ENERGY, MINES AND RESOURCES

ANNUAL REPORT 1989-90

Energy, Mines and Resources Canada
Hon. Jake Epp, Minister

Énergie, Mines et Ressources Canada
L'hon. Jake Epp, Ministre

Canada

THE ENERGY OF OUR RESOURCES

THE POWER OF OUR IDEAS

LETTER FROM THE MINISTER

His Excellency the Right Honourable
Raymon Hnatyshyn,
P.C., C.C., C.M.M., C.D., Q.C.,
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, 1990.

I remain Your Excellency's obedient servant.

Jake Epp
Minister of Energy, Mines and Resources

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OVERVIEW

Introduction

Energy, Mines and Resources is a scientific and economic department concerned primarily with Canada's landmass and offshore and the non-renewable resources they contain.

Throughout Canada, the department's 4000 employees work to promote:

- international competitiveness of client industries
- environmental quality
- geoscientific knowledge, technology and expertise
- health and safety in the mineral and energy industries
- security of supply of mineral and energy commodities
- regional development
- Canada's sovereignty

Mandate

Under the provisions of the Department of Energy, Mines and Resources Act, the Resource and Technical Surveys Act, the Canada Explosives Act, and various acts and regulations governing the management of the Public Service, the Minister of Energy, Mines and Resources is responsible for coordinating, promoting, and recommending national policies concerning energy, mines, minerals and other non-renewable resources, and formulating plans for their conservation, development and use. In addition, the Minister is authorized to conduct research and technical surveys to assess mineral and energy resources, including a full and scientific examination and survey of Canada's geological structure and legal boundaries; to prepare and publish maps; to conduct scientific and economic research relating to the energy, mining and metallurgical industries; and to establish and operate scientific laboratories required to perform these duties.

Program Objective

The Energy, Mines and Resources program seeks to advance the development of Canada's economy, in a manner consistent with federal environmental and social objectives, by contributing to the timely and efficient development and use of Canada's mineral and energy resources and by augmenting knowledge and understanding of the Canadian landmass.

Organization

Energy, Mines and Resources Canada is made up of nine sectors.

- Geological Survey of Canada
- Surveys, Mapping and Remote Sensing
- Mineral and Energy Technology
- Mineral Policy
- Energy
- Canada Oil and Gas Lands Administration
- Corporate Policy and Communications
- Finance and Administration
- Human Resources

SCIENCE AND TECHNOLOGY

GEOLOGICAL SURVEY OF CANADA SECTOR

Since its founding in 1842, the Geological Survey of Canada (GSC) has provided 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 land and seabed use. The Survey's high standards and traditions of excellence are nationally and internationally recognized, as is its impressive track record for promoting multidisciplinary, cooperative work.

The Survey has almost 1000 employees working across Canada. Its main research centres are located in:

- Dartmouth, Nova Scotia
- Ste-Foye, Quebec
- Ottawa, Ontario
- Calgary, Alberta
- Vancouver and Sidney, British Columbia

Measuring core samples

Base camps for Arctic research are maintained by the Polar Continental Shelf Project at Resolute and Tuktoyaktuk, Northwest Territories, and on an ice island in the Arctic Ocean. Observation facilities for national seismological, geomagnetic and geodynamic research are found throughout Canada.

Fieldwork is carried out both onshore, often in Canada's most remote areas, and offshore.

Environment

GSC, Fisheries and Oceans Canada and Environment Canada released a joint **report on the marine environmental quality of Halifax Harbour.** Results show a greater degree of heavy metal contamination in that harbour than in others in eastern Canada. The report indicates, however, that most of the metals are bound in sediments and are quite insoluble under these conditions.

GSC carried out the first stage of an onshore-offshore megatransect of the Beaufort Sea coastal zone in March 1990. This multidisciplinary **investigation of permafrost surficial geology and geotechnical conditions of the Beaufort Shelf** is taking place in the area of a proposed pipeline from the Amauligak oil field.

The geological record is a crucial baseline of past environmental conditions from which we can reconstruct past global change, monitor contemporary change, and predict future impacts. Therefore, the GSC has an important contribution to make to the **international Global Change initiative.** During 1989-90, GSC set up a second Global Change 'observatory' in the Mackenzie Valley to complement the one at Hot Weather Creek on Ellesmere Island. In both areas, environmental variables affecting vegetation distribution, ground ice conditions and permafrost, and rates of geomorphic processes are monitored, recorded and analyzed.

Geoscience

Consultation with provincial counterparts, and a workshop held in Toronto in March 1990 with industry, university and government participation, defined the scope

and objectives of a new initiative called the **National Geoscience Mapping Program (NATMAP).** NATMAP will be a cooperative, multidisciplinary program to improve the quality, relevance and completeness of bedrock and surficial geological database coverage. An interim steering committee has been set up to establish guidelines and procedures required to implement NATMAP.

In the Appalachian region of Quebec, work from the new **Quebec Geoscience Centre** focused initially on structural and sedimentological investigations, with a view to establishing a framework for metallogenic studies. Work in Grenville Province was begun to identify critical geological units in Laurentide Park between Quebec City and Chicoutimi. Two other new projects will involve collaboration with the Ministry of Energy and Resources of Quebec. Surficial geology surveys were also conducted in previously unmapped areas of northern Canada and in several areas of high mineral potential in Quebec.

GSC continued its commitment to the national LITHOPROBE program which aims to 'map' the third dimension beneath the Canadian landmass and its surrounding oceans. LITHOPROBE's success has stimulated joint ventures with industry. For example, during a Newfoundland survey, BP-Selco partially funded and provided logistic support for work across Buchans Mine; interpretation of survey results shows great potential for a better understanding of the region's geology that will be of benefit to both parties.

The world's oldest terrestrial rocks were discovered in the Northwest Territories. At about four billion years old, the rocks are just a bit younger than the moon, which is 4.6 billion years old.

A GSC-university-industry team discovered something that may have important archaeological implications. While studying a sediment core from the continental shelf seafloor, they found the **first incontrovertible evidence that the sea level just north of Vancouver Island was at least 95 m lower relative to land 10 500 years ago.** If humans were present at that time, as seems likely, they may have occupied large areas of the continental shelf that are now under water.

Energy

GSC and six major oil companies (Amoco Canada, Canadian Hunter, Esso Resources, Mobil Oil, Pan Canadian Petroleum, Petro-Canada) signed an agreement in January 1990 to undertake a **high resolution aeromagnetic survey of southern Alberta.** The survey will provide data about the energy-rich Western Canada Sedimentary Basin to all participants at very moderate cost. The survey work will be carried out over the next three or four years. Under the agreement, GSC will make the data public after five years.

Preparations for a **quantitative assessment of the Western Canada Sedimentary Basin's natural gas resources** is well under way: the delineation of Devonian gas plays in the western and northern segments of the basin are nearing completion, with work proceeding toward completing Devonian plays throughout the entire basin in 1990.

In the western Arctic, seismic refraction data recorded from the Ice Island indicated the presence of **hitherto unknown major sedimentary basins** containing at least 12 km of sedimentary strata along the northwest coast of Ellesmere Island. Initial studies suggest that the basins may be similar to Beaufort Sea basins, implying that they could also be sources of oil and gas. GSC research also resulted in a new

understanding of the hydrocarbon potential of the Bowser Basin, in northwestern B.C., and the Chilcotin-Nechako Basin.

The GSC's unique capabilities in borehole logging were employed to assist in the development of a **groundwater heat pump system** for Carleton University. The system, now in operation, is expected to save $450 000 a year in the university's fuel bills.

Minerals

An integrated, multidisciplinary project to improve concepts and technologies applicable to **exploration for massive base metal sulphide deposits** was initiated in the Snow Lake area of Manitoba. The EXTECH (Exploration Science and Technology) project will develop integrated deposit models, enhanced airborne, ground and borehole geophysical techniques, surficial geochemical methods and GIS (Geographic Information System)-based data integration techniques. An important initial result of the Snow Lake studies was the identification of a zinc-rich stratigraphic marker capping the Chisel Lake orebody.

GSC seismologists examine seismograms in the Ottawa seismic data laboratory to detect, locate and quantify earthquakes in Canada.

Borehole logging investigations were conducted in close cooperation with mining companies in Bathurst, New Brunswick, Kemptville and Moose River, Nova Scotia, and Timmins, Ontario. At Timmins, demonstration of a new **mise-à-la-masse** method (a down-borehole geophysical test) resulted in a significant increase in the Redstone Nickel Deposit's estimated reserves.

Work in the Northwest Territories yielded important information on mineral potential. Two greenstone belts – one in the Whitehills-Tebek Lake area north of Baker Lake, the other near Rankin Inlet – are considered to have good potential for **gold.** Geological mapping has improved knowledge of the structure and stratigraphy of the two belts; both factors are considered important in the control of gold mineralization.

Seafloor minerals research continued to build momentum with the announcement that submarine massive sulphide deposits on the Juan de Fuca Ridge will be drilled in 1991 as part of the international Ocean Drilling Program.

During their ongoing program to revise obsolete geological maps, GSC scientists discovered that **gold-bearing strata** associated with the rich Eskay Creek gold prospect in British Columbia extend at least 50 km north and south of the discovery.

In a joint, one-year, cooperative mapping project in the Yukon, GSC and Department of Indian and Northern Development geologists made two important discoveries of base metal deposits (lead and zinc sulphides). Logistics coordination with a geological consulting company working in the region allowed fieldwork for three 1:50 000 map areas to be completed in just three months.

Geology and Public Safety

Work begun under GSC's new **environmental geochemistry initiative** includes:

- Airborne and ground radioactivity mapping to determine the potential radon hazard in buildings on various soil types in southern Manitoba;

- A study with Health and Welfare Canada to evaluate potential radon hazards on Indian reserves across Canada;
- Analysis to determine the extent of contamination from arsenic used in wood preservatives on children's play structures.

The GSC operates a national network of **seismological observatories** to monitor and assess earthquake hazard. Of particular note, eastern Canada's largest earthquake in 65 years took place December 25, 1989, in the unpopulated interior of the Ungava peninsula of northernmost Quebec. It was felt quite strongly in isolated coastal communities but no damage was reported. Seismic data has many other applications: data from GSC's seismograph station in Inuvik have been used to help the inquiry into the fatal CF-18 crash of January 29.

Arctic

The **Polar Continental Shelf Project (PCSP)** runs a sophisticated logistics network that allows scientists to conduct research safely and efficiently in the Canadian Arctic. PCSP experienced one of its busiest field seasons in 1989. It provided logistical support to 220 science research groups from federal and territorial agencies and Canadian universities, and to 13 artists working under the Arctic Awareness Program, sponsored jointly by PCSP and the Canada Council.

