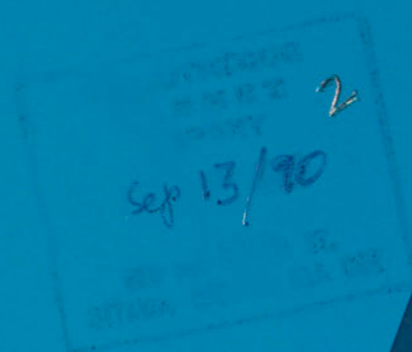


ANNUAL
REPORT
1988-89



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Energy, Mines and
Resources Canada

Énergie, Mines et
Ressources Canada

Hon. Jake Epp,
Minister

L'hon. Jake Epp,
Ministre

Canada

THE ENERGY OF OUR RESOURCES

THE POWER OF OUR IDEAS

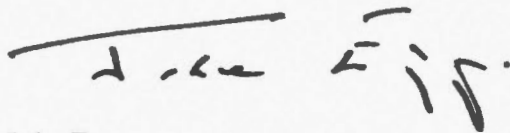
Letter from the Minister

*Her Excellency the Right Honourable Jeanne Sauv , P.C., C.C., C.M.M., C.D., D.H.L.,
D.Sc., L.L.D., D.U., Governor General and Commander-in-Chief of Canada.*

Your Excellency:

*I have the honour to present the Annual Report for the Department of Energy, Mines and
Resources for the fiscal year ending March 31, 1989.*

I remain Your Excellency's obedient servant.

A handwritten signature in black ink, appearing to read "Jake Epp". The signature is written in a cursive style with a horizontal line above the first part of the name.

*Jake Epp
Minister of Energy, Mines and Resources*

Think Recycling!



Pensez à recycler !

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***E**nergy, Mines and Resources Canada explores Canada's landmass, conducts research and development and pursues policies and programs to ensure that our energy and mineral resources are developed and extracted in ways that are safe, efficient and, above all, respectful of the environment.*

More than four thousand persons from coast to coast are employed in the department's three major sections: the Minerals and Earth Sciences Program, the Energy Program and the Administration Program.

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Minerals and Earth Sciences Program

The Minerals and Earth Sciences Program has four sectors:

- Mineral Policy
- Geological Survey of Canada
- Mineral and Energy Technology
- Surveys, Mapping and Remote Sensing

The program gathers, generates and transfers information and technology, and contributes expertise and policy advice concerning the Canadian landmass, including offshore areas, and its minerals, metals and fuel resources.

The program guides land use management and economic and environmentally sound resource development, and ensures public safety, security and sovereignty through:

- surveying, mapping and remote sensing
- geoscience research and surveys
- research, development and demonstration for safe and efficient extraction, processing and use of minerals, metals and fuels
- regional mineral development
- economic, financial, regional and international trade research and analysis.

MINERAL POLICY SECTOR

This year, in accordance with the *Mineral and Metal Policy of the Government of Canada*, released in May 1987, the Mineral Policy Sector continued to devise, recommend and coordinate policies and programs that further develop the national minerals and metals sector and ensure its maximum contribution to our economy.

The Canadian minerals and metals industry continued to reap the rewards of the extensive productivity gains achieved in the early 1980s. The commodities price recovery, which began in 1986, carried over into 1988 and appears to be holding this year as well, with some major producers recording historically high returns. While giving particular attention on the domestic front to R&D and environmental issues, the Mineral Policy Sector kept up its efforts to improve market access and increase market information throughout the industry.

During the year, the Mineral Policy Sector published two reports. The first, *Ownership Structure and Control of the Canadian Nonfuel Minerals and Coal Sectors*, demonstrated that during 1987 Canadian participation in the nonfuel sector, already at a high level, continued to increase. The second, *Canadian Minerals and Metals Industry: Trends and Short-Term Outlook*, showed a number of financial and economic trends within the mining industry. It has been widely circulated and has been well received by the industry and the investment community.

Consultation

The Minister of State (Forestry and Mines) consulted extensively with provincial and territorial governments, industry and labour. Formal discussions were held at the Mines Ministers' Conference, and with the National Advisory Committee on the Mining Industry. Informal discussions took place regularly as well.

The Minister and officials of the Mineral Policy Sector also consulted with industry on the status of flow-through shares in the light of tax reform changes and stock market conditions following the October 1987 market crash. Out of these talks came a recommendation that cash incentives could make flow-through share financing more effective. Shortly thereafter, in May 1988, the Canadian Exploration Incentives Program was announced.

With regard to mineral taxation issues, the Mineral Policy Sector directed policy research and analysis and government-industry consultations. These issues, which are to be discussed at Mines Ministers' Conferences, included the taxation of particular mineral resources and the income tax treatment of future mine reclamation expenditures.

In May, the Mineral Outlook '88 Conference was held in Ottawa. In keeping with its theme, "Moving Into the World of the 1990s",

the conference provoked valuable discussion on the challenges facing Canadian mining and mineral production. Representatives from industry, government and the financial community participated in the program.

Mineral Development Agreements

EMR implements and administers mineral development agreements (MDAs) with the provinces, and co-manages (with the Department of Indian and Northern Affairs) similar agreements with the Yukon and Northwest Territories.

In 1988-89 MDAs were in place in nine provinces and two territories. They are carried out, mainly over five-year terms, under federal-provincial economic and regional development agreements (ERDAs). The federal government provided \$143 million of a total commitment of \$253 million.

During the year, amendments to the Canada-Quebec MDA brought about:

- a budget increase from \$100 million to \$107 million
- a new financial assistance program for exploration
- assistance to the Asbestos Institute
- more funding for technical economic studies
- a new program on technological development.

The Canada-Newfoundland MDA was amended to establish a Mineral Industry Assistance Program. Amendments were also made to the Canada - British Columbia MDA to increase the funding for feasibility, market and technical studies.

International Developments

The Mineral Policy Sector participated in several international initiatives undertaken to improve market transparency and encourage consultations between governments. More than 30 countries, including Canada,

successfully negotiated the terms of reference for study groups on copper and tin, patterning the new groups after the highly regarded International Lead and Zinc Study Group (ILZSG). Canada remained chairman of the ILZSG and continued to pursue the inauguration of the International Nickel Study Group, for which terms of reference were negotiated in 1985-86.

The sector coordinated and led a government-industry nickel mission to the Soviet Union. The mission obtained considerable information on the Soviet nickel industry, and made contacts for the private sector that could result in commercial opportunities.

In November, the Mineral Policy Sector organized an earth sciences and mining mission to Saudi Arabia and certain other Middle Eastern countries. The mission, composed of representatives of government and the private sector, took place under the leadership of the Assistant Deputy Minister of Surveys, Mapping and Remote Sensing Sector.

Trade Negotiations

The Mineral Policy Sector conducted special research and analyses in preparation for two events of prime importance to Canadian commerce: the Uruguay Round of the Multilateral Trade Negotiations in Geneva; and the implementation of the Canada - U.S. Free Trade Agreement, which took effect January 1, 1989.

Acid Rain Abatement Program

EMR joined industry representatives, the provincial government of Manitoba and several other federal departments to establish a program for modernizing the zinc-copper smelters in Flin Flon, Manitoba. The program would lessen sulphur dioxide emissions, permitting industry to comply with provincial regulations scheduled to take effect in 1994.

Asbestos

On June 16, 1988 the Canadian Government ratified the International Labour Organization's 1986 Convention on Safety in the Use of Asbestos. The convention came into force as an international instrument exactly one year later, and is expected to benefit workers worldwide. Canada continued to promote the safe use of asbestos, encouraging other countries to adopt regulations in keeping with the scientifically derived controlled-use principle.

In April and May, the U.S. Environmental Protection Agency (EPA) released new documents in support of its proposal to ban asbestos. The Canadian Government, through EMR, continued to monitor developments and presented the EPA with written comments on the new evidence in June and October.

In June, additional funding for the Asbestos Institute was announced. The Institute, a joint venture of the Government of Canada, the Government of Quebec and the asbestos industry, is the primary vehicle promoting the safe use of asbestos.

Coal

Funding of the Coal Utilization Program ended in March 1988, following successful completion of major projects such as the 22-megawatt circulating fluid bed combustion unit at Chatham, New Brunswick and the coal-water fuel combustion test at Charlottetown, Prince Edward Island.

EMR participated in the Intergovernmental Secretariat to the Deputy Prime Minister's Action Committee on Western Canadian Low-Sulphur Coal to Ontario. In May, the federal government committed up to \$27 million, to be sourced from Western Diversification, towards projects designed to improve the competitiveness of western coal in Ontario. Additional funds for these projects are to be provided by industry and the provinces.

Exploration and Reserves

If the Canadian mining industry is to maintain production beyond the mid-1990s, it must discover new ore bodies of copper, zinc and lead. By way of addressing this urgent need, officials from the Mineral Policy Sector presented a paper entitled "Base Metals: Today's Exploration Challenge" to industry representatives. News media gave the paper wide circulation.

Offshore Mining Legislation

Canada's continental shelf is a new frontier for nonfuel minerals. Increasing private-sector interest in Canada's nearshore areas has been expressed mainly through requests for permits to search for gold, though some requests for sand and gravel permits have been received as well. The lack of appropriate regulations was addressed in the 1987 Mineral and Metal Policy, which announced the intention to establish, in full cooperation with the coastal provinces, uniform regulations for all of Canada's offshore area. Consultations during the past two years with the provinces, industry and other interested parties established the basis for a unique cooperative management scheme that would integrate environmental and fisheries protection objectives with mineral development.

Mine Safety Statistics

In cooperation with the Association of Chief Inspectors of Mines, the sector is developing a National Mine Accident Data Base. Thus far, Canada's three largest mining provinces have agreed to participate in the system, which will allow detailed analyses of trends in mine accidents. This year, for the first time, the Mineral Policy Sector began to compile annual statistics on Canadian mining fatalities.

GEOLOGICAL SURVEY OF CANADA SECTOR (GSC)

Founded in 1842, the Geological Survey of Canada continues its tradition of excellence by providing Canadians with the best possible geoscientific knowledge, technology and expertise about Canada and its offshore, its mineral and energy resources, and the natural conditions that affect the use of its land and seabed.

During the past year, the GSC management team conducted a vigorous appraisal of the sector's role and responsibilities in light of rapidly changing government and industry priorities and growing concerns about the state of the environment.

As a result, plans to enhance or refocus important research programs were developed. Among these are:

- a national mapping program to address the increasing need for up-to-date geological and geophysical maps
- technology development linked to mineral exploration, particularly relating to base metals

- an enhanced environmental geology program focusing geoscience on national and global problems

GSC is divided into five groups:

- Sedimentary and Marine Geoscience Branch
- Geophysics and Terrain Sciences Branch
- Continental Geoscience and Mineral Resources Branch
- Program, Planning and Services Branch and Office of the Chief Scientist
- Polar Continental Shelf Project

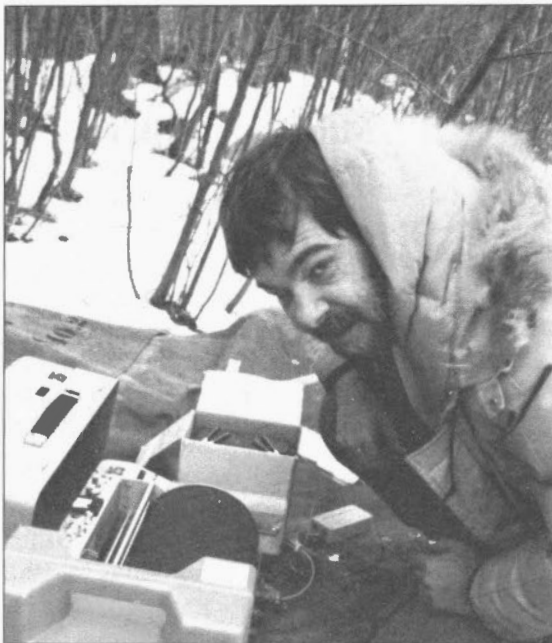
To strengthen and focus productivity and to encourage sharing of common services and logistical support, activities that relate to the same themes and policies are grouped together.

Energy

The Sedimentary and Marine Geoscience Branch ensures that geoscientific information and resource assessments of Canada's oil-, gas- and coal-rich sedimentary regions, located mainly in western and Arctic Canada, the Appalachians and the offshore, are available. It analyses earthquake hazard for the west coast and carries out marine research on both coasts and in the Arctic. The branch has three divisions:

- Atlantic Geoscience Centre (Dartmouth, Nova Scotia)
- Cordilleran and Pacific Geoscience Division (Vancouver and Sidney, British Columbia)
- Institute of Sedimentary and Petroleum Geology (Calgary, Alberta)
- In the fall, Canada, a member of the international Ocean Drilling Program (ODP) since 1985, signed a Memorandum of Understanding with Australia to share its ODP membership in a ratio of 2:1 (Canada: Australia). GSC scientists participated in two ODP research cruises in the Indian Ocean. Findings are directly applicable to ongoing research on east coast sedimentary basins and to the opening of the Labrador Sea and

Scientist installs a seismometer in the field following the Saguenay earthquake in Quebec in November 1988.



