major effort that was mounted through the Atlantic Geoscience Centre in preparation for the hearings at the International Court of Justice on the offshore boundary between Canada and the United States on Georges Bank. These special programs also draw upon and contribute to the GSC's primary activities in ensuring the availability of basic geoscience knowledge, expertise, and technology concerning the Canadian landmass and offshore areas.

1984 will be remembered as the year of the very successful launching of Lithoprobe, a new collaborative Canadian geoscientific research program which involves the co-ordination of geophysical, geological and geochemical techniques, and collaboration among scientists from universities, government and industry, to extend and relate surface geology to structures at depth. Scientists from various parts of the Geological Survey of Canada have played an important role in this project from its inception. During 1984, staff from the Cordilleran Geology Division participated in a major experiment involving approximately 200 km of seismic reflection profiling on Vancouver Island, to determine the deep structure and the relationships to the adjacent ocean basin. The preliminary results of this very successful venture will be reported in a number of scientific papers, and at a number of forthcoming meetings, including our Current Activities Forum in January. Another Lithoprobe experiment, on the Kapuskasing structural zone in the Canadian Shield north of Lake Superior, consisted primarily of a seismic refraction study involving 20 shots consisting of explosive charges ranging from 800 to 2000 kilograms, fired in small lakes. It aims to provide the framework for testing the hypothesis, developed by GSC geologists, that the Kapuskasing structure provides a "window" on the lower part of some of the oldest Continental Crust in Canada.

MESSAGE DU DIRECTEUR GENERAL

La parution du Geogram en décembre est une occasion unique de donner une rétrospective des évènements de l'année écoulée et de faire entrevoir quelques perspectives prévisibles au cours de l'an nouveau.

En 1984, il y eut un effort considérable au sein de la CGC au niveau de la planification et de l'exécution d'un bon nombre de nouveaux programmes qui permettent l'évolution et l'accroissement de la tâche fondamentale de la CGC; ce qui commande une certaine élaboration.

De nouvelles ententes coopératives fédéral-provinciales de mise en valeur des minéraux ont été signées au cours de la première moitié de cette année par le Manitoba, la Saskatchewan, Terre-Neuve, la Nouvelle-Écosse et le Nouveau-Brunswick. Les composantes géo-scientifiques de ces programmes ont pour but de stimuler et de faciliter l'exploration minérale régionale par l'entreprise privée. L'évolution de ces programmes va demander plus d'effort au cours de la prochaine année; il y a là une possibilité d'accroissement des ententes fédéral-provinciales de mise en valeur des minéraux pour l'année 1985.

Il faudra se rappeler que l'année 1984 fut celle du lancement avec grand succès du projet Lithoprobe; c'est un bel exemple d'un programme coopératif canadien de recherches géoscientifiques qui comprend la coordination de techniques géophysiques, géologiques et géochimiques, la collaboration de scientifiques universitaires, de l'État et de l'industrie, dans le but de mettre en relation la géologie de surface et la structure en profondeur. Les scientifiques de différentes parties du Canada y ont joué un rôle important dès le début de ce projet. Au cours de 1984, le personnel de la Division de la géologie de la Cordillère a pris part à une expérience importante qui a consisté à établir un profil de sismique réflection d'une longueur approximative de 200 km sur l'île Vancouver afin de mettre en évidence la structure en profondeur et ses relations avec le basin océanique adjacent. Les résultats préliminaires de cette entreprise heureuse ont paru dans de nombreuses publications scientifiques et à ce nombre, on doit signaler que ces résultats seront publiés et diffusés au cours de notre prochain Forum des travaux en cours en janvier. Une autre expérience dans le cadre de Lithoprobe qui eut lieu dans la zone structurale de Kapuskasing située au nord du lac Supérieur dans le Bouclier canadien a consisté, en premier lieu, en un sondage de sismique réfraction mettant en jeu 20 coups constitués de charges explosives variant de 800 à 2000 km que l'on fît exploser dans de petits lacs. Le but de cette expérience était de donner plus de crédibilité à l'hypothèse émise par les géologues de la CGC que la structure de Kapuskasing joue le rôle d'une «fenêtre» sur la partie la plus basse d'une partie la plus vieille de la Croûte continentale canadienne. D'autres recherches sont planifiées dans d'autres régions du Canada afin de pousser plus avant les connaissances d'ordre fondamental concernant la structure en profondeur du continent et de ses marges.

Further studies, to address fundamental problems concerning the deep structure of the continent and its margins, are planned for various other sites in Canada.

The Frontier Geoscience Program, which was approved by the Treasury Board in June, involves major expansion of capabilities for basic geoscience by the Earth Sciences Sector in the frontier areas offshore of the East Coast and West Coast and in the North. This program, which will have profound long lasting effects on the GSC, is focussed on the understanding of frontier sedimentary basins, their evolution, and their resource potential, including their deep geophysical structure and the hazards and constraints affecting exploration and development of the resources they contain.

The "Ice Island" project is another new initiative with major implications for us. It involves using a large, thick slab of ice that recently broke off the Ward Hunt Ice Shelf of northern Ellesmere Island, as a platform from which to study the Arctic Continental Shelf and Arctic Ocean Basin. One aspect of GSC participation will be through the Frontier Geoscience Program, which will be co-ordinated with the Ice Island Project for the study of sedimentary basins beneath the Arctic Continental Shelf and Slope.

Other major new initiatives include plans for Canadian participation in the Ocean Drilling Program, including preparations for sampling ocean floor sediment and rocks in the Labrador Sea and Baffin Bay. This also may have a major impact on the future of the GSC. There is also GSC participation in the new Northern Oil and Gas Action Program (NOGAP) co-ordinated by the Department of Indian Affairs and Northern Development, in a major new geoscience program for mineral resource development in Thailand, and in various new geoscience programs on mineral and petroleum resources, through the International Union of Geological Sciences.

Concurrently with all of the new developments, there have been Canadian Geoscience Council Advisory Committees studying the GSC's activities in Mineral Deposits Research and in Quaternary and Engineering Geology. Their reports should be available early in 1985.

1984 obviously has been a very busy year that has brought many fundamental challenges and opportunities to the GSC, which GSC has been very successful in meeting. I am confident that it can also meet the challenges and opportunities presented to it by the new government in the months ahead.

R.A. Price

Le «Frontier Geoscience Program», approuvé par le Conseil du Trésor et sous la direction du Secteur des sciences de la Terre, consiste en une expansion importante des possibilités géoscientifiques de base pour les régions frontalières en mer des côtes Est et Ouest et du Nord. Ce programme, qui aura des effets profonds et durables pour la CGC, a pour optique une meilleure interprétation des basins sédimentaires frontaliers, leur évolution et leur potentiel en ressources, y compris, leur structure géophysique en profondeur ainsi que les risques et les contraintes que comportent l'exploration et la mise en valeur des ressources qu'ils contiennent.

Le projet «Ice Island» est une autre nouvelle initiative qui revêt des implications importantes pour nous. L'objet principal de ce projet est l'utilisation d'une large et épaisse dalle de glace (d'où son nom) qui s'est récemment détachée de la plate-forme glaciaire Ward Hunt au nord de l'île Ellesmere. Cette dalle sert de laboratoire pour l'étude du plateau continental et du basin océanique de l'Arctique. La CGC participera à ce projet par l'intermédiaire du «Frontier Geoscience Program», celui-ci agira conjointement avec le projet «Ice Island» pour l'étude des bassins sédimentaires en contrebas du plateau continental de l'Arctique et son talus.

D'autres nouvelles initiatives d'importance se situent au niveau d'une participation canadienne à l'«Ocean Drilling Program», cette activité de recherches comporte une organisation technique adéquate pour l'échantillonnage des sédiments et des roches du fond océanique dans la mer du Labrador et du voisinage marin de l'île Baffin. Ce programme peut avoir un impact majeur pour l'avenir de la CGC. Il faut signaler, également, une participation de la CGC au nouveau «Northern Oil and Gas Action Program» (NOGAP), coordonné par le ministère des Affaires indiennes et du Nord, aussi une participation dans un nouveau programme géoscientifique important pour la mise en valeur des ressources minérales en Thailande et de même dans divers programmes, tous nouveaux, en ressources minérales et pétrolières sous l'égide de l'Union internationale des sciences géologiques.

Concurrement à tous ces nouveaux champs de recherches, les comités consultatifs du Conseil canadien des sciences de la Terre ont étudié les activités de la CGC dans les recherches en gisements minéraux et en géologie quaternaire et appliquée; des rapports à ce sujet seront diffusés au début de 1985.

Il n'y a aucun doute que 1984 a été une année de travail intense qui a apporté des défis fondamentaux et des chances inespérées à la CGC, entre autre son excellente participation à de nombreuses réunions. J'ai bon espoir que dans notre tâche nous pourrons encore faire face brillamment à de grands défis que nous présentera ce nouveau gouvernement dans les mois à venir.

R.A. Price

STAFF NEWS

DIRECTOR GENERAL'S OFFICE

Ed Hall, Scientific Executive Officer to four Directors retired from the Survey in June 1981 but at the request of Ray Price he accepted a part-time assignment. This he completed on 31 October so now at long last Ed can enjoy the full benefits of retirement.

Don Picklyk has been appointed Program Officer for the Frontier Geoscience Program and will be working on the preparation of planning documents, analyses, tabulations and summaries of this major new Earth Science Sector program.

George Cameron, who had been on loan from Resource Geophysics and Geochemistry Division was formally transferred to the DGO at the end of March 1984.

John Hussar, who is on a secondment assignment from the National Capital Commission, became Personnel Advisor for the Earth Sciences Sector at the beginning of July. As part of the new sectoral arrangement, John's office along with Pay and Benefits is at 615 Booth whereas Staffing and Classification remain at 601 Booth.

GEOLOGICAL INFORMATION DIVISION

M.J. Kiel was appointed Head, Publication Production Unit in September filling the vacancy created by the retirement of Leona Mahoney at the end of 1983.

Diane Tremblay, divisional secretary, proceeded on maternity leave in October and Jacinthe Caron was seconded to GID from the Word Processing Centre.

Vern Foster was the successful candidate for the vacant position of Supervisor, Unit B, Cartographic Section and moved into "his own office" in March after being in an acting role for some time.

M.J. Rowan joinded the staff of the Publication Distribution Unit at the end of August giving Bruce Murphy much needed support.

Kirsten Lindgreen joined the Project Unit of the Library in September. Kirsten has a B.Sc. in geology from St. Mary's University, Halifax, where she developed a special interest in soft rock geology. Kirsten will be indexing GSC documents for GEOSCAN until March 1985.

Anne Barkworth is working in the National Geoscan Centre on database conversion and clean-up activities.