Major projects supported by PCSP included a climatology-vegetation-soil hydrology study at GSC's High Arctic Global Change Observatory at Hot Weather Creek on Ellesmere Island; completion of a GSC-Fisheries and Oceans reconnaissance bathymetry survey north of Parry Channel; wildlife studies by the Yukon and Northwest Territories governments and the Canadian Museum of Natural Sciences; and the Canada-China Dinosaur Project.

PCSP, Atmospheric Environment Service, and Parks Canada initiated a long term cleanup project in the Arctic, with the removal of 4800 empty oil drums from Eureka on Ellesmere Island; these were returned south for recycling.

International Cooperation

USSR: In September 1989, the very successful Canada-USSR Arctic Science Exchange Programme was extended for another two years with the negotiation of a new protocol in Leningrad. Jointly produced paleogeographic maps and correlation charts of the Arctic circumpolar region neared completion; these will provide a valuable resource for interpreting Arctic Ocean Basin development. Another achievement was a Quaternary map of the land portion of North America; this will be integrated into a Quaternary map of the Arctic to be published jointly with the Soviets.

Thailand and Zimbabwe: GSC provided scientific supervision to Canadian International Development Agency (CIDA)-funded airborne geophysical surveys in Thailand and Zimbabwe. Both projects were successfully completed during the year, and resulted in substantial contract revenues for the Canadian geophysical service industry.

GSC scientist records strength and vertical gradient of Earth's magnetic field during an investigation of subsurface crust.

Latin America: Working with the Pan American Institute of Geography and History (PAIGH), the GSC is involved in a series of informal bilateral agreements with various Latin American countries to help produce their national gravity maps.

New Services, Facilities and Programs

The newly refurbished **Yellowknife Seismic Array** was opened in September; delegates from 21 countries concerned with the detection and discrimination of underground nuclear explosions attended the ceremony. The new facility, which was the result of a three-year, $3.5 million upgrade, has already made an outstanding contribution to an international data exchange experiment started in January 1990.

The GSC's **geomagnetic activity forecasting service** has been upgraded to a seven-day-per-week operation to provide more timely forecasts and data for users such as Hydro-Québec and Ontario Hydro. Geomagnetic storms disrupted power, communications, and navigation systems several times during the year.

The new **Canadian Superconducting Gravimeter Installation** at Cantley, Quebec is a joint project involving seven Canadian universities and the GSC. GSC provides the site and monitors the gravimeter's performance.

GSC's new **Communications and Marketing Service** ensured that the results and implications of GSC's research program were more widely publicized. Activities of particular note included a major GSC display at the International Geological Congress (held in Washington, D.C. in July), publication of a 'new look' annual review of research results, and more agressive marketing of GSC publications.

Information

New Publications

The first volume of the Geology of Canada series, *Quarternary Geology of Canada and Greenland*, was released in January 1990 in both English and French. Representing the work of 63 researchers from federal and provincial governments, universities and industry, it will stand for decades as the definitive text on Canada's Quaternary.

A unique *Circum-Arctic geological map* (at the 1.6 million scale) resulted from collaboration between GSC scientists and their Soviet colleagues under the Canada-USSR Arctic Exchange Agreement. It was presented to the Soviets during the Prime Minister's visit to the USSR in the fall of 1989.

Coal Resources of Canada, published in April 1989, was acclaimed by the Canadian coal industry as "the finest, most complete assessment of this resource ever available in Canada."

The *Labrador Sea Basin Atlas*, the first in a series of East Coast Basin Atlases, was published. A comprehensive investigation of minerals present in the Hemlo gold deposits culminated with the publication *The Mineralogy and Geochemistry of the Hemlo Gold Deposit, Ontario.*

Conferences

The GSC's Annual Current Activities Forum, held in Ottawa in January, took the Arctic as its theme. Timed to coincide with the first-ever Minerals Colloquium, the two events attracted a combined audience of more than 900, with substantial representation from both industry and universities. The 1989 Western Canada Coal Geoscience Forum, co-sponsored by GSC, Alberta Geological Survey and B.C. Geological Survey, was another major venue for information exchange.

SURVEYS, MAPPING AND REMOTE SENSING SECTOR

Environmental Monitoring

The Canada Centre for Remote Sensing (CCRS) continued work on the Radar Data Development Program (RDDP) in preparation for Canada's RADARSAT satellite, now scheduled for launch in 1994. The Canada Space Agency will be responsible for construction and launch; EMR for applications development and the ground system. To simulate the data that will be obtained from RADARSAT and other satellites, the RDDP uses CCRS's state-of-the-art, aircraft-based radar system, assessing the technology and developing applications, with more than 100 researchers involved from coast to coast. Primary applications include agriculture, ice monitoring, oceans, forestry and freshwater systems.

Mapping Canada's Surface Features

In 1989-90, the Canada Centre for Mapping's Topographical Mapping Division completed a five-year project that will provide digital data on the surface features (or topography) of Canada's entire landmass. To obtain the data, an electro-optical device scanned all the reproduction materials used to produce the 917 map sheets required to cover the country. One of the first countries in the world to have complete digital topographic data coverage, Canada will find ready applications for the new data in map production and geographic information systems (GIS).

New PC-based hardware was purchased to replace the Topographical Mapping Division's decade-old digital stereo compilation system. The new system, purchased from the private sector, allows for the production of clean, structured data.

The Geographical Information Technology Development Program is a joint federal/provincial venture managed by the Topographical Mapping Division in Ottawa and the Canada Centre for Geomatics in Sherbrooke. Under this five-year program, federal and provincial governments work together to develop geographical information databases and technology. Arrangements were made this year with all the provinces and Yukon to contract with Canadian industry for various projects.

National Technology Centre for Geographic Information Systems

In March, the National GIS Technology Centre in the GIS Division was formally opened. The centre, equipped with five commercial GIS platforms, is involved in data management, networking and applications development. It is now a focal point for GIS expertise and technology.

Work has begun on three major GIS projects. A National Road Transport Network is being developed, using EMR databases and designed to provide a national, coast-to-coast digital network of Canada's road systems. A second project will develop effective digital modelling techniques to produce a seamless Digital Elevation Model of the complete Canadian landmass. Third, the Division is cooperating with the Department of National Defence (Canada), the Ministry of Defence (U.K.) and the Department of Defence (Australia) in testing and evaluating the 'Digital Chart of the World'. Data will be provided by the U.S. Defense Mapping Agency at a 1:1 000 000 scale.

Improved Survey System

The Geodetic Survey Division of the Canada Centre for Surveying, together with the U.S. National Geodetic Survey and the Danish Geodetic Institute, completed the

final continental adjustment for a new positional reference system called the North American Datum, NAD83. NAD83 will eliminate distortions inherent in the previous system (introduced in 1927), and give utility companies, municipalities, surveyors and engineers more accurate information on the latitude and longitude of reference points on the Earth's surface. The new system would be officially adopted in May, 1990.

Computerized Mapping
In 1989, the Canada Centre for Geomatics (CCG) developed an automatic digitizing system, using an optical scanner on existing map sheets. With this system in operation, the centre produced its first digitized topographic data set by scanning a 1:50 000 map.

Electronic Map Publishing
The Cartographic Information and Distribution Centre recently began to work towards publishing digital cartographic information. The centre is using software packages to produce computer files for four-colour separations.

In the field of satellite image map production, the Ottawa Image Map is a recent achievement, combining data from the U.S. (Landsat), France (SPOT), and the Topographic Mapping Division. Current projects include the Peterborough Image Map and Instrument Approach Procedure Charts.

Surveys for Native Land Claim Settlements
In 1989-90, the Legal Surveys Division completed boundary surveys valued at more than $1 million for the Inuvialuit Native Land Claim Settlement. These surveys were carried out under contract by the private sector. Preparatory work continued on surveys of several large native land claim settlements in Yukon and the Northwest Territories.

International Cooperation
Through its External Relations Office, the sector provided assistance to several countries, including Indonesia, Barbados, Egypt, Tanzania and Zimbabwe. This assistance took the form of professional and technical consulting, contract inspection and monitoring services.

The Office of External Affairs helped to develop international cooperative agreements with corresponding agencies in Saudi Arabia, Qatar, Kuwait, Yemen Arab Republic and Hungary. These umbrella agreements encourage cooperation between foreign clients and the Canadian public and private sectors.

Turning Satellite Radar Signals into Images
Work on a Synthetic Aperture Radar processor neared completion. The system, being built under a $10-million contract in the private sector, will turn signals from radar-equipped spacecraft (such as Canada's RADARSAT and the European Space Agency's ERS-1) into images. This development should help keep Canada's industry at the forefront of such technology though the mid-1990s.

Work on facilities to accommodate the new processing system is under way. Additional antennas installed at the Gatineau and Prince Albert Satellite stations will ensure data capture from two or more satellites passing at the same time.

New Spatial Reference System
The Geodetic Survey Division continued to develop the Active Control System (ACS) – a national, satellite-based spatial reference system. A pilot project is underway featuring four special Canadian sites that

continuously monitor signals from U.S. military navigation satellites. Each active site is an automated survey station equipped with a microcomputer-controlled GPS receiver, recording observations from all visible NAVSTAR (Navigation Satellite Timing and Ranging) satellites. Recorded data is now used to compute precise satellite orbits. Also, the recorded information is archived and will be used to derive data products for surveyors and navigators.

The National Atlas Information Service

In January 1990, an Opportunities Seminar pointed out the commercial advantages available to electronic and conventional publications through the National Atlas Information Service (NAIS). This is being followed up by invitations to industry for proposals on innovative uses of NAIS information in conventional or electronic media.

This year the Geographical Services Division devoted significant time and effort to the National Atlas. The division received expert confirmation of the final 100 topics to complete the 5th edition of the *National Atlas of Canada*, and approved a policy for the National Atlas Information Service (NAIS), including renewing the government's mandate to provide access to Canadian geographical information.

Videodisk Mapping

The Videodisk production program continued this year with cooperation and joint funding from National Defence, National Search and Rescue, Emergency Preparedness Canada, Fisheries and Oceans and EMR.

The videodisk is a new and effective medium for map distribution. One side of a twelve-inch disk can hold 54 000 analog images from a maximum of 200 standard maps. With a personal computer, a 12" videodisk player and a colour monitor, map images can be retrieved quickly by map number, place names and geographical coordinates. The Canada Map Office plans to sell videodisk maps at $2000 per double-sided disk.

Originally developed in response to demands from users of the first Canadian videodisk (produced by National Defence and EMR for National Search and Rescue), the program calls for the production of four or five videodisks covering all of Canada at 1:250 000, with coverage of the larger cities and areas of special interest at 1:50 000. The disks will also show offshore and federal waterways. The first disk (British Columbia) will be available in the fall; the remaining disks will be completed within two years.

