

THE MINERAL INDUSTRY OF CANADA

By David B. Doan

Led by the mineral fuels group, the total value of mineral production in Canada increased almost 14% compared with that of 1995. By reaching a high of about \$36.1 billion,¹ the total value had climbed by \$4.3 billion over that of 1995, according to the Minister of Natural Resources (McLellan, 1997a, p. 1). In spite of the relocation of operations by many Canadian companies to the United States and especially Latin America, mining was doing well in Canada. The country's nominal gross domestic product (GDP) reached \$797.8 billion, an increase of about 1.5% over that of 1995 (Robert Watts, U.S. Department of State, oral commun. 1997) and the total value of production of all mineral commodities exceeded 4.5% of GDP. This was a robust performance by the mineral industry that boded well for the future of this sector of the national economy.²

For most of 1995, the entire nation had been concerned over the prospect of secession by the Province of Quebec, with various troublesome economic consequences if Quebec delivered a "Yes" vote on secession. The Secessionists' narrow loss was enough to alleviate tension and foster a return to confidence in the credit markets and the general health of the economy.

Higher prices for base metals in 1995 had softened significantly by mid-1996, but exploration and production continued to show strength as prices improved through yearend.

Exploration for diamond moved forward, after spreading to most of Canada, but with less public excitement than in 1994 and 1995. The biggest news-maker in the Canadian mining industry continued to be the huge nickel-copper-cobalt deposit at Voisey's Bay on the Labrador coast, where drilling results confirmed an unusually large, high-grade ore body that was open east and west, as well as downward. Drilling continued through the year, steadily expanding the recognized limits of the ore body.

Although a stream of Canadian mining companies has entered Central America and South America, where the

welcome has been encouraging, such discoveries as Voisey's Bay reaffirmed that there is much still to be explored in Canada. Outlay for 1996 exploration costs in Canada amounted to about \$693 million, up sharply from the \$458 million spent in 1995.

Environmental concerns continued to influence mineral exploration and development activity throughout Canada, leading some companies to look elsewhere for projects. Latin America proved attractive, as companies saw that foreign investment was likewise welcomed, mining laws were coherent and reasonable, and profits could be repatriated.

In the meantime, however, Canada mounted a strong effort to reconcile the disparate views of the mining industry, the Federal Government, Provincial interests, the financial community, environmentalists, and the aboriginal peoples with the social and economic infrastructures, and the requirements for mineable materials. Unlike former times, or even 10 years ago, the aboriginal peoples grouped as the "First Nation" were making their presence and their wishes explicit politically and were ready to participate economically in the development of new mines and the mineral industry of Canada. They were inclined to negotiate for the protection of their hunting and fishing grounds while gaining the benefits of development, such as jobs and technical assistance.

Government Policies and Programs

Canada reacted quickly to the so-called Helms-Burton legislation passed by the U.S. Congress earlier in the year by drafting legislation in June to allow Canadians to countersue in Canadian courts for damages incurred in U.S. courts under Helms-Burton. Indignation in Canada over Helms-Burton ran high as the U.S. Department of State announced that it would be ready by late summer to revoke the visas of persons deemed to have violated the provisions of the act. A probable target was Sherritt International, a Canadian company investing in the development of Cuban nickel mining operations (Mining Journal, 1996b, p. 481).

Primary jurisdiction over mineral resources in Canada is exercised by Provincial governments. Exceptions have been the Yukon Territory and the Northwest Territories which, while still under the resource-management control of the Federal Government, were slowly accumulating more independent powers.

Federal and Provincial policies (though not entirely consistent among Provinces) are generally stable and have traditionally favored research and information services relating to the mining industry. The Federal Government had negotiated multiyear

¹Where necessary, values have been converted from Canadian dollars (CAN\$) to U.S. dollars at an average rate of CAN\$1.364=US\$1.00 for 1996. All values in this report, unless otherwise specified, are expressed in U.S. dollars.