-
- Atlantic Ocean. Canada submitted three proposals to the ODP for drilling in the northeast Pacific in 1991-92.
- In April, GSC released a major publication entitled *Conventional Oil Resources of Western Canada (Light and Medium)*. Of special use to industry and government planners, this report has already sold 1400 copies. Another important GSC release, *Coal Resources of Canada*, neared publication. It has generated much interest from the coal and investment communities, and is expected to become a leading reference on the exploration and development potential of Canada's coal resources.
 - A major seismic survey near the Queen Charlotte Islands, B.C. was completed in the summer. GSC used data collected to produce the first modern multichannel reflection results for the western Canadian margin between Vancouver Island and Dixon Entrance. This was a solid first step towards catching up to the level of seismic coverage now available for Canada's other continental shelves. In view of public concern about the Queen Charlotte Islands and the possible effects of seismic testing on the marine environment, the GSC held a series of public information sessions before conducting the work.
 - The *Labrador Sea Basin Atlas*, produced under the Frontier Geoscience Program, is scheduled for release in the summer of 1989. The first in a new series of east coast basin atlases, it synthesizes four years of geoscience research carried out by some 45 industry and government scientists. The series will evaluate eastern Canada's continental margins and associated sedimentary basins in terms of geological structure, sedimentary facies, history of basin development, and the generation, maturation and preservation of hydrocarbons. Atlases for the Scotian Shelf and Grand Banks are slated for production in 1990.
 - In the fall, GSC released a report on *Petroleum Resources of the Mackenzie Delta - Beaufort Sea*. It contributes to the basin atlas of the Mackenzie - Beaufort Sea planned for publication in 1991. The report has already been used to address policy issues on the development of petroleum resources, possible pipeline construction and the Northern Accord.
 - The Peace River Arch Project, aimed at increasing our understanding of the economically important Western Canadian Sedimentary Basin, progressed substantially this year. The study involves a range of geoscientific subdisciplines and is of particular interest because significant hydrocarbon resources are associated with Alberta's Peace River Arch.
 - GSC continued to study earthquake hazard in the West Coast Cordillera and adjacent offshore, one of Canada's most seismically active regions. Researchers have already recognized the potential threat of a 'mega-earthquake' in British Columbia.
 - The "Terrane Map of the Cordillera" and "Metamorphic Map of the Cordillera" were released. These maps, at the 1:2 million scale, provide a synthesis of this tectonically complex region and the most detailed analysis of a major orogenic belt ever produced. The mineral exploration industry has particularly welcomed their release.
 - In February, the sixth annual Cordilleran Geology and Exploration Roundup was held in Vancouver. A joint venture of four organizations (the B.C. and Yukon Chamber of Mines; the B.C. Ministry of Energy, Mines and Petroleum Resources; Indian and Northern Affairs; and the GSC), the Roundup attracted more than 1600 participants, mainly from industry. That same month in Calgary, about 1800 industry, university and government geoscientists attended GSC's second Forum on Oil and Gas Activities in Canada.
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Thanks to excellent presentations and careful preparation by GSC staff, both events rewarded participants with fruitful discussions and new contacts.

Environment

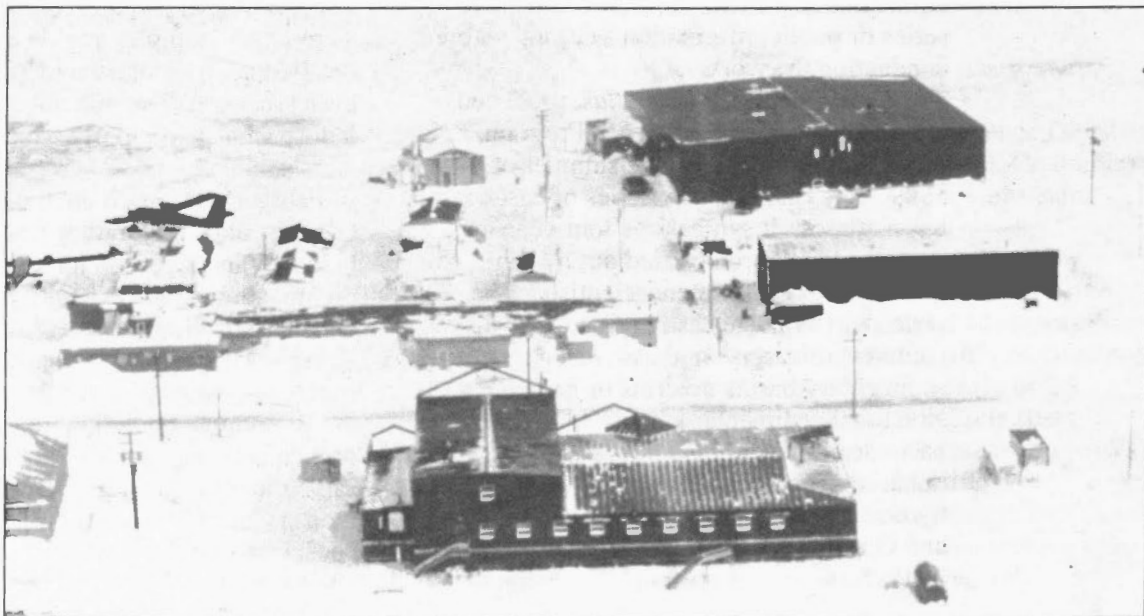
The Geophysics and Terrain Sciences Branch conducts national scientific information programs designed to study geophysical processes (earthquakes, permafrost) considered hazardous to either public safety or commercial development. It also researches the geophysical and Quaternary geological attributes of the Canadian landmass. Headquarters and research facilities for its two divisions, the Terrain Sciences Division and the Geophysics Division, are located in Ottawa. Observation facilities for the national seismological, geomagnetic and geodynamic networks are placed throughout Canada.

- In the past year, 86 strong earthquakes, 37 of which were felt, were documented in or near Canada. The magnitude 6.2 (on the Richter scale) earthquake of November 25, 1988 near Chicoutimi, Quebec was the largest in eastern North

America since 1935. Because a magnitude 4.7 foreshock had occurred two days before, GSC seismologists were already conducting intensified field monitoring in the region, and they continued to do so for two weeks through the aftershock period. Because earthquakes are rare in this region, GSC established additional permanent seismic monitoring facilities in the Saguenay area to provide continuing coverage with greater station density. In March, two earthquakes (4.3 and 4.4) in the Charlevoix seismic zone near Chicoutimi aroused concern.

- Interest in GSC's magnetic forecasting program increased sharply on March 12, when a major geomagnetic storm caused a massive power failure in Quebec and electrical transmission problems elsewhere. The earth is entering a period of high solar activity, and resultant sunspots and flares will lead to more magnetic disturbances of this kind. This year GSC issued 19 magnetic alerts to power utilities and communications operations, compared with 10 in the previous year. The sector is

Aerial view of Resolute base camp, showing newly constructed accommodation and storage facilities.



finalizing plans to offer an expanded magnetic forecasting and geomagnetic storm warning system to users across the country.

- Under federal-provincial Mineral Development Agreements, GSC continued to manage some \$11 million worth of aeromagnetic survey contracts tendered out to the Canadian geophysical industry over the past five years. In 1988-89, GSC published an additional 400 aeromagnetic maps, which support mineral exploration across the country. Other projects were designed to provide maps of surficial geology and to stimulate mineral exploration by producing data on the lithology and geochemistry of till. In northern Manitoba, northern New Brunswick and northwestern Ontario, significant numbers of mining claims were staked as a result of MDA publications on the gold content of till in new exploration "plays" and extensions of existing mining camps. Exploration methods being developed in these projects have contributed to the success of private-sector exploration, as is shown by recent gold discoveries in Newfoundland based on the geochemistry of till.
- Canada's recognized leadership in aeromagnetic surveying is largely due to GSC research and development of instrumentation over the past 40 years. GSC established an industry-government committee to promote future private-sector developments in this exciting field. In the first year, the Department of Supply and Services, with EMR support of less than 10 per cent, funded almost \$2 million in private-industry projects. These developments include enhanced sensitivity in survey instrumentation, advanced data acquisition hardware and improved navigation capabilities for aerial surveys.
- A major publication entitled *Quaternary Geology of Canada and Greenland* neared completion. This will be the first volume of

GSC's new "Geology of Canada" series, and is expected to become the definitive reference on the Quaternary geology of Canada. It is also a contribution to the Decade of North American Geology series of the Geological Society of America.

- In 1988, GSC, Atmospheric Environment Service and McMaster University scientists began a project to study links between surficial materials, vegetation and climate. Ongoing studies at Hot Weather Creek, Ellesmere Island, will provide an analog for possible 'greenhouse effect' warming in the Arctic.
- The first long-term field program for the absolute gravity meter established three sites around Hudson Bay in Quebec and Manitoba. Researchers will periodically revisit these sites to detect the minute but continual uplift this region undergoes following removal of its glacial load.
- Joint government-university-industry studies in the Beaufort Sea's coastal zone continued to produce valuable results. Work in 1988-89 improved our understanding of the complex connection between the geology, permafrost, geothermal conditions and geotechnical properties of earth materials in the area. This information will prove valuable for pipeline design and regulation in the Beaufort-Mackenzie region.

Minerals

The Continental Geoscience and Mineral Resources Branch, using the most sophisticated technology available, carries out comprehensive geological mapping and assessments of the mineral-rich Canadian Shield and Appalachian region. It also documents Canada's onshore and offshore non-fuel mineral resources. It has two Ottawa-based divisions: the Lithosphere and Canadian Shield Division, and the Mineral Resources Division. A new division, the Quebec Geoscience Centre at Ste-Foy, Quebec was established in October.

-
- Investigations in the Lupin Mine area north of Yellowknife, N.W.T. identified two new volcanic belts in sedimentary sequences that include gold deposits hosted in iron formations.
 - Under the Canada - New Brunswick Mineral Development Agreement, work in Bathurst Camp, N.B. included studies of the volcanic rocks that host base metal deposits and led to the development of new structural models and tectonic syntheses that could influence local mineral exploration.
 - In northern Manitoba, a study of metamorphosed alteration zones related to massive sulphide deposits in the Flin Flon and Lynn Lake volcanic belts has led to recognition of three main alteration types: potassic, aluminous and ferromagnesian. These rocks could serve as important prospecting guides.
 - GSC participated in the second phase of seismic reflection profiling for the LITHOPROBE southern Cordillera transect. High-quality deep data were acquired along 950 km of profile, thus completing a series of lines that extend from east of the Rocky Mountain trench to the west coast. Analysis is not yet complete, but preliminary findings suggest that this work may have important implications for understanding the nature of earthquakes in the region. A contract to conduct vector CSAMT (Controlled-Source Audiomagnetotelluric) surveys over the Lemieux Dome in the Gaspé region of Quebec was awarded to Phoenix Geophysics (Toronto) Ltd. The CSAMT data, in conjunction with gravity data, may precipitate a reassessment of the accepted theories on metallogenesis of the Dome.
 - Investigation of submarine sulphide deposits on the Juan de Fuca Ridge off the west coast yielded two important results: the first detailed maps of the Middle Valley sulphide mounds, and precisely located cores from the high-heat-flow area. Studies of this underwater phenomenon will help interpret analogous ore deposits on land.
- At Axial Seamount, definitive evidence for fluid phase separation and the fractionation of gold between fluids explains the occurrence of massive gold-rich sulphide deposits.
- Studies of gold camps in the Canadian Shield and Cordillera showed that ore distribution can be predicted from district- and deposit-scale structural analysis. Furthermore, such analyses suggest that many lode gold deposits formed during seismic activity in regimes dominated by reverse or transcurrent faults. Research on gold metallogeny in ophiolite terranes identified new occurrences of gold in the Baie Verte Peninsula, Newfoundland, and led to significant private-sector exploration.
 - A five-year study of hydrothermal zoning around Devonian granites in Quebec's Gaspé region resulted in a tenfold increase in the size of the target area for potential base metal mineralization.
 - In eastern Nova Scotia, over an area of active gold exploration, GSC completed Canada's first regional biogeochemical maps. And in British Columbia, GSC tested the use of helicopters in rapid, cost-effective biogeochemical sampling.
 - The sector released a set of eight 1:500 000 radioactivity maps of Nova Scotia-the first coloured regional radioactivity maps published in Canada. A contract research project demonstrated the usefulness of airborne gamma ray surveys in locating residential areas prone to high radon levels.
 - Working through the Canadian International Development Agency, GSC provided technical expertise for geophysical projects in Thailand and Zimbabwe, and for a geochemical project in Jamaica. The sector won, from the Asian Development Bank, an important contract for a feasibility study of airborne geophysical surveys in Indonesia.
-

- Pursuing technology transfer, GSC licensed an induced polarization borehole logging system for use in mineral exploration to a Quebec-based company. The sector also designed and built groundwater-sampling equipment, which is now being transferred to a Canadian company for manufacture, sale and service.
- On October 1, 1988, GSC, working in conjunction with l'Institut national de la recherche scientifique du Québec, established the Quebec Geoscience Centre at Ste-Foy. The centre has already hired 13 staff (of a future total of 25), and plans to launch seven scientific projects in the summer of 1989.

Information

The Program, Planning and Services Branch and Office of the Chief Scientist plans, coordinates and evaluates the Survey's scientific programs. It manages cooperative work with the provinces and territories under the Mineral Development Agreements, coordinates corporate communications and technology transfer, oversees the departmental Research Agreements Program and provides central administrative services. The group also publishes the results of the GSC's research, and maintains Canada's National Geoscience Library.

- In September Cabinet renewed the Frontier Geoscience Program (FGP), which aims to evaluate the resource potential of the Arctic and east- and west-coast offshore regions. Recognizing the FGP's importance to Canada's energy future, Cabinet converted it from a short-term program to a permanent part of the Survey's research responsibilities.
- The GSC produced 41 publications, 503 maps and 170 Open File reports; responded to almost 9000 information requests from clients; and delivered nearly 16 000 documents to external users. More than 14 000 records were added to the library's

three databases (GEOSCAN, GEOCAT and PHOTOLIB).

- GSC acquired computerized equipment that streamlined the production process for maps and publications. In a pilot project, the new system produced 15 colour separations in-house for geological maps and almost 500 digitally generated graphics.
- GSC set up a new communications and marketing service to ensure that Canadians are kept informed of the results and implications of GSC's research program.
- The departmental Research Agreements Program, administered by the GSC, continued to fund scientific work in support of EMR priorities at Canadian universities and research institutes. In 1988-89, the program provided \$1.4 million to 178 projects at 42 research centres.

Arctic Sovereignty

The Polar Continental Shelf Project

(PCSP) runs a sophisticated logistics network that allows more than 1000 scientists to conduct research safely and efficiently in the Canadian Arctic each year. PCSP also keeps the scientific community and Arctic residents informed of research projects under way in the Arctic. Headquartered in Ottawa, PCSP operates primarily from its N.W.T. base camps at Tuktoyaktuk and Resolute, while maintaining a permanent research station on an ice island floating in the Arctic Ocean.

- Recognizing the strategic importance and economic potential of the Arctic, the federal government announced in April 1988 that PCSP's funding would be increased by \$4.5 million over the next two years and by \$1.2 million each year after.
- During the 1988 field season, PCSP provided logistics support to 214 field parties from more than 40 different agencies. This included about 100 researchers who worked at the Ice Island Research Station and carried out navigation,

physical oceanography, chemical oceanography, seismic reflection, submarine geology, heat-flow measurement, and geochemical-microbiological studies.