ECONOMIC GEOLOGY AND MINERALOGY DIVISION

Larry Hulbert joined the division as a Research Scientist in the Mineral Deposits Geology Section. Larry did undergraduate studies at the University of Regina in his native Saskatchewan, and then worked for $2\frac{1}{2}$ years as an exploration and mine geologist with Sherritt Gordon Mines in Lynn Lake, Manitoba. During his time with Sherritt, he became interested in layered igneous complexes and returned to Regina to undertake an M.Sc. study of the Fraser Lake intrusion near Lynn Lake. Upon completion of his master's, Larry went to the Institute for Geological Research on the Bushveld Complex at the University of Pretoria in South Africa, where his doctoral dissertation dealt with aspects of platinum, chromium and nickel mineralization in the complex. Larry's initial assignment at GSC is to work with the "Ultramafia", the group within EGM Division studying the metallogeny of mafic and ultramafic rocks. His other research interests include contact and high grade regional metamorphism.

Economic Geology and Mineralogy Division is delighted to welcome our new isotope geochemist, Bruce Taylor, from the University of California at Davis. He arrived to take up duties 1 October in the dual role as manager of the new joint Ottawa U-Carleton U-GSC supported stable isotope laboratory at Ottawa U, and research scientist specializing in stable isotopes related to mineral deposits at the GSC.

Bruce's impressive list of credentials began with a B.S. (cum laude) degree, 1968, at the University of Redlands, California, and a M.S. degree in 1971 at the Colorado School of Mines. His Ph.D. studies at Stanford University documented a field and stable isotope investigation of skarn deposits, and signalled the beginning of his interest in mineral deposits and stable light isotopes.

After two years of related research at Tuebingen, West Germany, Bruce returned to the U.S.A. in 1977 to become Assistant Professor of Geology at the University of California (Davis). There he taught economic geology, geochemistry and instrumental analysis. In order to pursue stable isotope studies, he built his own mass spectrometer and associated sample treatment facility. In so doing, he introduced several improvements in equipment design that are now in use at other laboratories. While at Davis he studied stable isotopes in a variety of geological environments including tungsten skarns and metamorphic fluids, pegmatites, Mother Lode gold deposits, massive sulphide deposits, silver veins, graphite veins, acid mine drainage and sulphide oxidation mechanism, ecology of Nautilus, and magma degassing.

Bruce will be splitting his time between Ottawa U, where he will continue the setting up and management of the isotope lab, and 601 Booth St., where he will maintain his research office.

He and his wife are not intimidated by horror stories of Ottawa winters, and are looking forward to continuing cross-country skiing and also testing their skills in ice skating and curling.

RESOURCE GEOPHYSICS AND GEOCHEMISTRY DIVISION

Best wishes to Alice I. MacLaurin who left the Analytical Laboratories Section in early September. During her fifteen years of service, Alice made significant contributions to the operation of the laboratories. Her skills in almost every aspect of analytical chemistry were well appreciated by all members of the Geochemistry Subdivision. Of perhaps even greater importance, Alice's congenial and friendly personality will be missed. A very successful dinner and reception were held in her honour at the Courtyard Restaurant located in the historic Byward Market area of Ottawa.

A.V. Dyck of the Borehole Geophysics Section has taken a one year exchange posting to Queen's University, Kingston, Ontario from August 1984 to August 1985.

Tony Luyendyk is visiting from the Australian Bureau of Mineral Resources, Canberra. He and his wife arrived on 3 September 1984 and are looking forward to a white Christmas and New Year in Ottawa before returning on 3 January 1985 to a warm and beautiful Australian summer. Tony has a special interest in the GSC's aeromagnetic compilation techniques for 1:1 million magnetic anomaly maps and also airborne gamma-ray spectrometry map compilation.

The Mineral Development Agreements with the various provinces has provided the Resource Geochemistry Subdivision with two term employees:

P.W.B. Friske joined the geochemistry subdivision on 28 May as Mineral Agreement Survey Geochemist for the duration of the Federal-Provincial Agreements. Dr. Friske, who obtained his doctorate in applied geochemistry from the University of New Brunswick, brings to the subdivision several years of experience in geochemical research and exploration activity with government and industry.

Martin McCurdy, a recent geology graduate from Carleton University, will be assisting John Lynch in handling material for the contract analytical requirements for each of the MDA projects. Martin is no stranger to geochemistry, having spent several summers here as a student assistant.

ATLANTIC GEOSCIENCE CENTRE

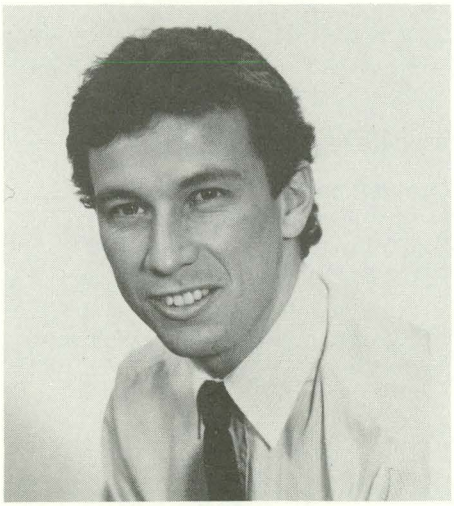
David Ross (formerly Head of the Regional Reconnaissance Subdivision, and at present, Director of Research with NORDCO Ltd., St. John's) has accepted the appointment as Assistant Director effective 16 July.

TERRAIN SCIENCES DIVISION

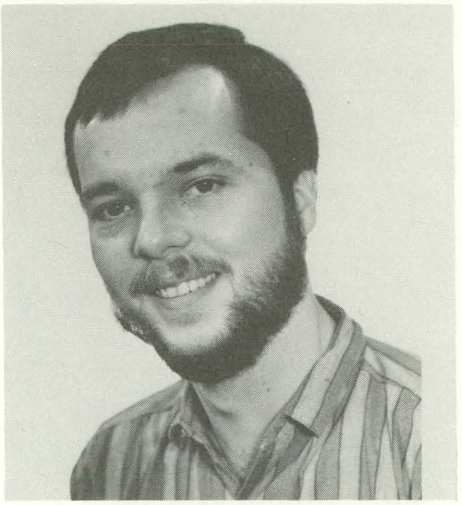
Christine Kaszycki joined the Sedimentology and Mineral Tracing Section in June as a term employee, during which time she will lead the glacial prospecting and Quaternary mapping program associated with the Canada-Manitoba Mineral Development Agreement. She obtained a B.A. in Geography from Carleton University in 1978, and subsequently joined the Terrain Sciences Division, for the first time, as an AECL employee to study the depth of glacial erosion in Shield areas. She resigned in 1980 to undertake Ph.D. studies at the University of Illinois. Her doctoral research involves a study of glacial and proglacial sedimentation in the Shield terrane of south-central Ontario.

Christine Kaszycki

Martin Clarke comes to the Division to work on the compilation of an atlas of the surficial geology of northern and central Manitoba as part of the Canada-Manitoba Mineral Development Agreement. In the past he has participated in similar projects in the District of Keewatin with both the GSC and Urangesellschaft Canada Ltd. while attaining a B.Sc. Honours in Geography at Carleton University.

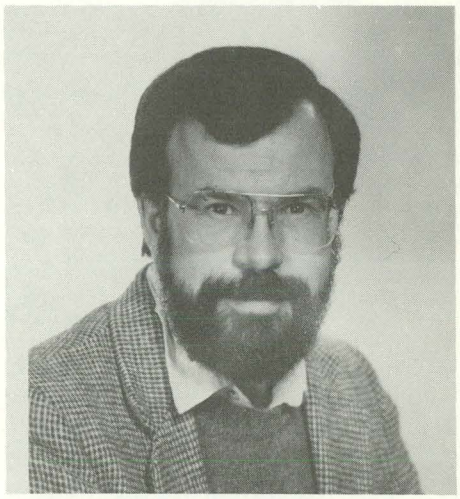


Martin Clarke



Robert Burns

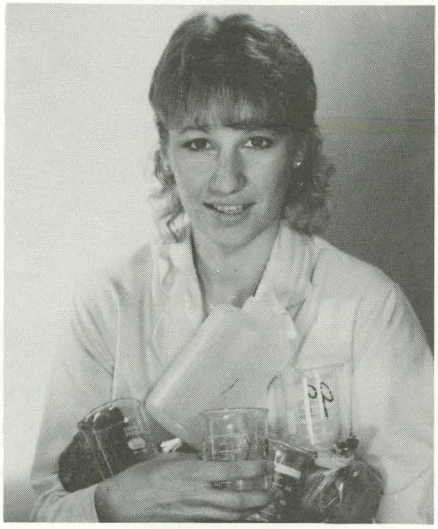
Robert Burns joined the Sedimentology and Mineral Tracing Section in September as an Earth Sciences Data Manager. Rob is currently involved in updating several SIR (Scientific Information Retrieval) data bases, maintaining and developing graphics and statistical programs. Rob received his B.A. and M.A. in Geography from Sir Wilfrid Laurier University.



Frank Thompson

Frank Thompson joined the Sedimentology and Mineral Tracing Section in July and will be directing glacial studies in Labrador under the Canada-Newfoundland Mineral Development Agreement. After receiving his B.Sc. in Geology from the University of Manitoba in 1971 Frank initially worked in hard rock geology. He became increasingly involved in glacial geology and for the last 10 years has provided consulting services in overburden drilling and glacial

Pam Midgley



Maria Pirnat

exploration. His varied experience in mineral exploration and in drift prospecting combine with a distinctive and enthusiastic approach to field work. He is a welcome addition to the Division.

Pat Higgins returned to the Division in August as Senior Technician of the Drift Chemistry and Mineralogy Laboratory.

Pam Midgley and Maria Pirnat joined the Lab this past November and June 1984, respectively. Their positions, as "Mud Engineers", involve:

Duties: Distilling, Mud Pies to Order, Sandcastles, Dirt Shakes, Sole Supplier of Custom Coloured Lab Coats (cheap).
Favourite Colour: Brown
Pet Peeves: Clay Balls, Pebble Paranoia
Inspired by: Tom Selleck, Rod Klassen
Suffering from: Dirt Bag Blues, Grinder's Elbow, SLS (Sed. Lab Syndrome)

INSTITUTE OF SEDIMENTARY AND PETROLEUM GEOLOGY, CALGARY

In June 1984, Deanna Boyce, a SCY-03, was transferred from the ISPG to the Department of Transport. Barbara Acker assumed Deanna's position and is now working as secretary to the Regional Geology and Paleontology subdivisions of the Institute. Dan Copithorne left his position in the Core Storage Section for a position at Prudential Steel. Anita Oliver, receptionist at ISPG, left her switchboard in September to work for the Petroleum Incentives Program. She has been replaced by Cathy Brennan. Elizabeth Zuba left her clerical position at ISPG library for a position as librarian at Shell Canada Limited. Terry Rendall, of the Word Processing Centre, left her Xerox 850 to return to Saskatchewan.