²For more detailed information on the mineral production in Canada, see the Canadian Minerals Yearbooks for 1995 and 1996, prepared by the Mining Sector, Natural Resources Canada, Ottawa, Canada, which were used extensively as source material for this report. The U.S. Department of the Interior has arranged to have these Canadian publications placed in selected depository libraries of the 50 States and Puerto Rico. Please note that any datum or statistic in the text not referenced elsewhere may be assumed to be from either the Yearbook or the related series of separate, preliminary, topical periodicals containing information compiled by Statistics Canada and issued by Natural Resources Canada.

Mineral Development Agreements with Provincial governments that fund initiatives intended to strengthen the mining industry in each region. One example is the Canadian Geoscience Information Center which provides centralized access to technical information on the geology of Canada. Although new environmental assessment legislation was passed in 1992, the Government has been deliberate in producing regulations to implement the new laws. One subsequent measure, however, was tax deductibility for funds set aside for the cleanup of closed mine sites, thus complementing emerging Provincial reclamation requirements. The recent shift of international mining investment away from Canada had prompted industry representatives to urge changes in the regulation and taxation of the mining industry.

Near yearend, Natural Resources Canada announced (Northern Miner, 1996b, p. 8) a series of policy initiatives aimed at clarifying its relation to the mining industry, including the following:

- Streamlining investment, securities, and environmental regulations to encourage investment.
- Promotion of mining-related research and development.
- Resolution of native land claims and encouragement of businesses spun off from mines, with collaboration of natives and mining companies at all stages of development.
- Requirements for owners of hazardous nonproducing mines to pay for cleanup costs, and to balance environmental protection with the industry's need for land access.
- Greater consideration for the social and environmental impact of proposed mines rather than focusing only on economics.

Environmental Issues

Having shut down the multibillion-dollar Windy Craggy copper-gold-silver-zinc-cobalt mine development in northern British Columbia 2 years ago, environmental forces mobilized to do the same thing to Huckleberry Mines Ltd.'s \$120 million copper-gold-molybdenum-silver mine development near Smithers, British Columbia. A group calling itself the Canadian EarthCare Society charged that the Huckleberry project was being rushed to approval in secret dealings to which the media and public were excluded. In response, however, Environmental Assessment Office authorities stated that meetings were proceeding in an orderly way and were closed to the public only to permit frank and open discussion, and that the minutes of all meetings were available. They estimated that any approval of the project would not come before late 1996. But in July, the Supreme Court of British Columbia dismissed a motion by the Sierra Legal Defence Fund for an injunction against further work on the project, thus setting a precedent of tolerance for orderly development where in compliance with environmental requirements (Mining Journal, 1996c, p. 42). Construction proceeded on schedule with the goal of building completion before winter.

Hard on a settlement by the Province of British Columbia with its 6,000 First Nation Nisga'a people, the Yukon First

Nation of Na-Cho Nyak Dun announced that it had given conditional environmental approval to the operating and closure plans of United Keno Hill Mines Ltd. in connection with its resumption of commercial production from its Elsa, Yukon mines (First Nation of Na-Cho Nyak Dun, 1996, p. 1). The First Nation's Land and Resources Department prepared an environmental impact statement through its internal Development Assessment Process, and praised the cooperation extended by the mining company.

At Lac de Gras in the Northwest Territories, where an environmental assessment panel had recommended that the Government approve development of the diamond mines, other environmentalists and people of the First Nation Ndilo community criticized the findings, saying that there would be social disruption and extra traffic on winter roads across their hunting grounds (Mining Journal, 1996d, p. 27). The World Wildlife Fund (WWF) threatened a court challenge unless land be set aside as protected areas near the mine, although the WWF said it did not want to delay construction of the mine. It remained to be seen how all this would be untangled after approval of the \$10 million environmental impact statement including detailed mapping and sampling, 2 years of environmental baseline work, and 3 years of community consultation.

In a concerted effort to devise national policy fundamentals aimed at forestalling the kinds of "Huckleberry" shutdown actions described above, Natural Resources Canada issued a wide-ranging statement of policy goals linking environmental considerations with minerals, metals, markets, labor, investment, and taxation (Natural Resources Canada, 1996b, p. 1-25). This paper addresses life-cycle management, safe use, health and the environment, reclamation, recycling of minerals and metals, the role of science and technology, and First Nation concerns, aiming to establish the equilibrium between interests necessary for sustainability.