- Construction of the new living accommodation and storage facilities at Resolute was completed and is to be officially opened in 1989-90. PCSP also finished upgrading its facilities at Tuktoyaktuk, N.W.T.
- Through its new Arctic Awareness Program, PCSP opened its logistics support network to Canadian artists and writers, giving them the opportunity to travel to some of the more remote regions of the Arctic. The program's first participants are to be in the field in 1989.
- Studies of the 45-million-year-old 'fossil forest' on Axel Heiberg Island continued during the summer. A film about research conducted at the site, entitled "Search for a Tropical Forest", was completed and premiered by CBC. The film, a co-production of the Royal Canadian Geographic Society and EMR, received logistics support from PCSP.
- News media interest in the Arctic remained high in 1988. PCSP supported several media groups covering scientific activities in the Arctic.

MINERAL AND ENERGY TECHNOLOGY SECTOR

The sector is made up of three organizations: the Canada Centre for Mineral and Energy Technology, the Explosives Branch and the Office of Energy Research and Development.

Canada Centre for Mineral and Energy Technology (CANMET)

The Canada Centre for Mineral and Energy Technology (CANMET) is EMR's main research and technology development arm. Working through five laboratory groups, CANMET develops safer, environmentally acceptable and more cost effective methods to extract, process and use Canada's natural resources.

With research facilities in the National Capital Region, Nova Scotia, northern Ontario and Alberta, CANMET serves the minerals, metals and energy industries in all parts of Canada. CANMET maintains close ties with industry and other research organizations to ensure that its programs meet the needs of its clients. The centre also receives program guidance from the Minister's National Advisory Council to CANMET, made up of representatives from industry, provincial research councils and universities.

This year CANMET officially put its 1988-91 Business Plan into effect. The plan's main objective is to place industrial clients at the centre of CANMET's activities. Accordingly, industry now takes a more active role in planning, funding and setting priorities for CANMET's R&D projects. In light of this, more CANMET resources were allocated to joint projects and cost-recovery work in 1988-89.

During the year, CANMET directed 318 ongoing research projects with a budget of \$74 million. Working mainly with the private sector, CANMET launched 105 cost-shared projects with industry contributions of \$4.5 million. Through cost-recovery services

provided to industry, CANMET recovered \$2.26 million, approximately half a million dollars more than in the last fiscal year. CANMET also aided industry with eight major technology transfer projects, totalling \$13.1 million, through NRC's Industrial Research Assistance Program.

To foster closer ties with its clients, CANMET sponsored several conferences in collaboration with Canadian industry. These conferences, whose theme was "CANMET in Partnership with Industry," promoted technology transfer and provided an opportunity for industry to comment on CANMET's research programs.

To further enhance communications between CANMET and its clients, CANMET launched the first edition of its newsletter, *Technology Focus*. The newsletter will be published three times a year to keep clients well informed of CANMET activities.

Mining Research Laboratories

To improve air quality in mines, CANMET used small amounts of harmless, extraneous gases to trace ventilation patterns in coal and rock mines, and developed instruments capable of measuring small concentrations of these tracer gases. CANMET also developed a thermodynamic ventilation network program, which is used with a complex computer system to monitor mine atmospheres and control ventilation systems.

CANMET and the Domtar Chemicals Group began a joint project to improve mine safety by monitoring methane gas levels in Domtar's Goderich salt mine under Lake Huron. The project is aimed at more efficiently monitoring and controlling the quality of air in the Goderich mine. Within three years, CANMET and Domtar hope to develop a cost-effective automated ventilation system that will reduce down time, routine ventilation measurements and heating requirements. The

monitoring system will also evaluate sensors used to measure gases and soot from diesel engines.

The Canada-Ontario-Industry Rockburst Project aims to develop technology to reduce the hazards of rockbursting. It successfully completed its first phase, which involved designing, building and installing new seismic monitoring equipment. Participating organizations include CANMET, the Geological Survey of Canada, the Ontario Ministry of Labour, the Ontario Ministry of Northern Development and Mines, Denison Mines Limited, Falconbridge Limited, Inco Ltd., Lac Minerals Ltd., Placer Dome Inc. and Rio Algom Limited. Most companies have conducted in situ trials to test new design concepts and techniques. CANMET provides scientific and technical personnel for the project.

Mineral Sciences Laboratories

The Mine Environment Neutral Drainage (MEND) program was set up to develop technologies for the prevention and control of acid mine drainage. This five-year program is a cooperative venture involving CANMET, Environment Canada, the Canadian mining industry and the provincial governments of British Columbia, Manitoba, Ontario, Quebec and New Brunswick. MEND has two objectives: first, to make it possible for the mining industry and government agencies to predict long-term management requirements for reactive tailings and waste rock; and second, to establish techniques that will permit the operation and closure of acid-generating tailings and waste rock disposal areas in a predictable, affordable, timely and environmentally acceptable manner.

CANMET developed Hyceram, a series of polycrystalline ceramics with high strength and high conductivity to hydrogen and its isotopes. Successfully developed and

demonstrated, the materials are protected in the United States under a recently issued patent. Materials are available under the CANMET-registered trademark Hyceram, and are now being evaluated in Belgium, Denmark, Germany, Israel, Japan, the United Kingdom and the United States. A joint program to use Hyceram as the basis for hydrogen sensors, tritium pumps and other applications is under way with Atomic Energy of Canada Ltd.

CANMET led an investigation of the degradation of concrete caused by the reaction of alkali-reactive aggregates with the cement matrix. The project managed to identify rock types in the Maritime Provinces that are potentially reactive with alkalis in cement. The study has revealed that many greywacke-argillite rocks are potentially reactive in moist environments. Authorities involved in the construction of concrete dams, roadway structures and foundations where such conditions prevail are being advised to

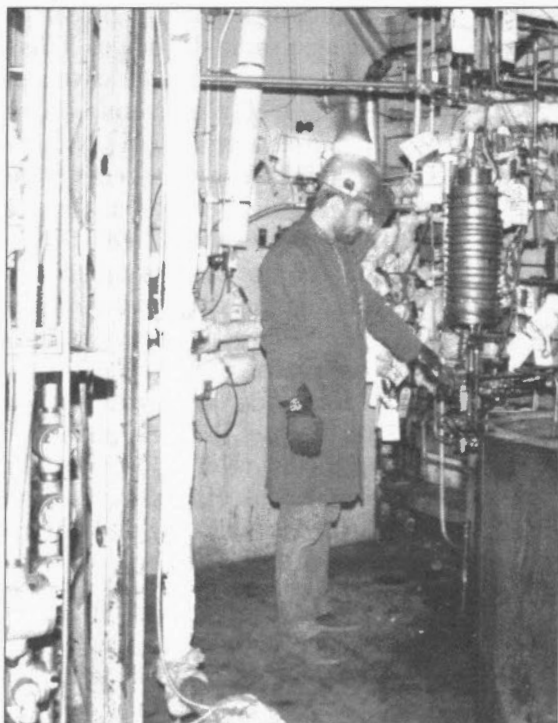
avoid using these aggregates or to take precautionary measures to stabilize the reactions.

CANMET and Kidd Creek Mines recently developed an expert system for on-line data validation and substitution in the sampling system of copper-zinc flotation plants. The NEXPERT development shell used in the system was chosen, after consideration of several other software packages, mainly because of its portability. Early results indicate that the system is performing as designed.

Metals Technology Laboratories
Pioneering research performed at CANMET in cooperation with Alcan has led to the development of a novel process to reduce weld-zone corrosion. The process involves metallizing with aluminum. Although the U.S. Navy has long employed it above the waterline, this is the first time the process has been applied under water. To simulate the corrosion found on ships that travel through ice, CANMET has developed a unique 'tank testing' facility. CANMET is looking forward to participating with Alcan and the Canadian Coast Guard in feasibility testing at sea.

CANMET installed new rod- and wire-forming facilities to produce experimental quantities of improved welding materials (consumables). Higher strength steels with lean alloy compositions are being developed in Canada for icebreakers, naval vessels and offshore structures. To obtain the greatest economic benefit from these new alloys, it is necessary to use welding consumables that closely match the composition and properties of the steel. CANMET, working in partnership with steel companies and welding consumable manufacturers, will now be able to develop consumables that simplify welding procedures while maintaining the excellent properties of higher strength steels, and reduce costs by eliminating pre-weld heat treatment.

*Energy Research
Laboratories,
CANMET, Bells
Corners.*



CANMET has developed a corrosion-resistant, rapidly solidified copper base alloy for marine applications. The fine microstructure achieved by rapid solidification produces a tensile strength of more than 890 megaPascals. In cooperation with the Manufacturing Technology Centre of the National Research Council of Canada and Ortech International, CANMET is exploring ways to reduce costs by applying laser surface alloying to conventionally manufactured alloy parts. Potential applications include pump and valve components and seawater piping systems.

In developing technology for the casting of higher melting point alloys in permanent moulds, CANMET has completed wide-ranging investigations into the production of iron parts in cast-iron moulds, and has begun to examine the possibilities of using water-cooled aluminum or copper alloy moulds with cast iron. Advantages over traditional sand-casting techniques include closer dimensional control, improved surface finish, increased environmental compatibility and improved working conditions.

Coal Research Laboratories

CANMET collaborated with the Alberta Government and Obed Mountain Coal Company Limited and Luscar Sterco (1977) Ltd. to assess the use of electrocoagulation in cleaning up waste water. CANMET's previous research helped to optimize the design of bench facilities for tracking coagulation efficiency, power and electrode consumption. Results will be used to design a scaled-up field system model.

CANMET developed specialized methods to improve recovery of bitumen, including advanced cryogenic and image analysis techniques. These enabled researchers to elucidate froth structure, to assess the role of the interface in tar sands flotation, and to evaluate the stability of oil-water emulsions.

This knowledge has contributed to improved recovery of bitumen from tar sands and has attracted interest in several cost-recovery and collaborative projects.

CANMET's 10 tonnes/hour coal preparation plant, together with performance evaluations and troubleshooting, helped the mining industry improve coal recovery. With regard to coal preparation generally, CANMET continued in accordance with its objective: to develop technologies that will help industry improve recovery and meet environmental protection standards, while producing saleable coal for carbonization, conventional combustion and coal-liquid fuel mixtures.

Energy Research Laboratories

CANMET's staged burner concept for controlling nitrogen and sulphur oxide emissions from a pulverized coal-fired generator was successfully demonstrated at Canadian Forces Base Gagetown, New Brunswick. During the combustion of Eastern Canadian coals containing three per cent sulphur and 10 per cent ash, the retrofit installation reduced emissions by half and improved generator efficiency.

Joint efforts of scientists and engineers from CANMET and the New Brunswick Electric Power Commission have produced substantial improvements in sulphur capture at the Chatham circulating fluidized bed demonstration, one of CANMET's most noteworthy development projects. Thanks to these efforts, the calcium-sulphur ratio required for 90 per cent sulphur capture has been reduced by 40 per cent. This will reduce costs since less calcium will now be required for sulphur disposal.

To demonstrate the advantages of coal-water fuel (CWF) over imported heavy fuel oil in an oil-designed package steam boiler, CANMET participated in a joint project with the Nova Scotia Government, the Cape Breton Development Corporation and the Minas Basin Pulp and Power Co. CWF

flows like oil and thus may be transported by pipeline and stored in tanks, eliminating the need for environmentally undesirable bulk coal transportation and storage equipment, and reducing capital and operating costs. In the demonstration boiler (owned by the Minas Basin Pulp and Power Co.), CWF is beneficiated to minimize sulphur-bearing ash pyrite, which emits about 33 per cent less sulphur oxide than the oil it replaces.

Explosives Branch

The Explosives Branch regulates the manufacture and distribution of explosives, as well as some aspects of their road transportation. It also classifies new explosives for all means of shipment, and acts as advisor to the Transportation of Dangerous Goods Directorate of Transport Canada.

During 1988-89, there was one serious industrial accident: an explosion in a research pilot plant working on emulsion explosives killed four laboratory personnel and injured two others. The Explosives Branch chaired the investigating committee.

This year the branch licensed 102 factories to manufacture explosives and issued 2176 magazine licences. Observance of the terms of licences and permits was monitored by 1030 factory and magazine inspections and 134 truck inspections.

The Canadian Explosives Research Laboratory determined the characteristics of approximately 400 explosives and pyrotechnic samples, allowing the Chief Inspector of Explosives to assess their safety for import or manufacture.

Courses for fireworks supervisors were conducted at centres throughout Canada. About 1000 persons attended some 60 educational courses.

Office of Energy Research and Development

The Office of Energy Research and Development, as secretariat to the interdepartmental Panel on Energy Research and Development (PERD), is responsible for coordinating the distribution of panel funds to

*Strip casting at
CANMET.*



the federal Energy Research and Development Program. This program provides R&D funds to 12 participating federal departments and agencies. The office also serves EMR in a science advisory role, providing expertise in a number of energy-related disciplines, and coordinating Canadian participation in cooperative energy R&D through the International Energy Agency and bilateral energy agreements.

The federal Energy R&D Program aims to develop the science and technology base for a diversified, environmentally sustainable energy economy. In 1988-89, the Government confirmed the program's new three-year plan, allotting it \$90 million a year. Last year this allotment was augmented by contributions from the private sector and participating departments. More than half of the federal funds were directed to research in two important areas: health and safety, and the environment. More than 60 per cent of the program's budget was spent in the private sector.

Technical progress continued in all of EMR's panel-supported work. Several activities showed significant results in 1988-89:

- a process for recycling used railway two-cycle diesel lubricating oils
- seismic hazards charts and maps for all Canadian offshore areas for use with CSA codes for offshore structure design
- an advanced sodium sulphur battery for electric automobiles (the only one able to pass US DOE ETX-11 target of 160 km between charges in road tests)
- the *Canadian coal atlas*
- proven capability of methanol-fueled buses to operate in commercial service with fewer undesirable environmental effects than diesel fuel.

SURVEYS, MAPPING AND REMOTE SENSING SECTOR

The Surveys, Mapping and Remote Sensing Sector formulates and develops programs for the survey and definition of Canadian lands and waters; prepares and distributes topographic, geographic, electoral and aeronautical maps and digital products; and manages a national program for acquiring and using remote sensing data.