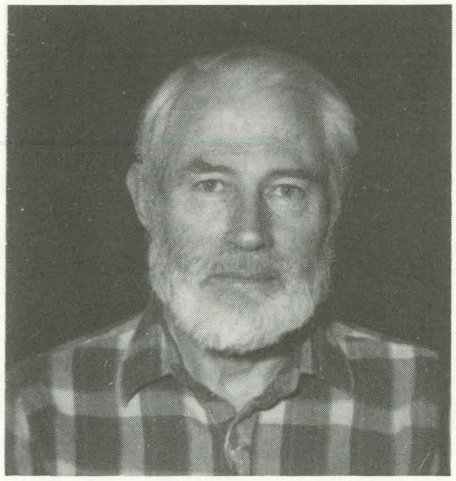
After ten years as a millwright in the Maintenance Unit, Earl Clayton retired from the Institute on 23 November. The ISPG library boasts two promotions: Flora Fritz became Chief Librarian in September and Shelley Webber became Acquisitions Clerk, a CR-4 position, in May.

Three new petroleum geologists were added to the staff of the Petroleum Resource Assessment Secretariat, ISPG, this summer. All have acquired diverse experience in the Calgary oil patch. Jim Barclay worked for five years with Dome Petroleum, Tony Hamblin spent six years at Amoco Canada, and Jim Podruski has over five years of experience with that company and Aberford Resources. These three PC-3's join the rest of the Secretariat personnel in research toward a geological appraisal of the future petroleum potential of Western Canada and frontier regions.

Derek Pugh retired in August of this year after spending thirty years as a research scientist with the Geological Survey of Canada in Calgary. A native of London, England, Pugh was the European champion in the category of the 400 metre run in 1950 and ran in the Olympics in 1952. At that time he was completing his Ph.D. in Geology at the Sorbonne in Paris and specialized in the sedimentology of the North Sea and English Channel sands. Shortly thereafter, he emigrated to Canada where he began his work for the GSC in Calgary in 1954.

He can be considered one of the "founding fathers" of the Institute, because he was a member of the exclusive club that formed when the Institute opened its doors in 1967. Following his retirement in August of this year, Derek and his family moved to Fairfield, Iowa, where he is completing a GSC research project while at the Majarishi International University.

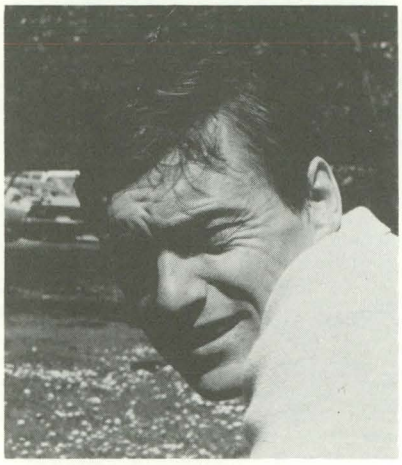
Lynn Machan-Gorham



Derek Pugh

CORDILLERAN GEOLOGY DIVISION

Geri Eisbacher left the GSC in summer 1984 to take up a teaching and research appointment at the University of Karlsruhe in West Germany. He was born and raised in Graz, Austria, and spent 2 years at the University of Graz, working the bass and guitar, before moving to the University of Innsbruck. After 4 years at Innsbruck his skiing had improved considerably and he had been turned on to geology by Triassic redbeds. Between 1964 and 1967 he did graduate work at Princeton University and completed a GSC-sponsored Ph.D. thesis on rocks that had been obliterated by movement along the Cobequid Fault zone, Nova Scotia. After a year of consulting at a pipeline tunnel that was bored through the Hahnenkamm Mountain in Kitzbühel, Austria, he started work with the GSC. In 1969,

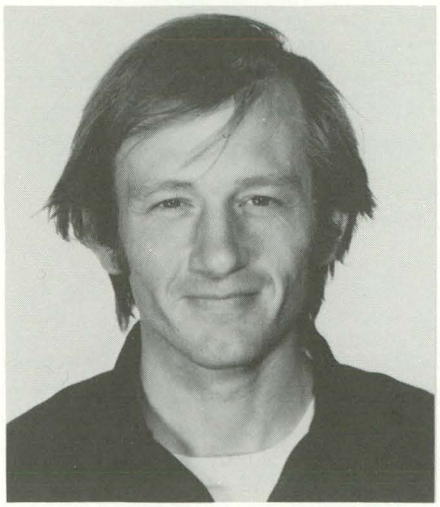


Geri Eisbacher

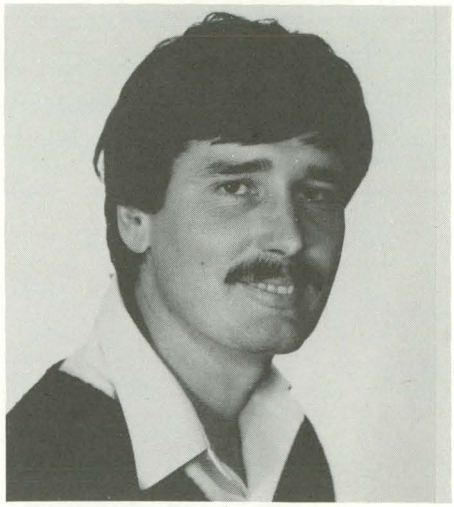
following a one-year exile in the uranium mines of Elliot Lake, he moved to the Vancouver office where he pursued his interests in sedimentary tectonics and environmental geology. Geri is looking forward to the challenges of his new post, and will undoubtedly maintain a keen interest in the stimulating earth science news emanating from Canada.

PRECAMBRIAN GEOLOGY DIVISION

Nicholas Culshaw is continuing his association with the Survey, began as a term employee in 1981, as postdoctoral fellow. A native of Britain, Nick obtained a B.A. in philosophy and geology from the University of Keele, England. He then joined the British Antarctic Survey, where he combined geology with dog-sledge driving in the icy wastes of Graham and Palmer lands (in the process undoubtedly having little trouble keeping his upper lip stiff). His subsequent career includes, inter alia, the award of a Ph.D. by the University of Ottawa, cab driving in Toronto, and teaching school in Malawi. He is currently engaged in structural studies in the Thelon Tectonic Zone along the Slave-Churchill boundary, working with Peter Thompson.



Nicholas Culshaw



Gary Yeo

Dennis Woods

Dennis Woods, assistant professor of geophysics at Queen's University, is spending a year with the Division on exchange with Alf Dyck of RGG. Dennis received a bachelor's and master's degree from Queen's and a doctorate from Australian National University. His interests lie in investigating the electroconductivity of the earth by means of geomagnetic deep sounding. At GSC he is concentrating on study of the Kapuskasing structure in northern Ontario.

Gary Yeo (B.Sc., Carleton Ph.D., Western Ontario) has joined the Division as a term employee in the ERDA program. A sedimentologist, Gary worked for Noranda Exploration from 1979 to 1983 out of their Yellowknife and Whitehorse offices. He was a contract geologist with DINA for three summers, including his doctoral thesis project on the Proterozoic Rapitan Group in the Mackenzie Mountains. Before joining the survey, Gary, this time as a project geologist for DINA in Yellowknife, was in charge of a regional mapping project in the High Lake Belt. At GSC he is doing a basin analysis of the Upper Carboniferous Stellarton Basin in northern Nova Scotia.

Thomas Frisch

# of GENERAL INTEREST

ATTENDANCE AT THE 27th INTERNATIONAL GEOLOGICAL CONGRESS, MOSCOW, USSR

Highlights of the Congress were the field trip to the Aldan Shield in eastern Siberia to study iron, phosphate and mica deposits in metamorphic terrane that is strikingly similar to the Grenville Province of Canada; examination of rocks from the super deep borehole (12 000 m) in the Kola Peninsula; review of IGCP work on metallogeny of the Precambrian; and renewal of acquaintances with many colleagues from previous visits to the USSR and other countries.

Simultaneous sessions in the smorgasboard of program subjects made it impossible to attend or evaluate the extensive amount of material presented on special subjects of interest; manganese, iron, ocean minerals, marine geology, global tectonics, metallogeny and Precambrian geology. I was very favourably impressed by the progress made by the IGCP project group reporting on the broad spectrum of manganese resources, but the sessions on Precambrian geology were probably the most disappointing.

Gordon A Gross

WORK IN CHINA CONTINUED

Gordon Gross returned to China in April, for three weeks, to continue research on the metallogenetic significance of iron formation that was started during his 1978 visit. Lecture sessions in Tianjin, hosted by the Ministry of Metallurgical Industries, were attended by several hundred geologists and engineers from many parts of China. A field tour included Qianan Iron Mine in Hebei Province, Baiyuenabo Mine in northern Inner Mongolia, and a manganese mine south of Changsa in Hunan Province. Study of the very rich rare-earth deposits in the Baiyuenabo iron formation proved to be rewarding, especially after the five hour motor trip across the Gobi desert, and added yet another dimension to research on the origin of metalliferous sediments. He was delighted to have Wan Liang Guo, a research associate in Ottawa for two years and now a Division Chief in the Institute of Geology at Huhehaot in charge of metallogenic work in Inner Mongolia, participate in a large part of the China tour.

VOLCANO EXPERT SMELLED A RAT

The smoke looked right for a volcano.

The smell was something else.

People living near Fishpot Lake, west of Quesnel, rang the alarm bells recently when smoke and flames started belching from a long-inactive volcano.

"Mount St. Helens came immediately to mind," a witness said.

The alarm call came to Dr. Jack Souther, government volcanologist with the Geological Survey of Canada.

Souther wasted no time, flying to Prince George and driving immediately to the site.

"The police and the forest service had the roads blocked off with big signs saying 'Danger, Active Volcano.' And it looked like one," Souther said.

The flames and black tarry smoke continued pouring out of a crack in the peak as Souther climbed toward it.

"And then I smelled it," he said. "It was just awful. I've never smelled anything quite like it."

"People nearby had been complaining of headaches from it. No wonder. You get downwind from that lot and you're *going* to get a headache."

The smoke was rolling from a cavern formed maybe 1,000 years ago when the volcano last fired up.

Pack rats and other little creatures over the years have used the cave as a winter hideaway and comfort station.

"There was a pile of about six feet deep of rodent droppings," Souther said.

Some magic of combustion had occurred and the whole lot was alight.

Souther is still accepting calls on volcanoes. But he'll start his checks upwind.

