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FOREWORD

Although 1984-85 saw general economic conditions improving both internationally and in Canada, the depressed markets and low prices for minerals, metals, and mineral products continued. The second year of a two-year modest program of assistance called Short Term Assistance in Research and Technology (START) was continued successfully and brought to completion at the end of the fiscal year. The START program in its two-year life involved interaction with 100 companies and led to joint CANMET/industry projects for a total value of $5 million.

A few of the more important of these diversified projects included seminars on controlling fires in underground mines, potash-mining research, the mobile foundry laboratory, and a state-of-the-art image analysis system for mineralogical studies. A participant in the seminars reported considerable savings to his company as a result of implementing the fire prevention methods. The potash-mining companies have committed considerable sums to a research and demonstration program after START. A large number of regional foundries reported significant savings and efficiency improvements. The demand for the image analyzer, unique in the world, has created a backlog of 7-9 months on cost-recovery work.

Continued effort was devoted to the commercialization of the CANMET hydrocracking process by numerous test runs on the pilot plant, while construction of the 5000-barrel-per-day upgrader proceeded at Petro-Canada's Montreal East refinery.

In 1984, Mineral Development Sub-Agreements were signed between the federal government and the provinces of Saskatchewan, New Brunswick, Nova Scotia, and Newfoundland; a similar agreement had been signed with Manitoba in 1983. The Sub-Agreements have a five-year life. CANMET is responsible for the federal minerals technology components of the Sub-Agreements, which will be done entirely by contract.

Of the roughly 200 research projects coordinated by the Research Program Office, a large number have international connections, either formal or informal. Technology advancement will be a key factor in restoring the productivity and competitiveness of Canada's mineral industry, and this can only be done within a framework of knowledge about mining technology throughout the world. CANMET is well equipped with highly qualified scientists, engineers, technical, and support staff to meet the research challenges that lie ahead, and to serve the nonrenewable resource industries of Canada.

W.G. Jeffery
Director General
CANMET

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CANMET'S PROGRAM

Mission: ***To enhance the role and contribution of minerals and energy in the Canadian economy by means of mission-oriented research and development in mining, mineral processing and utilization of metals, industrial minerals and fuels.***

Since 1907, scientists at the Canada Centre for Mineral and Energy Technology (CANMET) have been researching and developing safer and more efficient ways to extract, process, and utilize Canadian energy and mineral resources. In so doing, CANMET fulfills its three primary goals:

- providing information to the Minister for policy-making related to non-renewable resources;
- serving government social objectives for health, safety, and the environment;
- supporting R&D performed by industry in order to improve the economic performance and productivity of industry.

The funds for about 48 per cent of CANMET's program were drawn from the departmental Minerals and Earth Sciences Program (MESP).

- About 10 per cent of the program is designed to assist government policy-making and regulation by other agencies. This includes standards, certification, and resource assessment.
- A third of CANMET's research concerns protection technologies: health, safety, and the environment. Among other things, this includes mining, mine environment, fire safety, safety in explosive atmospheres, treatment of water and effluents, the quality and integrity of mine structures, and technology related to the abatement of acid rain.
- Over half of the program is designed to improve the mining, mineral processing, and manufacturing industries' productivity and competitiveness. The output ranges from new processes and hardware, to incremental improvements in existing processes and instrumentation.

Energy-related R&D projects also received funds from the Energy Research and Development Activity of the departmental Energy Program. This comprised about 42 per cent of CANMET's research program. The remainder of the program was funded through special projects such as the National Uranium Tailings Program.

Since the ultimate test of the usefulness of CANMET's programs is their utilization by industry, the transfer of technology forms an integral part of all CANMET activities. To aid in the transfer of this technology, CANMET collaborates with industry in many ways, including dedicating nearly a third of its budget to contracted research. At industry's request, the Branch conducts investigations on a cost-shared basis when the services it offers are not available in the private sector. Last year, an estimated 15 000 requests for technical advice were addressed to CANMET's scientists and engineers.

ORGANIZATION

CANMET carries out its mandate with a staff of 797 employees, organized into five operational laboratories. The laboratories are supported by several staff units that provide services to all divisions.

The **Energy Research Laboratories** develop technologies related to the upgrading of oil sand, heavy oil, and synthetic crude production; coal combustion and carbonization, coal gasification and liquefaction; and the improvement of oil and gas domestic-heating furnaces.

The **Coal Research Laboratories** have regional laboratories in Edmonton, Calgary, and Cape Breton. They are responsible for coal mining, coal preparation, coal transportation, and coal carbonization.

The **Mining Research Laboratories** are concerned with rock mechanics, the development of mining methods and better and safer mining equipment, explosives' testing, mining environments, the certification of equipment for gassy mines, fire and explosion hazards research, tailings control, and uranium reserve assessment.

The **Mineral Sciences Laboratories**' efforts are primarily in the areas of mineral processing, including some coal preparation research, and the development of ceramic and other materials for advanced energy storage and conversion systems.

The **Physical Metallurgy Research Laboratories** deal primarily with improved materials for rail lines, coal combustion, offshore structures, pipelines, and pressure vessels. They are also concerned with erosion/corrosion and the fabrication of metals and alloys.

The **National Uranium Tailings Program** was established in 1982 as a five-year program with a budget of $9.5 million. The program is aimed at identifying potential problems associated with the long-term disposal of uranium tailings. During the forthcoming year, this program will be integrated into the Mineral Sciences Laboratories.

The **Research Program Office** is charged with planning and designing research programs that are carried out both in-house and through CANMET's contracting-out program.

The **Office of Technology Transfer** addresses technology transfer issues, as well as developing guidelines to aid at all stages of research and development — from the planning stage, bench-scale, pilot-plant and demonstration phases, right through to commercial applications.

The **Technology Information Division** provides library, editorial, and publications production facilities; technical literature analysis and documentation; inquiry response and information dissemination services.

The **Technical Services Division** provides engineering support services to all divisions.

In the pages that follow some highlights of the work of the Branch are outlined.

ENERGY TECHNOLOGY

During the fiscal year 1984-85, CANMET devoted substantial effort to energy research and development — primarily to the processing and use of oil, gas, coal, and uranium reserves. These efforts were designed to contribute to the availability to Canada of technology for the supply, processing, and use of energy, and to help Canada achieve energy self-sufficiency as soon as possible. Other objectives were to assist in strengthening the competitive capabilities of Canadian industry, as well as providing leadership and liaison in dealing with groups at the international, provincial, or industrial level.

To aid in the development of sound energy policies and effective resource management, CANMET participated in the assessment of reserves derived from geological surveys and exploitation programs, through the application of resource-quality parameters and technical and economic criteria. In cooperation with departmental resource economists, CANMET researchers assessed Canadian uranium reserves and the productivity of uranium mines in operation. Safe and effective ways to dispose of high-level wastes were also studied. The extent of Canada's coal reserves was evaluated and safer, more efficient methods of mining these coals were studied. Because the type of coal and the mining methods differ greatly for eastern and western Canadian coal mines, much of this research was site-specific. To increase the supply of fossil fuels, techniques were developed to extract more heavy oil from producing wells and more bitumen from oil sands. Research centered on low-grade resources that, in the future, could contribute significantly to Canada's energy supply.

To ease the transition from Canada's heavy reliance on conventional energy feedstocks to a more diversified supply, it will be necessary to combine the implementation of existing technology with the development of new technologies. Our future energy supplies will probably include sources such as heavy oils, oil sands, coal, nuclear, and renewable biomass sources. CANMET's role in the search for a secure and abundant energy supply is to ensure that the latest and best technologies are available.

Advances were made in developing technology to convert coal, natural gas, and oil shale to liquid fuels. Coprocessing of coal and heavy oil makes use of two abundant Canadian energy resources. CANMET has taken a leading role in the development of a single-stage hydrogen addition process for coprocessing either heavy oil or refinery distillation residues, with significant quantities of coal to produce feedstocks that can be upgraded in existing refineries.

As the importance of high-quality fuel became more apparent, catalysts were developed to make upgrading processes more effective and to allow the most desirable products to be produced selectively. CANMET devoted substantial research effort to support the commercialization of the CANMET hydrocracking process developed to upgrade heavy oils and bitumen. A 5000-barrel-per-day upgrader, which uses this process, will be integrated into Petro-Canada's Montreal East refinery. This upgrader will be commissioned in 1985.

Means were found to reduce the amount of premium fuel used in domestic heating and in industrial processes. Scientists developed retrofit packages to make existing equipment more efficient and new technology that allows coal, biomass, or electricity to be used in the place of premium fuels.

Strides were made in the development of advanced technologies for the combustion of coal under environmentally acceptable conditions. These technologies

include fluidized-bed combustion, the burning of coal-liquid mixtures as fuel, and pollution abatement through low NO_x/SO_x burner development. Branch programs in combustion continued to support the demonstration of advanced technologies such as fluidized combustion and coal-water mixture combustion funded by the Coal Division, Conservation and Non-Petroleum Sector through the Coal Utilization Program. Participation in several multi-lateral R&D programs through the International Energy Agency provided valuable knowledge with a minimum financial outlay.

Health and safety in the underground mines of Cape Breton, the preparation of western Canadian coals, and the productivity of Canadian coal mines remained important considerations. Branch scientists studied means of reducing respirable dust and ways to reduce the danger of fires caused by the spontaneous combustion of coal in mines and in storage silos. Studies of geotechnical properties of rocks and rock support interactions will lead to greater mine safety and productivity. CANMET provided certification and quality-control services for flameproof equipment and materials used in the explosive atmospheres found in both coal mines and in industry.

To improve coal preparation techniques, mobile test units developed at CANMET provided research opportunities under plant-operating conditions. The mobile water treatment plant was used in fieldwork at two coal washeries. Construction of a mobile coal-dewatering plant was completed and preliminary field tests with the unit conducted.

CONSERVATION

- Work on home-heating furnaces resulted in a 20-30 per cent improvement in efficiency, provided the basis for a standard adopted by the Canadian Gas Association for measuring seasonal efficiency, and led to the acceptance on the American market of a retrofit condensing furnace developed at CANMET.

- The Enersolve program was initiated to find ways to reduce the amount of oil and gas consumed in industrial processes. CANMET sponsored studies in different industrial sectors and regions of Canada, and identified 11 industrial processes where combustion systems could be upgraded significantly. Based on the results of this test program, the Branch is writing a detailed combustion manual that will be used in a technology transfer program set up by the Industrial Energy Division of EMR's Energy Conservation and Oil Substitution Branch.

- Plasma technology will allow electricity to be used in the place of fossil fuels in some industrial processes. Therefore, CANMET is studying the technical and economic potential for this technology in the direct smelting of iron ore, as well as in vanadium production and drying.

- Branch scientists continued their search for less energy-intensive materials to use in producing concrete. Materials tested included natural pozzolans and mineral wastes such as fly ash, slags, and silica fume.

RENEWABLE ENERGY

- Scientists continued to develop materials and methods to fabricate systems that can conserve and store energy. A small-scale thermoelectric generator, which uses solid electrolytes to convert heat directly into electrical power, was demonstrated on an industrial stack. Thus, power was produced from waste heat that would ordinarily be vented.

- Silicate systems that produce three-dimensional solid electrolytes could replace two-dimensional conducting beta-aluminas in both thermoelectric generators and in sodium batteries. Of the three silicate systems studied, two were highly conductive materials.

- Stable low-cost materials can be used as electrodes in cells that convert solar energy into chemical energy or biomass into liquid fuels. CANMET built a magnetron sputtering unit, and then used it to make and alloy semi-conductors. Sputtering a cobalt film onto GaAs modified its electrocatalytic charge transfer properties. Although TiO_2 films that have been alumina-doped convert photons efficiently, the conversion efficiency for solar energy is limited.

- CANMET developed equipment to measure the dielectric properties of materials. A device was developed in-house to scan, log, and plot automatically the impedance that occurs when electrode/electrolyte systems undergo excitation. A transducer, custom-made by a contractor, will be used to detect the small sub-surface flaws occurring in ceramics when they are stressed either electrically or mechanically.