The sector is made up of five groups:

- Geographic Information Systems Division
- Canada Centre for Remote Sensing
- Canada Centre for Mapping
- Canada Centre for Surveying
- Office for Planning, Coordination and Cartographic Services

Geographic Information Systems Division

In September, the Surveys, Mapping and Remote Sensing Sector established a Geographic Information Systems (GIS) Division. The division develops strategic plans and national policies related to GIS, and represents the sector in GIS matters on national and international commissions and committees.

The division is responsible for coordinating the technical subcommittees of the federal Inter-Agency Committee on Geomatics, and promotes data sharing and cooperation among federal and provincial government agencies. It develops and maintains national GIS standards, addresses data-management issues, and conducts GIS-related R&D. The division also undertakes application projects designed to further the use of information from the National Topographic Data Base (NTDB) and other such data sources or systems.

During 1988 the division organized the technical program for the National Conference on GIS held in Ottawa, and participated in the departmental earth sciences mission to Saudi Arabia, Jordan, Kuwait, Qatar and Egypt. It

also helped the Geomatics Industry Association of Canada promote technology abroad by preparing several technical proposals. Also during the year a GIS bulletin was launched and a GIS video is currently in production.

Canada Centre for Remote Sensing (CCRS)

The centre provides remotely sensed data, improves the technology for resource management and environmental monitoring, and works with Canadian industry to ensure that Canada maintains its leadership in important areas of remote-sensing technology.

During 1988-89, CCRS continued the Radar Data Development Program, designed to prepare Canadian agencies to use data from future radar satellites. The program developed a Radar Training Manual in cooperation with Canadian industry, made extensive use of the specially equipped CCRS aircraft in support of Canadian business efforts and sold nearly a million dollars worth of satellite imagery.

To better receive data from the European Space Agency's ERS-1 satellite (scheduled for launch in 1990), CCRS upgraded reception systems at the Gatineau, Quebec and Prince Albert, Saskatchewan satellite stations. Under an agreement with Japan, CCRS is already receiving data from the Marine Observation Satellite (MOS-1).

This year CCRS completed work on the Landsat-D Image Analysis System, the most powerful of its kind in Canada, and licensed the software to several companies, universities and provincial agencies.

NASA accepted two CCRS projects on global change monitoring for the Earth Observation Program, making CCRS one of the major international players in this program.

CCRS continued to work with industry and overseas agencies on environmental issues. Last year the centre arranged an international mapping and remote sensing seminar in Ottawa. Sponsored by the Canadian International Development Agency and hosted by External Affairs, the seminar was attended by 16 developing countries. CCRS

Remote Sensing and Geographical Information Systems integration for resource management.



also participated as an exhibitor in several national and international meetings held in Canada.

Canada Centre for Mapping (CCM)

The centre maps the nation for economic development and sovereignty. It produces the *National Atlas of Canada*, aeronautical charts and topographical and geographical maps.

Over the next decade, CCM will increasingly use computer and space technology in mapping and charting. Digital systems are now being integrated into the production of aeronautical charts, the *National Atlas*, topographical maps and data bases.

During 1988-89, the centre participated in several forward-looking projects.

- The Inter-Agency Committee on Geomatics (IACG), comprised of about 20 federal government agencies, was organized to develop standards and coordinate federal geographical information programs. The centre provides the secretariat and chairperson for the committee.
- Following the Minister's August announcement of a Cooperative Geographic Information Technology Development Program, CCM began formulating, in consultation with the provinces, cost-shared projects designed to develop Geographic Information System technology and standards. Federal-provincial projects were initiated during 1988-89, and in future years the program will form a cornerstone of the Topographic Mapping Program.

Topographical Mapping Division

The division develops national standards for topographic mapping of Canada. Using information acquired by aerial photography, space imagery and field surveys, the division coordinates map design and production to accurately represent the earth's elevations, natural features and major structures. Resource development, environmental

protection, transportation, communications and defence are only a few of the applications for topographical maps in Canada today.

Until recently, the paper topographic map was the accepted medium for presenting topographic information to the user. The introduction of the computer, together with increasing use of Geographic Information Systems by resource and infrastructure managers, has created a demand for information in digital data form. The division is currently engaged in converting existing paper maps into digital data form and in creating accurate digital data on Canada's more highly developed areas.

The entire country has been mapped at the reconnaissance scale of 1:250 000 in 917 map sheets. At the larger scale of 1:50 000, 176 first-edition sheets were recently produced, bringing total national coverage to 85.9 per cent. Also, the division revised 260 maps, using both conventional and digital methods. **Satellite imagery is extensively employed in revising the 1:250 000 scale maps and in detecting changes on the 1:50 000 scale series. During 1988, the Cartographic Data Processing System for automated digitizing of the 1:250 000 scale series was used to convert 250 maps into digital format.**

The division aided the Canadian International Development Agency on surveying and mapping projects in Egypt, Indonesia, Tanzania and Zimbabwe; and continued to help manage federal-provincial flood-damage mapping programs.

Geographical Services Division

The Geographical Services Division gathers and disseminates geographical data, and produces aeronautical charts and flight information publications for national planning, administration, education, research and aviation safety. One of its major programs is the **National Atlas Information Service**, the only comprehensive summary of the socioeconomic, physical and historical

elements of Canada's geography at a national scale. This service produces the *National Atlas of Canada*. The atlas is now in its fifth edition, with 61 subject maps completed to date. The fifth edition is expected to be complete by fall 1992.

The division maintains the National Toponymic Data Base, which contains information on the names of more than 480 000 features. This data base is used for gazetteers, national mapping and general names inquiries. During the year, gazetteers of Alberta (third edition) and Yukon Territory (fifth edition) were published.

Cost-recovered cartographic support is given to other government departments and agencies, including the Chief Electoral Officer and Canadian Parks Service. Waterton Lakes Park map was published; maps for Elk Island and Pacific Rim are near completion; and work has begun on a park map for South Moresby. In cooperation with the Department of Indian and Northern

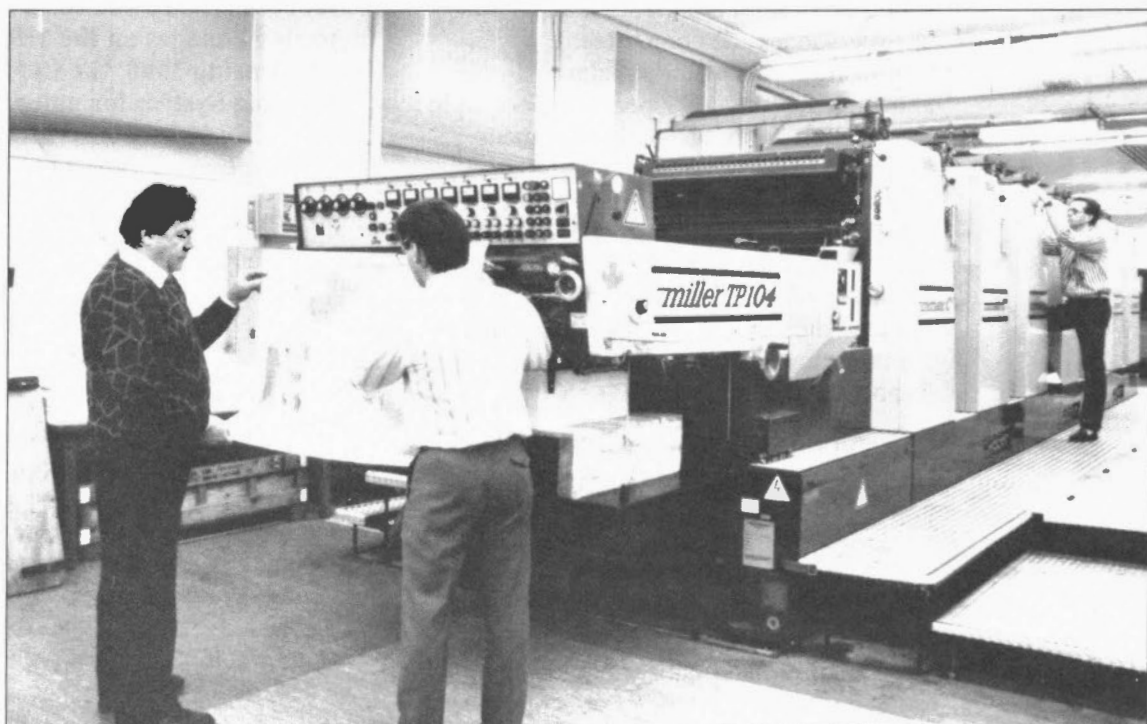
Affairs, the division is producing an important new base map of the northern circumpolar region.

In response to requirements from Transport Canada and the Department of National Defence, the Aeronautical Charts and Information Service produced, revised and published more than 1500 aeronautical charts and related flight publications for air safety.

The division is bringing two new computer systems into production: the National Atlas Information System (NAIS), and the Canadian Aeronautical Charts System (CANAC). The NAIS system will permit integration of the National Atlas Data Base, the National Toponymic Data Base and the Electronic Atlas to produce a powerful geographic information processing and cartographic production capability.

During the year, the division successfully undertook several joint ventures, including application of the 34th Election Results

The Miller TP104, a seven-color printing press, can print a maximum size of 71 cm x 102 cm and make up to 7000 impressions an hour.



Map information to Hypercard. It is now engaged in a prototype project to add recreational and cultural information to standard topographic base maps.

Canada Centre for Geomatics (CCG)

In September, the CCG acquired 60 new employees and doubled its office space, thus realizing the government's goal of establishing a fully equipped centre of specialization in Sherbrooke. Two divisions share this location: the Canada Centre for Geomatics and the Quebec Regional Office of the Legal Surveys Division. The facility now has 100 employees.

Together with the Canada Centre for Mapping, the centre participates in the topographical mapping program, and also helps to prepare, maintain and update the national digital topographical data base. In keeping with its mandate to discover better methods of map-making, this high-technology centre undertakes research in digital mapping, topographical data base management and remote sensing.

- The centre acquired new mapping equipment reflecting the latest technological developments, including an automated digitizing system for scanning maps at 1:50 000 and a system of digital image processing.
- The centre distributed digital topographical data exchange software (developed according to the format of the Canada Council on Surveying and Mapping) to several users during the year. It is now taking steps to have this exchange format adopted as a national standard.
- In cooperation with the Topographical Mapping Division, the centre is preparing a book of standards for establishing the national topographical data base.
- In the fall, the centre organized an international symposium on the application

of SPOT (Système pour l'observation de la Terre) data. The symposium provided a timely opportunity to announce the results of recent French and Canadian experiments, and attracted nearly 200 people from 12 countries.

Canada Centre for Surveying (CCS)

The centre provides a national survey framework, legal survey services on Canadian Lands and maintains and regulates the Canada - United States International Boundary.

CCS has three divisions, some 290 staff and an annual budget of about \$20 million. Over the next decade, the centre will make increasing use of computer and space technology and will continue to monitor and adapt emerging technology through in-house and contracted research and development.

The centre continues its long-standing tradition of providing advice on surveying to other federal agencies, provinces, industry and universities.

Geodetic Survey Division (GSD)

The division maintains national positioning and elevation reference systems that provide the basis for resource-related information such as land and offshore surveys, maps and charts.

The division continued to develop a satellite positioning system for national use. Based on the Global Positioning System satellites, the Active Control System will comprise a nationwide series of automatic satellite monitoring stations. The data derived will have several applications involving precise positioning and navigation.

The division participated in a worldwide GPS Global Orbit Tracking Experiment known as GOTEX-1. The experiment aimed to collect data for computing more precise orbits of GPS satellites, and to position future Active Control Points

(ACP) in a global reference frame with the highest possible accuracy. Organized by the GPS Subcommittee of the International Association of Geodesy (IAG) and the International Union of Geodesy and Geophysics (IUGG), the experiment brought together, under one campaign, tracking stations belonging to various worldwide networks, including many Very Long Baseline Interferometry (VLBI) and Satellite Laser Ranging (SLR) sites. Six main sites in Canada participated in the campaign.

Legal Surveys Division

The division, headed by the Surveyor General, under the terms of the *Canada Lands Survey Act*, manages and regulates all surveys of Canada Lands and maintains a framework for registering interests within Canada Lands. These activities safeguard the government's interests and those of holders of rights in Canada Lands, particularly native people. Canada Lands consist of national parks, the Yukon and Northwest Territories, the offshore and 2300 Indian reserves. Properties protected by the Canada Lands Surveys Records are valued at more than \$20 billion.

The division completed approximately \$1.1 million in boundary surveys for the Inuvialuit Native Land Claim Settlement, carrying out the work under contract to the private sector. Progress continued in several important areas including the Manitoba Northern Flood Agreement, preparatory surveys for several large native land-claim settlements in the Yukon and Northwest Territories and the modernizing of divisional survey standards.

The division pushed ahead with automating the Canada Lands Information System, acquiring the necessary equipment, and completing installations at 10 offices.

International Boundary Commission (Canadian Section)

The International Boundary Commission is a bilateral treaty organization that maintains and regulates the land and water boundary between Canada and the United States.

The commission continued field maintenance along the Quebec-Maine and the British Columbia - Washington/Idaho/Montana portions of the international boundary. Vista clearing was carried on for 62 km and 74 boundary monuments were completely rebuilt.

A jointly operated Canada - United States customs facility was officially opened on the international boundary between Carson, B.C. and Danville, Washington.

Office for Planning, Coordination and Cartographic Services

This office organizes sector activities, including external relations; and manages the reproduction and distribution of the sector's maps and charts.

Cartographic Information and Distribution Centre

The centre makes available, on a cost-recovery basis, data compiled by other divisions of the sector. Topographical and geographical maps, aeronautical charts and air information publications are reproduced by multicolour offset printing. These materials are sold either by authorized dealers in Canada, the United States and 12 other countries, or by mail order from the Canada Map Office. Custom-made reproductions of aerial photographs and satellite images are sold to the public through the National Air Photo Library.

In 1988-89, the centre printed 1624 map titles, distributed 2 658 000 maps and reproduced 190 000 aerial photographs. The centre produced and distributed the first Canadian videodisk. With many government agencies and private-sector companies

already anxious to invest in the production of new disks, the technology appears to be succeeding beyond all expectations. Progress has also been made in replacing the analog image with digital data. The centre is playing a leading role in coordinating development of the technology and the production of maps on videodisks.