Production

Total value of production of all mineral commodities, including mineral fuels, was \$36.04 billion, an increase of about 13.4% over that of 1995. In the three nonfuels groups (metals, nonmetals, and structural materials), changes from the previous year were mixed. Production values of metals and nonmetals declined \$293 million and about \$147 million, respectively, but structural materials increased more than \$52 million compared with those of 1995. The performance of these three groups, however, was greatly offset by an increase of \$4.69 billion in the value of mineral fuels produced, amounting to \$23.5 billion, up almost 25% from that of 1995. Each of the mineral fuel commodities participated in the jump in value of production, with crude oil up \$2.71 billion; natural gas, \$1.4 billion; natural gas byproducts, \$513 million; and the value of coal output up more than \$73 million compared with that of 1995.

Geographically, the sources of mineral fuels production were Alberta for 79.5% of the total; Saskatchewan, 10.7%; British Columbia, 7.0%; and all other Provinces and Territories, 2.8%.

In terms of value of production in 1996, the top nonfuel

commodities were gold at \$2.05 billion, followed by copper and nickel at \$1.47 billion each, zinc at \$1.25 billion, iron ore at \$950 million, and potash also at \$950 billion.

Market prices played a role in the mineral commodity values, particularly for copper, whose production tonnage decreased by 6.4% compared with that of 1995, but whose value declined by 28% as the result of price weakness in 1996 after the highs of mid-1995. Values for the output of nickel, potash, silver, and zinc were affected similarly but to a much lesser degree. The value of gold production, by contrast, was proportionately higher than the increase in tonnage produced in 1996.

Ontario was the leading producer of nonfuel mineral commodities, accounting for 32.6% of the total value, followed by Quebec, 19.5%; British Columbia, 11.7%; Saskatchewan, 10.5%; Newfoundland, 5.5%; Manitoba, 5.4%; and New Brunswick, 5.3%. Remaining Provinces and Territories registered the final 9.5%. Although production of fuels tended to be concentrated in the western plains Provinces, the output of nonfuel mineral commodities is characterized by a much wider distribution throughout Canada.

Trade

As the world's greatest exporter of minerals and metals, Canada enjoyed economic benefits from its mineral industry that included a significant contribution to its trade surplus and hence to its merchandise trade balance, as well as major support of the national standard of living.

Mineral and mineral-product exports, including fuels, totaled \$49.68 billion, an increase of about 10% over the comparable figure for 1995, and represented 26% of all Canadian exports for that year. Metals registered 47.4%; fuels, 42.1%; nonmetals, about 9.4%, and building materials, about 1.1%. Value of exports of nonfuel minerals (but including coal) was \$30.7 billion, representing an increase of 1.5% over that of 1995. Included in these exports were crude minerals, smelted and refined products, and semifabricated and fabricated products. Prominent among the crude minerals exported were iron ore, potash, and sulfur to the United States; copper concentrates to Japan; iron ore and zinc concentrates to the European Union (EU); smelted and refined metals, including aluminum, copper, gold, iron and steel, nickel, silver, and zinc to the United States; aluminum and gold to Japan; and copper and nickel to the EU. Coal exports went mostly to Japan.

Mineral and mineral-product imports, including fuels, were valued at \$30.9 billion, amounting to about 18% of the value of all imports. In terms of net trade, the mineral (including fuels) surplus was valued at \$25-billion. Total trade between the United States and Canada exceeded that of any other two countries in the world. Exports to the United States from Canada were a record \$159.1 billion, up 7.4% from those of 1995.

Structure of the Mineral Industry

The Canadian mineral industry comprised as many as 3,000 domestic and perhaps 150 foreign companies. Companies

whose corporate voting rights were at least 50% non-Canadian were considered to be foreign, although other distinctions could apply in some large companies. Roughly 300 mine sites were active, including coal. Another 3,000 mines and quarries produced sand, gravel, and other construction materials. At least 40 smelters were in operation, plus other processing plants in the iron and aluminum industries. Foreign companies were subject to the same taxes as domestic companies, but repatriation of earnings was unimpeded.