Determining International Boundaries

To help define the Nigeria-Benin land and maritime boundaries, the Canadian International Boundary Commissioner spent six months in Lagos as a consultant to the Federal Government of Nigeria. This task was supported by EMR, External Affairs and Nigeria.

The International Boundary Commission continued clearing work along the Highlands section of the border between Quebec and Maine, and published and distributed the Annual Joint Report for 1988. The Highlands section extends over 281 km, and the Commission cleared a total of 45 km during the year, while rebuilding or repairing 43 monuments and surveying 31 km of the boundary.

National Toponymic Data Base

One hundred and fifty-one thousand toponymic records from the Commission de toponymie du Québec were added to the

Geographical Services division's National Toponymic Data Base, providing even more comprehensive national coverage. There are now about 484 000 toponyms and associated data in the data base.

Canadian Aeronautical Charts System
Development continues on the Canadian Aeronautical Charts System (CANACS) to provide digital information for modern navigation systems to help maintain flight safety. The Geographical Services Division's CANACS efforts this year emphasized database development and the generation of graphic products. In future, digital aeronautical data for airborne navigation systems will be needed to support Transport Canada's Air Traffic Control System.

Air Photo Processing
The National Air Photo Library and the Airborne Imagery Service (AIS) now offer computerized processing for ease and speed of access. The automated AIS database improves retrieval and use of the archives, while a new photographic proofing system quickly verifies AIS reproduction accuracy.

Product Sales
The **Cartographic Information and Distribution Centre's** over-the-counter sales and service to map users are now provided at 130 Bentley Avenue in Ottawa. Revenue from sales of map products and air photo reproductions totalled more than $4.7 million.

Global Positioning System (GPS) Basenet Program
This was the first year of a GPS basenet program. Basenets are an essential means of calibrating GPS equipment (hardware and software) and help in the development of procedures. Basenets are constructed by the provinces, and the Geodetic Survey Division undertakes measurements and computation of precise coordinates. This year, three basenets were constructed and measured. They are located in Edmonton, Alberta, Yellowknife, Northwest Territories and Whitehorse, Yukon. In addition, measurements were made for a second time on the Ottawa basenet, constructed in 1988.

Board of Examiners – Canada Lands Surveyors
The Legal Surveys Division's Board of Examiners for Canada Lands Surveyors (CLS) is currently updating its syllabus to ensure complete coverage of the CLS system. Also, active provincial surveyors can now qualify for a CLS commission by passing a set of five examinations. At a recent sitting, 16 candidates from various regions successfully completed their exams.

Technology Transfer Programs
Cooperation with the provinces and territories remains an important part of the sector's work. Technology transfer programs between the Canada Centre for Remote Sensing and the Northwest Territories and Alberta are successfully under way, with completion expected in the new fiscal year. Negotiations towards formalizing the program through Memoranda of Understanding were completed with Nova Scotia and Manitoba, and begun with New Brunswick, Quebec, Yukon and British Columbia.

Research into Artificial Intelligence
With an eye to the future, the Canada Centre for Remote Sensing has begun working on interpreting satellite images by means of artificial intelligence, eventually allowing for image analysis without human intervention. In the initial stages, information contained in a Geographic Information System (GIS) has been used to help interpret information on forests from satellite imagery. That forest-related information is then used to update the GIS.

MINERAL AND ENERGY TECHNOLOGY SECTOR

The Canada Centre for Mineral and Energy Technology (CANMET) works to find safer, cleaner and more efficient methods to develop and use Canada's mineral and energy resources. Sponsoring and carrying out predominantly commercial and cost-shared R&D, vigorously pursuing new opportunities for technology transfer, CANMET serves industry across Canada through its research facilities and regional offices in Nova Scotia, Quebec, the National Capital Region and Northern Ontario, Alberta and British Columbia. In 1989-90, CANMET succeeded in bringing its programs into closer accord with the changing needs of both industry and the general public.

Environment

Cleaner Energy Generation from Coal

CANMET and the Nova Scotia Power Corporation (NSPC) completed a project to evaluate the use of Nova Scotian coal and limestone feedstocks at the Chatham circulating fluidized bed boiler (CFB) demonstration. The Chatham facility, constructed with EMR funding, is operated by the New Brunswick Electric Power Commission (NBEPC). Over the last six years, CANMET and NBEPC have worked together on the CFB demonstration to generate electricity from high-sulphur coal while controlling the sulphur and nitrogen oxide emissions that contribute to acid rain. These emissions, in comparison with those produced by a conventional utility plant, have been reduced by 90 and 45 per cent, respectively.

Metal Separator for Recycling

This year, with support from Alcan, CANMET developed a non-ferrous metal separator that permits industrial-scale recovery of aluminum from spent potlining and recycled cans. Although spent potlining (discarded liners of electrolytic baths used in aluminum production) contains valuable aluminum, conventional recovery methods are inefficient and hazardous. In a demonstration run, the CANMET-built prototype achieved a 90 per cent recovery rate at grades sufficient for recycling and conversion, suggesting a reclaimed product value of $300 000 per year.

MEND Program

CANMET is a major participant in this five-year Mine Improvement Neutral Drainage program, aimed at preventing and controlling acid mine drainage. The Canadian mining industry, Environment Canada and the provinces of British Columbia, Alberta, Ontario, Quebec and New Brunswick are also participants in the program. During 1989, the second full year of the MEND program, four projects were completed, fifteen were ongoing and six were approved. Industry support for the program is increasing; total costs for completed, ongoing and approved projects is $5.25 million, 45 per cent of which is financed by industry, 43 per cent by the government and 12 per cent by the provinces. CANMET, as secretariat for the program, provides brief abstracts on all MEND projects and ensures that all research results are communicated to industry, government and the public.

District Cooling for Environmental Enhancement

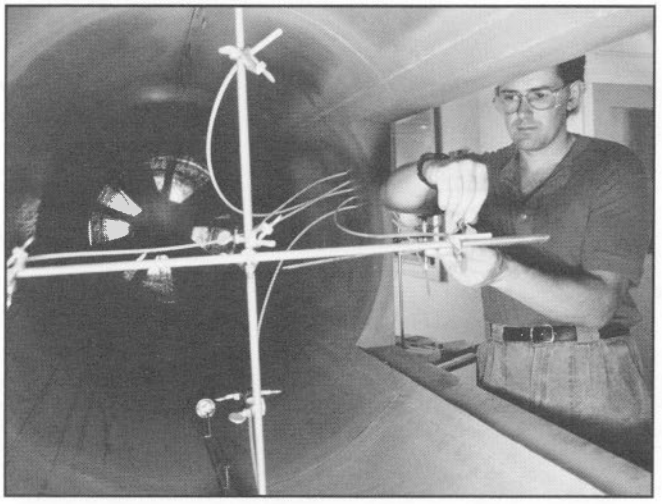
In a cooperative research program, CANMET developed a chiller for generating thin mixtures (slurries) of ice. Producing a slurry that can be pumped through a central cooling system, the new technology will reduce operating costs by more than 50 per cent. Recently, CANMET also patented additives designed to diminish friction in cooling water and ice slurry pipelines by some 70 per cent and 50 per

cent, respectively. In addition to increased energy efficiency and more cost-effective central cooling, these developments are expected to bring about a reduction in chlorofluorocarbon (CFC) releases to the atmosphere. Canada is now playing a leading role in innovative cooling technology and has been awarded International Energy Agency contracts for ice slurry transport.

Industrial Development

Research Consortium on Coal and Oil Coprocessing

If heavy oil is to compete with natural crude oil, we must develop innovative and more efficient upgrading technology. To improve existing methods of coal and oil coprocessing, CANMET formed a consortium with Amoco Canada Petroleum Company Ltd. and Rheinbraun Aktiengesellschaft of the Federal Republic of Germany. The $600 000 research program will be funded equally by CANMET and the consortium members; each company will contribute $150 000 per year for the three years of the project.



A research officer in the Coal Research Laboratory adjusts the air sampling port in a dust chamber. Dust chambers help create a uniform dust concentration.

Improved Recovery of Fine Coal

Research and testing by Westar Mining Ltd. and CANMET in the Crowsnest Pass region of British Columbia have led to improvements in coal recovery at the Greenhills Coal Preparation Plant. Up to ten times more fine coal particles than coarser particles are lost to tailings, and the cost of treating coal fines can be three to five times that of treating coarse coal. It is becoming increasingly difficult to find good storage space in the mountainous terrain for the large quantities of tailings that have been produced over the past 20 years. Research results are generating increased revenues and reducing the quantity of coal that would otherwise be lost to mine tailings.

New Technology for Direct Casting of Strip

CANMET designed and operated a single-roll caster that has produced experimental strips 0.5 to 2.0 mm thick in both ferrous and non-ferrous metals. A simple but unique tundish (a funnel-shaped instrument) designed by the research team allows liquid metal to be fed to a rotating copper wheel. A thin layer of metal solidifies on the wheel and can be removed easily to produce a continuous metal strip. This system has been applied by Cominco Metals to produce continuous crack-free strips of a lead-base alloy.

High-Volume Fly Ash Concrete

Pioneering CANMET research has shown that structural-quality, high-volume fly ash (airborne bits of unburnable ash) concrete can be produced with mechanical properties equivalent to those of conventional concrete, at considerable cost savings. These concretes have excellent potential for use in foundations, large retaining walls, piles and large columns; and their toughness and ability to control expansive alkali-aggregate reactions promise to make them serviceable in a wide range of conditions. One important aspect of the studies has been the collection of performance data on using this concrete in the Canadian climate. Last June in Trondheim, Norway, CANMET's work was recognized as a breakthrough in the industry at the Third International Conference on Fly Ash, Silica Fume, Slag and Natural Pozzolans in Concrete.

National Institute of Magnesium Technology

CANMET was one of the driving forces behind the establishment of the National Institute of Magnesium Technology (NIMT). The Institute aims to promote the growth of the magnesium conversion industry and to provide a national R&D centre for it. CANMET will provide a representative for the board of directors and will second a research professional to the Institute. The building of the Institute is being sponsored by Industry, Science and Technology Canada and the Quebec goverment under the Canada-Quebec Science and Technology Agreement.

Alternative Energy and Efficiency

'Advanced House' Demonstration Project

Funded jointly by CANMET, the Ontario Ministry of Energy, Ontario Hydro, and the FRAM Building Group of Toronto, the Advanced House Demonstration Project is intended to heighten awareness of energy-efficient techniques among Canadian builders, designers and consumers. A state-of-the-art suburban home, located in Brampton, Ontario, opened for one year of public viewing in February 1990, after which it will be sold by the builder. While conventional in appearance and built by a tract builder, the house showcases many passive solar design and energy-efficient features. Owing to these innovations, 'advanced houses' should be 75 per cent cheaper to heat than conventional ones, and more than 50 per cent cheaper to heat than R-2000 houses. The house will be monitored for two years, with results to be reported at the International Energy Agency experts meetings.