The review of all depository agreements (148) has been completed. A total of 104 depositories qualified and new agreements were signed. The remaining 44 depositories did not meet the requirements and the agreements were cancelled.

The automated order processing system for the National Air Photo Library and Airborne Imagery Services is now in use. This system permits instant, paper-free communication between the Library (615 Booth Street, Ottawa), the Reproduction Centre (2464 Sheffield Road, Ottawa), and the Cost Recovery Unit (130 Bentley Avenue, Ottawa).

On October 1, the centre adopted a new distribution and pricing policy for maps, charts and aerial photographics products.

Energy Program

In 1988-89, the Energy Program was reorganized into three sectors:

- Energy
- Programs
- Canada Oil and Gas Lands Administration

The Energy Program develops and maintains policies and initiatives for the supply, efficient use and conservation of energy resources. The program promotes the orderly development of secure sources of energy, and facilitates access to technical expertise in energy supply, use, R&D and processing.

ENERGY SECTOR

Under a new structure, the Energy Sector, combining the roles of the former Energy Policy and Energy Commodities sectors, advises on federal energy policies, strategies and activities and provides information and analysis. In addition to fulfilling its policy function, the sector monitors and advises on exploration and development in the Canadian petroleum industry and, through selected upstream indicators, also advises on activity in the United States and other countries. Where relevant, the sector assesses and advises on the international implications of federal energy policies and programs. Parliamentary Affairs which had previously been the responsibility of the Energy Policy Coordination Branch have been assumed by the Corporate Policy and Communications Sector.

The Energy Sector has seven branches:

- Energy Strategy and International Affairs
- Financial and Market Analysis
- Electrical Energy
- Petroleum Resources
- Natural Gas
- Uranium and Nuclear Energy
- Oil and Emergency Planning

Energy Strategy and International Affairs Branch

This year the branch coordinated federal participation in the August meeting of federal, provincial and territorial energy ministers. At

this meeting, which was co-chaired by the Governments of Canada and Quebec, ministers discussed a wide variety of energy issues and released a background document entitled *Recent Evolution of the Energy Sector in Canada*. They agreed to establish an intergovernmental task force to review energy recommendations made during the World Conference on the Changing Atmosphere held in Toronto. The task force is to examine the implications of a global reduction in carbon dioxide emissions, and is to report to energy ministers at their 1989 conference.

The branch also worked with federal and territorial governments in negotiating native land claims and developing oil and gas policy in the North; and assisted in preliminary negotiations toward an offshore accord with the Province of British Columbia.

During the year the branch continued to take prime responsibility for the management of energy trade policy issues, particularly in connection with the Canada - U.S. Free Trade Agreement (FTA) and the Uruguay Round of multilateral trade negotiations under the General Agreement on Tariffs and Trade (GATT). With respect to the FTA, activities focused on the agreement's implications for the regulatory activities of the National Energy Board (NEB) and on the passage of appropriate amendments to the *NEB Act*. With regard to the GATT, the branch examined the energy policy implications of proposals dealing with multilateral subsidies and trade remedy negotiations.

The branch conducted an in-depth review of the government's policy towards Atomic Energy of Canada Limited and the Canadian nuclear industry. By engaging in joint research with the Canadian Energy Research Institute (CERI), and by helping to found the Ottawa Chapter of the International Association of Energy Economists, the branch developed closer contacts with other

organizations undertaking energy policy analysis.

Throughout the year the branch advised the government on privatization issues, Canadianization and acquisitions in the upstream sector of the oil and gas industry. It reviewed Petro-Canada's Corporate Plan and Capital Budget, and advised Investment Canada on the energy policy implications of several proposed acquisitions of oil and gas businesses, including the acquisition of Texaco Canada by Imperial Oil.

In managing Canada's energy relations with other nations and international organizations, the International Energy Relations Division (IERD) ensures that EMR energy policies and programs are understood and defended internationally, that senior officials in the department are kept informed on international events and commitments, and that EMR's international energy responsibilities and relations are discharged appropriately and consistently.

Recognizing the interdependence of the Canadian and world energy economies, Canada has worked to improve international energy cooperation through consultations, joint programs and the removal of trade barriers. These efforts are helping to build a stronger, more predictable international energy economy.

In 1988-89 IERD organized programs for some 17 incoming and outgoing energy visits that contributed to bilateral and multilateral dialogue. Bilateral discussions took place with the United States, Venezuela, Norway, the United Kingdom, the Soviet Union, Jordan, Australia and New Zealand, the Commission of the European Communities and others. IERD also helped to coordinate visits abroad by both of the Parliamentary Energy Committees.

Of all the department's bilateral relationships, that with the United States is the most active and significant, especially after the 1988 FTA

negotiations. Roughly 80 per cent of total Canadian energy trade is with the United States. Bilateral relationships with the European Economic Community, Spain and the Netherlands also saw increased activity.

As multilateral institutions dominated this year's world energy scene, Canada continued to play an important role in International Energy Agency activities, the most relevant international institution for the energy program. Other organizations of particular importance to Canadian energy interests include the International Atomic Energy Agency, the UN Economic Commission for Europe, and the Intergovernmental Panel on Climate Change. This year many of these organizations displayed an increased interest in the complex relations that exist between energy and the environment.

Financial and Market Analysis Branch

The branch provides analysis and policy advice relating to energy markets, the financial and investment position of the petroleum industry, the oil and gas fiscal system and the development of major energy projects.

Over the past year, branch officials helped formulate an agreement to construct the Lloydminster Bi-provincial Upgrader, and worked towards the signing of Statements of Principles for developing the Hibernia oil field, the OSLO (Other Six Lease Operations) oil sands project and the Vancouver Island Pipeline (VIPL). The federal government, various provincial governments and project sponsors are now negotiating final agreements for Hibernia, OSLO and VIPL.

On fiscal and tax matters, the branch helped organize the Canadian Exploration Incentive Program (CEIP), analyse pre-budget submissions from industry associations and develop procedures leading to the promulgation of the *Canadian Petroleum Resources Act* (CPRA) royalty regulations.

In addition, the branch continued to assess the international competitiveness of Canada's offshore fiscal regime; and published the third edition of *Petroleum Fiscal Systems in Canada*, an authoritative guide to oil and gas taxation.

The branch continued to analyze the financial and investment position of the oil and gas industry, working in close consultation with some of the industry's most prominent associations. It prepared forecasts of energy prices, supply and demand; published a major working paper, "Long-Term Energy Outlook, 1987-2005"; and continued to issue the *Energy Statistics Handbook* and the quarterly *Review of Energy and Macroeconomic Indicators*.

Finally, to meet the needs of Canadian and international agencies, the branch maintained an integrated system of domestic energy statistics.

Electrical Energy Branch

The Electrical Energy Branch:

- collects and analyzes information on electrical energy in Canada and abroad
- provides advice on the electrical energy industry
- develops, negotiates and manages agreements with electrical utilities, provinces and the national industry association.

During the year, the branch continued to develop a new policy on electricity exports and international transmission lines.

Following a public review by the National Energy Board and consultations with the provinces, the branch refined its policy proposal to streamline the regulation of electricity exports. Cabinet later accepted this proposal, and the Minister announced it on September 6.

At that time, the Minister also called upon the provinces and the electrical energy industry to join the Government of Canada in addressing environmental problems associated with

electricity production and generation. As part of this initiative, the branch is now reviewing federal environmental legislation, regulations, standards and guidelines.

In 1988-89, the branch compiled a comprehensive inventory of Canadian hydro resources, and initiated an international comparison of electricity prices by sector. It also began to review medium-range projections for domestic electricity demand, supply and trade, and examined electrical energy in some of the world's major countries, focusing on patterns of industrial organization, demand and supply, trade, regulations and policy.

This year the branch continued to represent the government on the Management Board and Executive Committee of the Canadian Electrical Association's Research and Development Program. This cooperative program promotes R&D in all areas of electrical energy management: generation, transmission, distribution and use. Projects are funded by contributions from EMR and the Canadian electrical utilities.

The branch published *Electric Power in Canada*, an annual report that provides information on industry activities and planning, *Canada - U.S. Electricity Trade*, and *Electricity Rates in Canada*. In conjunction with Surveys, Mapping and Remote Sensing Sector, the branch produced "Electricity Canada, 1987", a map showing Canada's major generation stations and transmission systems.

Petroleum Resources Branch

The branch advises on exploration, development and production in the Canadian petroleum industry. Through selected upstream indicators, it also provides advice on oil and gas activities in the United States and other countries.

In collaboration with other federal agencies, the branch does technical and economic studies on discovered (unconnected) and

potential petroleum resources. Cost estimates for new supplies are used to provide economic discounts of the resources for conventional oils and natural gas, enhanced oil recovery, heavy oils and oil sands.

During the year, the branch reported on upstream activities and issued statistics on land holdings, reserves and production of companies operating in western Canada. It completed engineering and geological studies on light and heavy oils, bitumen and natural gas; and decided to go ahead with assessments of western and northern Canada natural gas. The branch is the scientific authority for the demonstration of lateral drain technology.

Acting through the Canada-Saskatchewan Heavy Oil and Fossil Fuel Agreements, the branch advised on pilot projects designed to increase recovery in heavy oil deposits. Funding for the agreement ended in 1988, but pilots and research are continuing. Also continuing are branch studies of horizontal wells and mining technologies for heavy oil and oil sands.

Natural Gas Branch

The branch provides policy advice and information on the natural gas industry in Canada. It analyzes foreign and domestic regulations that affect Canadian trade; reports on interfuel competition in domestic and export markets; and evaluates proposals to expand these markets for natural gas. The branch prepares reports to ensure that special interest groups and the general public are informed of developments in all natural gas markets.

The branch also advises the Minister on National Energy Board recommendations concerning the certification of new natural gas pipeline facilities and the issuing of long-term export licences. Such recommendations are subject to Governor-in-Council approval.

To ensure full compliance with the principles of the 1985 Agreement on Natural Gas Markets and Prices, the branch oversees a committee of officials representing signatory governments. The committee monitors the deregulation of the natural gas industry, paying particular attention to improvements in market access. As part of this process, the branch publishes the *Natural Gas Price Monitoring Report* each September and March, providing valuable information on both domestic and export prices of Canadian natural gas.

This year the branch played a leading role in analyzing the Vancouver Island natural gas pipeline project, and later exerted an important influence in the negotiation and signing of the project's Statement of Principles, which set federal government assistance at \$150 million.

The Quebec Natural Gas Laterals Program, officially terminated in December 1986, will continue to bear operation and maintenance costs until March 1991.

Uranium and Nuclear Energy Branch

The branch provides policy advice and information on the uranium and nuclear industries and on radioactive waste management and radiation issues.

Canada is the world's leading producer and exporter of uranium. Acting through the Uranium Exports Review Panel, the branch helps to examine uranium contracts for consistency with Canadian export policy. The branch also coordinates the Uranium Resource Appraisal Group, which assesses and publishes a biennial report on Canadian uranium supply capability.

This year the branch advised on Canada's new policy concerning nonresident ownership in the uranium mining sector. Branch counsel focused on two important areas: the privatizing of Eldorado Nuclear Limited and

the Saskatchewan Mining Development Corporation, and the effect of the uranium provisions in the Canada - U.S. Free Trade Agreement.

The branch recommended that the problem of nuclear fuel waste disposal, together with a broad range of nuclear fuel waste management issues, be made subject to an environmental assessment and review. In June a response to *The Eleventh Hour*, the Standing Committee on Environment and Forestry's report on high-level radioactive waste disposal, was tabled in the House of Commons.

The branch prepared a response to *Opting for Cooperation*, the Siting Process Task Force Report on low-level radioactive waste disposal. Afterwards, it organized a Siting Task Force for low-level radioactive wastes in Ontario. The Task Force developed an innovative, cooperative and voluntary approach to siting waste management facilities, which precipitated a similar solution to the disposal of historical wastes in British Columbia.

As in past years, the branch provided guidance to the Atomic Energy of Canada Limited's (AECL) Office of Low-Level

Radioactive Waste Management in Port Hope. It also continued to collaborate with Ontario on uranium mine tailings and with British Columbia on the issue of historical wastes.

Highlights in nuclear power and the nuclear industry were:

- participating on the Privy Council Office Task Force and Working Group on the nuclear industry
- helping to organize the Canadian Nuclear Association Marketing Conference and the OECD-Nuclear Energy Agency (NEA) 1989 Conference on Good Performance in Nuclear Power Plants
- testifying before the Ontario Legislative Select Committee on Energy regarding Canadian and international nuclear programs and issues
- representing Canada on an NEA study of electricity generating costs
- coordinating the federal government approach to the Point Lepreau 2 Candu 3 project in New Brunswick.

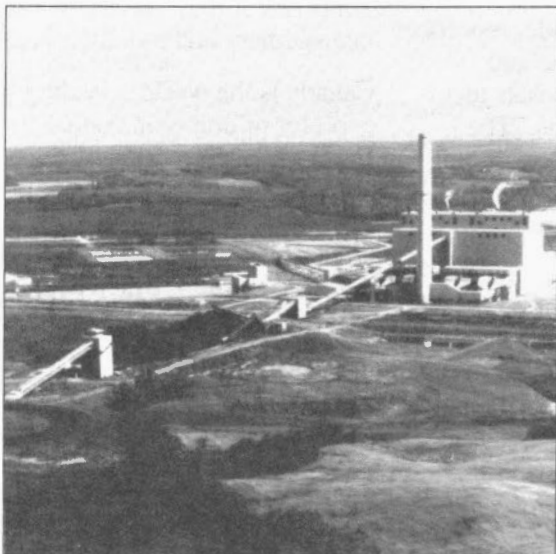
Other notable projects included coordinating Canadian submissions to the NEA questionnaire on electricity and the nuclear fuel cycle, and participating in planning for negotiations of Canada-USSR and Canada-China Nuclear Cooperation Agreements.

Branch officials serve as expert representatives on several international committees including the NEA Steering Committee; the Fuel Cycle Committee, which oversees the NEA's economic and technical studies; the NEA Uranium Group, which, with the International Atomic Energy Agency (IAEA), produces the authoritative biennial assessment of the world uranium supply; and the Steering Committee for the World Energy Conference's Triennial Survey of Energy Resources.