By Don Hunter, Staff Reporter
(The Province, 25th Sept. 1984)

GSC SHIRTS, CAPS, ETC.

Andy Douma of Economic Geology & Mineralogy Division organized two "GSC t-shirt drives" in the past year, arranging for the distribution of several hundred t-shirts, golf shirts, sweatshirts, caps and crests to a hundred or so people. The GSC crest can now be seen popping up everywhere, including such far-away places as Australia, China, France, England, Colorado and Brazil. Chris Durham of RGG handled similar drives in previous years and the thought has occurred to many that, by adding a few cents to the cost of each article, this could become part of a fund-raising activity for such groups as the GSC Christmas Party Committee or the Geological Wives Association. Any interested parties please contact Andy.

GSC VOLLEYBALL '84

The 1984 GSC volleyball league held their championship game in August, the team of Marc St. Martin prevailing over that of Richard Lancaster to take the trophy. Each of the 5 teams played 12 games during June, July and August, turnout was good, the weather co-operated and all enjoyed the action. In fact, a dozen or so "keeners" had so much fun, they continued with pick-up games on the south lawn until the end of October. Many thanks to Richard Lancaster for organizing the GSC league and thanks to all the participants for a successful season. It seems that the GSC bunch may have inspired a group from the tower to start a league, so there should be plenty of volleyball action next summer.

1984 GEOLOGICAL WIVES' ASSOCIATION AWARD

Rebecca Fahrig, daughter of Walter and Ruth Fahrig of Nepean, was the recipient of the annual Award of the Geological Wives' Association.

The award is based on academic standing, extracurricular and community activities, interests, general aim and accomplishments.

Rebecca, an Hon. Stud., graduated from Woodsworth H.S. and is furthering her studies at the University of Toronto where she will major in Physics.

CANADIAN GEOSCIENCE COUNCIL ADVISORY COMMITTEE ON MINERAL DEPOSITS RESEARCH AT THE GSC

A CGC Committee chaired by A.J. Naldrett, University of Toronto, spent the week of 24-30 September, 1984 at the GSC, Ottawa, investigating the Survey's mineral deposits research program and related activities. They interviewed more than 30 individual scientists, and heard presentations by Division, Branch and Sector Management, other EMR agencies (CANMET, Mineral Policy Sector and Earth Physics Branch), as well as invited comment from industry, provincial government and university representatives.

Other committee members are: R.J. Cathro, Archer Cathro and Associates, R.H. Wallis, Canadian Occidental Petroleum, E. Hoffman, Nuclear Activation Services, McMaster Nuclear Reactor, and R.Y. Lamarche, INRS - Georessources.

Left to right: Lamarche, Hoffman, Naldrett, Cathro and Wallis.

After further meetings in Toronto in November, the Committee will complete its final report for submission to the Director General in December.

The "Lone Ranger" is actually Steve Birk of R.G.G. on the Ice Island Project, October 1984.

Collin Cannon of R.G.G. Division carrying supplies at Ice Island Project.

GEOLOGICAL SURVEY OF CANADA ICE ISLAND EXPERIMENT, 1984

In 1983 a tabular iceberg, or ice island, broke off the Ellesmere Island ice shelf; it is subrectangular and measures some 8 by 5 km by 44 m thick. This phenomenon occurs infrequently in cycles of approximately 20 years. The last well known occurrence was that of Fletcher's Ice Island T-3, which was used by U.S. scientists as a platform for multidisciplinary scientific investigations from 1952 to 1974. These ice islands afford an exceptional opportunity for conducting multidisciplinary geoscience and environmental programs of the polar continental shelf, whose unstable, mobile ice pack poses hazards so great that very little geoscience data exist on this last frontier of Canada.

These studies would provide much needed information for hydrocarbon and mineral exploration in this vast unexplored area of Canada, as well as providing a data base for establishing Canada's sovereign offshore limits.

In 1984 operation Ice Island became an official operation of the Polar Continental Shelf Project (PCSP), and in July some fundamental problems of state-of-the-art seismic reflection surveying from a thick ice platform, with translational and rotational motion, were recognized. In September and October of 1984 the GSC, with support from PCSP embarked on an experimental program to study navigational requirements, hole drilling techniques (mechanical drill or hot water melter), seismic sources (dynamite, detonating cord, and air gun), and seismic detectors (hydrophones and geophones). These tests showed that the hole melter was far superior to the mechanical drill in producing holes that could be used for several purposes, could be kept from refreezing for future use, and employed fewer and less experienced personnel; geophones deployed on the ice surface gave

much better quality records than hydrophones suspended through holes in the ice, and were much cheaper and easier to use; dynamite sources produced much better quality data than either detonating cord or air gun. No special noise problems were caused by the thick ice layer, or the underlying water layer. The maximum ice movement observed was 1 km per day. At the location of the experiment, some 30 km offshore from Nansen Sound, water depths ranging from 300 to 570 m were observed. The sedimentary section appears to be very thin. Basement events are incoherent and non-correlating. Because of the successful conclusion to the experimental program seismic reflection surveying is being planned for 1985 from the Ice Island.

A. Overton

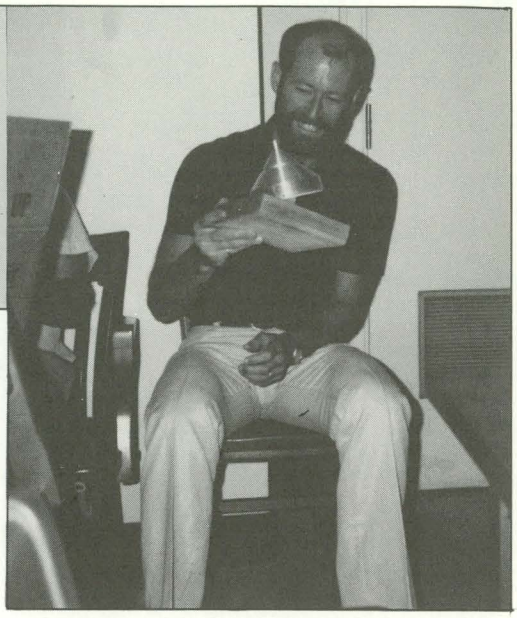
THE LIBRARY REQUESTS YOUR ASSISTANCE

The Library often experiences difficulty in acquiring Canadian university theses and Conference and Symposium fieldtrip guidebooks and proceedings. It would be very helpful if GSC staff members would pass on, to the Library, items in these two categories even if just to permit photocopying.

We also welcome the receipt of serial publications resulting from memberships and would appreciate knowing from whom we receive them, and whether we can expect them on a regular basis.

TILL TOMORROW

Bill Shilts, Ron DiLabio, and Mark Nixon attended a workshop called "Till Tomorrow" in Kirkland Lake in May. Organized by the Canadian Institute of Mining and Metallurgy and the Ontario Geological Survey, the workshop featured 23 papers on till geochemistry in mineral exploration, with special emphasis on gold. Shilts and DiLabio each presented a paper and a poster display by Inez Kettles and Shilts was shown. Short field trips were run to see the Quaternary and Precambrian geology of the region and an excellent operating display was set up to show the full range of drills used to sample till and other sediments in mineral exploration. Naturally, the display was set up under field conditions, complete with pouring rain.



Rod Klassen (Terrain Sciences) proudly displays his "Tin Man" trophy for completion of the National Capital Ski Marathon, National Capital Marathon, Ottawa-Kingston Bicycle Ride, and Rivière du Lièvre Canoe Marathon. The trophy was presented to him by John Scott and Rod's colleagues in Sedimentology and Mineral Tracing Section.

601 BOOTH STREET: OUR H.Q. FOR 25 YEARS

In 1959 the Survey abandoned its cramped facilities in the Victoria Memorial Museum, headquarters since 1910, and the rabbit-warrens that had been pressed into service to meet the post-World War II expansion (The Auditorium Playhouse, the Motor Building on Sparks St., No. 8 Temporary, the "T" Building, 529 Sussex, and 541 Sussex - our Ottawa home from 1880 to 1910) - and moved into a brand-new building. Planning for this had begun in 1955, tenders were called in 1956 and the $6.3 million contract awarded to Thomas Fuller Construction with a 1959 completion date. Field staff had packed up before leaving for the 1959 season and returned to find their "stuff" piled in their new offices; other staff and services were moved during the summer and by the spring of 1960 the building was ready for the Official Opening on 18 May. This was performed by the Hon. Paul Comtois, Minister of Mines and Technical Surveys and was followed the next day by an Open House.

All too soon the available space again became inadequate and despite the expansion in 1967 of the Western Plains Office into the ISPG which resulted in staff moves to Calgary, and the absorption of the former Geographical Branch by other agencies, which freed parts of four floors at 601 Booth, the Survey again occupies space in several nearby buildings. The advantages seen in 1959 of bringing everyone together - better and quicker communications and interdisciplinary co-operation - have not been fully realized. Now how we wish we had floors 8, 9 and 10 or that our colleagues in CANMET at 555 Booth had obtained their new building at Bell's Corners and that 601 and 555 were joined by a skywalk.

SCIENCE AND TECHNOLOGY OFFSHORE BRIEF NOTES FROM THE ATLANTIC GEOSCIENCE CENTRE

The names in parenthesis are contacts from whom more information can be obtained.

(1) The southern margin of the Grand Banks is an example of a continental margin which developed by slippage along its length, rather than by pulling apart. Work from HUDSON may have delineated the exact site of the fracture zone as a spectacular "basement" ridge running parallel to the margin beneath the slope (C.E. Keen).

(2) The deformation of the lithosphere which follows stretching has been described. Convective and stretching models have been explored. The mountains of Baffin Island and Labrador have been explained (C.E. Keen).

(3) A GSC paper (Initial Geological Report on CESAR - the Canadian Expedition to Study the Alpha Ridge, Arctic Ocean) has been completed for publication. Shows, among other things, that the Alpha Ridge is older than Late Campanian, and that the spectacular cycles of the "Cyclic" sediments aren't annual (R. Jackson, P. Mudie).

(4) Early Tertiary igneous rocks in Union et al., Montagnay I-94 well on the Scotian Shelf, may represent a meteorite impact in the proto-Atlantic. If re-examination of coeval microfossil assemblages indicates a catastrophic event, this would represent the first proven record of such an event (L. Jansa).

(5) Studies of dinoflagellates suggest that in the Pliocene a massive freshwater lens 100 m thick covered the North Atlantic possibly as far south as the Azores (P. Mudie).

(6) BIO Open House in June attracted 20 000 - 30 000 people.