Heat Pump Technology

Heat pumps could play an important role in improving energy efficiency in industrial and municipal energy systems – but only if we can develop heat-pump refrigerants that do not contain ozone-depleting chlorofluorocarbons (CFCs). Under a joint program with the National Research Council of Canada, Du Pont Canada Inc. and le Centre de Recherche Industrielle du Quebec (CRIQ), CANMET has identified promising pure refrigerants and new refrigerant mixtures that can be substituted for existing CFCs. Results of this collaborative program will ensure that these CFCs can be replaced, thereby permitting the use of energy-efficient heat pumps, while reducing or eliminating the release of ozone-depleting substances into the atmosphere.

Methanol Buses and Trucks

Under the CANMET-sponsored Methanol in Large Engines (MILE) Program, transit buses fueled with methanol are currently being demonstrated in Winnipeg and Medicine Hat. Methanol has assumed prominence as one of the 'friendly fuel' alternatives for bus and truck fleets. It can be stored and transported in much the same way as conventional fuels, and it reduces some of the noxious emissions from gasoline and diesel trucks. Project MILE represents the first comprehensive trials in the use of methanol in larger engines. The Medicine Hat bus system is now adding more methanol buses to its fleet and plans to convert completely to methanol fuel within a few years.

Health and Safety

Air Quality in Mines

As a result of a CANMET study undertaken in cooperation with the Newfoundland Inspectorate, Newfoundland has adopted measures to improve the quality of air in its underground mines. In a larger but related effort, CANMET collaborated with a major Canadian mining company on what may be the most extensive air-quality survey undertaken in Canadian mining history. The

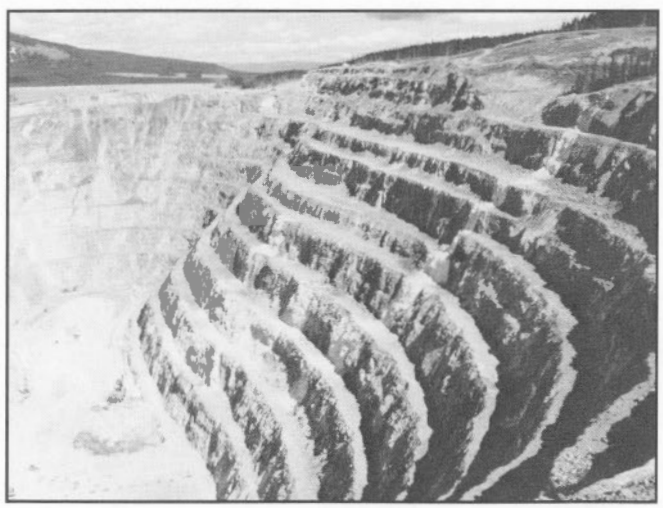
study should bring about measures that will optimize the supply of fresh air to mines and have a major impact on worker health and operating costs.

Explosives Research and Certification

CANMET regulates the manufacturing and distribution of explosives and some aspects of their road transportation, classifies new explosives for shipment and advises Transport Canada's Transportation of Dangerous Goods Directorate.

This year, a three-year project to monitor the quality of fireworks that are avaliable in Canada was initiated. Draft standards were also completed for the use of low-hazard recreational fireworks and are now being reviewed by industry.

Pit overview of the Equity Silver Mine, B.C.



CANMET, in collaboration with major Canadian fireworks manufacturers, importers, the American Pyrotechnics Association and the British government, began a study to evaluate mortars used to fire high altitude display shells. The study will provide data that will be used in the development of standards for mortars.

Office of Energy Research and Development

The Office of Energy Research and Development (OERD), as secretariat to the interdepartmental Panel on Energy Research and Development (PERD), is responsible for coordinating the distribution of Panel funds to the federal Energy Research and Development Program. The panel provides financial support to 12 participating federal departments and agencies. OERD also serves EMR in a science advisory role, providing expertise in several 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. This allotment is augmented by contributions from the private sector and participating departments. More than half of the federal funds are directed to research in two important areas: health and safety, and the environment. More than 60 per cent of the program's budget is spent in the private sector.

Technical progress continues to provide the technology and knowledge to use energy efficiently; to develop and use Canadian coal, oil sands, heavy oils, natural gas and frontier hydrocarbons safely and cleanly; and to produce energy from renewable and fusion sources.

OERD has, during 1989-90, launched a major evaluation of the rationale, structure, objectives/benefits and delivery of the PERD Program to help in designing its future.

A video, 'Shaping our Energy Future', and a brochure, 'Putting Imagination to Work', have been produced to describe the program and its products.

The OERD is also strengthening its capability to develop science and technology policy in the energy sector.

Economic Development

MINERAL POLICY SECTOR

This year, in accordance with the Mineral and Metal Policy of the Government of Canada, the Mineral Policy Sector (MPS) 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.

Despite falling prices and generally declining earnings, 1989 was another good year for Canada's mining companies, with the notable exception of gold producers. Quarterly financial results for the industry, however, provide evidence that the current minerals cycle has peaked; the quarterly trend in sales over 1989 was in decline and various surveys of first quarter 1990 industry earnings show a decline compared with the same quarter last year. The debt/equity ratio for both metal mining and other mining as of fourth quarter 1989, however, appears healthy at 0.30 and 0.41, respectively.

The Environment

With growing recognition of the importance of the environment to all Canadians, Mineral Policy Sector (MPS) has given special attention to environmental aspects of the minerals and metals industries. MPS is working with other sectors of the department, as well as with other agencies and industry, to achieve Canada's sustainable development objectives for the minerals and metals sector. Currently, the sector is focusing its efforts on mineral waste management, identification and encouragement of recycling opportunities, and securing a better understanding of the toxicology of certain metals and their compounds.

Acid Rain Abatement Program

EMR participated with the private sector and the Government of Manitoba in negotiations to reduce sulphur dioxide emissions from base-metal smelters at Flin Flon.

Coal

Since coal is Canada's most abundant fossil energy resource, the sector undertook to develop a more comprehensive understanding of coal's environmental effects and the measures required to mitigate them. Given the wide variation in kind, quality and use of coal, MPS concentrated on providing accurate information on acid-gas and greenhouse-gas emission levels. For policy development purposes, sector personnel monitored the progress of emerging technologies that will permit coal to be burned more cleanly and efficiently.

Pit excavation and coal removal.

Metals Toxicity

Certain metals and metal compounds are known to be toxic to humans and the public is increasingly concerned about excess exposure to those substances. Regulatory agencies are responding by instituting or proposing more rigorous limits on occupational exposure, use, emission and disposal of such metals and compounds. An important part of the regulatory process involves hazard identification and risk assessment to ensure that regulations are as appropriate as possible. EMR is supporting, through the Canada/EC Minerals and Metals Working Group which EMR co-

chairs, a Heavy Metals and Human Health workshop in September 1990, in Brussels. The workshop, being organized by Eurometaux, an association representing European nonferrous metals industry, will focus on hazard identification, risk assessment and risk management for nonferrous metals.

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 1987 Mineral and Metal Policy addressed the lack of appropriate controls, announcing the intention to establish, in full cooperation with the coastal provinces, uniform regulations for all of Canada's offshore area. During the past several years, consultations with the provinces, industry and other interested parties have led to a projected management scheme that would integrate environmental and fisheries protection objectives with mineral development.

In a Nova Scotia salt mine, a miner replaces a drill bit.

Taxation and Incentives

Tax Policy

In August 1989, the 46th Mines Ministers' Conference in Sudbury gave the Minister an opportunity to consult with his provincial counterparts on mining issues of mutual concern. MPS was instrumental in completing a heavy agenda of policy research work on behalf of the Subcommittee on Taxation of the Intergovernmental Working Group on the Mineral Industry (IGWG). Reports tabled at the conference made recommendations on mineral classification issues relating to the income tax treatment of dimension stone quarries and mine tailings reprocessing projects. A report on the efficacy of the present method of defining a 'mineral resource' in the Income Tax Act was also presented for mines ministers' consideration.

On behalf of IGWG, MPS also completed a comprehensive report on the tax treatment of mine reclamation expenditures and the placing of provincially mandated payments in reclamation funds. As a consequence of this report and a parallel joint submission by The Mining Association of Canada and the Ontario Mining Association, mines ministers directed that a government-industry task force be formed to continue investigating new mechanisms to allow mining companies to set aside funds for reclamation of mining lands. MPS is serving as the responsibility centre for tax policy research work on mine reclamation funds. Recommendations of the task force will be on the agenda of the 1990 Mines Ministers' Conference.

Canadian Exploration and Development Incentive Program (CEDIP)

During its three-year existence, CEDIP has contributed more than $1 billion to oil and gas exploration and development.

Canadian Exploration Incentive Program (CEIP)

Introduced in 1988 to help junior mining and oil-and-gas companies raise new equity

through the issue of flow-through shares, the program provided qualified corporations with a 30 per cent cash incentive based on eligible expenses. Forecasts suggest that, for 1989-90, companies will claim some $470 million in eligible expenses, resulting in incentive payments of $141 million.

Although the program was terminated in the budget of February 20, 1990, consultations with industry led to a workable regime that permitted grandfathering of arrangements substantially completed before February 20, 1990. As a result of grandfathered activities, the program may pay out up to $100 million in contributions.

Petroleum Incentives Program (PIP)

The program has continued with the final well reconciliation process for all major offshore operations. This fiscal year, recoveries totalling $2.3 million were billed to various PIP applicants.