Oil and Emergency Planning Branch

The branch monitors supply, demand, price levels and related issues in both the

TransAlta Utility Corporation's 754-megawatt Keephills coal-fired electric generating plant, 75 km west of Edmonton.



international and domestic oil markets, with particular emphasis on Canadian developments. The branch also provides advice on processing, transportation and markets in the oil and natural gas industries; and represents Canada on the International Energy Agency's (IEA) Standing Group on the Oil Market.

Branch staff work with government agencies, especially the Energy Supplies Allocation Board (ESAB), to develop and test plans for dealing with a national emergency; and **represents Canada on the IEA Standing Group on Emergency Questions.**

During the year, the branch provided advice on the oil trade, concentrating on Canadian markets. In collaboration with other departments, the branch prepared a report on the management of used and waste lubricating oils in Canada. It also provided advice on the effect of lead phase-out on the oil refining industry, and upgraded ongoing reports monitoring crude oil, petroleum products and natural gas liquids markets.

Emergency staff completed work on proposed amendments to the *Energy Supplies Emergency Act*, and prepared a report on establishing emergency oil stocks. The branch negotiated Memoranda of Understanding with federal and provincial agencies, and conducted provincial orientation sessions for ESAB emergency standby organizations.

Canada participated in IEA and the North Atlantic Treaty Organization (NATO) emergency oil sharing systems, and signed a Memorandum of Understanding with the U.S. Department of Energy for the protection of vital points. The branch made plans for establishing and operating the natural gas and electric power components of the National Emergency Agency for Energy (NEAE), and began to formulate EMR responses to major national disasters such as earthquakes.

PROGRAMS SECTOR

The sector assists consumers, industry and government in the responsible acquisition and use of energy sources. Recently, the sector was reorganized to permit a more effective response to client needs and departmental program requirements.

The Programs Sector is now in charge of two new initiatives: Energy Efficiency and Diversity and the Canadian Exploration Incentives Program. It is also phasing out three programs: the Canadian Exploration and Development Incentive Program, the National Conservation and Alternative Energy Initiative and the Petroleum Incentives Program.

Energy Efficiency and Diversity

The Energy Efficiency and Diversity (EED) initiative, announced in September, is designed to enhance Canada's industrial competitiveness, physical environment and energy security through efficiency in energy consumption and diversity of energy sources and technologies. EED replaces former energy conservation, renewable energy and alternative transportation fuels programs. For each of the next four fiscal years, EED will spend some \$35 million on carefully targeted R&D and information technology transfer.

The program undertook a wide range of technology development and transfer activities designed to further EMR's commitment to cleaner, more efficient energy sources.

Energy Diversity

In 1988-89 approximately 300 R&D projects involving bioenergy, active and passive solar, small hydro (<15 millawatts), geothermal, wind and photovoltaic technologies were under way. Contracted out to universities, scientific establishments and the private sector, these projects accounted for approximately \$11 million in expenditures. Last year 88 projects, several major

publications and information transfer activities were completed. Also published were a new series of fact sheets for industrial and institutional users, and overviews of renewable energy Research, Development and Demonstration Projects.

Bioenergy Technology Development.

Bioenergy projects figured prominently in the year's technical activities, which included the conversion of biomass to transportation fuels, new fermentation techniques and the reduction of emissions from combustion systems. The sector completed a training manual for the residential wood-heating industry, which is now being used by professional groups. In addition, an integrated bioenergy data base was established to provide more technical information to the scientific community and the private sector.

New Energy Supplies Technology Development.

The sector continued to register advances in photovoltaic, solar, wind and small-hydro technologies. Progress was also made in passive solar energy devices such as high-performance windows. To increase consumer confidence, several activities were initiated in the fields of safety, product performance and installation standards. The sector also launched several new joint ventures with international agencies and domestic energy organizations, thus improving both general cooperation and Canada's reputation for industrial expertise.

Energy Efficiency

EMR is actively encouraging the development and use of technologies, services and products that will increase energy efficiency, particularly in the industrial sector.

Industry Energy Research and

Development Program (IERD). IERD helps to develop energy-efficient products and processes for industry. Normally IERD contributes less than half of a project's

eligible costs. During the year, IERD provided \$5 million to 25 projects. Of particular interest were projects that developed large industrial motors, sodium sulphur batteries capable of powering electric vehicles and impulse drying for newsprint machines using electrically heated press rolls. These projects will reduce Canada's use of fossil fuels and help improve our competitiveness in world markets.

Accelerated Capital Cost Allowance -

Class 34 Program. This program permits a three-year write-off on eligible assets that either save energy or use a renewable source of energy. Since it began in 1976, about \$220 million in eligible investments have been made, resulting in annual energy savings equivalent to 1 100 000 cubic metres of oil.

Earth Energy Systems. EMR developed and published Canadian standards for the performance and installation of ground-source heat pumps. In the Maritimes, three information seminars on the technology were given to buildings designers. In Ottawa, an EMR representative led a technical session at the American Society for Heating, Refrigeration and Air Conditioning Engineers' international conference. And in Manitoba, three projects are being monitored and design manuals are in development.

Appliance Energy Efficiency Initiative.

Canada's Energuide appliance labelling program requires that all kitchen and laundry appliances, commonly referred to as white goods, manufactured domestically and imported into Canada be tested according to agreed-upon test procedures and the energy use marked on the product via an Energuide label.

While our major competitors (notably the United States) have established standards which stipulate maximum energy consumption levels for products (legislated energy performance standards), Canada has

relied on the Energuide Program to inform consumers on the energy consumption of the various products.

Improved appliance efficiency could have significant energy, economic and industrial benefits for Canada. Estimates suggest that, given current technology, more than 500 megawatts of electrical capacity could be economically avoided by 1995 if refrigerators sold in Canada met the 1990 U.S. standards. In aggregate, economic conservation potential from the improved efficiency of kitchen and laundry appliances might be as high as 175 000 barrels of oil equivalent per day.

The sector distributes the *Consumer's Guide to Buying Energy Efficient Appliances and Lighting* in approximately 400 point of purchase displays at major appliance dealers across Canada.

The Programs Sector, the Government of Quebec's Bureau des Economies de l'Energie (BEE), the Ontario Ministry of Energy (OME), the Manitoba Department of Mines and Natural Resources, the Canadian Electrical Association, the Canadian Appliance Manufacturing Association and the Consumers' Association of Canada have all been working to examine the status of Canadian appliance energy efficiency, the possible effect of U.S. legislation on the structure and competitiveness of our industry, and the federal government's role in efforts to improve appliance energy efficiency.

Transportation Energy R&D

This \$4.7 million dollar program carries out research activities in five areas.

The **Gaseous Fuels Research Program** runs in cooperation with the natural gas and propane industries. This year the program made good progress in three areas: electronic fuel-injection equipment for motor vehicles; refuelling nozzles for use in harsh Canadian conditions; and truck and bus engines capable of running on natural gas.

The **Methanol In Large Engines Program** conducts field trials of methanol engines in trucks and buses in several Canadian and U.S. locations. It is of great interest to countries and manufacturers throughout the world, more and more of which are looking to reduce their dependence on petroleum and adopt new emission standards for heavy-duty vehicles.

The **Hydrogen and Electrochemistry Program** develops technologies for use in two main fields: the production of hydrogen from electrolysis and the manufacture of fuel cells and high-energy-density batteries for transport applications.

In 1988-89 the **Transportation Energy Research Assistance Program** was launched to help develop innovative proposals from industry and universities.

This year the **Transportation Efficiency R&D** program investigated fuel consumption and emissions from heavy-duty engines operating on future diesel fuels. Fuel consumption in automobiles was also assessed and forecast.

Demand Side Management Initiative

This new initiative, a cooperative venture with the Canadian Electrical Association (CEA), focuses on encouraging electrical utilities to adopt Demand Side Management (DSM) technologies and techniques. 1988-89 activities included documenting the status of DSM in Canada and designing an interactive electronic data base.

Independent Power Production (IPP) Initiative

Still in development, this new initiative will concentrate on lowering barriers to independently produced power. 1988-89 activities focused on identifying the present role of IPP in utility resource plans and planning a barrier reduction program.

EED Technology Export Initiative

This initiative aims to increase the use of Canadian energy efficiency and diversity

(EED) products, services and technologies throughout the world. Working closely with External Affairs Canada and the Canadian International Development Agency, EMR will develop an information network to integrate the department's expertise with current conditions in the international EED industry.

EMR believes that significant, unexploited opportunities exist for EED products and services worldwide. Export sales could strengthen the EED industry in general, and the renewable energy industry in particular, thereby providing Canadians with a greater range of energy options for the future.

Energy Performance Contracting (EPC)

In this innovative business arrangement energy service companies are reimbursed for energy retrofit projects solely on the basis of resultant energy savings. Through EPC, federal departments have access to a wide range of privately performed energy retrofit projects including initial studies, staff training and results monitoring. All these are available at no additional cost to the client department's present energy bill.

Pro-Trucker

This very successful information program for energy efficiency in the trucking industry, conducted in the Atlantic Provinces, Quebec, and Manitoba, produced and distributed the first edition of *Driving Edge*, the national Pro-Trucker newsletter, to more than 5000 truck drivers across Canada. It also sent a program evaluation survey to all truckers and trucking companies who participated in Pro-Trucker seminars.

Driver Outreach Program

The Driver Outreach Program sponsored fuel economy events and displays at several locations, and distributed tens of thousands of pieces of program literature, including the popular *Car Economy Book*.

Transportation Energy Management Guide

EMR and the Canadian Federation of Municipalities made plans to publish a *Transportation Energy Management Guide for Municipalities*.

The Canadian Industry Program for Energy Conservation

Industry-organized and government-assisted, this program has a core network of 14 voluntary energy management task forces charged with promoting industrial energy efficiency. In 1987-88, industry reported a one-year energy-efficiency improvement of 2.7 per cent, representing the equivalent of 67 million barrels of oil. Although the 1988-89 figures will not be available until the fall of 1989, they are expected to be comparable to those of the previous year, since all task forces are performing well.

Commercial/Institutional/Agricultural Task Forces

During the year, the six commercial-institutional-agricultural task forces held 16 awareness sessions with each of their sectors, provided display units for nine conferences, presented 18 seminars and workshops, published four energy management manuals, printed five newsletters, made several successful energy management awards and produced six video-taped presentations.

FEDSAVE Energy Management Program

The FEDSAVE program helps federal departments to become more energy efficient. Federal energy consumption has declined by 29 per cent over the past 10 years, representing a total saving of some \$1.1 billion since 1975, and a 1987-88 cost avoidance of \$250 million.

All federal government departments and agencies have been asked to participate by showing leadership in two important areas:

- reducing federal energy consumption a further 10 per cent over the next 10 years, 1985-86 as the base year, and
- doubling the use of alternative transportation fuels by 1992-93.

Natural Gas for Vehicles Program

Using resources from a fund created by the Alberta Natural Gas producers, this program provided 3348 incentive grants of \$500 to encourage the conversion of motor vehicles to natural gas, and disbursed \$500 000 for constructing public refueling stations. The network of public refueling stations now stands at 115. Recently, the program received approval to extend the \$500 grant program to March 31, 1991 in Alberta and provinces to the east.

National Conservation and Alternative Energy Initiative (NCAEI) Wind-Down Activities

1989 was the first of two wind-down years for NCAEI, which was created in early 1985.

R-2000

R-2000 is part of the Super Energy Efficient Home Program. In 1982, the Government of Canada and the Canadian Home Builders' Association (CHBA) decided to acquaint Canadian builders with the techniques for constructing and marketing super-energy-efficient, or R-2000, houses. At the beginning of 1988-89, CHBA assumed total responsibility for program delivery, leaving EMR to manage overall operational activities. In addition to producing a national R-2000 marketing prospectus and a marketing manual for the regions, staff began work on a *Consumer's Guide to R-2000*, which will supersede previously published materials.

New education and training courses were given to address ventilation system design and installation. Through the Quality+ Housing Program, R-2000 and other energy-efficiency literature was provided to approximately 125 Canadian educational institutions.

EMR continued to test heat recovery ventilators at the Ortech International (formerly Ontario Research Foundation) facilities, concentrating on units suitable for cold climates. The program updated various reports on energy use and equipment performance, while monitoring northern heat recovery ventilation systems and Whitehorse's unique R-2000 multiple-unit building.

Energy Advisory Service (EAS)

EAS encourages Canadians to improve the energy efficiency of their homes through a consumer information program conveyed by booklets, folders, magazine and newspaper articles, and most recently, home video.

To maximize the effectiveness of this information program, EAS has aimed direct mail campaigns at specific audiences, such as energy-conscious home buyers who are likely to renovate, or do-it-yourselfers apt to include energy-efficiency measures in their plans.

In cooperation with energy-efficiency materials manufacturers, the Contractors' Warranty Corporation and public utilities, EAS used the Supermarket Infocentre Network to distribute materials promoting the benefits of energy efficiency. Working closely with manufacturers and the Canada Mortgage and Housing Corporation, the service maintained a Point-of-Purchase Display program in building-supply and hardware stores; and tested a similar program featuring the booklet, *Consumer's Guide to Energy Efficient Appliances and Lighting*, in appliance departments of major retailers.

In cooperation with the Ontario Ministry of Energy, EAS published two additional consumers guides: *Buying an Energy Efficient Resale Home*, and *Windows and Doors*. Heavy consumer demand occasioned a booklet on heat pumps. And *Keeping the Heat In*, EMR's classic book on home energy retrofit, was completely revised and updated.

EAS launched the sale of EMR's home energy videos through a private-sector distributor. To ensure ease of access, EMR offered copies of all video materials to public libraries across the country.

In all, EAS distributed more than four million pieces of informational material. Strong evidence, based on evaluations of similar campaigns, suggests that a high proportion of those obtaining home energy information put the recommendations into effect in their own homes.

Development and Demonstration: Residential Sector

EMR developed and tested house assessment methodologies, which the National Energy Conservation Association plans to use in training home retrofit contractors. In cooperation with the Government of Manitoba, EMR conducted field tests in the Winnipeg area on the energy-efficient retrofit of residential gas furnaces. Other projects studied the performance of materials and the energy effects of their installation. In addition, the department published technical manuals and test method standards; and carried out regional technology demonstrations, including one in which several Quebec apartment buildings were used to show the merits of making energy conservation measures standard practice in the building renovation industry.