PETROLEUM SUPPLY

- CANMET, the Alberta Oil Sands Technology and Research Authority (AOSTRA), and industry are funding jointly a program to demonstrate new-generation technology that will separate bitumen from oil sands efficiently, and with less detriment to the environment. In conjunction with this program, an engineering study for the construction of an Oil Sands Development Centre in the Fort McMurray area has been completed. The Taciuk/UMATAC process was selected as the first extraction process to be demonstrated at the centre.

- Under a bilateral agreement with Canada, the U.S. Department of Energy screened additives to steam that could improve both the production rate and recovery efficiency of heavy oils. Also under bilateral agreement with the U.S., Canada has initiated a field project at the Gregoire Lake In Situ Pilot Project in the

Athabasca oil sands. This field project will develop techniques and expertise to monitor thermal and fluid frontal movements that proceed from injection to production wells. Ground truth seismic studies were completed.

- Under CANMET's cost-shared program, Gulf Canada is investigating the use of waterflooding to enhance the recovery of heavy oil. This technology is intended for use in marginal reservoirs where oil is recovered by waterflooding.
- A 70-barrel-a-day miniplant designed by Branch engineers will be used to separate oil from emulsions of oil and water produced during in situ recovery of tar sands bitumen, and during enhanced recovery of heavy oils.
- The CANMET hydrocracking process, developed and patented by CANMET, has been licensed to Petro-Canada for commercialization in a fully integrated 5000-barrel-per-day demonstration plant. This process upgrades heavy oil, bitumen, and residua to distillate fuels. To support this commercialization, experiments were carried out at CANMET to:
  - optimize operational conditions, yields, and conversions;
  - develop alternative and more efficient additives;
  - hydrotreat distillates derived from the CANMET process;
  - characterize new feedstocks.

Contractors developed instruments to measure ash concentration in the reactor; they also determined the effect of gas and liquid properties on gas voidage, solids dispersion coefficient, solids concentration profiles, and sparger design.

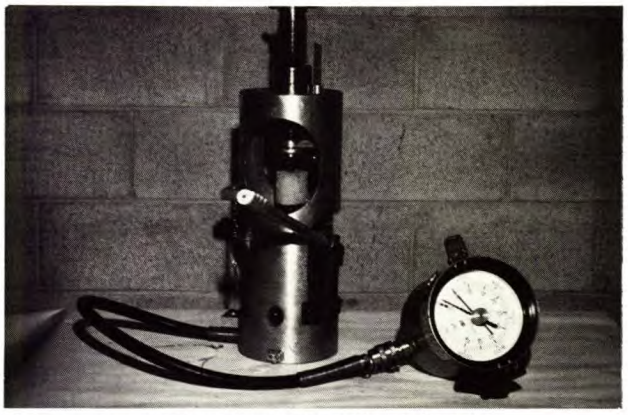
- Advances were made in catalytic research in the screening, testing, and preparation of catalysts for:
  - coprocessing coal with bitumen;
  - reducing the asphaltene content in heavy oils to meet viscosity requirements for the Interprovincial Pipeline;
  - removing heteroatoms from coal distillates;
  - converting refractory aromatics in synthetic middle distillates under mild operating conditions using metal catalysts;
  - pyrolyzing pitch;
  - converting acetylene to liquid fuels;
  - increasing product selectivity when producing diesel fuels from natural gas.
- Determining the chemical composition of catalyst surfaces, both before and after reaction, gave scientists a better understanding of catalytic processes, and of reactions occurring during upgrading and conversion processes for heavy oils, bitumens, and coal.
- Progress was made in the use of adsorbents and membranes to separate problematic compounds from synthetic crude distillates. Techniques for reverse osmosis fractionation of petroleum and synthetic crude fractions were developed.
- Significant contributions were made to the identification of specific compound types, present in different hydrocarbon fractions, produced from both conventional and non-conventional feedstocks. Characterization studies were extended to include residua from the CANMET hydrocracking visbreaking processes and the Eureka carbon rejection process.
- CANMET staff served on Canadian Standards Association (CSA) committees concerned with the selection and use of steels for structures such as pipelines and offshore platforms. They developed engineering data on high-strength, but lightweight, concrete and grouts for offshore structures. Candidate plate for these structures was characterized and methods developed to test welds. Results from the test program are currently being used in writing a CSA standard for fabricating steel fixed offshore structures.
- Ultrasonic systems, which are automated and can be controlled from a remote location, are being developed to identify defects in offshore structures, and to determine the orientation and size of the defects.

COAL

Coal Mining

- Estimates of recoverable coal reserves were updated. For the first time, statistics on productivity and on equipment used in Canadian coal mines were gathered. The physical and chemical properties of coal samples collected under CANMET's biennial sampling program were analyzed. Samples were collected from all active mines and wash plants.
- Field and computer-modelling studies of surface-mining operations defined haulage network and equipment performance characteristics. State-of-the-art studies of surface-mining technology drew attention to new concepts and equipment available for hauling and loading. The high-rolling resistances of the haul roads in surface oil sands mines can be counteracted using soil binders to improve road conditions or equipment with lower ground-bearing pressures.

- In eastern Canadian underground coal mines:
  - — Studies of rock-support interactions led to modifications to tunnel support and tunneling machine thrust systems.
  - — Researchers determined the pressure distribution that the gateside packs, which support strata around roadways, must withstand.
  - — Gateroad sealants used to prevent air leaking through the collapsed waste (gob) were evaluated (up to 70 per cent of the ventilation air entering a longwall district can be lost in this way).
  - — Monolithic packing trials initiated jointly with the Cape Breton Development Corporation were monitored.
  - — Methods to measure rock consolidation and re-compaction in the gob were examined.
  - — Proper water pressures and volumes for water-jet roadheaders, which reduce the risk of frictional ignition and the amount of respirable dust, were established.
  - — A long-term program was initiated to measure seafloor subsidence, and to define how much tensile strain can be tolerated before the risk of seawater entering the mine becomes unacceptable.
  - — Hydrofracturing techniques were used to release stress in areas of the mine which are prone to outbursts.
  - — Up to two hours of an eight-hour shift are used in travelling to and from the coalface in the Sydney coalfield. CANMET sponsored a review of commercially available and emerging technologies that would lessen the time required to transport personnel and materials to and from the coalface.
  - — Advances in longwall coal-mining technology included a computer technique to calculate the strength and stability of, and critical dimensions for, rib pillars left between panels to keep gateroads from closing.
  - — A contractor recommended longwall face cutting and loading technology particularly suited to the Sydney coalfield.
- A rock-classification system was developed and drill cores tested. In conjunction with a major coal company, down-hole geophysics will be correlated with the geotechnical properties of rocks. CANMET's rock-testing program is being extended to surface mines.
- Last year saw the conclusion of the subsidence-monitoring program at Westar's underground mine. The instruments and techniques developed to monitor subsidence over the underground mine — computerized telemetry, electro-optical distance measuring, and aerial photogrammetry — can all be used successfully to monitor and measure movement of pit slopes in surface coal and oil sands mines.



Robertson point load tester used to test rocks

Coal Preparation

- CANMET's pilot-plant facilities for coal preparation at the new Devon Research Centre have a nominal capacity of 10 tonnes per hour and provide 15 different flowsheet options for preparing a product that has been freed of impurities, dried, and sized. This unit was used to optimize thermal recovery for two British Columbia coals, and for three Nova Scotia and New Brunswick coals with high sulphur and ash contents. The design of preparation plants in the Maritimes will be based on the results of experiments with the eastern coals.
- Researchers analyzed properties of polymeric flocculents and correlated these properties with flocculation efficiencies obtained from settling-rate tests.
- A simple technique, devised by Branch scientists, measures the amount of sulphur in coal in its different forms — organic, pyritic, and sulphatic. Biodepression was used to separate pyrite from coal selectively.
- Mobile test units developed by CANMET provided researchers with opportunities to conduct experiments under actual plant-operating conditions. Tests with the mobile water-treatment plant at two coal

washeries showed that the performance of the washeries' thickeners could be improved substantially by a propitious choice of flocculent and operating parameters. Using CANMET's mobile dewatering plant, researchers improved the quality of the cake and filtrate, while increasing the amount of solids recovered. Construction of a second dewatering plant is complete, and a mobile unit that will be used to treat coal fines has been designed.

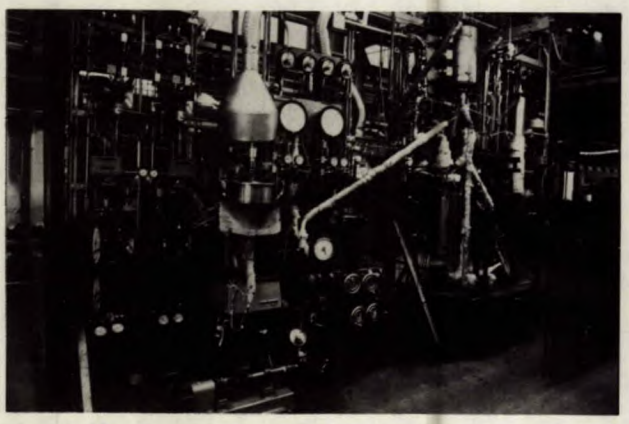
- A computer program which can be used to characterize, model, and manipulate coal preparation processes has been completed, and staff are preparing a companion operating manual.
- CANMET coordinates a cooperative program between Canada and the Federal Republic of Germany. Activities include dense coal slurry preparation and transportation, as well as pipelining of metallurgical and coarse coals. Results of in-house work on the propagation of longitudinal tension and compression waves in pipes will influence the design and operation of pipeline systems. Contract work on Carbogel slurry pipelining has been completed.

Coal Carbonization

- Most of Canada's coal exports — about 23 million tonnes in 1984 — are high-grade coking coals from western Canada. As a member of the Canadian Carbonization Research Association, CANMET provides experimental facilities, as well as scientific and technical personnel, to assist in planning and to carry out research of immediate interest to both the coal and the steel industry. The coking properties of both coals and blends having commercial applications were evaluated. Tests in CANMET's coke ovens showed that coke quality is affected by coking time, blend composition, coal storage time, quenching technique, location within the oven, and coke oven bulk density. The bulk density was found to depend upon charge height, charging pile size, and coal moisture.
- Researchers assessed the chemical, rheological, and petrographic properties of coals and cokes. Improvements were made in grinding and polishing techniques, and in making pellets. Progress was made in standardizing petrographic analyses. The staining technique was used on naturally oxidized coals.

Coal Conversion

- Low-value feedstocks such as coal rejects, petroleum cokes, or pitches from coprocessing or coal pyrolysis can be gasified to produce synthesis gas. In 1984-85, studies concentrated on the reactivity of petroleum cokes produced at the Suncor and Syncrude oil sands plants.
- With a view to improving the economics of combined-cycle, power-generation processes, CANMET scientists have identified naturally occurring adsorbents and low-cost materials that have the potential to remove sulphur-containing compounds from product gases at gasification temperatures.
- Direct coal liquefaction technology offers a means of producing alternative liquid fuels. Branch scientists participated actively in projects that addressed direct hydroliquefaction of low- and high-rank Canadian coals, the petrography of parent coals and liquefaction residues, as well as other processing and fundamental research areas.
- The low-rank coals of Alberta and Saskatchewan can be combined with tar sands bitumen or heavy oil to form coprocessing feedstocks; Nova Scotian coals combined with conventional crude residuals show potential for producing synthetic fuels. CANMET conducted bench-scale, continuous-flow, single- and two-stage experiments and microbatch autoclave experiments, then characterizing the liquid and solid products derived from these coprocessing experiments. CANMET is constructing a pilot plant that will be used to assess the coprocessing behaviour of coal-heavy oil slurries on a larger scale.



CANMET's bench-scale development unit used to coprocess heavy oil and coal

Coal Combustion

- The Canadian coal and utilities industry is actively pursuing the expanded use of indigenous and often low-quality coals. Since many of these coals are from newly developed deposits, their combustion characteristics are unknown. CANMET researchers continued to assess these coals, and provided industry with reliable data on their heat transfer and emission characteristics during combustion. Branch scientists made significant progress in developing non-intrusive laser techniques that will provide further information on combustion characteristics.