(7) Laurentian Slope and the 1929 Earthquake: A report on earlier field work describes the catastrophic effects of the 1929 earthquake as seen from a deeply towed sidescan system (Seamarc I). These effects include a vast field of gravel waves. The results give clues to the thickness of the turbidity current generated (less than 300 m) and can be integrated into observations from the ancient record. Studies of seismicity in the area show that the probability of a large earthquake somewhere on the east coast margin is not negligible (D. Piper, I. Reid).

(8) Photographs from a towed body and records from sidescan of an iceberg scour only 7 months old show that scour degrades quickly; these results will affect thoughts on ice scour frequency and the safe depth for pipelines (C.F.M. Lewis).

(9) A cruise along the Venture pipeline corridor revealed large-scale bedforms never seen before. These were generated by a severe storm prior to the cruise, and had not been observed before because of degradation by bioturbation and wave stirring. This suggests that previous observations were biased towards fair-weather conditions, and has obvious implications for the design and installation of the pipeline (C. Amos).

(10) C^{14} dating of boreholes through shelf-edge sand ridges shows that these ridges are modern phenomena, not submerged barrier islands. This affects our thinking on modern shelf-edge conditions and geological interpretation of, e.g., Cretaceous shelf-sediments in the western interior, and the design and use of sea-floor installations (C. Amos).

(11) Beaufort Sea Coastal Zone: With Terrain Sciences: (a) Short field program directed towards determining long term rates of coastal erosion and accretion completed, with assistance of PCSP and DIAND. Aerial video coverage was obtained of most of the coast from the Tuk peninsula to the Alaska border, and coastal profiles were resurveyed. (b) Large contract using DIAND money let to investigate historical changes in coastal zone (D. Forbes).

(12) Ocean Drilling Program Safety and Pollution Prevention review panel cleared (with restrictions) sites in Baffin Bay, and requested additional information on a number of sites. The Panel will review all sites and holes in Baffin Bay and the Labrador Sea in March 1985 (D.I. Ross).

UNITED WAY CAMPAIGN

This year the Survey passed the 130% mark of its goal of $20 500, with a total contribution of $26 817.10. The GSC track record is still in good shape, as we have never failed to hit the target assigned to us. Just over 75% of the staff of 470, approximately, participated in reaching this new level of generosity, which is both applauded and appreciated. This summit was attained partly by the wonderful gifts of the staff, and partly by the willing perseverance of our GSC canvassers. These canvassers were the soldiers in the trenches, so to speak, and enough credit cannot be paid for their effort; they were asked to help, and they responded by serving.

We had George Cameron from the Director General's Office, Susan Gagnon from Administrative Services along the hall, and Randy Taylor from Finance. Also on the second floor at 601 Booth, we had a great contingent of helpers from Geological Information: Lynn Villemaire went after her co-workers in Publications, Debbie Busby signed up her Division neighbours on the second floor together with Richard Potvin in Cartographic Unit C; Peter Corrigan was detailed for Cartographic Unit B, on the third floor, while Yolande St. Pierre-Savard and Gordon Currie looked after business on the fourth floor; D'Arcy Beckstead campaigned on the fifth floor to complete the GID contribution.

Another hustling group of canvassers was provided by Regional Geochemistry and Geophysics. Here we got Laurel Schock, Marion Grierson, Mary Ann Blondin, and Dennis Teskey

Busy at the United Way car wash is our ADM Bill Hutchison who demonstrated his devotion to the cause. GSC's Yvon Claude (Admin.) was Departmental Co-ordinator for the 1984 Campaign and Karen Knudson (GID) was seconded to provide secretarial support to the Campaign Committee.

doing their duties for the Division in 601 Booth, while Rick Sloka worked over his mates at 401 Lebreton. Precambrian decided to split their chores right down the middle by assigning Rein Tirrul to 588 Booth Street, and Pat Hunt to 601. Terrain Sciences spread their wares over three different buildings: Charlotte McFarlane commanded Tunney's Pasture, Dave Harry moved things at 401 Lebreton, and Jean Percival signed up her AECL associates - also at 401 Lebreton.

Meanwhile back at 601 Booth Pam Midgley looked after the fifth and sixth floor TS staffers, and Jan Aylsworth besieged her pals on the third floor and rounded up some loose ends elsewhere. Economic Geology and Mineralogy provided Richard Lancaster, Andy Rencz, Jocelyn Martin, and Bob Delabio to run down their Division staff in the upper halls of 601 Booth, and it paid off.

Finally I would like to make an additional mention to the other stalwarts of the campaign: Chris Durham who served as deputy organizer and kept the progress of our rising thermometers up to date - amongst other things; Gordon Currie who, in addition to canvassing, carried out the onerous duties of treasurer; and Maria DiMillo, who happily agreed to back up Gordon and be our deputy treasurer. This was your team, and I hope that you are as pleased with their efforts as I am.

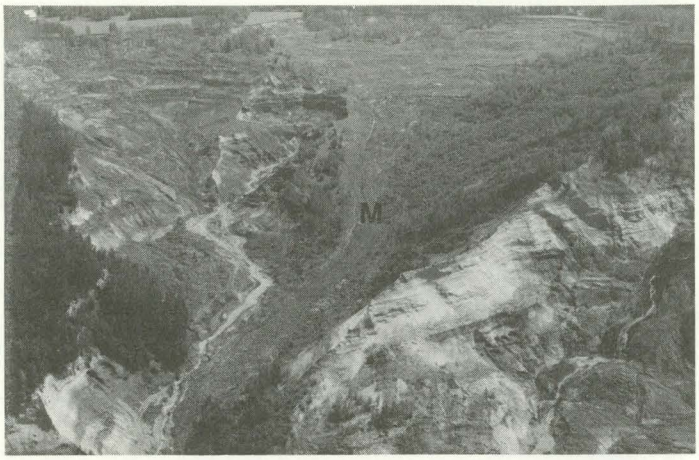
B.R. Pelletier

BIG SLIDE, BRITISH COLUMBIA - A UNIQUE MASS MOVEMENT MACHINE

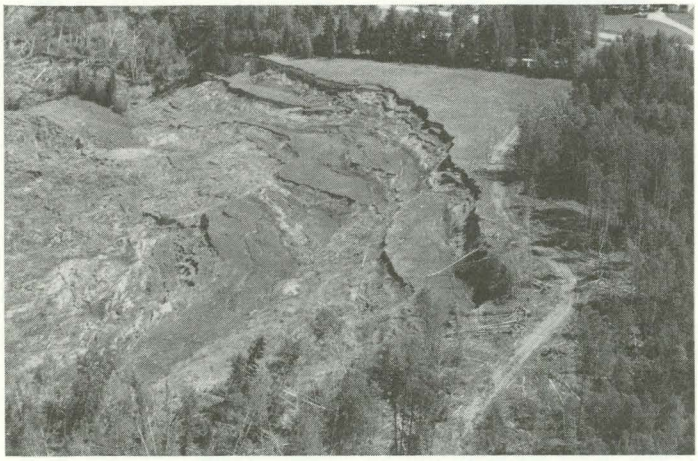
Big Slide is an active landslide complex, about 1.5 km^2 in area, on the east side of Fraser River at the Big Bend, 12 km north of Quesnel, British Columbia. The first report of a large landslide complex at Big Slide appears in "Great Slide" on G.M. Dawson's GSC Map 120 (1875-76) and the same Big Slide appears on an early B.C. Department of Lands map in 1921.

Steve Evans and John Clague of Terrain Sciences Division are investigating the development of Big Slide, the mechanics of landslide processes active in the complex, and the stratigraphical controls on movement. The materials involved in the movement are Pleistocene silt and clays and, as well as being important from the landslide point of view, the excellent exposures in these materials are vital in the interpretation of the Quaternary stratigraphy of the Quesnel-Williams Lake region.

Big Slide is unusual in the Canadian context since regular air photography of the site extends back to 1931. This has allowed a reconstruction of the development of Big Slide over a 53-year period. During this time, the complex has expanded by retrogressive slumping at its head into the farmland on the plateau surface, 230 m above Fraser River. Based on measurements from aerial photographs, the rate of expansion (or retrogression) was found to vary between 6 and 12 m per year, which is the highest rate recorded in the landslide literature. This rapid rate of retrogression is a source of much concern to farmers on the plateau surface, who sometimes wake up to see that large parts



Oblique aerial view of Big Slide. Note farm buildings in upper left corner. Mudflow (M) extends from base of rotational slide zone to the bottom of the picture.



Aerial view of rotational slump blocks at actively retrogressing headscarp. Note farm buildings.

Blocky surface of mudflow. The middle of the mudflow has moved 271 m between June 1983 and May 1984. Dwayne Tannant is standing on lateral shear surface of mudflow.

of their fields have been displaced overnight. They also report hearing the groaning of the landslide complex.

The slump blocks at the head of the slide gradually move downslope and in doing so lose their block form, disintegrating into a material which has a consistency of thick wet cement. This remoulded material forms a huge mudflow, beginning at about 155 m above the Fraser, which flows down to the river. It is this mudflow which has yielded some startling rate-of-movement data. In June of 1983, Evans and Clague installed lines of survey pegs across the mudflow at various points. A re-survey of these same pegs in June 1984 showed that some pegs in the centre of the mudflow had moved up to 271 m from their 1983 positions. This again is the highest rate of mudflow movement recorded in the literature and the fact that a re-survey in September 1984 indicated no further movement suggests that the 1983-84 movement was surge-like. No obvious correlation exists with meteorological data and the nature of the movements is still being evaluated.

Big Slide can be viewed as a very active mass movement machine that processes large masses of intact material which enters the top of the complex as rotational slump blocks, is disaggregated in mudflow transport, and is debouched into the Fraser, where it forms part of the sediment load of the river. The machine is dependent upon groundwater to fuel this process.

S.G. Evans

GEOSCIENCE INFORMATION SOCIETY

Annette Bourgeois, Chief Librarian at Ottawa headquarters, was elected Vice-president and President-elect of the Geoscience Information Society at their annual meeting in Reno. Annette is the first Canadian to be elected to this post.