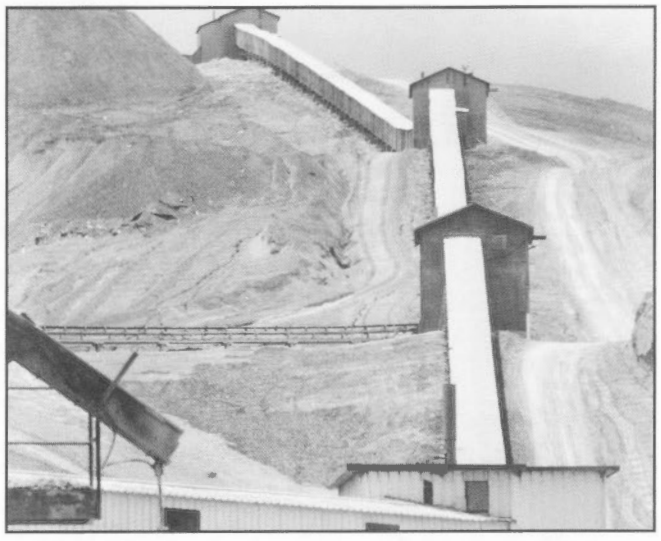
Information

Publications from the Mineral Policy Sector

Mineral Policy Sector continued its efforts to satisfy the increasing demand for comprehensive statistical information and analyses describing the Canadian mineral industry. MPS produced monthly and annual publications, comprehensive descriptive data, statistical highlights and reviews covering all facets of the mineral industry, including assessments of the industry's importance to the Canadian economy. Each year the sector publishes the *Canadian Minerals Yearbook*, a comprehensive volume featuring approximately 50 commodity-specific reviews and articles. Information provided by the sector is widely used as source material for mineral industry analyses and for numerous articles and reviews appearing in newspapers and other publications.

International Statistics

In March 1989, an association of iron ore exporting countries, which had been publishing international iron ore statistics for more than 15 years, terminated its activities. To ensure the continuity of these statistics, Canada helped make an interim arrangement under the United Nations Conference on Trade and Development (UNCTAD), and participated in further consultations towards a more permanent arrangement, now scheduled to take effect in October 1990.



Tailings pile at asbestos mine in Thetford Mines, Quebec.

Conferences

In March 1990, the sector led the Canadian delegation at the International Labour Organization's 5th Technical Tripartite Meeting for Mines other than Coal Mines. Held about every five years, these meetings bring mining nations together to discuss labour-related issues facing the industry.

In May, the Mineral Outlook '89 Conference was held in Ottawa. In keeping with its theme, 'Expanding Horizons,' 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.

Regional Development Initiatives

The British Columbia and Ontario Mineral Development Agreements (MDAs)

terminated in 1989-90. While at one time MDAs were in place with nine provinces and two territories, only the Quebec, Yukon and Northwest Territories MDAs remained active in 1989-90. During the year, the sector produced many MDA publications, documenting projects carried out under agreements that terminated in 1988-89. Over the lifetime of the MDAs, the federal government contributed $134.4 million of the total expenditure of $256 million.

As follow-up to the MDAs, the sector helped to negotiate new Cooperation Agreements on Mineral Development with Nova Scotia and Newfoundland. Discussions were held on possible programming for new MDAs in New Brunswick, Manitoba, Saskatchewan and British Columbia, and on an extension for the Yukon MDA.

Developing International Markets

Together with the Department of External Affairs and International Trade, the Mineral Policy Sector participated in several international initiatives to improve market transparency and consultative communications between governments.

Study Groups

Canada completed its second term chairing the International Lead and Zinc Study Group and continued negotiations for inaugurating the International Nickel Study Group, now scheduled to occur late in June 1990. Headquarters of the latter will be established in the Hague later in 1990. Canada is also considering membership in proposed international copper and tin study groups.

Latin America

The sector coordinated and led a very successful government-industry mission to the Cuban nickel industry. The mission obtained considerable information and produced private-sector contacts that could result in commercial opportunities.

Middle East

Following last year's earth sciences and mining mission to the Middle East, EMR signed several memoranda of understanding with Middle Eastern countries. In a related move, the department established a Committee on International Commercial Activity, which has helped a number of Canadian companies secure international contracts.

Claim Settlements

The 1985 collapse of the Sixth International Tin Agreement's buffer stock operation brought about a number of international financial obligations and a complicated legal situation. Claims against members of the International Tin Council – of which Canada was a member – approached £500 000 000. Canada undertook to bring the member governments of the council together with creditors. MPS played a key role in the initiative, and in the long, intense negotiations that in early 1990 produced an out-of-court settlement of £181 500 000.

Trade Negotiations

Mineral Policy Sector assisted the Department of External Affairs and International Trade to analyze mineral and metal trade issues in relation to 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.

In another trade-related matter, MPS, in consultation with other federal departments and the minerals industry, completed a study entitled 'Canada-EC Minerals and Metals Trade and the Impact of Europe 1992'. The study was published in February 1990.

Worker Protection

Asbestos

In April 1989, the World Health Organization held a Meeting of Experts to review all scientific data on asbestos. The resulting report concluded that the use of chrysotile asbestos can be controlled so as to render lifetime risks of lung cancer or mesothelioma either nonexistent or negligible.

In July, the U.S. Environmental Protection Agency issued its long-awaited asbestos rule. Promulgated under the Toxic Substances Control Act, the rule prohibits, at staged intervals, the commercial manufacture, importation, processing and distribution of 94 per cent of the asbestos products used in the United States today. The rule is currently being appealed by 31 American and Canadian entities, with a final court decision expected in early 1991.

The Asbestos Institute, with occasional assistance from the International Labour Organization, continued to hold training and information seminars on safe asbestos use. To date, more than 50 such seminars have been held throughout the world. The Institute, a joint venture of the Government of Canada, the Government of Quebec and the asbestos industry, is the primary vehicle for promoting the safe use of asbestos.

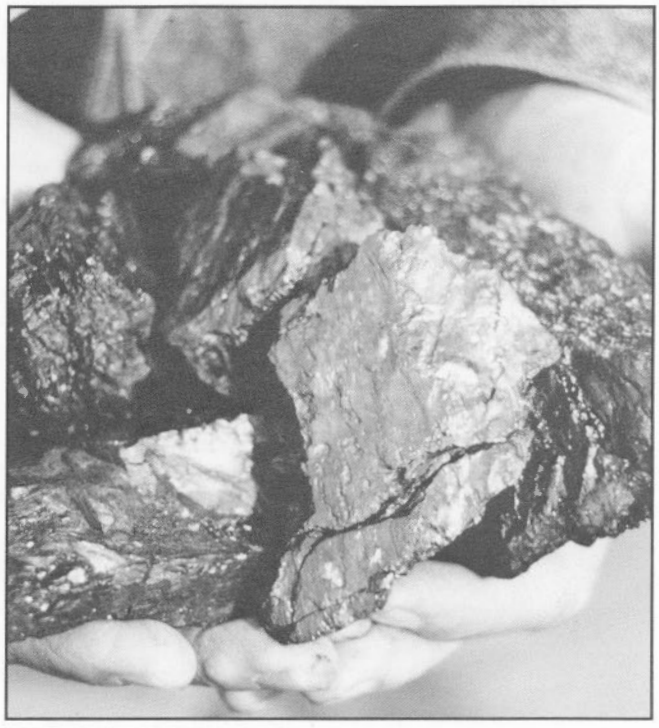
Mine Safety Statistics

In cooperation with the Association of Chief Inspectors of Mines, the sector developed a prototype National Mine Accident Data Base. Thus far, Canada's three largest mining provinces – Ontario, Quebec and British Columbia – have agreed to participate in the system, which will allow detailed analyses of trends in mine accidents. This year, for the second time, the sector compiled annual statistics on Canadian mining fatalities.

ENERGY SECTOR

The Environment

One of the major tasks of the Energy Sector is to ensure that Canada's energy policies and programs contribute to broader government objectives such as environmental protection. To this end, the sector devoted increasing resources in 1989-90 to analyzing domestic and international issues related to energy production, energy transportation and use, and the natural environment.



Mine worker holds raw coal.

Canada

The Energy Sector organized and participated in the August 1989 Toronto conference of federal, provincial and territorial energy ministers, which focused on energy and environment issues, including climate change. The sector also co-chaired, with the provinces of Ontario and Quebec, the Federal-Provincial Task Force on Energy and the Environment. The Task Force submitted a report to energy ministers that examined the energy recommendations of the 1988 Toronto Conference on the Changing Atmosphere. Selected for special attention was the recommendation that by 2005 global carbon dioxide emissions should be reduced by 20 per cent.

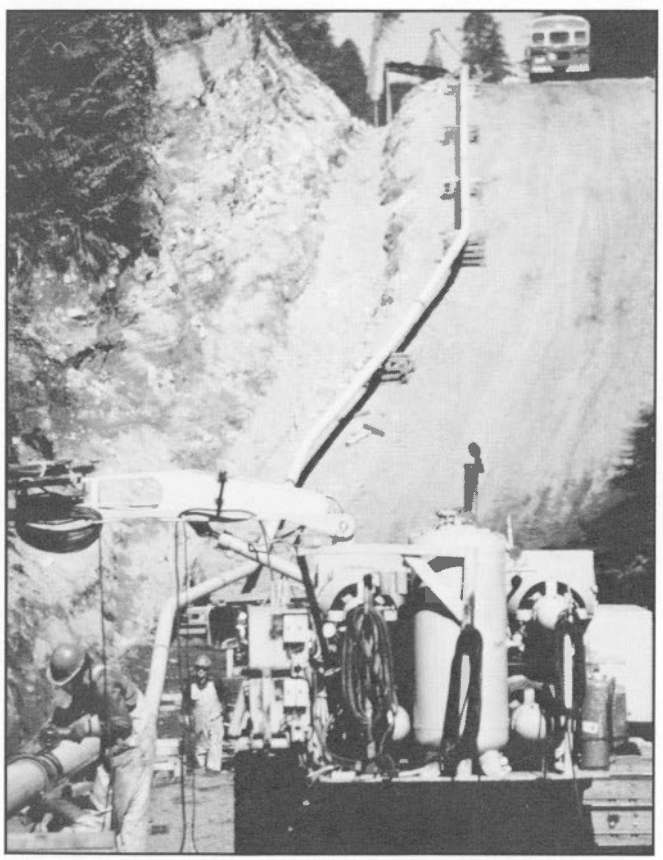
In addition, the sector played a key role in drafting the 'Management Plan on Nitrogen

Oxides and Volatile Organic Compounds,' prepared for the Canadian Council of Ministers of the Environment. As a result, energy efficiency and alternative energy were included in the options available for the emission abatement strategy.

Global

The Energy Sector is responsible for ensuring that Canada's international and domestic policies appropriately reflect international energy and environment trends and issues. The sector has continued to work closely with its foreign counterparts, and with organizations such as the International Energy Agency (IEA) and the Intergovernmental Panel on Climate Change (IPCC), an influential organization sponsored by the United Nations Environment Programme and the World Meteorological Organization. The Energy Sector has participated in several IPCC meetings, and in particular, has provided a Rapporteur for the Energy and Industry Sub Group.

Pipeline welding crew on the Vancouver Island Gas Pipeline construction site at Squamish, B.C.



International Trade

Throughout the year, the Energy Sector continued to take responsibility for managing 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 Canada-U.S. energy trade and associated regulations and policy. With regard to the GATT, the sector examined the energy policy implications of proposals dealing with multilateral subsidies and trade remedy negotiations.