- Fluidized-bed combustion provides a clean, efficient means of burning high-sulphur coal, of firing coal and wood waste, and of using waste materials such as coal washery rejects and residues from heavy oil upgraders. Atmospheric fluidized-bed tests were conducted with Syncrude coke, eastern Canadian coals, rice husks, and paper; sulphur sorbents for fluidized systems were characterized; and a circulating fluidized-bed pilot plant was designed.
- CANMET is evaluating technology and providing scientific support as part of an effort to demonstrate the combustion of coal-liquid mixtures (CLM). This technology will provide Canadian utilities and Canadian industries with an alternative to using premium liquid and gaseous fuels. The Branch's tunnel furnace was used to evaluate the transfer of heat during combustion and the emission characteristics of CLMs with commercial potential. An atomizer, developed under contract with the National Research Council specifically for coal-water slurries, was used in a demonstration at the Chatham, N.B. generating station.

Pollution Abatement

- Achievements in reducing NO_x/SO_x emissions include reducing emissions by 50 per cent, while maintaining boiler efficiency, in a demonstration of a burner designed as a retrofit to a hot-water heating boiler; acid gas emissions using burner air staging with limestone injection were also reduced substantially.

Coal Mine Safety Certification

- CANMET provides a national service to certify and to assure the quality of flameproof equipment, gas detectors, and fire-resistant materials used in the explosive atmospheres found in coal mines and other dangerous industrial environments. Forty-five certificates and amendments were issued in 1984-85. CANMET has been asked by the Saskatchewan potash producers to certify conveyor belting and by the Alberta Department of Labour to certify equipment for use in an experimental underground tar sands project, as well as equipment used at natural gas compressor stations.
- Standards activities continued to be important. CANMET developed appropriate new standards as conditions in industry changed. Staff participated in drafting standards for flameproof diesel equipment, conveyor belting, and blasting machines. Many existing flameproof standards were revised and updated in response to new information, requests for clarification, and changing technology. In addition to participating in several national and international standards committees on equipment for use in explosive atmospheres and fire-resistant materials, CANMET is represented on the Canadian Standards Association Steering Committee for Electrical and Mechanical Mine Safety, and the Committee for the Canadian Electrical Code.

Test for flammability of an electric cable carrying an electric current at the Canadian Explosive Atmospheres Laboratory

Coal Mine Health and Safety

- While defining design criteria for water scrubbers resistant to gas explosions, for diesel machines in underground mines, researchers found that thinner plates than previously considered can be used safely. Results of a round-robin study, held in conjunction with the U.S. Mine Health and Safety Administration, indicate that the small-scale flame test can be applied to conveyor-belt testing. Preliminary work on confined dust testing was completed.
- Water scrubber and water/oil emulsion fuel systems are particularly safe for use in underground mines. A flameproof underground vehicle design, developed with CANMET technology, has been sold to a Brazilian manufacturer.
- Emphasis was placed on developing, demonstrating, and improving techniques to control spontaneous combustion; to control and monitor methane emissions; and to monitor the environment in underground coal mines. Last year Branch scientists:

  — advised the Cape Breton Development Corporation (CBDC) on the use of inert gas technology, monitored changes in ventilation caused by fire buoyancy, conducted fire gas explosibility determinations, and monitored fire gas trends while the mine was being sealed during the mine fire at No. 26 colliery;

— conducted 10 full-shift, dust-sampling surveys in operating longwall sections, as part of a research program intended to reduce the risk of coal workers developing pneumoconiosis and pulmonary disorders;

— under a cooperative agreement with Westar mining, installed an environmental system at their underground hydraulic mine and reviewed its performance;

— recommended continuous monitoring of air within coal-storage silos to provide early warning of incipient heating, and the use of inert gas to prevent aggravation of heating;

— discovered that some metals known to possess catalytic effect were present in greater concentration in some subbituminous coals of western Canada, making them more vulnerable to spontaneous combustion;

— evaluated options available to deal with frictional ignition problems caused by sandstone channels and other incendive structures within the coal seam, immediate roof, and floor.

- A contractor found that methane-oxidized bacteria, isolated from water samples taken from coal mines, remain active over an extended period of time and oxidize methane at an appreciable rate. This method may have applications for methane control in coal mines, coal-storage silos, and shipholds.

MATERIALS DEVELOPMENT

- Branch scientists studied the corrosion/erosion behaviour of alloys used in fluidized-bed combustion of high-sulphur coal, and of materials used in processing tar sands and for in situ recovery of heavy oils. Stress-rupture properties of materials for heat exchange tubes and in-bed hardware for fluidized-bed combustion were evaluated.

NUCLEAR ENERGY

- Branch scientists contributed to EMR assessments of uranium deposits. Evaluation of an experimental data file provided insight into the interrelationship between assay values and the length of segments of core samples taken from stratiform deposits.
- Last year, Canadian uranium production capability was evaluated, and a database of mining and related information was established.
- EMR is participating in the Canadian Waste Fuel Program initiated to find safe and effective ways to dispose of high-level nuclear wastes. Atomic Energy of Canada Limited directs this program. At present, four research areas on plutonic structures are being used to investigate disposal of these wastes by burial.
- Characterization of Atikokan, Chalk River, Lac du Bonnet, and East Bull Lake research area formations is complete. Data from samples from the Lac du Bonnet region were used for design and modelling studies for the Underground Research Laboratory in Manitoba, where large-scale underground experiments will be conducted.
- Branch scientists studied alternative methods to leach high-grade uranium ores found in northern Saskatchewan.

ADMINISTRATION OF THE CANADA EXPLOSIVES ACT

In support of the Canada Explosives Act, the Branch certifies explosives, advises on technical problems that arise when handling explosives, and investigates accidents involving explosives. Research efforts centered on developing new, and on improving existing, methods used to evaluate explosives. CANMET acts as the national centre for the certification of explosives.

Through the United Nations, Canada is working with other countries to develop an international classification system for dangerous products. In conjunction with this study, it is expected that the Canada Explosives Act will be amended before 1987. The new standards are being evaluated at CANMET.

- Under the auspices of the United Nations, Canada continued working with other countries to develop a unified international classification system for dangerous goods — including explosives. CANMET staff characterized new emulsion explosives developed by Canadian industry.
- Three hundred and forty seven new explosives were examined for authorization, and staff assisted industry in identifying the causes of ignition in Nonel tubing and in delay elements.

MINERALS TECHNOLOGY

CANMET is EMR's centre for research and development related to mining and mineral processing, as well as to the conservation and use of mineral-based materials. Research efforts in mineral technology centered on improving methods to mine and process minerals in an environmentally safe manner.

Researchers assessed mineral deposits and developed new methods to evaluate the minerals. They participated in federal/provincial programs on underground mine communication and programs to develop safer underground mining methods. Activities included reducing noise, radiation, dust, and diesel pollutants within the mine. Means were devised to reduce pollutants in the liquid effluents produced by the mining industry. CANMET continued to certify materials and equipment for use in coal mines. Branch scientists developed new, and modified existing, mining equipment to make mining both safer and more efficient. Technology to reduce diesel emissions in coal mines was transferred to industry. In response to the serious rockburst problems that occurred in the Sudbury-Elliot Lake area, CANMET expanded its research in rock mechanics, particularly in microseismic geotechnology. CANMET worked in cooperation with the Ontario Provincial Government and several mining companies to either lessen or resolve rockburst problems in underground mines.

CANMET continued to provide the Canadian mineral-processing industry with the certified reference materials needed for quality control. Researchers evaluated the equipment and methods that industry uses to process minerals, and found ways to improve the quality of mineral concentrates. In conjunction with other federal government departments, CANMET assessed the modernization options available to the non-ferrous smelting industry. The goal of this study was to improve productivity while achieving long-term environmental benefits. They also developed a wet method for producing asbestos ores. The development of a biological method for in situ leaching of low-grade uranium ores represents a major advance in biotechnology research.

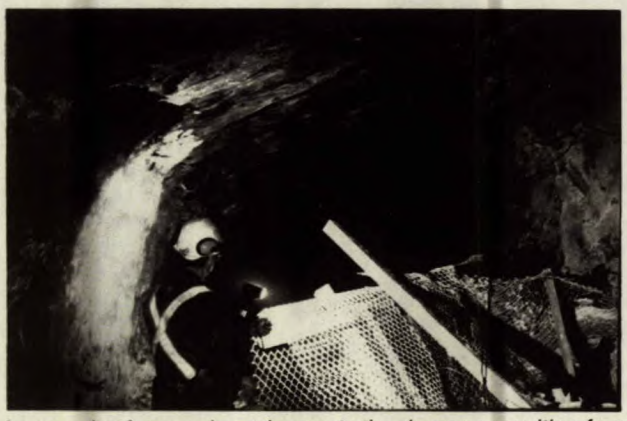
Attention was also focussed on developing new mineral-based materials for use in industry. In a series of demonstrations at non-ferrous foundries, Branch scientists demonstrated that the addition of trace amounts of elements such as sodium and calcium, greatly improves the quality, and therefore the marketability, of zinc-aluminum alloys. CANMET is evaluating the potential, in Canada, for commercial development of emerging technology for producing rapidly solidified metals and alloys. The CANMET Mobile Foundry visited more than 60 industrial foundries across Canada, and scientists assisted industry with quality control and production economics. Branch scientists devised innovative methods to weld and test structures, as well as to produce metal castings.

The most advanced techniques of analytical microscopy were used to examine the microscopic structures of many materials. Information about the state of material obtained in this way was used in developing new materials and improving the properties of existing ones.

MINING

- The Branch continues to be involved actively in developing innovative technologies for mine design, mine equipment, and mining methods, as well as in monitoring current technology. Researchers:
  - — concentrated on solving the problem of excessive noise at drilling sites, at the request of the Technical Committee of the Canadian Drilling Association. Bench dB readings of the pneumatic underground diamond drills were measured while operating without load;
  - — provided industry with sources of data on fire-retardant fluids used in equipment in underground mines;
  - — completed successful testing of a prototype for a remote-controlled miniscaler developed within the Branch;
  - — completed studies of potash-mining technology and ground-control constraints in potash mines;
  - — continued gathering information on both ongoing and planned R&D in the mining industry;
  - — initiated a project to evaluate new techniques and remote-controlled equipment for mining deep-seated, but high-grade, uranium deposits.
- Engineering equations that predict pillar load were formulated. This is of particular interest in areas where there are underground service and garage stations. In cooperation with a mining company, CANMET continued to evaluate mine stability, as well as conducting laboratory tests and field measurements of stress. Researchers investigated rockbursts, prepared case histories, and identified the sequence, causes, and mechanism of the rockburst at Campbell Red Lake Mine in December 1983. Pre-mining stresses in rockburst-prone mines were measured.

- Under the Federal/Manitoba Mineral Development Agreement, areas in which there is a need for research and development were identified. Six tasks for a total of $1.61 million were proposed.
- At the mining industry's request, CANMET is developing guidelines related to surface crown pillars. Detailed field observations were made of the weathered and structured rock in surface pillars at one mine.
- CANMET is preparing guidelines on mine backfill. In-house research in this area centered on the use of dewatered tailings and rockfill, sand and gravel, and underground emplacement of tailings.
- CANMET researchers designed, built, and tested an apparatus that uses a novel concept, *confined shear testing*, to measure frictional and strength properties of rock joints. Better definition of these properties will be important in the future, because an increasing portion of Canadian mining will take place under deep-mining and high-stress conditions.



A ground safety engineer inspects the damage resulting from a typical localized rockburst in an underground drift/tunnel

HEALTH AND SAFETY IN MINING

- Effort was devoted to developing effective technology for tailings disposal and management, to minimize the effect on the environment. CANMET scientists monitored the migration of contaminants from pyritic uranium tailings, measured the factors affecting radon exhalation from both vegetated and unvegetated uranium tailings, and studied the amount of contaminant taken up by vegetation.
- The Branch was actively involved in improving the quality of the environment in underground mines. Achievements included:
  - — developing instruments to monitor the decay products of radon, thoron, and radon gas;
  - — measuring noise levels so that technology for noise reduction can be developed;
  - — reducing critical diesel pollutants dramatically by replacing PTX converters on the load haul dumps (LHD) with recently developed ceramic filter traps and putting copper/manganese additives in the fuel;
  - — demonstrating a water-conserving recirculation system for a venturi-type, high-efficiency, water-scrubbing system;
  - — completing work on using diesel fuel/methanol emulsions as an underground fuel;
  - — identifying the advantages and disadvantages of the Johnson Matthey Catalytic Trap Oxidizer.
- Dust affects both the comfort and the long-term health of workers in all mining operations. Researchers developed instruments to monitor diesel, mineral, and fibrous dust; they found that blasting, crushing, and rock handling are major sources of dust.