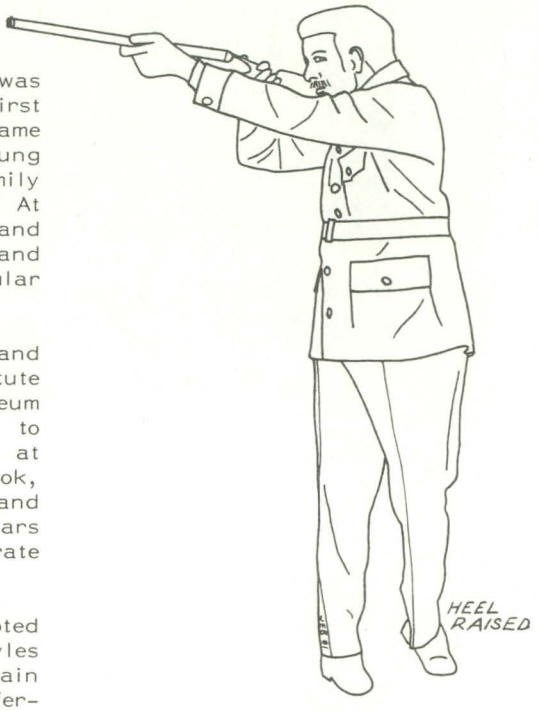
AQQUA 1984, SHERBROOKE, QUEBEC

The fifth congress of the Association québécoise pour l'étude du Quaternaire (AQQUA), held in Sherbrooke, 4-7 October, 1984, had a unique format and held much interest for the several GSC employees who attended. The conference was preceded, on 3 October, by a special session entitled "1st Symposium on Holocene Climates and Trends in North America and Greenland". This symposium was sponsored by the Subcommission for the Study of the Holocene (North America and Greenland) under its President, T. Webb of Brown University, and Secretary, Jean-Marie Dubois of Sherbrooke University.

The AQQUA conference itself had two full one-day sessions alternating with two field trips. Field trips on 5 and 7 October featured reviews of classical stratigraphic sections in the St. Lawrence Lowland (Pierreville section of Gadd) and of southern Quebec (Ascot section of McDonald) to which were applied refinements of interpretation supported by recent work on sedimentology and thermoluminescence.

The main conference was entitled "Pleistocene and Holocene Stratigraphy and Paleoenvironments of Quebec and Adjacent Regions". Not only were there reviews of previous work within Quebec, but studies of stratigraphy in Cape Breton, glacial limits in northern Labrador, ice lobe activity on Meta Incognita Peninsula of Baffin Island, lobate glacial flow patterns in Ontario and Manitoba regions west of Hudson Bay, and migration of centres of glaciation in the Churchill Falls region, as well as new studies in the Richmond Gulf and Ungava areas. New aspects of research included U-Th dating of wood and shells, and Holocene fluctuations of sea level in the estuary of the St. Lawrence. Most papers presented will appear in a special issue of Géographie physique et Quaternaire.

"SHOOT!"

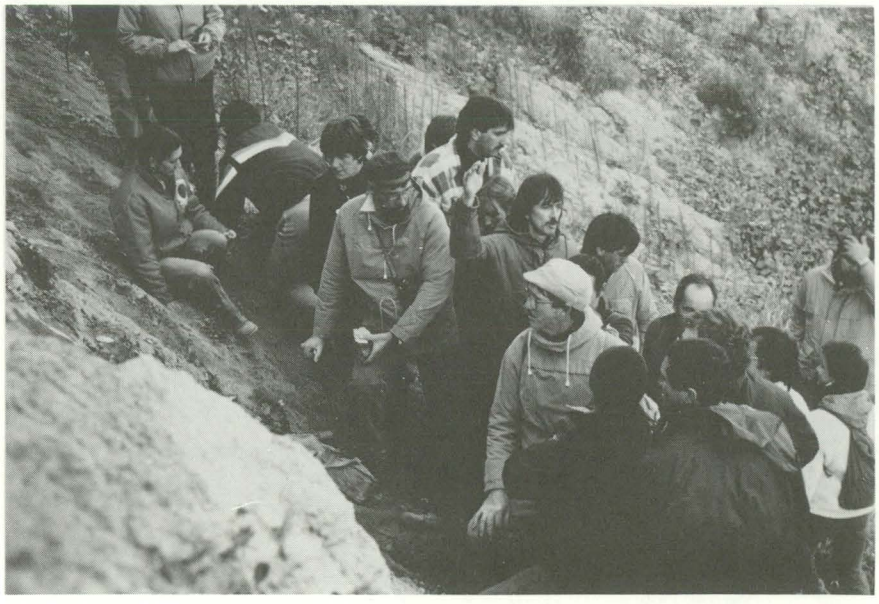


By the age of 7, John Brindle was already wielding his first firearm. Target practice became a favourite pastime of the young lad when he lived on the family farm in northern England. At age 13, John joined a trap and skeet club for the first time and continued to shoot, on a regular basis, for the next 20 years.

Brindle, a Senior Manager (and troubleshooter!) at the Institute of Sedimentary and Petroleum Geology in Calgary, decided to compile his years experience at the sport into a technical book, "Shotgun Shooting: Techniques and Technology" and, about ten years ago, began to write and illustrate the text.

Over the years, Brindle has noted the diversity of shooting styles that have developed in Britain and North America. The differences, he notes, are quite apparent in Britain where traditional methods and game laws have varied from place to place. The technology of gunmaking has also had an impact on the way people shoot. Different guns demand different styles. It is this concern with the techniques and history of shooting that has been fully documented in the 264 page book, currently being published and marketed in Europe by Nimrod Book Services of Surrey, England. This practical guide to shooting methods on both sides of the Atlantic will be of interest to all those who wish to sharpen their trap and skeet skills. Anyone interested in further information on the book should contact the author at ISPG.

Lynn Machan-Gorham



Pierreville section on Rivière St-François. Some familiar faces include André Bolduc, Michel Allard, Jean Veillette, Michel Lamothe (leader), and Denis St-Onge.

KATHY SULLIVAN, SPACE WALKER, DALHOUSIE AND AGC

Kathryn Sullivan, the first woman to "walk" in space, visited Halifax and Dartmouth on 3-6 December 1984. Kathy took her Ph.D. in the Geology Department of Dalhousie University (1978), working closely with staff in AGC (DEMR at BIO). Her thesis title was "The structure and evolution of the Newfoundland Basin, Offshore Eastern Canada" and her advisers were C.E. Keen (AGC), D.B. Clarke (Dalhousie) and M.J. Keen (then Dalhousie, now AGC). Her work was published as three papers jointly with C.E. Keen and others. She has a flair for languages, chattering in English, French, Norwegian, Spanish and Icelandic (slowly); she rowed for Dalhousie; and she sailed a lot from Armdale Yacht Club, principally with Wint Sparling (retired AFS Scotia-Fundy employee, now deceased) and Mrs. Sparling on their yacht "Finally". Following her graduate work, Kathy joined NASA as an embryonic astronaut specializing in remote sensing. She is the only earth scientist in the program. During her visit to Nova Scotia she spoke on geological and oceanographic aspects of the flight at Bedford Institute of Oceanography, Dalhousie University and Mount St. Vincent University, illustrating her comments with spectacular slides of earth and ocean. She visited two schools and made numerous TV and radio appearances.

COMMISSION ON GENESIS AND LITHOLOGY OF QUATERNARY DEPOSITS - ALBERTA MEETING

The 1984 Meeting of the Commission on Genesis and Lithology of Quaternary Deposits was held in southern Alberta, 19-28 August, 1984. It was organized by D.N. Proudfoot, University of Alberta and Alberta Research Council, and M.M. Fenton, Alberta Research Council, and consisted of a 2-day symposium followed by 7 days of field excursion. The meeting was attended by 19 participants from 9 countries.

The theme of the symposium was the relationship between glacial terrain and glacial sediment facies. The Commission business meeting reviewed the activities of the various work groups and discussed plans for future meetings. Work Group 1 (Till) members have been asked to outline the criteria they use to differentiate between the various genetic types of till and have been asked for comments on definitions and terminology proposed by the work group. There was also a discussion of the Morphological Classification of Glacial Features which was presented in the Work Group Report to the Moscow meeting of INQUA.

The field excursion began with three days detailed examination of the extensive exposures on the east side of the south Saskatchewan River, 5-10 km east of Medicine Hat. Dave Proudfoot has subdivided the sediments, up to 60 m thick, into 5 units. The basal units consist largely of fluvial sediments deposited before Quaternary glaciers reached the area and the upper unit consists of stratified sediments and loess deposited during and following the retreat of the last ice sheet. The other 3 units consist of a variety of different types of diamictons and include variable amounts of stratified sediments. The main controversies for discussion were over whether certain diamicton units were of flow, rain out, lodgment, or meltout origin; the position of the glacier during deposition of different diamictons; and whether certain discontinuities were caused by shearing.

A one day trip was made to look at a "thrust moraine" feature on the north flank of the Cypress Hills, to see the Tertiary-age paleosol on the unglaciated crest of the Cypress Hills, and to view interesting features and country to the west of the Hills. The final 3 days were spent travelling to Lethbridge, studying sections north of Taber, near Cameron Ranch and at Kipp, and in the mountains at Waterton Park. Some general similarities could be seen between the units exposed in these sections and those at Medicine Hat, 150 km to the east. In both areas the upper glacial unit was generally massive and underlying sediments consisted of one or two partly stratified and contorted units which overlay preglacial fluvial sediments.

Dave Proudfoot has done an excellent job of sorting out difficult stratigraphy, interpreting complex units and producing a system for describing and classifying diamictons which should be seriously considered by any sedimentologist faced with the problem of making detailed genetic interpretations of these poorly understood units. Mark Fenton and members of the Alberta Research Council are to be thanked for supplying the resources and organization which made this Commission Meeting productive, enlightening, and enjoyable.

R.J. Fulton

TERRAIN PERFORMANCE MONITORING ON THE NORMAN WELLS PIPELINE

This winter, Mackenzie valley will once again reverberate to the sound of trucks, backhoes, cats, and ditchers, as construction crews work to lay the remaining sections of the Interprovincial Pipe Line-Norman Wells Pipeline. When completed, the 868 km-long, 323 mm-diameter pipeline will transport oil from the expanded Norman Wells field to Zama in northern Alberta. It will be the first major hydrocarbon transport system to be constructed in Canada north of 60°N, and the first pipeline to occupy the much-debated Mackenzie valley corridor.

The pipeline route, which follows the east side of Mackenzie River to Fort Simpson and then runs south across the Alberta Plateau, traverses the zone of discontinuous permafrost. This region is characterized by areas of terrain highly sensitive to mechanical or thermal disturbance. For example, uncontrolled interaction between a buried oil pipeline and ice-rich permafrost could result in thaw settlement, slope instability, and increased erosion. For these reasons, terrain constraints and potential hazards have formed a major factor influencing pipeline routing, design, and construction.

Since August 1983, Terrain Sciences Division has been involved in a project to monitor terrain performance along the Normal Wells Pipeline route. Ultimately, this study will allow an evaluation of the terrain sensitivity concept as it applies to northern pipeline projects. The project is closely co-ordinated with permafrost monitoring programs undertaken by Earth Physics Branch and Interprovincial Pile Line (NW) Ltd. It also provides input into the Norman Wells Research and Monitoring Group, which co-ordinates scientific monitoring of the Norman Wells Project by federal and territorial government agencies.