Technology Transfer and Industry Training

In 1988-89 the "House as a System" series of technical training courses began. Government skills-upgrading agencies funded training for current practitioners. And initiatives with vocational and trade school systems lent support to newcomers in the residential retrofit trades.

EMR created additional courses to teach the skills required to sell problem-free retrofit services, and developed house assessment tools to help tradespeople identify energy-

efficiency opportunities. Other ventures made institutional landlords and utilities aware of the upgraded skills package available to their subcontractors.

Remote Community Demonstration Program (RCDP)

RCDP provides financial support and advice to 370 remote communities and their energy supply agencies, thus enabling them to adopt appropriate alternative energy supply systems and energy conservation methods. To illustrate how energy efficient technologies can benefit Canada's remote regions, the program carried out practical demonstration projects and information transfer activities.

The program administered 25 demonstration projects, 22 of which are operational. It completed monitoring on 16 projects, and released reports on eight.

RCDP gave workshops, seminars and training programs in most regions, focusing on energy-efficient construction technologies, wood heating and small power systems to be interfaced with diesel grids. To back up these activities, the program developed manuals and slide shows, which have now been widely distributed.

Transportation Energy Demonstrations

To help commercialize promising technologies, EMR supported several demonstrations.

- With assistance from EMR and Union Gas, the transit authority in Hamilton, Ontario has been running natural gas buses in normal revenue service. This test has generated interest from transit properties throughout North America.
- A fleet of Ford's flexible-fuel vehicles has been operating in several locations across Canada. The automobiles can use any combination of methanol, ethanol and gasoline in a single fuel tank.
- A fuel management system for fishing vessels produced energy savings in east coast vessels.

- The department funded construction of an innovative fishing trawler hull that reduced drag and hence fuel consumption.
- Several gas utilities, operating at more than 200 sites in Canada, are demonstrating residential vehicle refueling compressors to establish the viability of refueling natural gas vehicles at home. EMR supported initial testing of these compressors.

ENERDEMO Program

A nationwide program promoting energy conservation and alternative energy, ENERDEMO helped to commercialize products, create market opportunities, increase technical know-how and develop financing tools. ENERDEMO is now successfully demonstrating commercial applications of photovoltaic, solar, wind, mini-hydro, ground source heat pump and advanced energy conservation technologies. During the year, ENERDEMO continued work on about 140 demonstration projects, and contributed \$4 million to public groups and corporations across Canada. On March 31, 1989

ENERDEMO ended, entering into a one-year wind-down period.

Part of the ENERDEMO program, the BIODER subprogram, demonstrated the conversion of biomass to energy. During the year, federal funding of over \$1 million supported 30 new and ongoing projects and demonstration studies.

Major BIODER projects demonstrate more efficient waste combustion, the pilot plant production of liquid and gaseous fuel from peat and the improved environmental performance of biomass-fired heating and cogenerating plants. BIODER highlights included:

- Demonstration of grain waste cofiring in Ontario Hydro's Thunder Bay thermal generating station.
- Adaptation of the nonconsolidating biomass feeder to a large hog boiler in the pulp and paper industry.
- Cosponsoring an energy-from-municipal-solid-waste conference with the B.C. Regional Office and B.C. Hydro in Vancouver.

*Wind research
test site in
Lethbridge,
Alberta*



Alternate Energy Development Program

This joint Canada - P.E.I. program aims to stimulate the use of biomass (primarily wood) in the residential, industrial and commercial-institutional sectors so as to displace more expensive fuels, create jobs and support the local economy. Part of an Economic and Regional Development Agreement with Prince Edward Island, this program administered 35 projects, to which EMR contributed \$1.4 million. The program ended on March 31, 1989, with a one-year allowance to complete previously approved projects.

Canadian Exploration Incentive Program (CEIP)

CEIP became effective for oil and gas companies on October 1, 1988; and for mining companies on January 1, 1989. CEIP is designed to assist junior mining and oil and gas companies to raise new equity through the issuance of flow-through shares, enabling them to carry out their exploration activities. Explorers will receive a 30 per cent cash incentive for eligible exploration expenses. Early indications suggest industries have responded favourably to the program.

Canadian Exploration and Development Incentive Program (CEDIP)

CEDIP was established on March 25, 1987. Introduced as a temporary measure, the program offered assistance to the oil and gas industry in a time of falling prices, and encouraged industrial activity and investment.

In 1987-88 CEDIP paid out \$344 million. During 1988-89 CEDIP received 16 000 applications from 400 applicants, and will pay incentives totaling \$625 million. On October 1, 1988, the CEDIP incentive rate dropped from 33 $\frac{1}{3}$ per cent to 25 per cent. The rate was to drop to 16 $\frac{2}{3}$ per cent on July 1, 1989, and to 0 on December 31, 1989.

On April 27, 1989 CEDIP was terminated under the federal budget. There will be a grandfathering regime for prescribed activities under way as of April 27, 1989, and for those undertaken to satisfy obligations under agreements in writing signed before 2200 h EDT on April 26, 1989.

Petroleum Incentive Program

The program has gone through an orderly phase-out. Final reconciliations for major activities are being conducted.

CANADA OIL AND GAS LANDS ADMINISTRATION (COGLA)

COGLA was established in 1981 by a Memorandum of Understanding (MOU) between the Minister of Energy, Mines and Resources and the Minister of Indian and Northern Affairs. It reports to EMR for lands south of 60°, the west coast offshore and Hudson Bay. For areas north of 60°, with the exception of those in Hudson Bay, it reports to Indian and Northern Affairs.

COGLA regulates oil-and-gas exploration, development and production on frontier lands not under joint-management accord legislation. COGLA ensures that these activities are conducted in a manner that promotes worker safety, effective resource conservation, environmental protection and fair access by Canadians to the benefits and opportunities arising from hydrocarbon activities. COGLA also advises the Minister with respect to the exercise of his responsibilities and authority under *Accord Implementation Acts*.

In July, Parliament passed legislation to implement the Canada - Nova Scotia Offshore Petroleum Resources Accord. Upon proclamation of the legislation, an independent offshore board is to assume the legal responsibility for managing the Nova Scotia offshore on behalf of both governments.

Off Newfoundland, Petro-Canada continued its delineation program in the Terra Nova oil discovery area by drilling and testing two more wells. Both the Terra Nova C-09 and Terra Nova E-79 wells encountered good oil-bearing reservoirs and, when tested, flowed oil at significant rates. In addition, Husky drilled two delineation wells, Whiterose E-09 and Whiterose A-90, within the Whiterose Significant Discovery Area. When tested, Whiterose E-09 flowed oil at

good rates. The Whiterose A-90 well was abandoned by the operator without testing.

In the North, Gulf completed its delineation program with two additional wells at the Amauligak oil discovery area in the Beaufort Sea. Since the Amauligak discovery of 1984, six delineation wells have been drilled. Gulf also drilled one exploratory well just west of the Amauligak field. When tested, the well flowed oil at good rates: up to 1059 m³/day.

In the Arctic Islands, for the fourth year in a row, Panarctic undertook seasonal production and transportation of oil from its Bent Horn Development project. There were two tanker shipments of oil: one in August, the other in September. About 1700 m³ of oil were sold to the Northwest Territories Power Corporation power-generation facility at Resolute. Additional oil was produced and stored at the Bent Horn facility in preparation for the 1989 summer shipping season.

In April, the governments of Canada and Nova Scotia agreed to place a moratorium on exploration activity on Georges Bank (off Nova Scotia) until the year 2000. An independent panel, to be established by July 1, 1996, is to conduct a public review of the environmental and socioeconomic effects of oil and gas exploration and drilling on the Bank and is to report its findings to the ministers of Energy for Canada and Nova Scotia on or before July 1, 1999.

COGLA administered several major projects under the Interdepartmental Panel on Energy R&D (PERD). It initiated research projects on caisson-retained drilling platforms, evacuation technology, ice-structure interaction, pipeline protection, wave effects on the seabed and environmental design criteria.

During the year, COGLA and the Institute of Sedimentary and Petroleum Geology in Calgary completed a hydrocarbon

assessment of the Mackenzie Delta - Beaufort Sea basin. Oil and gas resources in the basin were estimated at 1.13 billion m³ of oil and 1.9 trillion m³ of natural gas.

The Environmental Studies Management Board was established under the *Canada Petroleum Resources Act* to advise the ministers of EMR and Indian and Northern Affairs on the operations of the Environmental Studies Research Funds (ESRF). Through a levy on oil and gas interest holders, the program supports environmental and social studies related to oil and gas exploration and development on frontier lands. In April and July, the board met to prepare a budget and levy rates for 1988; to develop a set of by-laws for the board's operation; to design the ESRF Evaluation/Planning Study; and to discuss the reorientation and future operation of the ESRF. At board meetings in January and March, a budget and study program for 1989 were established.

In September the governments of the Northwest Territories and Yukon signed agreements with the Government of Canada on the negotiating principles for a Northern Accord. The Canadian government agreed in principle to negotiate agreements on a phased transfer to the territorial governments of the administrative and legislative powers to manage oil and gas resources in northern onshore areas. The agreements in principle also provide for a commitment to future sharing between the federal and territorial governments of the legislative responsibility for regulating and managing offshore northern oil and gas resources. After sufficient experience with significant offshore development, the form of sharing will be completed. During the year, COGLA consulted fully with territorial governments on all regulatory decisions pertaining to onshore and offshore hydrocarbon activities.

During 1988 COGLA completed consultations with other government departments, the oil and gas boards, and the industry on guidelines for the treatment and disposal of waste from offshore hydrocarbon exploration and production. In January COGLA and the Canada-Newfoundland Offshore Petroleum Board released the **Offshore Waste Treatment Guidelines**.

In December 1988, two sets of diving regulations came into effect: the Canada Oil and Gas Diving Regulations, developed by COGLA and industry; and the parallel Newfoundland Offshore Area Petroleum Diving Regulations, developed in consultation with the province. These regulations address issues such as the technical and safety aspects of diving equipment and offshore diving operations.

The Canadian Standards Association (CSA) published preliminary standards for design criteria and loads, foundations, steel structures, concrete structures and sea operations; and COGLA and CSA set up a program to verify the technical and practical aspects of these standards.

Administration Program

The Administration Program ensures the effective management of departmental programs and central support services.

It has three sectors:

- Corporate Policy and Communications
- Finance and Administration
- Human Resources

CORPORATE POLICY AND COMMUNICATIONS SECTOR

Corporate Policy and Communications assists the Minister, Deputy Minister and the department's executive in directing and coordinating EMR policies and operations and complying with the department's environmental responsibilities.

The sector provides corporate policy, planning and operations analysis, advice and support and administers EMR's responsibility for environmental assessment. It helps the department develop cohesive responses to government priorities.

The sector consists of five branches: Communications, Strategic Policy and Plans, Cabinet Affairs, Corporate Affairs and the Office of Environmental Affairs.

Communications Branch

In consultation with the private sector and the provinces, the branch produced and distributed announcement packages and provided media relations support on four megaprojects: Hibernia; the Lloydminster upgrader; the OSLO oil sands project; and the Vancouver Island Pipeline. Communications support was also provided for announcement of changes to federal electricity export regulations.

The branch produced posters, booklets and buttons for Environment Week, using a dramatic and unified design to illustrate EMR's concern.

Several conferences received communications support, including Mineral Outlook, the

GSC's current Activities Forum and Cordilleran Roundup and the National Conference on Geographic Information Systems.

The earthquake in the Saguenay region required news conferences, response to public and media inquiries and preparation of articles and briefing notes.

Advertising support was provided for Environment Week, the CEIP information campaign and an information program for building contractors and suppliers. As well, public notices promoted various exhibits, seminars and special events and provided a channel for ministerial messages.

EMR participated in 110 exhibits in 1988-89 and produced 18 new audio visuals.

During the year, Communications Branch prepared 93 news releases and 129 speeches and responded to 1800 written and 4000 telephone inquiries. It answered 85 408 requests from the public for publications by mailing out more than 1.7 million publications.

A task force was established within the branch to support the 14th Congress of the World Energy Conference, to be held in Montreal September 17-22, 1989. Planning and research work was undertaken for a 360° multi-media theatre inside the Canada Pavilion showing an eight-minute production on Canada's energy story. The pavilion would feature a range of exhibits on energy and technology to emphasize and help market Canada's knowledge and expertise.

Fiscal 1988-89 was the first year the branch operated under a new structure. The Strategic Analysis and Coordination Division increased efforts to integrate communications considerations into departmental decision-making, in keeping with the new federal communications policy. In addition to strategic notes on a variety of issues, the division produced a framework through which

planning for sectoral communications could take place. The Client Services Division offered communications advice and planning to the sectors, who under the new policy assumed more responsibility for their own communications, while the branch developed departmental or corporate communications. Regional Communications Division played a similar role outside of the National Capital Region with regional clients and contributed local intelligence to strategic planning on specific issues.

Strategic Policy and Plans Branch

Strategic Policy and Plans Branch (SPP) provides analysis and intelligence to the Minister and senior managers to assist in articulating a corporate policy agenda that is consistent with government priorities.

In 1988-89, the branch arranged a series of strategic planning sessions and supported those sessions through key analytical documents. It participated in developing a consensus on the direction of the Canadian socioeconomic environment which helped

senior management identify upcoming priorities and strategies for the department.

The branch also played an important role in preparing the department for a series of transitions, including ministerial and parliamentary changes and changes in departmental senior management.

The branch participated in a government-wide review of federal science and technology coordinated by the Ministry of State for Science and Technology. SPP advised senior management on a wide range of horizontal issues such as regional development, federal-provincial relations, and public service and human resource matters. It also analysed provincial budgets and Throne Speeches.

The branch offered corporate-level coordination services to senior management and to the Minister with respect to domestic and foreign travel.