During 1989-90, commercial aspects of uranium export policy were reviewed, leading to a comprehensive restatement of the policy, including adjustments to ensure consistency with the FTA and the GATT. The Uranium Export Review Panel continued to monitor and oversee all uranium export contracts to ensure compliance with Canada's uranium export policy.

Canadianization/Privatization

The Energy Sector advised the government on privatization issues, Canadianization and acquisitions in the upstream sector of the oil and gas industry and the uranium mining sector. 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.

Energy Megaprojects

In 1988, the government signed Statements of Principles with industry sponsors and provincial governments for certain energy megaprojects. Negotiations were subsequently undertaken to convert those statements of principles into legal agreements. In September 1988, a Joint Venture Agreement was concluded for the $1.3 billion Lloydminster Bi-Provincial heavy oil upgrader. In November 1989, an agreement was signed providing financial assistance for the $280 million Vancouver

Island Pipeline project to transmit natural gas from the British Columbia mainland to Vancouver Island. At fiscal year-end, negotiations were being conducted on legal agreements to provide assistance towards the engineering phase of the OSLO oil sands mining project near Fort McMurray, Alberta and the $5.2 billion Hibernia development project off the east coast of Newfoundland.

Frontier Energy Policy

The Energy Sector worked with other federal departments and territorial governments in negotiating native land claims and developing oil and gas policy in the North; and assisted in preliminary discussions toward an offshore accord with the Province of British Columbia.

In consultation with industry representatives and provincial and territorial governments, the sector continued drafting royalty regulations for the Canada Petroleum Resources Act. The regulations will establish a fair and reasonable royalty regime applicable to the development of Canada's frontier resources.

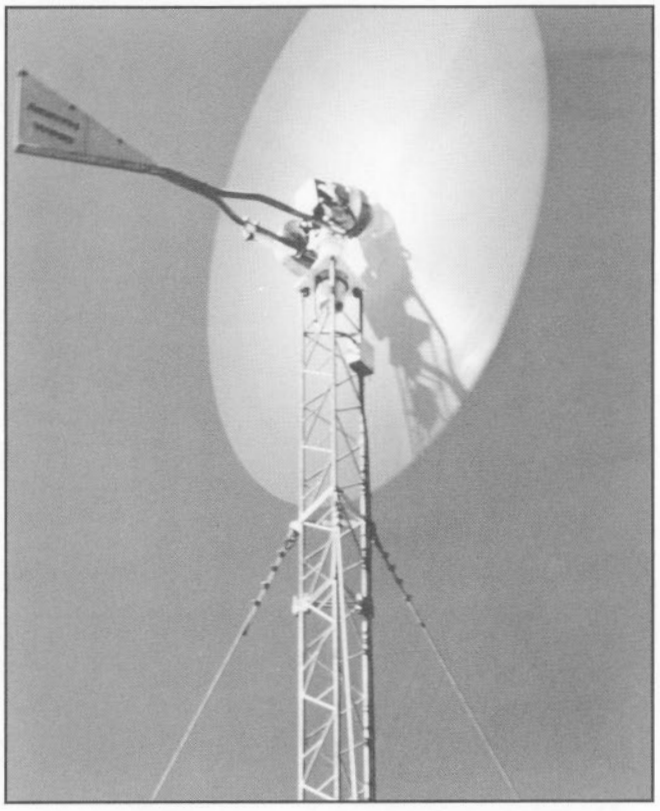
Oil and Natural Gas Industry and Markets

The sector provided advice on the certification of new natural gas pipeline facilities, long-term natural gas export licences, security of oil supply, oil and natural gas trade with the U.S., market trends and structural changes in the downstream petroleum industry.

Until March 1991, the sector will continue to pay the operating expenses of pipeline laterals constructed under the Quebec Natural Gas Laterals Program. Capital contributions under the program ended in 1986.

In fulfilling its emergency planning functions, sector staff conducted CAST-89, a test of domestic crude oil and petroleum products allocation systems, and held training sessions for designated stand-by staff who would be called up in an emergency.

As part of the ongoing monitoring and analysis of markets, the sector published several comprehensive reports that were widely distributed within and outside government. These included '2020 Vision: Canada's Long Term Energy Outlook', the biannual 'Natural Gas Price Monitoring Report', the monthly 'Crude Oil Pricing Report,' the 'Petroleum Product Market Report,' and the 'NGL Report.' 'The 1980s Decade in Review,' a ten-year look at Canadian gasoline markets, was widely quoted in the media.



Wind power for the B.C. Telephone Company's microwave repeater station.

Electrical Energy Industry and Markets

In 1989-90, the sector continued work on the development and legislative approval of a new policy on electricity exports and international transmission lines. A bill amending the National Energy Board Act, Bill C-23, was introduced into the House of Commons on June 7, 1989, and passed third reading on December 14, 1989. The Senate passed the Bill on March 27, 1990, and the new legislation is slated to come into force on June 1, 1990.

The Energy Sector advised the Minister on the National Energy Board's proposed terms of reference for its study on interprovincial electricity trade, and also on NEB recommendations on several proposed electricity export licences.

Of major significance this year is the government's renewed commitment to the nuclear industry. In March 1990, the Minister announced plans to sustain the nuclear industry through appropriate funding for Atomic Energy of Canada Limited (AECL) R&D. AECL will be restructured to encourage utilities and private sector companies to participate in reactor engineering.

In October, in response to a request by the EMR Minister, the Minister of the Environment announced the appointment of a seven-member Environmental Assessment Panel to review the concept of deep geological disposal of nuclear fuel waste in Canada.

The Energy Sector continued to address issues relating to public acceptance of nuclear energy, and a report was submitted to the Organization for Economic Cooperation and Development (OECD) on public information programs and public acceptance of issues in the Canadian nuclear industry.

The ongoing review of long-term jurisdictional responsibilities for uranium tailings led to the formation of a Canada-Ontario Working Group to define terms of reference and take action on the issue. The Ontario Siting Task Force continued with its siting process for low-level radioactive wastes, and will report its findings to the Minister. The Surrey Siting Task Force was established to locate a site in B.C. for the disposal of low-level radioactive wastes now stored at Surrey, B.C.

Sector representatives continued to serve on the Management Board and Executive Committee of the Canadian Electrical Association's Research and Development Program. This cooperative program, funded by contributions from EMR and Canadian electrical utilities, promotes R&D in all areas of electrical energy management.

During the year, EMR published several reports on electrical power and related industries, including '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.' The sector published the biennial report of the Uranium Resource Appraisal Group and collaborated with the Canadian Energy Research Institute in publishing a study entitled 'Critical Issues in Electric Power Planning in the 1990s.'

Energy Efficiency and Diversification

The Energy Sector provides policy advice on, and administers programs in support of, more efficient use of energy as well as alternative forms and applications of energy. (Alternative energies include biomass, small-scale hydroelectricity, and natural gas in motor vehicles.) These programs are administered under the Energy Efficiency and Diversity (EED) Program announced in August 1988.

The Minister signed a five-year agreement between Canada and Prince Edward Island on Alternative Energy Development and Energy Efficiency.

The sector reached agreement with the provinces for federal-provincial funding to revise the National Research Council's Measures for Energy Efficient Residential Construction. These guidelines, directed towards builders, prescribe residential equipment and levels of insulation that can

readily be incorporated into municipal building codes. The first pilot project of Energy Performance Contracting in Federal Buildings began at the National Research Council. Under this program, a private-sector company finances energy-efficiency improvements in return for the resultant savings in energy costs over a period of years.

The R-2000 Program entered its final phase. The housing industry assumed responsibility for program delivery and began negotiating privatization agreements in each region with potential partners, especially energy utilities. Negotiations are under way for a parallel program in Japan, through a licensing agreement with the Japanese 2 x 4 Home Builders' Association.

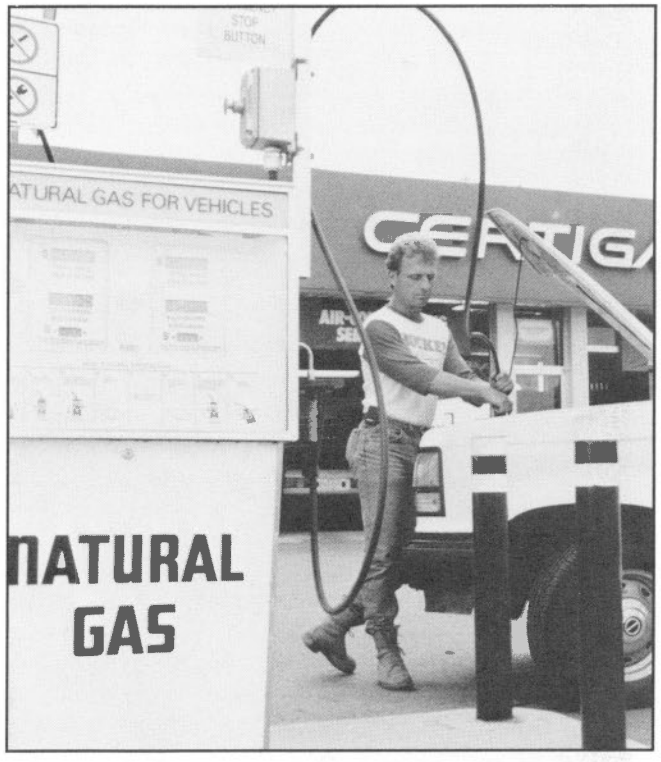
Following the Minister's announcement in August to expand and enhance the Energuide (home appliance labelling) Program, the sector developed new communication materials and began a marketing study to improve the label and consumer profile of the program.

Under the Export Development Initiative, the sector is developing a directory of Canadian EED firms and technologies, as well as training materials and services for officers of international aid agencies.

More than 2500 incentive contributions of $500 each were provided under the Natural Gas Vehicle Program to encourage conversion of motor vehicles to natural gas. Five contributions of $50 000 each assisted the construction of public refuelling stations under the Natural Gas Fueling Station Program.

The Demand Side Management (DSM) Support Initiative became operational, greatly strengthening the energy-efficiency aspect of EMR's relationship with Canadian electrical utilities. Working through the Canadian Electrical Association (CEA), EMR provided advice and support for several DSM initiatives, including technical seminars, training for utility personnel, consumer publications and three conferences.

The sector began a major review of policy options to improve Canada's energy efficiency and to enhance the adoption of certain alternative fuels. It initiated the review in light of increasing concerns about the effects of energy use on the environment, including the emerging consensus on the importance of energy efficiency as a means of addressing global climate change.



Natural gas pump in Richmond Hill, Ontario.