Construction of the pipeline began in January 1984, following right-of-way clearing, grading, and stockpiling of pipe and equipment. To reduce terrain impact, all mainline construction activities are limited to the period between fall freeze-up and spring thaw. Working simultaneously southwards from Norman Wells and northwards from Fort Simpson and Zama, giant arctic ditchers opened up a trench 1.5 m deep in permafrost and seasonally frozen ground. Behind the ditchers, welded pipe sections were lowered into the trench which was then backfilled. During periods of winter field work, the distribution of surficial sediments and ground ice exposed in the pipeline trench was recorded.

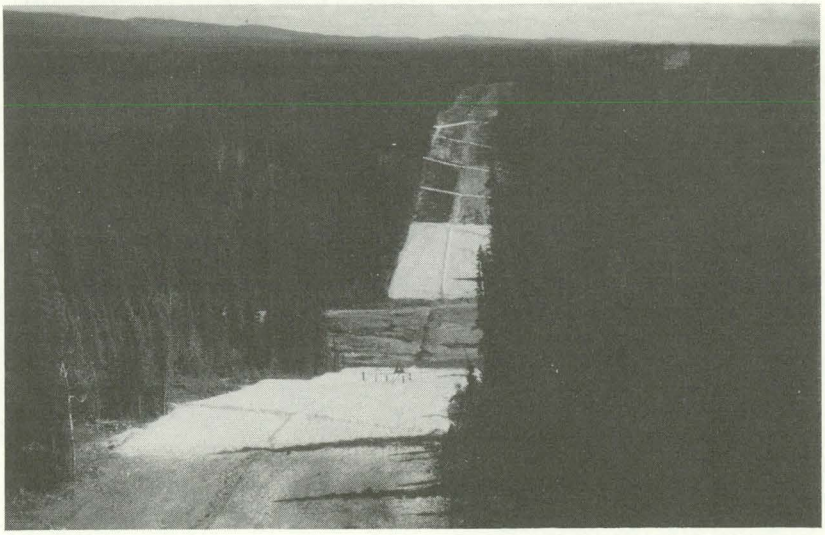
During summer 1984, preliminary studies were made of terrain conditions along completed sections of the pipeline. These focused on assessment of terrain stability and drainage conditions, and measurement of ground thermal regime. Sequential observations of this type will be used to establish terrain performance characteristics in the post-construction period, and to evalute measures used to mitigate terrain impacts. These include the construction of ditch plugs and berms to control erosion, and the innovative use of wood chips to insulate sensitive permafrost slopes and prevent the development of thaw-triggered slope instability.

Although significant advances have been made in the fields of permafrost engineering and environmental protection of sensitive terrain during the last decade, much remains to be learned. Construction of the Norman Wells Pipeline provides a good opportunity to increase our understanding of northern terrain and its response to disturbance.

David G. Harry

Arctic ditcher, excavating trench through organic terrain north of Fort Simpson (January 1984).

Erosion control berms on the north side of Bear Rock, near Fort Norman (June 1984).



Canyon Creek crossing, 19 km south of Norman Wells (June 1984). Note use of wood chips to insulate thaw-sensitive permafrost slopes.

IGU PERIGLACIAL COMMISSION, PARIS, 30 AUGUST, 1984

The 1984 meeting of the Commission on the Significance of Periglacial Phenomena was held in conjunction with the International Geographical Union Congress. The venue was the Cité Universitaire in Paris, and the meeting was attended by scientists from 10 countries. The main purpose of the meeting was to receive the reports of small working groups, each focusing on a phenomenon or process of ambiguous or unique periglacial significance. The presentations concentrated on fundamental issues, for example, definition, classification and identification of knowledge gaps, and were followed by a period of discussion.

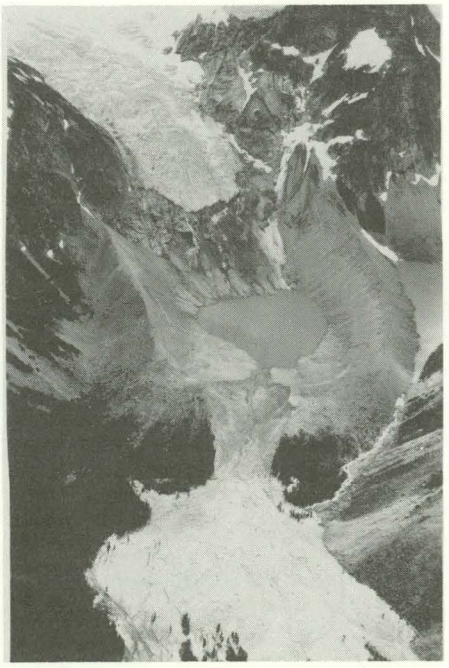
The first two papers dealt with broad aspects of process geomorphology in periglacial environments. Recent work on cryogenic weathering and developments in the study of frozen ground hydrology during the past decade were summarized. Both papers stressed the importance of controlled data gathering and use of process explanation in morphological analysis, and commented on the problems of scale and frequency/magnitude variation.

The following group of papers focused upon the common theme of ground-ice related processes and landforms. A general presentation on ground ice characteristics and distribution in Arctic Canada provided a framework for subsequent presentations on pingos, palsas, and seasonal frost mounds. A lively discussion ensued on the classification of ice-cored mounds and their recognition in areas of former permafrost occurrence. To a great extent, these problems reflect the ambiguities inherent in the use of landform definitions based on morphology rather than process.

Presentations on earth hummocks, cryoturbation, and grèze litées, illustrated some of the problems associated with the classification and climatic significance of periglacial microrelief forms and structures. Two final papers examined periglacial phenomena which seem to be particularly prone to ambiguities of definition and interpretation - problems associated with the study of rock glaciers, and nivation processes and landforms. Past acceptance of the nivation concept has engendered a false sense of security with respect to our understanding of the evolution of snowfall-dominated landscapes.

The meeting provided a valuable forum for discussion of recent progress in periglacial geomorphology. The participation of scientists from both North America and Europe facilitated information exchange across one of the major content boundaries that exist within the field. This separates studies of active processes and landforms in contemporary permafrost regions from studies of fossil landforms in areas of former permafrost occurrence. The presentations made at Paris suggest that these 2 lines of research represent convergent approaches to the resolution of some of the outstanding problems of periglacial terrain science.

D.G. Harry



Breached moraine and remnant of Nostetuko Lake, August 1984.

NATURAL HAZARDS IN BRITISH COLUMBIA

In the early morning hours of 19 July, 1983, the toe of Cumberland Glacier in the southern Coast Mountains of British Columbia collapsed into Nostetuko Lake, generating a series of waves that overtopped the Neoglacial end moraine damming the lake. The waves eroded the moraine, precipitating a catastrophic release of about 6 000 000 m^3 of lake water within the next few hours. The result was an enormous flood that swept down Nostetuko and Homathko valleys to the head of Bute Inlet 100 km away. The floodwaters eroded and transported large amounts of sediment and devastated tracts of forest on the Nostetuko and Homathko valley floors. Fortunately, because of the area's remote location and lack of development, there were no casualties.

Steve Evans and John Clague (Terrain Sciences Division) visited Nostetuko Lake and other sites in the Homathko River basin in summer 1984. The objective of this visit was to understand better the causes of catastrophic failures of natural dams like the Nostetuko moraine. This work is part of a larger study by Evans of the geotechnical character of moraine dams in the Canadian Cordillera; Clague is interested in the dynamics and chronology of floods and debris flows from glacier- and moraine-dammed lakes. These natural phenomena pose serious hazards to the development of some glaciated mountain valleys in the Canadian Cordillera. Similar events in other parts of the world have claimed thousands of lives and caused extensive damage to property and agricultural land.

J.J. Clague

JOINT CANADIAN-AMERICAN WORKSHOP ON CORRELATION OF QUATERNARY DEPOSITS AND EVENTS IN THE AREA AROUND THE BEAUFORT SEA

Canadian and American geologists concerned with the Quaternary have been studying the Beaufort Sea area in increasing detail over the last 10 to 20 years. Although there has been considerable contact between individual scientists working on both sides of the International Boundary, rather different pictures of the Quaternary geological history of the region have developed in Canada and Alaska. Given the continuing level of exploration and development activity in and around the Beaufort Sea, the need for a coherent picture of the Quaternary geology of the region as a basis for interpreting other earth science data, as well as for its intrinsic scientific value, is greater than ever.

Accordingly, Terrain Sciences Division hosted a special workshop on this subject in Calgary,

on 3 and 4 April 1984. The invited participants came from the academic and consulting community, from the GSC, from the USGS and from the Alaska Division of Geological and Geophysical Surveys.

The workshop was opened by J.G. Fyles who charged the participants to attempt to develop a correlation chart for the Quaternary of the Beaufort Sea region. The first session was devoted to short presentations by each of the participants in which they briefly summarized their knowledge of the region, made suggestions regarding correlations, noted areas where knowledge was lacking and recommended future research to resolve these problems.

These opening presentations were followed by animated periods of guided discussion. The first two were devoted to the chronology and limits of the Laurentide Ice Sheet, and of the Cordilleran and Brooks Range glacial complexes. Two shorter sessions on the sea level history of the area and the periglacial environment of the region followed.

These discussions on selected topics enabled the participants to familiarize themselves with the data, in the various regions, on which the chronologies and reconstruction of events were built. The strengths and weaknesses of the different frameworks as well as the converging elements of many of the schemes became apparent. These discussions provided the basis for the final session, which addressed the problem of creating for the first time a detailed correlation chart for the region.

The workshop concluded with consideration of possible future joint activities. A joint Canadian-American field excursion to examine key sites in both Canada and Alaska was proposed. This will take the form of a 20-day tour in late July-early August 1985 along the Arctic Coastal Plain, from southern Banks Island to Skull Cliff, west of Point Barrow. The party will comprise two scientists from each of the USGS and the GSC.

The Calgary meeting helped clarify long standing problems of Quaternary chronology and correlation. It contributed in clearly defining critical problems that remain, and in producing information for inclusion in the forthcoming volume on the Quaternary Geology of Canada and Greenland. In addition it created an avenue through which continuing contacts, between Canadian scientists from different institutions and between Canadians and Americans, was made possible. Because of the oil and gas developments in the Beaufort Sea area, basic information on Quaternary deposits is essential. This information will help provide a better understanding of the engineering behaviour of soils, of geological hazards, and of the location of aggregate deposits.

J.A. Heginbottom and
J.S. Vincent

ISPG FIELD TRIP TO DINOSAUR PARK

By 8 am on the 29th of September a drowsy but jovial group of ISPG staff boarded a chartered bus bound for Dinosaur Park near Brooks, Alberta. This year's field trip would provide ISPG'ers with an opportunity to examine the relicts of creatures that flourished in Alberta some 73 to 78 million years ago.