Most of the Canadian mineral industry was privately owned, with the exception of some Government participation in potash and petroleum, but even these were in transition to private ownership. Some companies, such as Potash Corp. of Saskatchewan Inc. and Saskatchewan Oil & Gas Corp., were owned, in part, by the Province of Saskatchewan. The Province of Alberta owned part of Alberta Energy Co. Ltd. Although the proportion of Government ownership was changeable, the trend was toward privatization. Petro-Canada was owned partly by Federal and partly by Provincial Governments but was expected to become completely privatized. A large proportion of the total number of mining and petroleum companies was partly publicly owned, with shares trading on various exchanges in Canada and, in many cases, the United States.

Overall, the mineral industry in Canada consisted of underground mines, open pits, leaching operations, concentrators, smelters, and refineries, as well as drilling and production operations characteristic of the petroleum industry. Table 2 lists the structure of the mineral industry by sectors of the major mineral commodities.

Employment in the mining and mineral manufacturing industries has stabilized after a decline that began in 1989, when the number of jobs in those industries peaked at 422,000. Preliminary employment estimates for 1996 by Statistics Canada indicated that total employment in mining and mineral manufacturing, including coal, was about 350,000, up 2.7% from that of 341,000 in 1995. The total number of employees in metal, nonmetal, and coal mining, and quarrying was estimated by Statistics Canada to be 59,000, down about 1,000 compared with that of 1995. Employment in nonferrous smelting and refining was estimated to be 63,500, up about 4% from that of 1995. Altogether, employment in the mining, smelting, and refining sectors, with an estimated 122,500 jobs, showed a net gain of about 2.1% compared with that of 1995. About 8,900 people were also employed in diamond drilling and other support services incidental to mining operations.

Commodity Review

Metals

Aluminum.—Production of primary aluminum was 2.283 million metric tons (Mt), an increase of about 3.7% compared with that of 1995. This put Canada third, after the United States and Russia, in the world in volume of production and second, after Russia, in volume of exports.

After postponing an investment of \$729 million to double its smelter's capacity at Sept-Iles, Quebec, Aluminerie Alouette

Inc. announced that in 1996, it would begin a 3-year shift from carbon potlines to graphitized cathodes costing about \$27 million. This would increase the smelter's capacity from 218,000 metric tons per year (t/yr) to 229,000 by boosting the current from the original 300,000 amperes to 315,000. Elsewhere in Quebec, Aluminerie Luralco Inc. finished a \$12 million overhaul of its smelter's 264 pots at its potline refurbishing center at Deschambault, where it produces 215,000 t/yr.

After having to take a \$420-million write-down of its Kemano hydroelectric power project near Kitimat, British Columbia, when the provincial Government decided to cancel the half-built project, Alcan negotiated an agreement on a projected 22-year power-exchange project with Hydro-Quebec. With Hydro-Quebec furnishing additional power that Alcan may need for modernization and expansion of its smelters in Quebec, Alcan's hydroelectric power system stood ready to accommodate Hydro-Quebec's requirements when feasible.

Canadian Reynolds Inc.'s Baie Comeau, Quebec, aluminum smelter was the world's first to obtain the QS 9000 registration required by U.S. auto manufacturers. Moreover, the smelter also received the ISO 9002 certification, significant not only to the auto industry, but also to Reynolds' fabricating plants and independent buyers in the United States and Canada.

Antimony.—Output of antimony soared to 1,716 metric tons (t) representing an increase of 150% over that of 1995. In mid-1996, Roycefield Resources Ltd. announced that they planned to open one of the largest antimony mines outside China. Their Beaverbrook deposit, near Gander, Newfoundland, will yield 100,000 t/yr for at least 13 years, which would represent 5% of the world's antimony supply. This \$15 million project will produce high-purity antimony trioxide, Sb_2O_3 , for use as a fire retardant for the plastics and vinyl industries. Because the deposit is open in all directions, its full extent may not be known until further exploration is completed. Gold is also present in one zone, showing 8.8 grams per metric ton (g/t) over a 1.1 meter (m) intercept, which could mitigate production costs (Mining Journal, 1996e, p. 47).