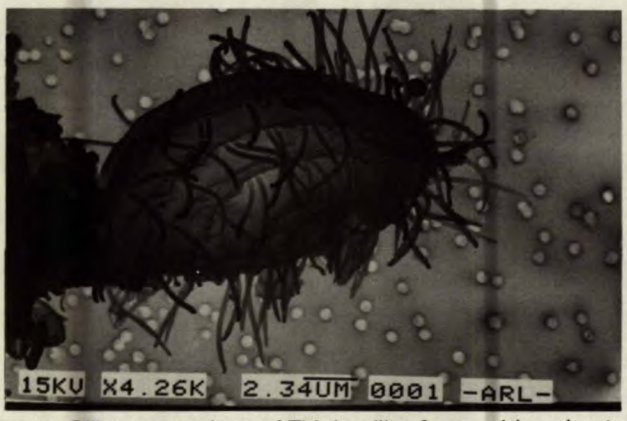
CONSERVATION AND RESOURCE ASSESSMENT

- Applied mineralogical investigations carried out in the Buchans area of central Newfoundland and in New Brunswick on copper-zinc ores, in the Northwest Territories on beryllium/niobium ores, and in New Brunswick on tin ores; identified potential recovery problems; and assisted in development of recovery schemes.
- Automated image analysis techniques have been refined and applied to solving recovery problems by defining the way in which minerals occur in different mill products, including tailings and concentrates. These properties provided the following results used in designing mill tests to improve metal recoveries:
  - — impurities were eliminated from a zinc concentrate;
  - — the nature of iron minerals lost to the tailings was defined;
  - — liberation characteristics of niobium minerals lost to tailings were defined.

MINERAL PROCESSING

- Scientists are studying three minerals — talc, calcite, and quartz — in impact, vibratory, and attritor-type grinding mills and in four types of air classifiers.

- A study of domestic barite resources, with potential for the drill-mud and pharmaceutical markets, was initiated in 1984 with the intent to document deposits and specific beneficiation problems. Information and samples have been obtained from several deposits located in Newfoundland, Nova Scotia, Ontario, and British Columbia.
- A detailed evaluation of the more promising domestic silica deposits was initiated:
  - The first two phases of this study — Ontario and Quebec — were completed.
  - The third phase, now in progress, includes silica from deposits in Nova Scotia, New Brunswick, Manitoba, Saskatchewan, Alberta, and British Columbia. Beneficiation procedures to produce sand ceramic and filler grades include attrition scrubbing, magnetic separation, froth flotation, and acid leaching.
- Crushing characteristics of two hammer mills were compared, in particular for reducing large *book* vermiculite. Pebble mill, vibratory, and attritor-type grinding are being studied for a number of minerals.
- Classification studies and modifications are being made with several classifiers to achieve minus 5- to 10-μm range products. A *gate* was designed and installed on the Knapp and Bates air jig to improve separation of minerals of different gravities.
- Surface chemical investigations are being conducted to improve understanding of the salt flotation mechanism for separating sylvite from halite. The results of this study will be used to enhance the recovery of sylvite in dodeclyammonium chloride flotation of potash ores.
- An alternative to the conventional flotation process for recovering sylvite is electrostatic separation. The separation of potash from salt underground could have a major impact on the industry. It would increase minable ore reserves, reduce environmental problems caused by salt disposal, and reduce overall operating costs. The program is designed to study factors that control the surface charges of sylvite and halite. The absorption of surfactants and temperature control are being studied to determine their effects in modifying the surface charges.
- Researchers continued to work on methods for improving the grade and quality of iron ore concentrates, improving the quality of pellets, lessening environmental impact, and improving process control. Project activity included the following:
  - implementation of a grade-control program at Quebec Cartiers Mount Wright operation;
  - a study of alcohol removal from magnetite concentrates;
  - water treatment for recycle and disposal;
  - testing of alternate binders for pelletizing;
  - testing pellets by cold extrusion;
  - analysis of the Mount Wright spiral circuit.
- Since three Canadian operations currently lose over 7000 t/a of tin worth about $90 million, CANMET researchers are developing methods to recover fine-sized tin from base-metal sulphide flotation tailings.
- Significant advances were again made in providing the mineral and coal industry with a user-friendly computer method for circuit and equipment optimization and design, under the Simulated Processing of Ores and Coals (SPOC) program. During 1984, a system of software demonstration was developed to provide remote industrial users with access to the EMR computer, to test a series of programs covering elements of computer-aided process evaluation and optimization. Forty separate programs can be accessed by this demonstration system. Short workshops demonstrating the main programs with SPOC libraries were given. Substantial savings in grinding costs were reported by some users of the grinding models.
- Secondary mineral values from sulphide ores, which are left underground to support the mine or are below cut-off grade, can be recovered by biohydrometallurgical processes. CANMET personnel are acting as technical advisors, and as the scientific authority, on the National Research Council's Program for Industry/Laboratory Projects (PILP) Biotechnology contract to optimize the bacterial leaching of chloritic uranium ores in place.
- Two databases have been developed for the BIOMINET Association, which coordinates communication between R&D groups interested in biotechnology. The first contains information on the activities, interests, and resources of research organizations, universities, companies, and associated agencies interested in using biological systems in mineral processing. The second is a bibliographic database covering scientific literature on the physiology, biochemistry, and genetics of thiobacilli; bacterial leaching of mineral values; bioadsorption studies; coal desulphurization; and microbial leaching of precious metals.



Large Ciliate, a predator of Thiobacillus ferro-oxidous bacteria (the smaller dots)

ENVIRONMENTAL TECHNOLOGY

- Laboratory and field investigations provided the information necessary to develop methods to minimize the detrimental effects that mine and mill wastes have on the environment. Results of lysimeter leaching tests on Elliot Lake uranium tailings showed that bacterial pyrite oxidation is decreased when the tailings are deposited as a thickened charge, or when pyrite is partially removed prior to deposition.
- Liquid effluents from the mining industry contain heavy metals, cyanide, arsenic, and thiosalts. Water pollution must be controlled to meet the standards set by regulatory agencies for mining and processing minerals. Last year, chemical oxidation and bio-oxidation were found to be effective methods to control this pollution.
- Investigations of noxious elements encountered in Canadian non-ferrous pyrometallurgical processes are currently focussed on SO_2 and arsenic-bearing systems. Researchers developed a method to predict stable condensed phases and gas compositions that occur during roasting or other pyrometallurgical processes. They found that the SO_2 present in emissions from thermal power plants was effectively reduced by reaction with pyrrhotite.

MATERIALS DEVELOPMENT

- Staff continued compiling long-term data on the performance of less energy-intensive materials used in making concrete. Materials tested last year included fly ash and silica fume. The mechanical strength of concrete containing ilmenite as a coarse aggregate was found to decrease, as the temperature it was exposed to increased. Lightweight concrete blocks, which contained an aggregate made from coal wastes, have enough compressive strength to be used in semi-structural concrete construction.
- The corrosion of asbestos cement pipe and asbestos cement material was examined.
- A simplified method of ranking comparable materials for resistance to thermal shock provided a good correlation of predicted values with those obtained by empirical test methods.
- Scientists found that erosion and corrosion cause the lining of ladles, used in the VOD and VAD processes for making high-alloy speciality steels, to degrade. Work continued on developing methods to predict service performance of electrode materials. The cost of graphite electrodes is a major part of the overall cost of electric-arc furnace technology used in the steel industry.
- Branch scientists are studying the effect that microstructure has on the properties of, and on the methods used to process, metals and alloys. The principles of microalloying were applied in three plate-steel development projects.
- Steel composition and steelmaking practice affect the machinability of commercial sheets of machinery steels. Tool wear rate depends strongly upon the inclusion population and microstructure. Scientists studied the behaviour of a large number of specimens from an experimental alloy steel rail, as well as developing a quantitative model for the buildup of hydrogen at the interface between a stainless steel weld overlay and a Cr-Mo pressure vessel shell.
- CANMET's tests for fracture toughness form part of a program to prevent structural failures. Scientists participated in writing national codes and standards, and tested structures known to contain defects. Analysis of ship-plate structures is performed at the request of Coast Guard Canada. Actual propellers were used in a study to determine the cause of low-fracture toughness in large cast propellers made of Mn-Ni-Al bronze. Lowering the Mn content to 8-10 per cent or annealing at 720°C improved the toughness in thick section castings. Varying casting practice and adding trace elements helped eliminate underside shrinkage defects in Zn-Al castings.
- Researchers developed a computer program to measure and calculate local stress patterns in materials. This program will assist in interpreting failure mechanisms in welded joints.
- Research on non-destructive testing focussed on process and product quality control for advanced technologies:
    - — Work continued on a novel system to detect surfaces at high temperatures. The system can detect ultrasound generated by a laser from distances greater than one mile.

— A technique using laser and optical ultrasonic generation and detection to measure parameters such as grain size, without contact, was developed. This system is immune to the noise vibrations and fumes commonly found in industry.

— Acoustic emission technology being developed will be used to monitor defects that form during welding operations.

METALS PROCESSING

- CANMET is developing new, and modifying existing, processes to produce castings. Researchers found that:
  - — Application of a strong vacuum to the entire mold accelerated the rate of curing degradable sand and core binders.
  - — The composition of thin-wall hollow cylinders, cast using modified electroslag casting equipment, was homogeneous.
  - — Use of ceramic filters or lowering of the magnesium content reduced, but did not eliminate, the amount of dross produced when iron plate castings were poured in grey-iron molds.
  - — Low-pressure, disposable mold techniques can be used to make castings from commercial expanded foam patterns.
  - — Low-pressure casting characteristics derived from aluminum alloys were extended successfully to the recently developed family of zinc-aluminum alloys.

- CANMET's mobile foundry laboratory, designed and assembled under the Short Term Assistance in Research and Technology (START) Program, visited a total of 52 foundries. The mobile laboratory is used to demonstrate the latest technology, as well as to identify methods the foundries can use to improve both their efficiency and the quality of their castings. Sand control was a major problem at most of the foundries visited — 75 per cent of the defects noted in the castings were sand related. Many of the recommendations made have already been implemented.

- The CANMET rolling mill and cam plastometer were used interactively to develop high-temperature rolling schedule for Ti-Ni-V plate. The results demonstrated the technological opportunity for industry to produce 350 WT plate in half the time, and with rolling forces and mill powers lower than those required for conventional controlled rolling.

- Scientists examined through-thickness grain refinement of austenite during rolling, and of ferrite at the end of cooling, using scaled-down rolling schedules on strand cast steels. These experiments enabled the scientists to establish metallurgically the relationship between industrial and pilot-scale processing of these steels.

- Research on the metallurgy, processing, and formability of galvanized steel sheet focuses on understanding the separate and combined effects of galvanized layer and substrate metal on forming behaviour.

- An understanding of the interplay of metal flow and microstructural changes during the forging process will lead to greater precision in the process and, consequently, to a reduction in the materials and energy used. Research at CANMET centres on metal flow behaviour, the application of microalloying technology to forging, and the development of CAD/CAM programs.

- Physical metallurgical processes such as the formation of weld-heat-affected zones were simulated, and process variables affecting microstructure and mechanical properties were studied. A series of welding transformation diagrams is being developed for several steel compositions.

- Development of new welding processes encompassed a wide range of activities:
  - — disbonding of weld-surface overlay;
  - — evaluation of narrow-gap welding;
  - — application of high-power laser technology to welding;
  - — development of the gas-metal-arc/submerged-arc combination process;
  - — weld repair and reclamation technology.

- Canada is in the forefront of the development of technology for arctic marine activities. Researchers are developing procedures for welding processes that can be applied to arctic ships and to submarines. Welds have been prepared and evaluated using the submerged-arc-welding process.

STANDARDS AND SPECIFICATIONS

- Certified reference materials are necessary for quality control in the Canadian minerals processing industry. To ensure credibility and general acceptance, these are invariably prepared in national laboratories. The Canadian Certified Reference Materials Project (CCRMP) distributed approximately 1600 units of reference materials having a revenue of approximately $100 thousand to users in Canada and abroad. The following are some of the achievements of the Project:

  — Gold tailings samples GTS-1, base metal ore KC-1a, and gold-silver-copper ores CH-1 and CH-2 were certified and offered for sale.