As the bus pulled out of the Institute's parking lot, our guide, Professor Len Hills of the University of Calgary Geology Department, began to explain events which, over recent geological time, had shaped the face of terrane familiar to us - the northwestern corner of Calgary and roads like Charleswood, John Laurie Boulevard and the Sarcee Trail and TransCanada Highway intersection. Hills described the extent of Glacial Lake Calgary during Wisconsinan time. The lake formed in the Bow Valley between eastern Laurentide ice and the Bow Valley Glacier to the west some 42 000 years ago. We were told that, quite possibly, humans inhabited that part of the ice-free corridor which formed between glaciers to the east of Lethbridge some 20 000 to 30 000 years ago. About 18 000 years ago, sparse, herbaceous, tundra-like vegetation covered the foothills of southern Alberta.

Travelling towards Dinosaur Park, we were able to pick out the occasional erratic (or huge boulder) that had been swept out of the Cordillera and deposited eastward. We also noted the less than 10 feet of local relief and gently rolling topography of this broad region east of Calgary. The land surface had been glaciated by ice, bearing Shield-derived rocks, and the moraine that resulted consists predominantly of clay and glacial boulders.

Soon we would see plants common to arid regions: thorny, buffalo berry bushes, plains cottonwood shrubs and a variety of white clematis. In fact, as we entered Dinosaur Park we felt as if we had stepped back in time. For one thing, we had left the crisp autumn temperatures of Calgary for the arid 20°C environment of the "Badlands". We were also about to walk amidst the bones of ancient creatures. Our first task, however, was to make our way through a field of prickly pear and ball cacti to the site of a "dig".

The Cretaceous sediments that contain the bonebeds of Dinosaur Park are part of the Judith River or Oldman Formation. Interlayers of sand and bentonitic clay became the ideal burial site for the seven classes of dinosaur found here: theropods, ornithomimids, tyrannosaurids, hadrosaurs, pachycephalosaurids, ankylosaurs and ceratopsians. Dinosaur Park is such a rich repository of dinosaur history that the site was added to UNESCO's World Heritage List in 1979.

Park guide, John Wolper, explained how paleontologists from the Tyrrell Museum have carefully worked under grueling conditions in order to puzzle out the riddle of the rapid decline, over a few hundred thousand years, of the dinosaur population in this area. Complete and partial dinosaur skeletons have been housed in shelters and are open to visitors for viewing. Some of the bonebeds contain the scattered remains of thousands of animals. Several varieties of dinosaur at this location were relatively small and weighed between 100 and 200 pounds (45-90 kg). About 15 varieties ranged from 12 to 26 feet (4-8 m) in length and weighed between 3 and 4 tonnes. The bonebed that we examined contains the remains of 50 *Centrosaurus* animals at all stages of development, as well as other species of dinosaur. It has been suggested that a herd drowned in an attempt to cross a river during a flood and that the carcasses were washed up onto a sand bar. Later, the ravages of

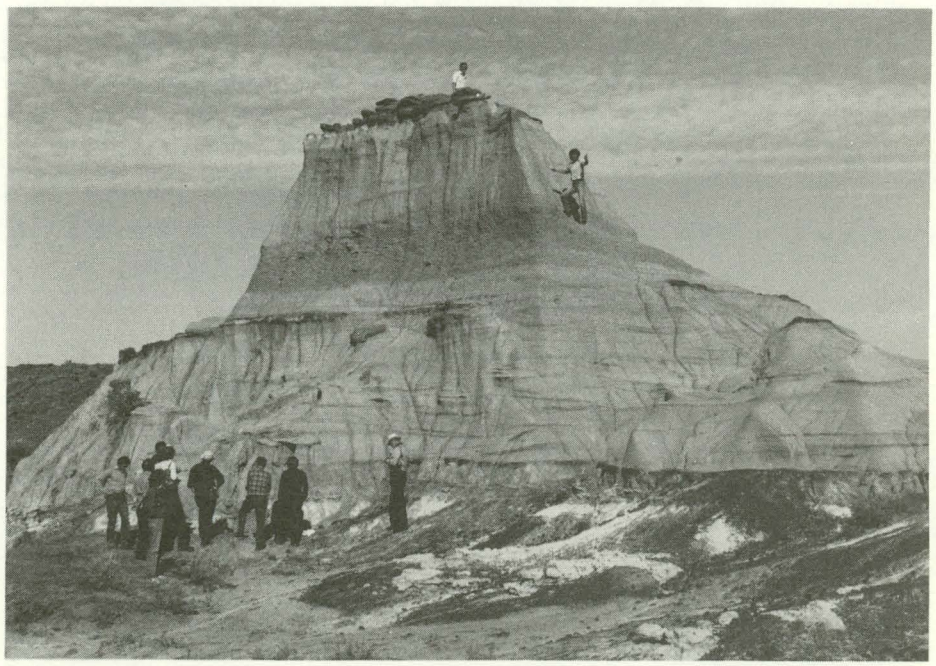
scavengers and a rising river resulted in the distribution of the bones at this site, known in the park as "the Citadel". Since 1979, when it was discovered, excavation has been carried out by Tyrrell Museum staff.

To date, only one-fifth of the bonebed has been excavated. On average, these dinosaurs measured $1\frac{1}{2}$ to 6 feet (0.5-2 m) in height at the shoulder. Gas-powered jackhammers have been used to remove the sandstone and clay to within a foot or so of the bones. From that point onwards, the scientists have worked with hammers and chisels in an effort to dig out the specimens. Temperatures of 41°C in the shade and 51°C in the sun have been recorded during such field seasons.

The bones are generally found at the contact of sandstone and bentonitic layers. Reddish brown horizons are commonly seen in the rocks, reflecting concretionary siderite (iron carbonate) which cements the bones to the surrounding rock. The iron tends to adhere to the surface of the bones, making them difficult to separate. In addition, the sandstones which formed point bars and sand bars in this area, 73 to 78 million years ago, may presently be as hard as concrete. The park is only part of a broad, low floodplain that extended east from the foothills of the Rockies for 600 miles (965 km) across southern Alberta, Saskatchewan and Montana some 65 million years ago.

Mr. Wolper explained that over 90 bonebeds have been discovered since 1979 in a 0.5 by 1 km area, with an average output of 15 to 20 bones per m^2. The *Centrosaurus* bed averages 60 bones per m^2. *Centrosaurus* dinosaurs belonged to the herbivorous ceratopsian class of dinosaur and were large, horned, herding animals. From an examination of this bonebed, workers are attempting to calculate average growth rates of this particular species. Other herbivorous dinosaurs that roamed Dinosaur Park during this period include the duckbilled and armoured varieties. The duckbilled *Lambeosaurus* is one of a group of hooded or crested dinosaurs that appeared toward the end of the Cretaceous period. Carnivorous inhabitants of Alberta at that time included

John Wolper (Dinosaur Park guide) explains to a group of ISPG how paleontologists painstakingly work to uncover the dinosaur remains from a Centrosaurus bonebed.



Field trip enthusiasts look at clay and sandstone layers of 'the Citadel' in Dinosaur Park, Alberta.

Daspletosaurus, *Albertosaurus*, and *Tyrannosaurus*. Pterosauran (winged) dinosaurs also glided through the skies and some flying species had wing spans that measured up to 42 feet (13 m) across.

According to Mr. Wolper, the crested cranial protrusions of hadrosaurs have been the subject of much speculation in the past. Some researchers felt that they were a kind of elaborate bony ornament peculiar to male animals. Others have postulated that the crest served as a snorkel. Another theory suggests that the protrusions afforded hadrosaurs a heightened sense of smell which was useful as an early warning defense system for the herbivorous dinosaur, especially when it shared a terrestrial floodplain environment with carnivorous neighbours. It has been suggested that because their teeth were continually regenerated, they must have survived on a diet that consisted of somewhat abrasive rather than soft and succulent food sources. Indeed, fossilized redwood tree specimens have been found in the park. Sycamore saplings and evergreen torreya also grew there. Evidence of amber was apparent as we examined the sediments at one locality where we also noted structures characteristic of a fluvial floodplain environment (point bar deposits, crossbedding and the fine grained nature of the sediments).

Populations of dinosaurs roamed the Earth over a period of 150 million years. Sometime near the end of the Cretaceous Period large populations of these creatures became extinct. Theories explaining their decline abound. One of the hypotheses which attempts to account for the inability of the dinosaur to survive attributes extinction to sudden environmental changes to which the warm-blooded dinosaur metabolism could not adapt. Unable to hibernate or burrow, and lacking the insulation of mammals, they may have simply frozen to death. Furthermore, predator/prey ratios have been used to show that in Alberta, where the low predator/prey ratios varied from 3 to 5%, the dinosaurs were warm blooded. At Dinosaur Park, where we were told the ratio is just under 4%, paleontologists have inferred a population of warm-blooded creatures. However, such theories are tentative and assume that the entire population (herbivores and carnivores) had similar, high metabolic rates. As we left the park, we became aware of the fact that much remains to be learned about the life forms that abounded here so many million years ago.

The following day we headed for a fossil site in a stream bed which had first been studied and sampled by John Wall in 1966. This part of our field trip allowed us to examine the late Campanian fossil life of an inland marine basin. John Wall pointed out the contact of the Bearpaw and Horseshoe Canyon formations and explained that abundant ammonites, pelecypods, and microfossils (foraminifers, pollen and dinoflagellates) could be found at this locality. Thus, a team of enthusiastic fossil hunters began to uncover examples of the ancient marine life contained in the Bearpaw Formation. Colourful specimens of ammolite were also gathered (Ammolite is sold as a semi-precious stone in Alberta.) Several fossil fragments clearly illustrated the internal structures of marine species. Several examples of the ammonite *Baculites* were gathered and an excellent example of *Placenticeras* (also an ammonite) was unearthed. Collecting samples from the Bearpaw near the gully was relatively easy. They were exposed in soft mud and had recently been washed out of the soil in several places. Climbing the face of the Bassano South Sandstone, however, we found a large ammonite (about 24 inches (61 cm) in diameter and 9 inches (23 cm) in height) which the rock would not release to our group.

Packsacks heavy with samples, we hiked back to our chartered bus. Another very impressive and enjoyable field trip had been completed under bright blue, cloudless Alberta skies.

Lynn Machan-Gorham

Many thanks to those who contributed to this issue of **Geogram**.

Material for the next issue of **Geogram** should be sent via your Division Office to GID

Les articles pour la prochaine parution de **Geogram** devront-être dirigés au secrétariat de votre division et de là acheminés à la Division de l'information géologique.

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