Cobalt.—Production of refined cobalt reached 3,552 t, an increase of nearly 9% compared with that of 1995. Part of this production was from the new \$15 million production facility near Cobalt, Ontario, established by Ego Resources Inc. Ego has developed a proprietary hydrometallurgical process for extracting cobalt from ore, tailings, or mine spoil that involves crushing, grinding, flotation, and solvent extraction. Pure cobalt is then further treated to produce simple salts, such as cobalt carbonate. Their process has been endorsed by the Ontario Government as being consistent with its "green" industries strategy, demonstrating that resource development can coexist with environmental responsibility.

Rising demand for cobalt for alloys, catalysis, magnets and batteries, and even pigment, its oldest use, has focused new attention on cobalt resources in Canada, led by the Voisey's Bay, Newfoundland, discovery of at least 40,000 t, with further results expected as exploration progresses.

Copper.—Mine output of copper dropped 5.5%, reflecting a reversal of the previous uptrend and weakness of world copper prices. Production of primary refined copper dropped very slightly, probably as a consequence. Copper production by solvent extraction-electrowinning (SX/EW) fell about 4% from that of 1995. After firming in 1995, copper prices weakened enough that some copper production was shut down.

Princeton Mining Corporation pursued its Huckleberry project on schedule, forecasting production of 29,500 t/yr after startup in 1997. This polymetallic ore body would also yield gold, silver, and molybdenum. Late in 1996, Princeton suspended production at its Similco mine in British Columbia, pending exploration results on-site and the hoped-for improvement of copper prices after their collapse in conjunction with Sumitomo's copper-trading scandal in Japan, involving losses of about \$1.2 billion.

At its 675-Mt deposit grading 0.24% copper in the Fish Lake-Williams Lake area of British Columbia, Taseko Mines Ltd. studied the feasibility of mining 90,000 metric tons per day (t/d) for production of 70,000 t/yr of copper, plus about 1,300 ounces per day (40 kilograms per day (kg/d)) of gold, for a 20-year mining life.

Noranda Mining and Metals Group planned to spend \$7 million at its Mines Gaspé copper mine in Quebec to develop the new E-34 ore body, whose minable reserves are projected to be more than 1 Mt grading 3.39% copper. An estimated 33,400 t of copper would be extracted, extending the mine life well into 1999. Another \$7 million would go to develop the E-38 zone with proven reserves of 1.07 Mt grading 3.59% copper, further extending the mine life. Noranda further planned a \$3.6 million pilot plant for copper recovery from stockpiled oxide ore at Mines Gaspé by using a SX/EW process. During the following 9 years, a full-scale SX/EW plant would produce about 8,000 t/yr of copper cathode. A subsidiary, Noranda Metallurgy Inc., planned an \$8 million concentrate-drying and concentrate-injection system that would increase the capacity of its Gaspé smelter from 85,000 to 110,000 t/yr of copper.

It may be noted that although the SX/EW technique for copper production leads to significant cost savings, all byproduct credits are lost in the process. The revenue flow is thus completely dependent on the price of copper. By normally conferring a so-called risk-reduction advantage as byproduct prices help buoy the revenue stream, Canada's many polymetallic copper deposits lose this benefit during SX/EW operations.

Overshadowing all potential copper production in Canada, the Voisey's Bay discovery, still being evaluated, suggested that Canada, ranking third after Chile and the United States, will continue to be a major world copper producer. Expectations were that Voisey's Bay might yield 99,000 t/y of contained copper.

Gold.—Continuing the gold production surge of 1995, output climbed to 165.8 t, up more than 9%. Predictions made in 1995 that output would reach 170 t by 1998 were seen as even somewhat pessimistic. Canada was the fourth largest gold producer behind South Africa, the United States, and Australia.

The pace of exploration for gold seemed to increase steadily, with various innovations in the chemistry and physics of search techniques supporting the effort in Canada and by Canadian companies in other countries. Canadian companies also pioneered in the improvement of recovery techniques in the ongoing effort to improve leach processing.

At the beginning of the year, about 50 primary gold mines in Canada accounted for 90% of the gold produced, with the remainder coming from base metal mines (8.5%) and placer operations (2.5%). Total employment in primary gold mines totaled 8,800 in 1993; 8,600, 1994; and 8,900, 1995. Employment figures have been improving since 1993, when the steady decline from the 1988 peak of 12,600 was halted.