  — Uranium ores DL-1a, DH-1a, BL-4a, and BL-5 were certified for lead-210.

  — Additional certified values were assigned to reference materials MP-1a, MP-2, CZN-1, CPB-1, CCU-1, SO-1, SO-2, SO-3, and SO-4.

  — Interlaboratory programs to certify uranium reference ore RL-1 and a suite of seven zinc-aluminum alloys, NZA-1 to -7 were carried out.

  — A suite of three bentonite samples were prepared by CCRMP and characterized by interlaboratory consensus on behalf of a Canadian-American Bentonite User's Committee.

  — Uranium reference sample RGU-1 was prepared on behalf of the International Atomic Energy Agency.

  — Vegetative materials for use as radionuclide reference materials were characterized on behalf of NUTP.

- CANMET analyzes ores, concentrates, metals, and related materials. Techniques used currently are infrared analysis, differential thermal analysis, X-ray powder diffraction analysis, and optical emission spectroscopy. Scientists are developing new analytical techniques as the nature of the projects changes.

- CANMET is coordinating a program, initiated at the request of the Committee on Hydraulic Cements of the International Standards Association (ISA) and the Canadian cement industry, to assess existing cement specifications and testing methods used in Canada.

- The Branch certifies, on a national basis, personnel who conduct non-destructive testing. Non-destructive testing ensures the structural integrity of engineering constructions such as nuclear plants and pipelines, as well as ensuring product quality and reliability.

- CANMET continues to take an active role in International Organization for Standardization (ISO) committees. Examples are REMCO, the council committee on reference materials; TC102, the Technical Committee charged with the development of standards for physical testing of iron ores; and TC183, responsible for standard methods of sampling, sample preparation, and chemical analyses of copper, lead, and zinc ores and concentrates. These standards have a significant effect on the acceptance of Canadian mineral and metallurgical products in international markets.

Research scientist, Elsie Donaldson, analyzing for trace elements using an atomic absorption spectrophotometer

NATIONAL URANIUM TAILINGS PROGRAM

The National Uranium Tailings Program was established in 1982 with a five-year mandate and a budget of $10 million. Activities under this program focus on predicting the long-term effects of current disposal methods for uranium mill tailings.

- Last year, a Senior Review Board of policy advisors was created. The Technical Advisory Committee continued to meet and produced a review of the detailed program plans. The NUTP staff used this report and other information to produce an Interim Report, in

which the April 1984 plans were aligned carefully to match existing resources. Programs will be funded to develop scientific understanding of basic processes, because this area is unlikely to be funded by other sources. It is the government's responsibility to show leadership by working actively to fill the gaps in our understanding of these problems.

- The NUTP staff continued implementing the long-term plans issued in April 1984. They placed 45 contracts amounting to $2.4 million. Fifty-eight per cent of the funds went to Ontario firms, 22 per cent to Saskatchewan firms, and 20 per cent was spread among four other provinces. The total includes four major field programs — one in Newfoundland, two in Saskatchewan, and one in Ontario. About 85 per cent of the funds went to the private sector. Contracts were given to:
  - — continue system model development;
  - — study risk assessment and De Minimis levels;
  - — study membrane liners, the practical aspects of pyrite oxidation, and ion exchange of radon;
  - — study radon, zoobenthic organisms, and sedimentation processes.
- During this period, a permanent home was sought for the NUTP database (CANUT). It now appears it will go to a federal government agency that uses environmental monitoring data. All development of the database has been postponed; data accumulated under this program have been stored as hard copy until the requirements of the new owner are defined.

TECHNOLOGY TRANSFER

During 1984-85, the final year of the special two-year Short Term Assistance in Research and Technology program, the Office of Technology Transfer (OTT) expanded its technology transfer activities and increased participation in the Program for Industry/Laboratory Projects. OTT also worked with CANMET's laboratories to plan technology transfer activities; assisted with patenting procedures by acting as a liaison with Canadian Patents and Development Ltd. (CPDL); and handled intellectual property, including licensing and legal matters arising from R&D contracts.

TECHNOLOGY EVALUATION

- CANMET continued to provide technical contributions for a major government/industry study on economic, technical, and environmental aspects of Canada's non-ferrous smelter industry, and evaluated contract R&D reports. CANMET was responsible for:
  - — the release, in May 1984, of the first in a series of reports entitled *Canada's Nonferrous Metals Industry: Nickel and Copper*;
  - — the evaluation of reports on uranium tailings management in Saskatchewan, process development studies for sulphur dioxide containment, and manganese extraction from New Brunswick ores and from Quebec asbestos tailings;
  - — the further development of the CANEVA process evaluation/costing software and database, and the O'Hara-derived software for determining the costs of mining projects.

PROJECT REVIEW

- Activities included studies contracted out to review the five-year SPOC project, and a preliminary review of the mobile foundry. An overall review of the two-year, $five million START program was also begun. Economic issues related to the Fossil Fuel program, such as tracking the benefits derived from CANMET work on waste heat recovery and improved gas furnaces, were studied briefly.

TECHNOLOGY TRANSFER ACTIVITIES

- The START program formalized and strengthened support to technology transfer activities in the laboratories, and enabled better preparation of technologies for transfer through the PILP program managed by the National Research Council. A $668 thousand technology transfer program funded by the START program sponsored patent applications, special promotional packages, workshops and seminars, market studies, and project reviews. Thirty-four projects were completed, including:
  - — patenting of gallium arsenide circuit contacts;
  - — preparation of brochures for the Erector Transporter;
  - — Canada-wide workshops on controlling fires in underground coal mines;
  - — a market study for abrasion-resistant ceramics from metallurgical slags;
  - — reviews of the five-year SPOC program and the mobile foundry;
  - — an assessment of horizontal continuous casting.

- The use of PILP funds to transfer CANMET technologies resulted in the approval of two new projects and extension of an ongoing project. Companies participating in these projects will contribute about $800 thousand of the $1.5 million total. These projects are:
  - — development of wet processing of asbestos fibre from tailings;
  - — development of a continuous on-stream cyanide analyzer;
  - — further development of improved (1-3 W) and large-scale (up to 70 W) thermoelectric generators.
- Other technology transfer activities included setting up an intellectual-property information system to keep track of all CANMET patenting/licensing activities since the 1960's.
- The first phase of the CANMET Client Study to better identify the end products of CANMET projects, their application in industry and government, and the CANMET-client relationship for each project was completed.

MINERAL AND ENERGY TECHNOLOGY INFORMATION

Access to up-to-date information reported in journals, conference papers, books, dissertations, and technical reports is a prerequisite to research and development. Not surprisingly then, a strong information support system is a necessary component of every effective research organization.

- To aid CANMET scientists in their research, the Library received on subscription or exchange, 2600 periodical titles in all major languages, and added to its inventory 2500 new books dealing with all aspects of mineral and energy technology. Staff loaned 66 000 items to CANMET personnel and 3600 items to external borrowers. A new reading room stocked with frequently used materials was established at the Bells Corners Complex, while the Main Library received an extensive face-lift and new equipment to improve service. In preparation for computer-based remote access to the Library's 250 000 holdings, 30 000 inventory records were converted to machine-readable form.
- The Branch's extensive text-processing and graphic production facilities were used to assist in producing the 581 papers and reports that CANMET published worldwide in professional journals or in CANMET's own publication series. The number of bilingual publications increased by 31 per cent last year.
- Information officers responded to over 2500 technical inquiries requiring 900 searches of scientific databases.
- CANMET added over 5000 new records to the four computer-based data files on coal technology, mining technology, mineral processing, and the database of CANMET publications. The first three of these databases are available through QL systems and CAN/OLE; public use of these databases during the last year exceeded 12 000 searches.
- Over 15 000 separate publications were mailed out on demand, on subscription, or on exchange to scientists and engineers in Canada, as well as in many other parts of the world.

The annual reports of the operating divisions contain details of CANMET's research activities and are available to the public.

For further information contact:

Technology Information Division
CANMET
Energy, Mines and Resources Canada
555 Booth Street
Ottawa, Ontario K1A OG1
Telephone:

Coal Technology	(613) 995-4075
Energy Technology	(613) 995-4075
Mining Technology	(613) 995-4064
Mineral Processing Technology	(613) 995-4064
Metallurgy	(613) 995-4807
General Inquiries	(613) 995-4029

APPENDIX

CANMET PROFESSIONAL STAFF

CANMET PROFESSIONAL STAFF

DIRECTOR GENERAL'S OFFICE

W.G. Jeffery; B.Sc., M.Sc. (Leeds); Ph.D. (McGill); Director General

J.T. Jubb; B.A.Sc., M.A.Sc., Ph.D. (Toronto); Deputy Director General

RESEARCH PROGRAM OFFICE

D.A. Reeve; B.Sc., Ph.D. (Birmingham); Director

D.B. Gladwin; B.Sc., M.Sc. (Queen's), P.Eng.; Assistant Director, Mining

R.W. Revie; B.Eng. (McGill), M.Eng. (R.P.I.), Ph.D. (M.I.T.); Res. Sci.

A.E. George; B.Sc., M.Sc., Ph.D. (Cairo); Assistant Director, Energy Processing

F.D. Friedrich; M.Sc. (Queen's); Assistant Director, Energy Utilization

C.J. Adams; B.Sc., M.Sc. (McGill); Ph.D. (McMaster), P.Eng.; Assistant Director, Energy Utilization

R.J.C. MacDonald; B.Sc. (St. Francis Xavier); Assistant Director, Mineral Processing

M.J. Stover; B.Sc. (UPEI); B.Ed (Western) Program Coordinator

D.H. Quinsey; B.Sc. (Queen's); P.Eng.; Program Coordinator

TECHNOLOGY INFORMATION DIVISION

J.E. Kanasy; B.Sc., B.A. (Windsor), M.A. (Michigan), Ph.D. (Pittsburgh); Director

Library

G. Peckham; B.A., B.L.S. (McGill); Section Head

M.T. Gagné; Bacc., M. Bibl. (Montreal); Librarian

J. Ho; B.A., B.L.S. (Ottawa); Head, Technical Services

K. Nagy; B.Sc., B.L.S. (McGill); Head, Reader Services

C.M. Nason; B.A., M.A. (Carleton); M.L.S. (Western Ontario); Librarian

Technical Inquiries

J.E. Beshai; B.Sc. (McMaster); Coal Technology Information Officer

C.F. Dixon; B.Eng. (N.S.T.C.); P.Eng.; Metallurgy Information Officer

R.T. Blake; A.C.S.M. (U.K.), P.Eng.; Mineral Technology Information Officer

J.J. Krocko; B.Sc. (Alberta); Energy Information Officer

G. Marois; B.Sc. (Ottawa); B.Sc. Génie Géol. (Laval); General Technology Information Officer

Documentation

W. Kent; B.A. (Carleton); Database Manager

G.M. Blondeau; B.A. (Queen's), M.A. (Guelph); Mining Abstractor

T.J. Patel; B.Sc. (Oregon State), M.Sc. (Washington State); Mineral Processing Abstractor

Publications

M. Close; B.A. (Toronto); B.A. (Hons) (Ottawa); Section Head

D. Davidson; B.A. (Hons); M.A. (Carleton); Editor (English)

E. Blackburn; B.A. spéc. en traduction, LL.L. (Ottawa); Editor (French)

M.P. Desrosiers; B.A. conc. en litt. française; B.A. spéc. en traduction (Ottawa); Editor (French)

TECHNICAL SERVICES DIVISION

J.M. Duchesne; B.Eng. (Montreal), M.Sc.Eng. (Arizona); P.Eng.; Director

D.M. Norman; M.I.Mech. Eng. Borough Polytechnique (U.K.); Engineer

OFFICE OF TECHNOLOGY TRANSFER

J. Kuryllowicz; B.Eng. (McGill); Director

J. Palmer; B.Sc. (Aberdeen); P.Eng.; Engineer

F.J. Kelly; B.Eng. (N.S.T.C.); Res. Sci.; Manager

W.S.H. Wong; B.Eng. (McMaster); P.Eng.; Engineer

R. Philar; M.S. (Connecticut), M.B.A. (Washington); P.Eng.; Manager

G.S. Bartlett; B.Sc., B.A. (Memorial); Economist

ENERGY RESEARCH LABORATORIES

B.I. Parsons; B.Sc., Ph.D. (McGill); D.Phil. (Oxford); Director of Laboratories

Engineering Services

L.P. Mysak; Dipl. Mech. Tech. (Algonquin); B.A.Sc., M.Eng., P.Eng. (Ottawa); Engineer

J.L. Harcourt; Editor

Synthetic Fuels Research Laboratory

J.M. Denis; B.A.Sc. (Ottawa), P.Eng.; Manager

Process Development

D.J. Patmore; B.Sc. (Bristol), Ph.D. (Alberta); Res. Sci.