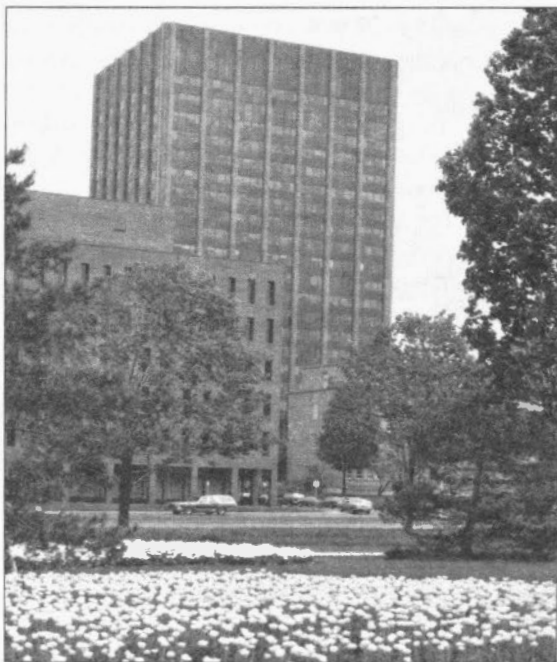
Cabinet Affairs Branch

This branch helps the Minister and senior management secure Cabinet approval or confirmation for EMR initiatives and evaluates other departments initiatives with respect to their potential effect on EMR's ministerial and departmental interests and activities.

The branch provides the Minister and senior management with intelligence, analysis and advice in the form of briefings on Cabinet matters and other issues.

It coordinates and maintains effective liaison with departments and central agencies and advises the Deputy Minister and the Associate Deputy Minister on EMR's compliance with, and implementation of, Cabinet decisions. This Branch also produces the Profile of EMR-Organization, which provides a general overview of the major structures and responsibilities of the department.

EMR headquarters building in Ottawa.



Corporate Affairs Branch

The Corporate Affairs Branch offers information, analysis and advice on operations and management issues. It communicates with central agencies and is the corporate focal point for parliamentary affairs. The branch also evaluates programs, conducts internal audits and offers management consulting services.

The branch successfully coordinated the department's effort to enter into an **Increased Ministerial Authority and Accountability MOU with the Treasury Board Secretariat**. This MOU enhances and facilitates good management by removing disincentives to economy and increasing managerial latitude in managing resources. The branch also coordinated the setting in place of a one-program structure, collapsing the previous three programs into one to simplify and integrate departmental operations. To complement these two exercises, the branch outlined a new accountability regime within the department, wrote a Management Profile outlining departmental practices in planning, monitoring and accounting for results, and coordinated the development of a Management Action Plan to strengthen management practices and systems.

Corporate Affairs Branch made independent and objective evaluations of the following programs: Administration of the *Canada Explosives Act* and Regulations and the Canadian Explosives Research Laboratory; Coal Utilization Program; Energy Emergency Planning; and ENERDEMO, Phase 1. Evaluation assessments, that is evaluation planning phases, were also completed for the following programs: Canada Centre for Remote Sensing; Canada Centre for Mineral and Energy Technology; and the National Conservation and Alternative Energy Initiative.

The branch does independent and objective audits of departmental organizations, programs, functions and systems. This year it reported on the management of the Federal-Provincial Mineral Development Agreements, the management of the Canadian Exploration and Development Incentive Program (CEDIP) and the controls of CEDIP's computer system. The branch also assessed the management processes and controls for the management of inventory, security, telecommunications and payroll.

Through its Management Consulting Services, the branch offered consulting services, including a mandate and organization review of the Programs and Energy Sectors, and of the Information Management Branch in the Finance and Administration Sector. It analysed and made recommendations to resolve paperburden issues facing the department's scientific and technological sectors. In addition, Management Consulting Services provided support to the departmental Increased Ministerial Authority and Accountability (IMAA)-One Program initiatives such as the EMR Performance Summary, the Management Action Plan and the Management Profile.

Office of Environmental Affairs

The Office of Environmental Affairs is the main contact point in the department for cross-sectoral environmental issues. It provides both policy and technical advice on environmental and related socio-economic matters to senior management, EMR branches, other federal and provincial governments, industry and the public. It has specific responsibility for carrying out the Federal Environmental Assessment Review Process within EMR.

1988-89 was marked with considerable action in the area of environment-economy integration. The Office made significant progress in developing an environmental policy framework for the department. In

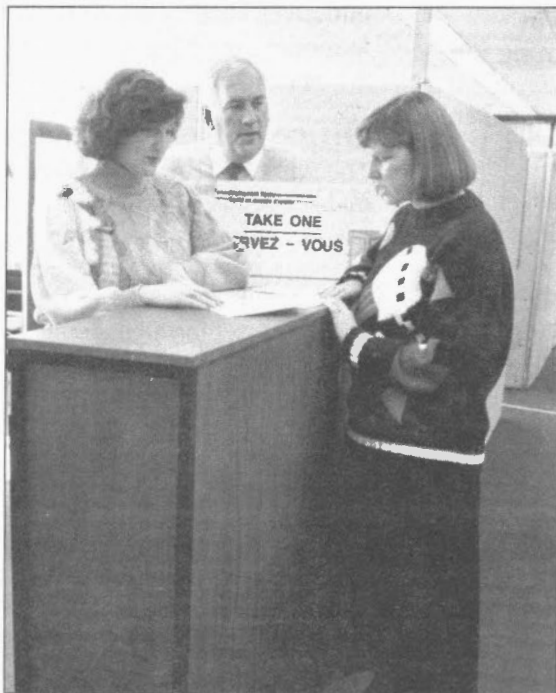
order to assist industry in understanding the importance of environment-economy integration, talks were given to various groups on environmentally sustainable economic development, the greenhouse effect and energy environment integration at the policy level.

The Office also made a major effort to communicate EMR's environmental awareness. For Environment Week, a brochure, poster and button carrying a common theme and entitled *It's the only one we've got* were produced and received popular support. For the Toronto Conference on the Changing Atmosphere, specialty notes were produced and distributed to an international audience. In addition, the EMR Action Plan entitled "EMR's Commitment to the Environment" was released publicly by the Minister in June to help focus departmental effort on addressing environmental issues. To ensure better representation of the public's concerns in designing federal screening procedures, the Office revised the

Environmental Assessment Review Process (EARP), incorporating new federal government policies, and circulated the results for public review. Screening procedures within EMR were tightened during the year.

On the scientific front, the Office is still involved with Long-Range Transboundary Air Pollution Program and has broadened its involvement, both nationally and internationally by becoming involved with the Intergovernmental Panel on Climate Change and with the Federal-Provincial Task Force on Energy and the Environment. Also the Office has supported, with the National Research Council and the Canadian Housing and Mortgage Corporation, the development of a model for assessing generic building construction methods for potential radon intrusion into homes.

*Employment Equity
Office, headquarters.*



FINANCE AND ADMINISTRATION SECTOR

Finance

The department expended \$796 million for the Energy Program, \$365 million for the Minerals and Earth Sciences Program and \$53 million for the Administration Program. Offsetting revenues were \$170 million and total net expenditures were \$1044 million, including \$130 million for purchased goods and services.

Information Technology

The information technology function was downsized from 119 to 56 person-years, and the three divisions with responsibilities in the area were merged into one branch. Work began on an electronic network for the Executive Committee, and on consolidation of the department's central mainframe computers.

Assets Management and Administrative Services

The sector's administrative functions were realigned to reflect new priorities, particularly the need for greater emphasis on planning and management of capital assets, and to consolidate the management of security and occupational health and safety.

In September, Treasury Board approved the department's Long Range Facilities Plan, which included \$30 million over five years for essential health-and-safety and urgent management projects within the special-purpose facilities under EMR's custody.

The sector began to plan for implementing the Workplace Hazardous Materials Information System legislation, which came into effect in October. Implementation of the Government Security Policy continued as planned.

Information Management

Conversion of records to the departmental subject classification system was completed in Mineral Policy Sector, Human Resources Sector, the Office of Energy Research and Development and the Corporate Executive. The branch continued to build the corporate automated Information Management System (IMS) data base, and maintained existing bilingual information inventory and indexing systems.

FINANCIAL SUMMARY 1988-1989

	Operating Expenditures	Capital Expenditures	Grants and Contributions and Transfer Payments	Total
	(thousands of dollars)			
Administration Program				
Direction and Coordination	19,497	524		20,021
Finance and Administration	25,798	2,028		27,826
Human Resources Management	4,776	60		4,836
	<u>50,071</u>	<u>2,612</u>		<u>52,683</u>
Less: Revenues for Computer Services	<u>7,280</u>			<u>7,280</u>
TOTAL COSTS OF PROGRAM	<u>42,791</u>	<u>2,612</u>		<u>45,403</u>
Minerals and Earth Sciences Program				
Mineral Policy and Programs	12,840	310	17,467	30,617
Administration of the Canada Explosives Act	1,693	73		1,766
Mineral and Energy Technology	66,151	6,682	1,299	74,132
Geological Surveys	94,197	6,781	5,525	106,503
Polar Continental Shelf	6,478	5,917		12,395
Remote Sensing	20,751	10,006	19,410	50,167
Surveying and Mapping	59,653	7,402	277	67,332
Program Support	<u>18,049</u>	<u>3,013</u>	<u>663</u>	<u>21,725</u>
TOTAL COSTS OF PROGRAM	<u>279,812</u>	<u>40,184</u>	<u>44,641</u>	<u>364,637</u>
Energy Program				
Energy Policy	11,672	3,500	578	15,750
Conservation and Renewable Energy	48,837	3,638	18,329	70,804
Energy Commodities	16,064	274	17,490	33,828
Petroleum Ownership, Control & Incentives	7,634			7,634
Administration of Frontier Oil & Gas Lands	5,489	54	48,973	54,516
Program Support	3,502	242	674	4,418
Canadian Exploration & Development Incentive	<u>8,629</u>	<u>316</u>	<u>602,146</u>	<u>611,091</u>
	<u>101,827</u>	<u>8,024</u>	<u>688,190</u>	<u>798,041</u>
Less: Receipt of Levies pursuant to Section 65 of the Petroleum Administration Act			<u>2,345</u>	<u>2,345</u>
TOTAL COSTS OF PROGRAM	<u>101,827</u>	<u>8,024</u>	<u>685,845</u>	<u>795,696</u>
TOTAL EXPENDITURES FOR THE DEPARTMENT	<u>424,430</u>	<u>50,820</u>	<u>730,486</u>	<u>1,205,736</u>

HUMAN RESOURCES SECTOR

In 1988-89 the sector completed integrating strategic human resources management planning with the department's strategic planning process, and fully supported the Executive Committee in developing EMR's Strategic Human Resources Management Plan.

The sector implemented three programs to promote the revitalization of EMR's scientific community: the Emeritus Research Scientist Program, the Part-Time and Term Employment after Retirement Program, and the Treasury Board Person-Year Pool Incentive. Scientific sectors of the department are making good use of these programs and interest in them is expected to grow.

The sector made significant progress in increasing francophone representation in the department. In 1988-89, Management Category's representation climbed to 20.5 per cent and the Scientific and Professional Category's representation to 17 per cent.

To improve the timeliness and accuracy of personnel information, and to increase operational productivity, the sector initiated a phased approach to developing an integrated human resources information system. An automated generic classification system was also developed to help reduce the time required to classify positions.

Crown Corporations and Agencies

Regional Offices

CROWN CORPORATIONS

Atomic Energy of Canada Limited
Petro-Canada
Petro-Canada International Assistance
Corporation

AGENCIES

Atomic Energy Control Board
Board of Examiners for Canada Lands
Surveys
Canadian Permanent Committee on
Geographical Names
Energy Supplies Allocation Board
National Energy Board
Petroleum Monitoring Agency

REGIONAL INFORMATION OFFICES

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V6B 1R8
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CALGARY, Alberta
T2P 3M2
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7th Floor
119-4th Avenue South
SASKATOON, Saskatchewan
S7K 5X2
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213 Notre Dame Avenue
WINNIPEG, Manitoba
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TORONTO, Ontario
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200 René-Lévesque Blvd. West
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H2Z 1X4
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835 Champlain Street
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E1A 1P6
(506) 388-6080

Prince Edward Island
 Brecken Yates Bldg.
 Harbour Side No. 1
 CHARLOTTETOWN, P.E.I.
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 (902) 566-7373

Nova Scotia
 Bank of Montreal Tower
 5151 George Street
 Room 503
 HALIFAX, Nova Scotia
 B3J 1M5
 (902) 426-2167

Newfoundland
 215 Water Street
 Suite 301
 P.O. Box 65
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MINERAL POLICY

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 Mineral Policy Sector
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Atlantic Geoscience Centre
 Bedford Institute of Oceanography
 P.O. Box 1006
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 B2Y 4A2
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Institute of Sedimentary and Petroleum Geology
 3303 - 33rd Street NW
 CALGARY, Alberta
 T2L 2A7
 (403) 284-0110

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 VANCOUVER, British Columbia
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 (604) 666-0529

Pacific Geoscience Centre
 P.O. Box 6000
 9860 West Saanich Road
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 Energy, Mines and Resources Canada
 RESOLUTE BAY, Northwest Territories
 X0A 0V0
 (819) 252-3872

Base Manager
 Energy, Mines and Resources Canada
 TUKTOYAKTUK, Northwest Territories
 X0E 1C0
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Canada Centre for Geomatics
 2144 King Street West
 SHERBROOKE, Quebec
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 (819) 565-4992

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 Energy, Mines and Resources Canada
 P.O. Box 368
 40 Havelock Street
 AMHERST, Nova Scotia
 B4H 3Z5
 (902) 667-7249

Arpenteur Régional
 Énergie, Mines et Ressources Canada
 2144 King Street West
 SHERBROOKE (Québec)
 J1J 2E8
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 Energy, Mines and Resources Canada
 901 - 25 St. Clair Avenue East
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REGINA, Saskatchewan
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Energy, Mines and Resources Canada
Suite 610 CANADA PLACE
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EDMONTON, Alberta
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(403) 495-2496

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1300 - 800 Burrard Street
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V6Z 2J4
(604) 666-5313

Regional Surveyor
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208 - 204 Range Road
WHITEHORSE, Yukon
Y1A 3V1
(403) 668-2636/2638

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Bellanca Building
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Ontario Region
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Pacific Region
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CANADA CENTRE FOR MINERAL AND ENERGY TECHNOLOGY

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1950 Boulevard René Gaultier
VARENNES, Quebec
J0L 2P0
(514) 652-9966

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