International Cooperation

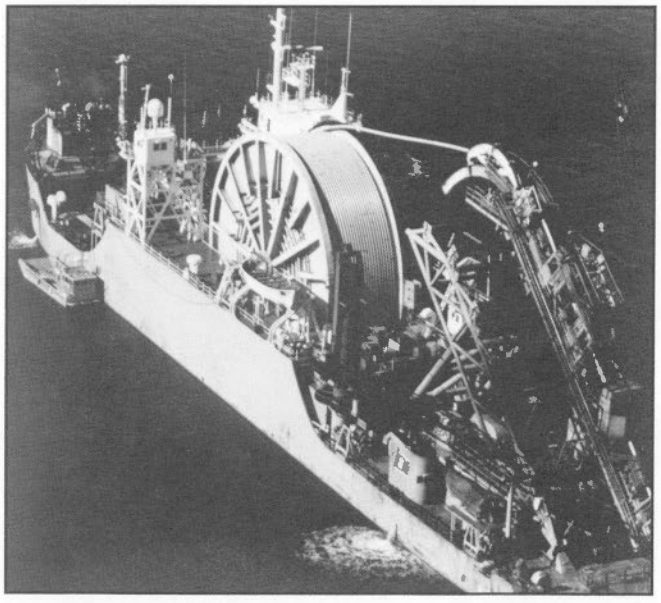
Recognizing the interdependence of the Canadian and world energy economies, Canada has worked to improve international energy cooperation through consultations and joint programs. These efforts are helping to build a stronger, more transparent and predictable international energy economy.

In 1989-90, the sector organized programs for more than 50 incoming visits by foreign ministers and deputy ministers of energy as well as outgoing visits by the EMR Minister and senior departmental officials, all of

which contributed to an active, bilateral energy dialogue. The 14th World Energy Congress, held in Montreal in September, led to a larger number of incoming visits than usual. The sector helped to prepare for the congress, and organized a series of concurrent, bilateral meetings involving Thailand, Israel, Korea, Spain, the United Kingdom and others.

In addition, the sector worked to promote closer bilateral relations with Japan, Korea, Mexico, the Middle East and Venezuela. Of all the department's bilateral relations, however, that with the U.S. remained the most active and significant: more than 80 per cent of Canada's energy exports go to the U.S. The sector had extensive consultations with the U.S. Government and its agencies, and these were reviewed at the semi-annual meetings of the Canada-USA Energy Consultative Mechanism, held in June 1989 and February 1990.

Laying submarine pipe for the Vancouver Island Gas Pipeline.



Multilateral institutions continued to play an important and growing role in Canada's international energy relations. Nations are giving unprecedented attention to global environmental issues, and energy is a significant element in these considerations.

The most relevant international institution for the Energy Program remains the International Energy Agency (IEA). The IEA has become an increasingly important actor on the world scene through its participation in a variety of international forums such as the Intergovernmental Panel on Climate Change. Other organizations of particular importance to Canadian energy interests include the International Atomic Energy Agency, the UN Economic Commission for Europe and the Commission of the European Communities. In the European context, the department closely monitored the emergence of Eastern Europe's new market-based economies, which have important energy implications.

The newest multilateral body, Asia Pacific Economic Cooperation (APEC), which resulted from an Australian initiative in November 1989, is being closely monitored by the department. After the U.S., the Pacific Rim represents Canada's second-largest energy commodity market.

The sector served on several international committees relating to uranium and the nuclear energy industry, including the OECD Nuclear Energy Agency's Steering Committee, Nuclear Development Committee, and Uranium Group; and the Steering Committee for the World Energy Council Triennial Survey of Energy Resources.

The Energy Sector also coordinated international science and technology (S&T) relations for the department through its participation in the Department of External Affairs and International Trade's Interdepartmental Committee on International Science and Technology Relations, the coordinating body for Canada's international S&T relations. We have witnessed, over the past year, an increase in initiatives directed towards international S&T agreements and strategies, including a Canadian strategy for S&T relations with Japan.

CANADA OIL AND GAS LANDS ADMINISTRATION

The Canada Oil and Gas Lands Administration's (COGLA) prime responsibility is to regulate exploration for, and development and production of, oil and gas on frontier lands in a manner that promotes environmental protection, worker safety, effective resource conservation and Canadian access to benefits and opportunities.

COGLA is the federal government's main contact with the oil and gas industry in matters relating to the regulation of oil and gas activity on Canada's frontier lands. These lands include Yukon Territory, the Northwest Territories, Hudson Bay and most of the country's offshore areas. Although COGLA has no jurisdiction over areas off Newfoundland and Nova Scotia, which are regulated by the Canada-Newfoundland Offshore Petroleum Board and the Canada-Nova Scotia Offshore Petroleum Board, it advises the EMR Minister on petroleum matters in these areas.

Environmental Protection

In September 1989, COGLA and other federal and territorial agencies held a workshop to review government contingency plans for a major pollution incident in the Arctic Seas Region. The agencies examined two spill scenarios, identified potential improvements and made arrangements to continue their consultations.

Last year, the Environmental Studies Research Funds (ESRF), a research program administered by a COGLA secretariat and managed by a board of representatives from industry, the federal government, regional boards and the public, investigated possible effects of hydrocarbons on the distribution of Grand Banks fish eggs and larvae, examined the potential for tainting commercial species of Grand Banks flatfish in the event of an oil spill and designed a program for monitoring the Beaufort Sea environment. In 1989, a representative from Petro-Canada was selected as Chairman of the ESRF Board. He is the first industry representative to serve in the position.

Federal-Provincial-Territorial Management of Frontier Lands

In 1989, federal and provincial governments, and Canada-Newfoundland Offshore Petroleum Board (CNOPB) representatives completed a memorandum of understanding (MOU). This MOU determines roles and responsibilities of governments and the CNOPB in respect of industrial and employment benefits arising from work on offshore projects. In addition, federal and provincial government agencies, together with the CNOPB, completed MOUs on marine safety and on occupational health and safety.

In January, the Canada-Nova Scotia Offshore Petroleum Board assumed responsibility for managing the Nova Scotia offshore area, previously managed by the Canada-Nova Scotia Offshore Oil and Gas Board. Federal and provincial governments jointly appointed the chairman and chief executive officer of the new board.

Rights Management

Six exploration licences and three exploration agreements were issued in 1989. Following bidding that closed in September, the CNOPB awarded five exploration licences for Newfoundland's offshore. The CNOPB received total work expenditure bids of more than $49.7 million.

In July, the Canada-Nova Scotia Offshore Oil and Gas Board awarded three

exploration agreements for rights near Sable Island. The board received total work expenditure bids of more than $19.6 million. A second generation exploration licence in the Beaufort Sea was issued to Gulf Canada Resources Ltd.

At the end of 1989, industry held 5.69 million hectares of frontier lands, comprising 49 exploration agreements and exploration licences, 98 significant discovery licences (SDL) and two production licences.

CNOPB administered rights are held under 11 exploration licences and 10 SDLs. The Canada-Nova Scotia Offshore Oil and Gas Board administered rights are held under three exploration agreements and 22 significant discovery area declarations.

In 1989 COGLA continued to develop regulations under the Canada Petroleum Resources Act for royalties, surveys and Canadian ownership.

Exploration

Two exploratory wells were drilled off Newfoundland, completing a three-well drilling program started by Texaco in 1988. Texaco et al. Amethyst F-20 was drilled on the east side of the Jeanne d'Arc Basin, about 10 km northeast of the 1986 oil discovery at Fortune G-57, but was abandoned without testing. Texaco et al. Springdale M-29 was drilled on the southeastern edge of the Jeanne d'Arc Basin and tested gas at rates of up to 331 000 m^3 per day.

LASMO Nova Scotia Ltd., a new operator on Canada's East Coast, and Nova Scotia Resources (Venture) Ltd., conducted a regional seismic survey east of the Cohasset oil discovery. LASMO and Nova Scotia Resources are preparing plans to produce oil from the Cohasset and Panuke discoveries, and are expected to submit a formal development plan application in 1990. Production could begin in 1992.

Four offshore wells were drilled in the Beaufort Sea in 1989 with significant tests of both oil and gas from Esso Chevron et al. Nipterk P-32 and Esso Chevron et al. Isserk I-15. Onshore, two wells were drilled in the Mackenzie Valley, Conoco et al. North Little Bear 0-51 and Chevron et al. Mountain River 0-18. In 1989, five tests in the Southern Territories resulted in two discoveries by Paramount et al. in the Cameron Hills, gas at Cameron B-08 and oil at Cameron L-47, and a gas discovery at Shell et al. Arrowhead B-41.

Resource Evaluation

In 1989, COGLA and the Institute of Sedimentary and Petroleum Geology embarked on two regional assessments of hydrocarbon resources: one for the oil and gas potential of the Mackenzie Corridor; another for the part of the Western Canada Gas Assessment that extends into the Northwest Territories and Yukon to 62°N. COGLA also reviewed drafts of the offshore Newfoundland Jeanne d'Arc Basin Assessment and the results of geoscientific research relevant to evaluating hydrocarbon potential offshore British Columbia.

Conservation and Development

In 1989, oil production at Norman Wells in the Northwest Territories totaled 1.789 million m^3, an increase of .061 million m^3 over 1988. The daily average oil production rate for 1989 was 4900 m^3 per day. At year's end, cumulative oil production from the field (including an increase of 1.083 million m^3 due to recalibration of the 1988 production data) totaled 12.138 million m^3.

Gas production from the Pointed Mountain gas field continued to decline. Production

for 1989 was 103 million m^3 compared to 154 million m^3 in 1988.

Panarctic again made two shipments of seasonal production from its Bent Horn oil field on Cameron Island. On September 5, the first shipment of 24 637 m^3 left on the *MV Arctic*. About 1900 m^3 of the crude was transferred to the tanker *MV Ours Polaire* for use in Resolute; the rest was transferred to a Norwegian-registered vessel, which delivered the oil to Statoil in Denmark.

On September 24 the *MV Arctic* picked up a second shipment of 18 444 m^3. This crude was also transferred to a Norwegian-registered vessel destined for Statoil.

Oil production from Bent Horn totaled 43 373 m^3 in 1989, with cumulative production from the Bent Horn field amounting to 180 000 m^3.

Columbia Gas Development of Canada began preparing plans to modify the Kotaneelee gas plant.

Worker Safety

In 1989, COGLA worked with the accord provinces and CNOPB to complete the legislative drafting instructions for safety amendments to the Oil and Gas Production and Conservation Act, the Atlantic Accord and the Canada – Nova Scotia Accord implementation acts. These safety amendments will bring into force the remaining recommendations from the Royal Commission on the *Ocean Ranger* Marine Disaster.