T.J.W. de Bruijn; B.Sc., M.Sc., Ph.D. (Delft); Res. Sci.

J. Chase; B.Sc.Chem. (Acadia), B.Sc. Chem.Eng. (McGill), Ph.D. (Univ. of London); Res. Sci.

W.H. Dawson; B.Sc. (McGill), Ph.D. (Western Ontario); Res. Sci.

D.D.S. Liu; B.Chem.Eng. (N. Taiwan Univ.), Ph.D. (Dalhousie); Res. Sci.

F.T.T. Ng; B.Sc. (Hong Kong), M.Sc., Ph.D. (British Columbia); Res. Sci.

P.L. Sears; M.A., Ph.D. (Cambridge); Res. Sci.

R.B. Logie; B.Sc. (New Brunswick); P.Eng. Engineer

Bitumen/Oil Recovery

D.K. Faurschou; B.A.Sc. (Toronto); Res. Sci.

J. Margeson; B.Sc. (Carleton), M.Sc. (Ottawa); Res. Sci.

Analytical Section

R.J. Lafleur; B.A. (Ottawa), B.A.Sc. (Waterloo), M.Sc. (Alberta), P.Eng. Chemist

D.M. Clugston; B.Sc., Ph.D. (McMaster); Chemist

V. Whelan; B.Sc. (Waterloo); Chemist

Coal Liquefaction

J.F. Kelly; B.Eng., Ph.D. (McGill); P.Eng.; Res. Sci.

S.A. Fouda; B.Eng. (Cairo), Ph.D. (Waterloo); Res. Sci.

M. Ikura; B.Eng. (Himeji), M.Eng. (Osaka), Ph.D. (McGill); Res. Sci.

P. Rahimi; B.Sc. (Iran), M.Sc. (Brock), Ph.D. (Alberta); Res. Sci.

Combustion and Carbonization Research Laboratory

G.K. Lee; B.Sc., M.Sc. (Queen's); P.Eng.; C.Eng.; Manager

Coal Treatment and Coke Processing

T.A. Lloyd; B.Sc. (Carleton); Phys. Sci.

R.G. Fouhse; B.Sc. (Saskatchewan); P.Eng.; Engineer

Carbonization Research

J.T. Price; B.Sc. (Calgary), Ph.D. (Western Ontario); Res. Sci.

J.F. Gransden; B.Sc. (London), A.R.S.M., Ph.D. (Western Ontario); Res. Sci.

J.G. Jorgensen; B.Sc. (Carleton); Phys. Sci.

Energy Conservation Technology

A.C.S. Hayden; B.Eng., M.Eng. (Carleton); P.Eng. Res. Sci.

S.W. Lee; B.Sc. (Rangoon); Ph.D. (McMaster); Res. Sci.

F. Preto; B.A.Sc. (Toronto), Ph.D. (Queen's); Res. Sci.

R.W. Braaten; B.Eng. (Carleton); P.Eng.; Phys. Sci.

Emerging Energy Utilization Systems

F.D. Friedrich; B.Sc. (Saskatchewan); M.Sc. (Queen's); P.Eng.; Res. Sci.

E.J. Anthony; B.Sc.; B.A. (open university), Ph.D. (Swansea), C.Chem.; Res. Sci.

D.L. Desai; B.E. (Sardar Patel), M.Eng. (Ottawa), P.Eng.; Engineer

I.T. Lau; B.Sc. (Chengkunk), M.A.Sc. (Ottawa); Engineer

V.V. Razbin; Dipl.Eng. (Higher Mechanical-Electrical Institute, Sofia, Bulgaria); Engineer

Industrial Combustion Processes

H. Whaley; B.Sc., Ph.D. (Sheffield), P.Eng., C.Eng.; Res. Sci.

G.N. Banks; B.A. (British Columbia); Res. Sci.

P.M.J. Hughes; B.Sc. (Waterloo), M.Sc. Mech.Eng. (Waterloo); Res. Sci.

K.V. Thambimuthu; B.Sc. (Birmingham), M.Eng. (McGill), Ph.D. (Cambridge), C.Eng.; Res. Sci.

B. Cox; B.App.Sci. (Ottawa), Mech.Tech. (Algonquin); Engineer

J.K.L. Wong; B.Sc. (Calgary); Phys. Sci.

Coal and Coke Constitution

B.N. Nandi; B.Sc., M.Sc. (Calcutta), Dr.Eng. (Karlsruhe); Res. Sci.

J.A. MacPhee; B.Sc. (St. Francis Xavier), Ph.D. (British Columbia); Res. Sci.

L. Ciavaglia; B.Eng. (Carleton); Phys. Sci.

Quality Assurance

R. Prokopuk; B.Sc. (Alberta); Phys. Sci.

Project Monitoring and Engineering Design

S.I. Steindl; Dipl.Eng. (Budapest), M.Sc. (Queen's), P.Eng.; Engineer

Hydrocarbon Processing Research Laboratory

M. Ternan; B.A.Sc. (British Columbia), Ph.D. (McGill), P.Eng.; Manager

Hydrocarbon Conversion

D.P.C. Fung; B.Sc. (British Columbia), Ph.D. (Windsor); Res. Sci.

M. Skubnik; B.Eng., M.Eng. (Bratislava); Phys. Sci.

Analysis and Standardization

L.C.G. Janke; B.Sc. (Sir Wilfred Laurier), B.Ed. (Queen's); Phys.Sci.

M.D. Farrell; B.Sc. (Carleton); Phys.Sci.

J.Z. Skulski; Chem.Eng. (Wroclaw, Poland); Chemist

Separation and Characterization Section

H. Sawatzky; B.S.A., M.S.A., Ph.D. (Toronto); Res. Sci.

S. Coulombe; D.E.C., B.Sc., Ph.D. (Montreal); Res. Sci.

B. Farnand; B.A.Sc., Ph.D. (Ottawa); Res. Sci.

G. Jean; D.E.C., B.Sc., Ph.D. (Western Ontario); Res. Sci.

M.A. Poirier; B.Sc., M.Sc. Ph.D. (Montreal); Res. Sci.

S.M. Ahmed; B.Sc., M.Sc. (India); Chemist

Catalytic Hydroprocessing

J.F. Kriz; Dipl.Eng. (Prague), Ph.D. (Dalhousie), P.Eng.; Res. Sci.

C.W. Fairbridge; B.Sc., M.Sc. (Lakehead), Ph.D. (St. Andrews); Res. Sci.

J. Monnier; B.Sc. (Laval), Ph.D. (McMaster); Res. Sci.

M.V.C. Sekhar; B.Sc. (Madras), M.Sc. (Itt-Madras), Ph.D. (Calgary); Res. Sci.

M.F. Wilson; B.Sc., Ph.D. (St. Andrews); Res. Sci.

Catalysis Research

J.R. Brown; B.Sc., Ph.D. (Western Ontario); Res. Sci.

V.M. Allenger; B.A.Eng. (McGill), M.Sc. Chem.Eng. (Ottawa); Res. Sci.

J.Z. Galuska; B.Sc., M.Sc., Ph.D. (Jagiellonian, Cracow, Poland); Res. Sci.

S.H. Ng; B.Eng. (Taiwan), Ph.D. (New Brunswick); Res. Sci.

Pyrolysis and Gasification

E. Furimsky; Dipl. Eng. (Prague), Ph.D. (Ottawa); Res. Sci.

MINING RESEARCH LABORATORIES

J.E. Udd; B.Eng., M.Eng., Ph.D. (McGill), P.Eng.; Director

Rock Mechanics Laboratory

G.E. Larocque; B.Sc. (Carleton); Manager

A. Boyer; B.Sc. (Montreal); Phys. Sci.

R. Boyle; B.Sc. (Ottawa); Comp. Sci.

A. Fustos; B.S.F./F.E., B.Sc. (UBC), M.Sc. (Carleton), P.Eng.; Engineer

L. Geller; Dipl. Mech. Eng. (Budapest); B.Sc. (Eng.) (London), M.A.Sc. (Toronto); Phys. Sci.

R.W.D. Clarke; B.Eng. (N.S.T.C.), P.Eng.; Engineer

G. Herget; B.Sc. (Goettingen, West Germany), M.Sc., Ph.D. (Munich, West Germany); P.Eng.; Res. Sci.

S. Vongpaisal; B.Eng., M.Eng., Ph.D. (McGill); Res. Sci.

M. Gyenge; Dipl. Eng. (Budapest), P.Eng.; Res. Sci.

N.A. Toews; B.Sc. (Queen's); Res. Sci.

Y.S. Yu; B.Sc., M.Eng. (McGill); Res. Sci.

D.F. Walsh; B.Sc. (Memorial); Phys. Sci.

A.S. Wong; B.Sc. (National Taiwan University), M.Sc. (Ottawa); Phys. Sci.

A.B. Annor; B.A.Sc. (Ottawa); P.Eng.; Phys. Sci.

R. Jackson; B.A.Sc. (Waterloo); (AECL Employee) Phys. Sci.

J. Pathak; B.E., M.Eng. (Sager, India); Ph.D. (Freiberg, Germany); Engineer

M. Bétournay; B.Sc., M.Sc.A., B.Eng. (McGill) P.Eng. Phys. Sci.

R.J.R. Welwood; B.Sc. (Queen's); Phys. Sci.

N. Billette; B.A. (Bourget), B.Sc., M.Sc., Ph.D. (Ecole Polytechnique); Res. Sci.

Elliot Lake Laboratory

R.O. Tervo; B.A.Sc. (Toronto), Ph.D. (Bradford), P.Eng.; Manager

J. Bigu; M.Sc. (Barcelona), DTC (Slurry), Ph.D. (Queen's); Res. Sci.

D.G.F. Hedley; B.Sc., Ph.D. (Newcastle), P.Eng. Res. Sci.

G. Knight; B.Sc. (Birbeck, London); Res. Sci.

M. Savich; Dipl. Min. Eng. (Ljobljan, Yugoslavia), B.Eng., M.Eng. (McGill); Res. Sci.

N.K. Davé; B.Sc., M.Sc., (Rajastman, India), Ph.D. (Queen's); Res. Sci.

G. Swan; B.Sc. (London), Ph.D. (London); DIC; ARSM; Res. Sci

M. Grenier; B.Sc., M.Sc. (Laurentian); Res. Sci.

T.P. Lim; B.Sc. (Ottawa), Dipl. (Radio Chem Tech, West Germany); Phys. Sci.

B. Arjang; B.Sc., M.Sc., Ph.D. (Germany); Res. Sci.

S.G. Hardcastle; B.Sc., Ph.D. (Nottingham); Res. Sci.

Canadian Explosives Research Laboratory

R.R. Vandebeek; B.Sc., M.Sc. (Carleton); Manager

K.C. Cheng; B.Sc., M.Eng. (Tainan Chen Kung, Taiwan); Eng.

E. Contestabile; B.Sc. (Carleton); Phys. Sci.

K.K. Feng; B.Sc., M.Sc., Ph.D. (Iowa); Res. Sci.

C.A. Vary; B.Sc. (Ottawa); Tech. Off.

P. Lee; B.Sc. (Hong Kong Baptist); Chemist

D.E.G. Jones; B.Sc., Ph.D. (Western); Res. Sci.

Canadian Explosive Atmospheres Laboratory

J.A. Bossert; B.Sc., (Queen's); Manager

E.D. Dainty; B.Sc., M.Sc., (Toronto) P.Eng.; Res. Sci.

G. Lobay; B.Sc., (Manitoba); Engineer

P. Mogan; B.A.Sc. (Toronto), P.Eng.; Res. Sci.

N. Sarin; Dipl. (Mech. & Auto Eng.) (Oxford College of Technology), B.A.Sc. Mech.Eng. (Waterloo); Engineer

M. Gangal; B.Sc. (Agra, India), M.Sc. (Rokee, India and McGill), Ph.D. (Calgary); Res. Sci.

K. Mintz; B.Sc., M.Sc. (UBC), Ph.D. (Toronto); Res. Sci.

MINERAL SCIENCES LABORATORIES

W.A. Gow; B.A.Sc. (Toronto); Director

E.G. Joe; B.Sc. (Queen's); Phys. Sci.

L.L. Sirois; B.A., B.Eng., M.Eng. (McGill), P.Eng.; Res. Sci.

W.J.S. Craigen; B.Sc. (Queen's); Phys. Sci.

Chemical Laboratory

R.G. Sabourin; B.Sc. (Ottawa); Manager

R.J. Guest; B.Sc. (Acadia); Assistant Manager, Operations

Metals and Alloys

D.J. Barkley; B.Sc. (Carleton); Chemist

E.H. MacEachern; B.Sc. (Mount Allison); Chemist

J.W. Wittwer; B.Sc. (Carleton); Chemist

Ores and Fire Assay

J.C. Hole; B.A. (Toronto); Chemist

R.R. Craig; B.Sc. (Glasgow); Chemist

Radiation and Mineral Physics

M.G. Townsend; B.Sc., Ph.D. (Southampton); Res. Sci.

Solution Chemistry

G.A. Hunt; B.Sc. (Carleton); Chemist

J.E. Atkinson; B.A. (Queen's); Chemist

J.A. Graham; B.Sc. (Carleton); Chemist

XRF, Radiometry and Fluorimetry

J.L. Dalton; B.S., M.Eng. (Carleton); Chemist

C.W. Smith; M.Sc., Ph.D. (Queen's); Res. Sci.

D.L. Curley; B.Sc. (Carleton); Chemist

R.H. McCorkell; M.Sc., Ph.D. (Manitoba); Chemist

M. Desgagne; B.Sc. (Laval); Chemist

Optical Emission and NAA

T.R. Churchill; B.Sc. (Western Ontario); Chemist

R.E. Horton; B.Sc. (Carleton); Chemist

Special Analysis

A. Hitchen; B.Sc. (McMaster); Chemist

M.E. Leaver; B.Sc. (Queen's); Chemist

Research/Special Projects

E.M. Donaldson; B.Sc. (Manitoba); Res. Sci.

E. Mark; B.A. (Toronto); Chemist

Reference Materials Research

H.F. Steger; B.Sc., Ph.D. (McMaster); Res. Sci.

Extractive Metallurgy Laboratory

M.C. Campbell; B.Sc. (St. Francis Xavier), B.Eng. (N.S.T.C.), D.I.C., M.Sc. (London), P.Eng.; Manager

Metallurgical Chemistry

J.E. Dutrizac; B.A.Sc., M.A.Sc., Ph.D. (Toronto); Res. Sci.

D.J. MacKinnon; B.Sc., M.A., Ph.D. (Ottawa); Res. Sci.

K. Bartels; B.Sc. (Carleton); Chemist

E. Rolia; B.A. (UBC); Chemist

O. Dinardo; B.Sc. (Carleton); Phys. Sci.

R.M. Morrison; B.Sc.; Ph.D. (British Columbia); Res. Sci.

Physical Chemistry

A.H. Webster; B.A., M.A., Ph.D. (UBC); Res. Sci.

S.M. Ahmed; B.Sc., Ph.D. (Saskatchewan); Res. Sci.

R.F. Pilgrim; B.Sc. (Queen's); Res. Sci.

R. Sutarno; B.E., M.E., Ph.D. (N.S.T.C.), P.Eng.; Res. Sci.

S.A. Mikhail; B.Sc., M.Sc., Ph.D. (Cairo); Dr. Eng. (Norway); Res. Sci.

V.H.E. Rolko; B.Sc. (Manitoba); Chemist

J. Leduc; B.Sc., (Montréal); M.Sc., Ph.D. (McGill); Res. Sci.

Solution Purification

G.M. Ritcey; B.Sc. (Dalhousie); Res. Sci.

G. Pouskouleli; B.Sc. (Greece), M.Sc. (Montréal); Ph.D. (McGill); Res. Sci.

R. Molnar; B. Eng. (McGill); Ph.D. (London); D.I.C.; Res. Sci.

G. Pouskouleli; B.Sc. (Aristotelian Univ. Greece), M.Sc. (Université de Montréal), Ph.D. (McGill); Res. Sci.

Pyrometallurgy

J.M. Skeaff; B.A.Sc., M.A.Sc., Ph.D. (Toronto); Res. Sci.

C. Hamer; B.E. (N.S.T.C.), M.Sc. (Queen's); P. Eng.; Res. Sci.

V.M. McNamara; B.Sc., B.Eng., M.A.Sc. (Toronto); P. Eng.; Res. Sci.

L.J. Wilson; B.Sc. (McMaster); Chemist

D. Liang; B.Sc., M.Sc. (Queen's); P.Eng.

Leaching

B.H. Lucas; B.Sc. (Queen's); P.Eng.; Res. Sci.

D. Shimano; B.Sc. (Concordia); Phys. Sci.

K.E. Haque, M.Sc., Ph.D. (Ottawa); Res. Sci.

W. Howell; B.Sc. (Calgary), M.Sc. (Ottawa); Phys. Sci.

Biotechnology

H.W. Parsons; B.Sc. (Alberta); Res. Sci.

A. Jongejan; Geol. Can. Drs. (Amsterdam); Ph.D.; Res. Sci.

M. Silver; B.Sc., M.Sc. (Manitoba), Ph.D. (Syracuse); Res. Sci.

V. Sanmugasunderam; B.Sc. (Ceylon); M.Sc. (Wales); Ph.D. (British Columbia); Res. Sci.

Mineral Processing Laboratory

G.W. Riley; A.C.S.M. (Camborne School of Mines), P.Eng.; Manager

Ceramics

K.E. Bell; B.E. (Saskatchewan), P.Eng.; Res. Sci.

V.V. Mirkovich; Ph.D. (Toronto); Res. Sci.

D.H.H. Quon; B.Sc. (National Sun Yat Sen U.), M.Sc. (Ohio State), Ph.D. (Michigan); Res. Sci.

T.A. Wheat; Ph.D. (Leeds); Res. Sci.

A. Ahmad; B.Sc., M.Sc., Ph.D. (New Brunswick); Res. Sci.

A.K. Kuriakose; (Madras, India); Ph.D., M.A., B.Sc.; Res. Sci.

J.D. Canaday; M.B.A. (Arizona); B.Sc. (Oklahoma); M.Sc., Ph.D. (Guelph); M.Sc. (Calgary); Res. Sci.

Construction Materials

V.M. Malhotra; B.Sc., B.E. (W. Australia); Res. Sci.

H.S. Wilson; B.E. (Saskatchewan); Res. Sci.

G.G. Carette; B.Sc. (Laval); Engineer

B. Nebesar; M.Sc. (McGill); Res. Sci.

E. Douglas; B.Sc. (Chem. Eng.) (Argentina); Ph.D. (McGill); Res. Sci.

Mineral Dressing

G.I. Mathieu; B.A., B.Sc. (Laval); Res. Sci.

A.I. Stemerowicz; B.Sc. (Queen's), P.Eng.; Res. Sci.

D. Laguitton; Chem. Eng. (Rennes), D.Sc. (Laval); Res. Sci.

K.S. Moon; B.Sc., M.Eng. (Seoul National U.); M.A.Sc., M.Eng. (British Columbia), Ph.D. (California); Res. Sci.

J.H.C. Leung; B.Sc. (Taiwan), M.Sc. (Waterloo); Phys. Sci.

J.M.D. Wilson; B.Sc., M.A.Sc. (Queen's); Phys. Sci.

W.H. Cameron; B.Sc. (Queen's); Phys. Sci.

V.G. Reynolds; B.Sc. (Carleton); Phys. Sci.

M. Cristovici; B.Eng. (Bucharest); Res. Sci.

J.M. Lamothe; B.Eng. (Ecole Polytechnique); Res. Eng.

Mineralogy

L.J. Cabri; B.Sc., M.Sc., Ph.D. (McGill); Res. Sci.

J.L. Jambor; B.A., M.Sc., Ph.D. (Carleton); Res. Sci.

W. Petruk; B.Eng., M.Sc., Ph.D. (McGill); Res. Sci.

T.T. Chen; B.Sc. M.Sc., Ph.D. (Cornell); Res. Sci.

J.A. Soles; B.A.Sc., M.A.Sc. (British Columbia), Ph.D. (McGill), P.Eng.; Res. Sci.

M.R. Hughson; B.A. (Western Ontario); Phys. Sci.

J.T. Szymanski; B.Sc., Ph.D. (London); Res. Sci.

P.R. Mainwaring; B.Sc. (Western Ontario); Ph.D. (Toronto); Res. Sci.

Non-Metallic Minerals

R.K. Collings; B.Eng. (N.S.T.C.), P.Eng.; Res. Sci.

S.S.B. Wang; B.Sc. (Hong Kong Baptist); M.Sc. (California), Ph.D. (Toronto); Phys. Sci.

P.R.A. Andrews; B.Sc., (Eng.) (London), M.Eng.Sc. (Melbourne); Res. Sci.

PHYSICAL METALLURGY RESEARCH LABORATORIES

W.H. Erickson; B.Sc., M.Sc. (Mich. Tech); Ph.D. (Durham), P.Eng.; Director

C.S. Champion; B.Sc. (St. And.); PGCE (Cambridge); Scientific Editor

Metal Processing Laboratory

W.N. Roberts; M.A., Ph.D. (Leeds); Program and Planning Coordinator (PMRL)

Foundry

R.K. Buhr; B.Eng. (McGill); Head

K.G. Davis; B.Sc. (Birmingham), M.A.Sc., Ph.D. (British Columbia); Res. Sci.

J.L. Dion; B.A.Sc. (Montreal); P.Eng.; Phys. Sci.

R.A. Matte; B.Sc. (Sherbrooke); Engineer

G. Morin; B.A.Sc. (Laval); P.Eng.; Engineer

A. Palmer; B.Sc., Ph.D. (London); P.Eng.; Res. Sci.

E.I. Szabo; M.Sc., Ph.D. (Nottingham); Res. Sci.

R. Thomson; B.Sc., ARCST, Ph.D. (Glascow)

R.D. Warda; B.A.Sc. (British Columbia), Ph.D. (Cambridge); Res. Sci.

L. Whiting; B.Sc., M.Sc., Ph.D. (McGill), MBA (Ottawa); Res. Sci.

Metal Forming

A.F. Crawley; B.Sc., Ph.D. (Glasgow), P.Eng; Head

D.L. Baragar; B.Sc., M.Sc., Ph.D. (Queen's); Res. Sci.

C. Galvani; B.Eng. (Montreal Univ.); Phys. Sci.

G.E. Ruddle; B.A.Sc., M.Sc. (Waterloo), D.Sc. (Virginia), P.Eng.; Res. Sci.

J.M. Too; B.Sc. (Taiwan); M.Sc. (McGill); Ph.D. (Wales); Res. Sci.

C. Ozsoy; M.Sc., Ph.D. (Technical Univ. of Istanbul); Visiting fellow

Nondestructive Testing

V.L. Caron; B.A.Sc. (Laval), M.Eng. (Paris) P.Eng.; Head

G. Landry; B.A.Sc. (Montreal); Phys. Sci.

D.K. Mak; B.Sc., M.Sc., Ph.D. (Toronto); Res. Sci.

J.P. Monchalin; D. Eng. (Paris); M.Sc., Ph.D. (MIT); Res. Sci.

Welding

J.T. McGrath; B.A.Sc., M.A.Sc., Ph.D. (Toronto), P.Eng.; Head

R. Chandel; B.E. (Nagpur), Ph.D. (Birmingham); Res. Sci.

J.T. Bowker; B.Met., Ph.D. (Sheffield); Res. Sci.