Last year, as a result of the work of the Survival Suits Committee, which COGLA chairs, the Canadian General Standards Board published standards for marine abandonment immersion suit systems and for marine anti-exposure work suit systems. Operators have a reasonable amount of time to comply with these standards.

Under the Panel for Energy Research and Development (PERD), COGLA continued to chair the Task 6.2 Marine Engineering Committee, which funds programs in environmental design criteria, marine engineering, ice-structure interaction and personnel safety. These programs address problems in designing and operating oil and gas exploration and production facilities. Research results will improve technologies in the oil and gas industry and will enhance the safety requirements of regulations and guidelines.

Under PERD 6.2, two studies were conducted to address various aspects of helicopter passenger safety. In 1989, a two-year study was completed on factors that affect a passenger's prospect of escaping from a flooded helicopter. A second program assessed the overall practice of helicopter operations in support of offshore drilling, including regulatory regime, search and rescue, aids to navigation and safety equipment.

Industrial Benefits

In 1989, land and offshore oil and gas activities created 2319 jobs. In the North, 2129 jobs were created, all but 10 being filled by Canadians. On the East Coast, Canadians filled 175 jobs out of a total of 190.

Foreign business groups and governments continued to express interest in the opportunities in Canada's offshore development. Many groups came to Canada to learn more about these opportunities; others formed joint ventures with Canadian companies. COGLA gave presentations to the Association of British Offshore Industries and to Canadian and Norwegian companies that participated in seminars sponsored by the Canada-Norway Offshore Working Group.

Administrative Support

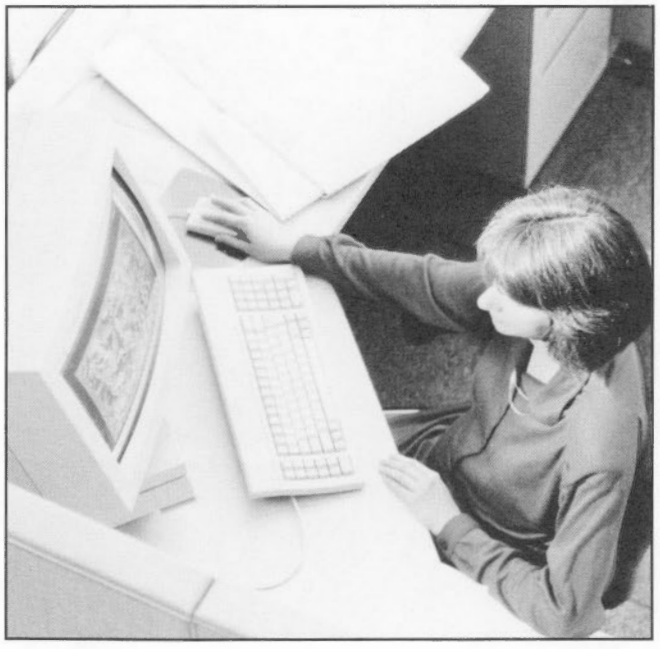
CORPORATE POLICY AND COMMUNICATIONS SECTOR

Management and Accountability

In June 1989, the department signed an Increased Ministerial Authority and Accountability (IMAA) Agreement with Treasury Board. The new IMAA allows the department to manage more effectively by giving EMR more flexibility in aligning its business instruments according to government priorities.

As part of EMR's commitment to improving the management of its people, the sector organized the first annual EMR Managers Conference. The conference focused on the department's needs and issues as well as on suggestions for initiatives to address them.

As a result of this meeting, a corporate Mission exercise was launched and will include input from all EMR staff.



An audit committee chaired by the sector ADM has been established to provide direction on senior management's audit needs and to discuss audit findings that affect the department and are important in the accountability framework.

This year the sector managed final evaluations of five provincial Mineral Development Agreements (MDAs): Saskatchewan, Manitoba, New Brunswick, Nova Scotia and Newfoundland.

Environment

The Environmental Assessment and Review Process (EARP) played a large part in the sector's work. The sector carried out environmental screenings on three West Coast seismic programs, two PCB storage facilities, the Vancouver Island pipeline, the Nanaimo refuse-derived fuel facility and seventeen smaller projects. In addition, it participated in three major EARP project reviews outside EMR.

During the year, the sector undertook several initiatives to support sustainable development, and produced a paper on sustainable energy use for the Canadian report at the Bergen conference.

The sector produced a report entitled 'Science of Climate Change' which explains the science of energy and the environment in layman's terms.

Communications Activities

Media relations projects were developed to enhance public awareness of EMR's regional programs, in particular those having to do with the environment. The sector assisted in developing and delivering multi-media presentations to schools on EMR's scientific activities. The audio-visual distribution program was expanded to schools and libraries as well as through a new satellite distribution system.

The sector provided communications support for the Federal-Provincial-Territorial Energy Ministers meeting in Toronto in August that dealt with energy and environmental issues, for several government-industry workshops, for the new electricity export bill (C-23) and for the field of nuclear energy.

Conferences and Exhibits

In September 1989, the sector coordinated federal government participation in the 14th Congress of the World Energy Conference (WEC) in Montreal. One of the federal government's contributions to the conference was its Canada Pavillion which featured technologies developed by Canadian researchers and engineers. The sector coordinated the contributions of other departments and agencies at WEC and provided all the necessary media relations and administrative support.

In March 1990, in Vancouver, the sector coordinated EMR's role in Globe '90 (Global Opportunities for Business and the Environment), an international conference and trade fair on environmentally sustainable economic development. In addition to support through speeches and press releases, the sector played an important part in Canada's trade fair presentation with the exhibit 'In Harmony with the Environment' which demonstrated how EMR uses technology to develop solutions for a safer, cleaner future for all Canadians.

The sector also provided support for the Cordilleran Roundup, the Mineral Outlook Conference, the Geographic Information Systems for the '90s conference and for the GSC Current Activities Forum.

FINANCE AND ADMINISTRATION SECTOR

Assets Management and Administrative Services

During the year, the sector's administrative work focused on managing capital assets and adopting a five-year work plan. The plan will incorporate critical base-building projects with related health and safety programs in the special-purpose facilities under EMR's custody. Further, a five-year accessibility plan is nearing completion, and environmental issues facing the department's administrative operations are under review.

Implementation of the Government Security Policy has continued as planned. A five-year Threat/Risk Program, to assess all EMR facilities, has been initiated as well. To amalgamate security responsibilities, the Access to Information and Privacy Secretariat was transferred to the Safety and Security Division.

Conversion of records to the departmental subject classification system has included the Communications Branch within the Corporate Policy and Communications Sector. Other updates were also required due to reorganizations within the department. The division has continued to automate its headquarters library.

Finally, to further facilitate managing departmental materiel, the sector is now establishing a central inventory system. It will be used to consolidate data fed to it from existing sectoral inventory systems.

Information Technology

An electronic network for the Executive Committee and support staff has been put in place, allowing documents created from a variety of microcomputer software packages to be electronically mailed and calendared. Owing to these improvements, financial and other corporate reports are now being disseminated electronically.

At the request of the Executive Committee, a major study was launched to identify options for better managing the department's computing capacity.

The sector also adopted a strengthened approach to coordination, with full senior-level input from line sectors.

Finance

This year the sector reorganized the Financial Management Branch into two branches, thereby rationalizing and improving services. Largely by centralizing the accounting and payment processing services, the cost of the function has been reduced from 170 to 145 person-years. Centralizing these functions allows financial advisors and analysts in the various sectors to concentrate on planning and resource management, thus benefiting line managers. The strengthening of central financial analysis and planning capability, together with the improvement of financial management reports, have enhanced advice given to the EMR Executive Committee and permitted a more cohesive and corporate approach to resource management.

In 1989-90, the sector put in place a new computerized Financial Accounting and Management Information System, which improves the provision and handling of financial data. The system's on-line nature, along with its ability to download data to line sectors' microcomputers or create custom reports and enquiries, has provided the flexibility to adapt the database to the needs of corporate headquarters and line sectors for the use of electronic mail, calendaring, and the exchange of documents created from a variety of microcomputer software packages.

ENERGY, MINES AND RESOURCES
SUMMARY STATEMENT OF EXPENDITURES 1989-90

	Operating	Capital	Transfer Payments	Total
		(thousands of dollars)		
Administration Program				
Direction and Co-ordination	20 171	632		20 803
Finance and Administration	23 141	1 472		24 613
Human Resources Management	5 473	691		6 164
	48 785	2 795		51 580
Less: Revenues credited to the vote	4 772	0		4 772
Total Program – Budgetary	**44 013**	**2 795**		**46 808**
Minerals and Earth Sciences Program				
Mineral Policy and Programs	11 712	595	13 841	26 148
Administration of the Canada Explosives Act	2 047	208	0	2 255
Mineral and Energy Technology	70 397	7 561	1 600	79 558
Geological Surveys	94 704	10 769	1 900	107 373
Polar Continental Shelf	8 221	1 184	0	9 405
Surveying and Mapping	64 355	7 270	205	71 830
Remote Sensing	20 267	10 270	0	30 537
Incentives Program	0	0	101 313	101 313
Program Support	24 153	5 293	688	30 134
Total Program – Budgetary	**295 856**	**43 150**	**119 547**	**458 553**
Energy Program				
Energy Policy	13 897	1 416	447	15 760
Energy Commodities	11 209	331	14 293	25 833
Energy Efficiency and Diversity	36 661	1 103	11 733	49 497
Incentives Programs	15 067	87	199 938	215 092
Administration of Frontier Oil and Gas Lands	5 146	229	29 690	35 065
Program Support	4 009	171	75	4 255
	85 989	3 337	256 176	345 502
Less: Receipt of Levies pursuant to section 65 of the Petroleum Administration Act	0	0	825	825
Total Program – Budgetary	**85 989**	**3 337**	**255 351**	**344 677**
Total Department – Budgetary	**425 858**	**49 282**	**374 898**	**850 038**

HUMAN RESOURCES SECTOR

In 1989-90, Human Resources Sector focused its activities on attracting and developing the people the department needs to maintain a productive, motivated workforce representative of the Canadian population. Such a workforce would meet operational objectives and make the department a more satisfying work place.

The sector implemented several initiatives to promote these objectives and principles – the Assignments Program, the Employee Voluntary Assistance Program, the Self-Funded Leave Program. It also pursued the automated generic classification system and put into place a study to develop generic statements of qualifications to help reduce the time required to classify and staff positions. The Human Resources Sector has taken a lead role in preparing for establishing a day care centre in the work place. Work on this project will continue through fiscal year 1990-91.

The department, with the support of the sector, made progress in increasing francophone participation at EMR. In 1989-90, Management Category's representation climbed to 21.7 per cent and the Scientific and Professional Category's representation to 17.5 per cent.

Crown Corporations and Agencies

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

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