J.E.M. Braid; B.A.Sc. (Waterloo); Ph.D. (Cambridge); Res. Sci.

R.D. McDonald; B.Sc. (Queen's), P.Eng.; Res. Sci.

Metal Development Laboratory

D.W.G. White; S.M., Sc.D. (M.I.T.), P.Eng.; Manager

Corrosion Science

J.B. Gilmour; B.Sc. (Queen's), Ph.D. (McMaster), P.Eng.; Head

G.J. Biefer; B.Sc., Ph.D. (McGill); Res. Sci.

D.C. Briggs; B.Eng., M.Eng. (McGill), Ph.D. (Queen's); Res. Sci.

H.M. Hindam; B.Sc. (Cairo), Ph.D. (McMaster); Res. Sci.

G.R. Hoey; B.Sc., M.Sc., Ph.D. (Toronto); Res. Sci.

A.W. Lui; B.Sc., M.A.Sc., Ph.D. (Windsor); Res. Sci.

J.C. Saiddington; Chem. Eng., M.A.Sc. (Toronto); Res. Sci.

V.S. Sastri; B.Sc., M.A., Ph.D. (New York); Res. Sci.

R.J. Brigham; B.Sc., M.Sc., Ph.D. (McMaster); Res. Sci.

Engineering Physics

W.R. Tyson; B.A.Sc. (Toronto), Ph.D. (Cambridge); Section Head

S.B. Biner; M.Sc. (Technical Univ. of Istanbul), Ph.D. (Univ. of Aston); Visiting Fellow

J. Boutin; B.Eng., M.A.Sc. (Montreal); Phys. Sci.

B. Faucher; Eng. INSA (Lyon), M.Sc. (Laval), Ph.D. (Ottawa), P.Eng; Res. Sci.

J. Harbec; B.Eng. (McGill), P.Eng.; Phys. Sci.

G. Roy; M.Sc. (Silesian Univ.), Ph.D. (P.A.S.); Res. Sci.

O. Vosikovsky; B.A.Sc., Ph.D. (Prague); Res. Sci.

K.C. Wang; B.A.Sc., Ph.D. (Rensselaer); Res. Sci.

Metal Physics

W.N. Roberts; M.A., Ph.D. (Leeds); Section Head

G. Carpenter; B.Sc., Ph.D. (Wales); Res. Sci.

E.J. Cousineau; B.Sc. (Carleton); Phys. Sci.

R. Holt; B.A.Sc. (Toronto); Res. Sci.

J. Ng-Yelim; B.A. (Carleton), B.Sc. (Ottawa); Phys. Sci.

R.H. Packwood; B.Sc., Ph.D. (Birmingham); Res. Sci.

Metallurgy

J.D. Boyd; B.A.Sc. (Toronto), Ph.D. (Cambridge); Head

L.E. Collins; B.Sc., M.Sc. (Queen's), Ph.D. (M.I.T.); Res. Sci.

D.M. Fegredo; B.Sc., M.Sc., Dipl., I.I.Sc., Ph.D. (Sheffield), A.I.M.; Res. Sci.

M.J. Godden; B.Met., Ph.D. (Sheffield); Res. Sci.

R.F. Knight; B.Sc., M.Sc. (Queen's); Res. Sci.

A. Couture; B.A., B.A.Sc. (Laval), P.Eng.; Res. Sci.

M. Sahoo; B.Sc., B.E. (I.I.Sc., Bangalore) Ph.D. (British Columbia), P.Eng.; Res. Sci.

T.F. Malis; B.Sc., M.Sc., Ph.D. (Manitoba); Res. Sci.

D.E. Parsons; B.A.Sc. (Toronto); Res. Sci.

M.T. Shehata; B.Eng. (Cairo), Ph.D. (McMaster); Res. Sci.

B. Dogan; B.Sc., M.Sc., Ph.D. (Manchester); Visiting Fellow

COAL RESEARCH LABORATORIES

T.D. Brown; B.Sc. (Durham); Ph.D. (Sheffield) C. Eng.; Director

Coal Research Laboratory: Edmonton

H.A. Hamza; B.Sc. (Cairo); Ph.D. (Newcastle-on-Tyne); Manager

Process Control and Computer Applications

J.L. Picard; B.Sc. (Alberta); Phys. Sci.

N.A. Mansour; B.Sc. (Cairo), B.Sc. (Alberta), Ph.D. (Alberta); Res. Sci.

A. Salama; B.Sc. (Alexandria), Ph.D. (Alberta); Res. Sci.

W. Friesen; B.Sc. (Brock), Ph.D. (British Columbia); Res. Sci.

A.W.F. Mo; B.Sc. (Alberta); Phys. Sci.

Engineering and Field Demonstration

K. Hashmi; B.Sc. (Alberta), P.Eng.; Engineer

Z. Potoczny; B.Sc. (Toronto), M.Sc. (Toronto); Engineer

Fossil Fuel Science and Applications

W.H. Michaelian; B.Sc. (California); Ph.D. (Simon Fraser); Res. Sci.

W.M. Leung; B.Sc. (Hong Kong); M.Sc. (Manchester); Ph.D. (McGill); Res. Sci.

N.E. Andersen; B.Sc. (Alberta); Phys. Sci.

D. Axelson; B.Sc. (Toronto), Ph.D (Toronto); Res. Sci.

C.W. Angle; B.Sc. (Alberta); Phys. Sci.

S. Twa; B.Sc. (British Columbia); Phys. Sci.

R. Frenette; B.Sc. (Santo Tomas); EG-ESS

R. Mikula, B.Sc. (Saskatchewan), Ph.D. (British Columbia); Res. Sci.

Coal Preparation

M.W. Mikhail; B.Sc. (Assuit), M.Sc. (Alberta), P.Eng.; Engineer

I.S. Parsons; B.Sc. (Western Ontario); Phys. Sci.

J. Szymanski; M.Sc. (Wroclaw), Ph.D. (Wroclaw); Res. Sci.

Carbonization

A.B. Fung; B.Sc. (Waterloo), P.Eng.; Engineer

R. Zrobok; B.Sc. (Alberta); Phys. Sci.

Coal Research Laboratory: Calgary

G. Zahary; B.Sc. (Alberta), M.Eng. (McGill); P. Eng.; Manager

Coal Mining Research

B.M. Das; B.Sc., A.I.S.M. (Indian School of Mines); Ph.D. (Tech. U. of Mines, Ostrava, Czechoslovakia), P.Eng.; Res. Sci.

M.Y. Fisekci; Dipl. Eng. (Turkey), M.Eng. (Sheffield); Ph.D. (Sheffield); Res. Sci.

N.J. Stuart; B.Sc. (Nottingham), Ph.D. (Nottingham); Res. Sci.

R.N. Chakravorty; B.Ch.E. (Jadavpur), Ph.D. (Nottingham); Res. Sci.

R.J. Kolada; B.Sc. (Nottingham); Ph.D. (Nottingham); Res. Sci.

Coal Reserve Assessment

A.S. Romaniuk; B.Sc. (Queen's), P.Eng.; Phys. Sci.

H.G. Naidu; B.Sc., A.I.S.M. (Indian School of Mines); P.Eng.; Engineer

Mining Technology

V. Srajer; M.Sc. (Univ. Appl. Sci., Kosice), P.Eng.; Engineer

R.K. Singhal; B.Sc. (Nottingham), Ph.D. (Newcastle-on-Tyne), C.Eng., P.Eng.; Phys. Sci.

Coal Research Laboratory: Cape Breton

D.B. Stewart; B.Sc., M.Sc. (Queen's), P.Eng.; Manager

Advanced Technology

G.A. Haslett; B.Sc. (Durham), C.Eng., P.Eng.; Engineer

Mining Technology

P.R.M. Cain; B.Sc. (Cardiff), Ph.D. (Cardiff); Res. Sci.

T.R.C. Aston; B.Sc. (Cardiff), Ph.D. (Nottingham); Res. Sci.

Coal Mine Environments

J.C.Y. Hwang; B.Sc. (Taiwan), M.Sc. (Central), M.Sc. (McGill), Ph.D. (McGill); Res. Sci.

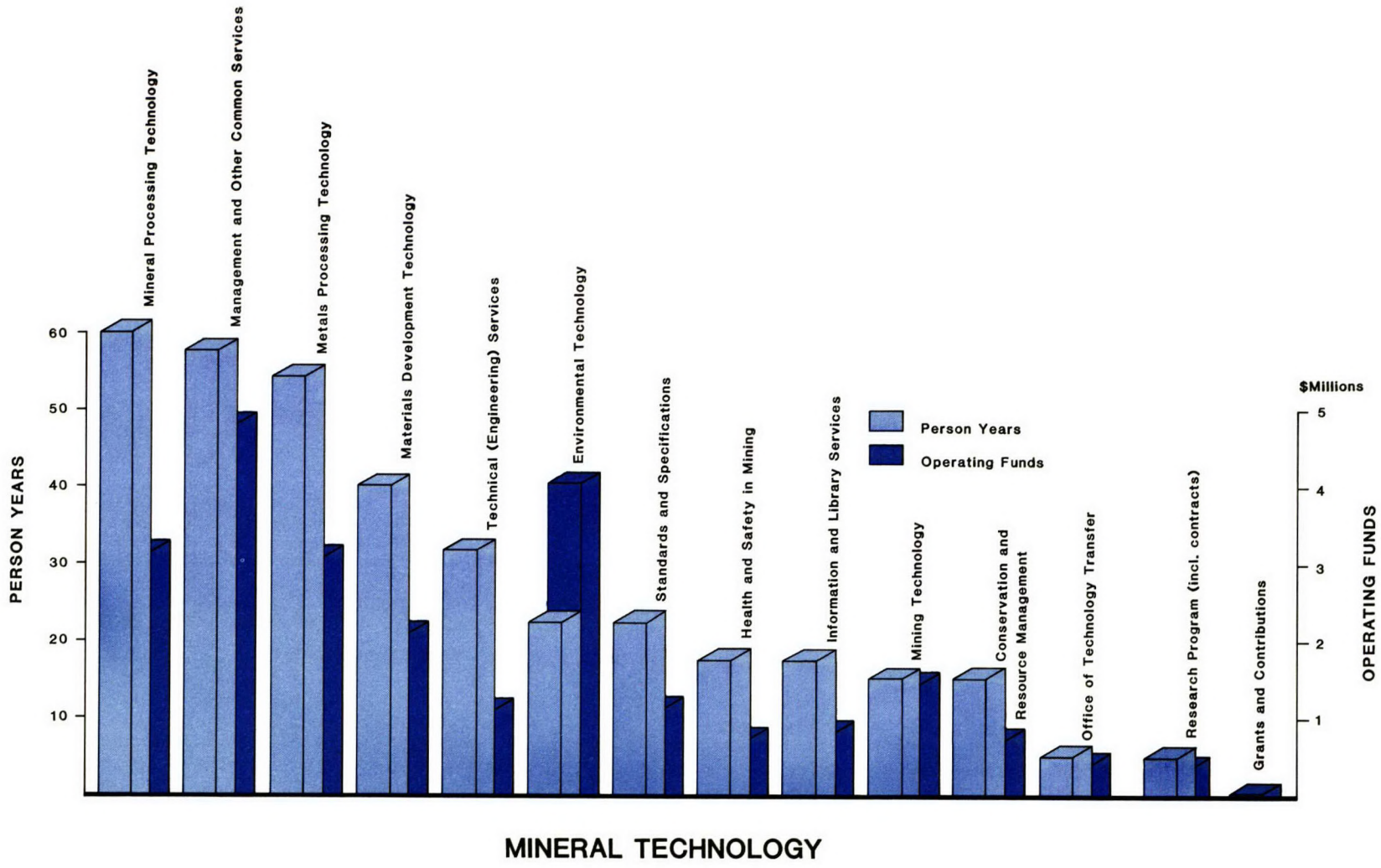
A.W. Stokes; B.Sc. (Nottingham), Ph.D. (Nottingham); Res. Sci.

B.W. Konda; B.Eng. (Osmania), Ph.D. (Nottingham), P.Eng.; Phys. Sci.

Coal Testing

G.W. Bonnell; B.Sc. (Dalhousie); Chemist

Distribution of Resources 1984–1985



Distribution of Resources 1984–1985