After finishing its reevaluation of the venerable San Antonio Mine at Bissett, Manitoba, which has already produced more than 1 million ounces (31 t), according to mining records held by the former owners, Rea Gold prepared for full production with a first pour in 1997. Rea carried out an intensive sampling program after pumping out all the levels of the mine, which is 5,500 feet deep. Reserves are projected as being 3.5 Mt grading 9 g/t, or about 30 t of gold altogether, with projected output of 3 t/yr.

Technological progress in gold recovery moved in several directions during the year. Raymo Processing Ltd., a subsidiary of Electra Mining Consolidated of Vancouver, started the recovery of gold from mine tailings on the old Rambler property near Baie Verte, Newfoundland. Extraction is by indoor vat leaching, a technique developed by NovaGold Resources Inc. of Halifax. Recovery has exceeded 80%, with 85% as an eventual goal (Canadian Mining Journal, 1996, p. 21).

Following 13 months of design, fabrication, development, and modification, Ariel Resources Ltd. announced successful production tests of its "innovat" continuous vat leaching process. The equipment uses a novel skimmer design of floating launders along the periphery of the vat, along with selected flocculents for process improvement with fine-particulate ore. By using low-grade, 1 g/t ore crushed to -1/4 inch, the system recovers 67% of contained gold in 30 hours. Experiments showed that, by using finer grinds, the process could recover 87% in 48 hours (Ariel Resources Ltd., 1996).

Gold seemed to be the principal targeted metal for exploration virtually throughout Canada. In terms of value of production, gold led the list, exceeding copper (second) and nickel (third).

Iron Ore.—Production of iron ore dropped to 36.03 Mt compared with 38.56 Mt in 1995 for a difference of almost 6%. This category comprised concentrates, pellets, and sinter from hematite and siderite ores. Major iron-ore-producing companies included Quebec Cartier Mining (QCM), Iron Ore Company of Canada (IOC), Wabush Mines, and the Algoma Ore Division (AOD) of Algoma Steel Inc.

Although data are not available for 1996, the previous year gives an approximation of the proportions of pellets and sinter versus concentrates. QCM produced 16.1 Mt of ore in 1995, 0.1 Mt more than in 1994. Of this, 8.3 Mt was used for pelletization and the remainder, sinter feed. Shipments

exceeded production so that stocks were drawn down to meet demand. IOC produced 15.9 Mt of ore, of which 10.8 Mt went to pelletization; the remainder went to concentrates that were not used for pellets. Wabush Mines turned out 5.3 Mt of iron-ore pellets. AOD produced 975,000 t of sinter at its complex in Wawa, Ontario.

Exploration and development continued in various parts of Canada, including Roche Bay in the Northwest Territories; the Peace River area of Alberta; and Ungava Bay and Schefferville in Quebec.

Pig iron production increased somewhat from 8.46 Mt in 1995 to slightly less than 8.64 Mt, an increase of about 2%. Industry predictions of the proportion of direct-reduced iron to pig iron produced was roughly 16%, thus increasing the ratio of 10% forecast the year before. Crude steel production was estimated to be 14.5 Mt compared with 14.4 Mt in 1995, making it the highest in 5 years, but less than the peak of 15.5 Mt in 1989.

Lead and Zinc.—Canada was the world's largest mine producer of zinc and the fifth largest producer of lead with totals of 1.235 Mt of zinc and 256,674 t of lead in concentrates, respectively. Lead production, in particular, was up sharply, showing an increase of 22% compared with that of 1995. Zinc showed a parallel gain of more than 10%. The notable increase in production of both commodities resulted from the opening of Cambior Inc.'s Langlois mine near Lebel-sur-Quevillon, Quebec, as well as the first almost full year of operation of the Anvil Range Mining Corp.'s Faro mine in Yukon Territory. Closed in 1993, the Faro mine was purchased by Anvil Range after completing financing for reopening. Stripping of the Grum deposit at Faro began late in 1994, and commercial production began in 1995. By August it had reached its capacity of 150,000 t/yr of zinc and 98,000 t/yr of lead in concentrate. However, the mine was suspended on December 20, 1996, because of base-metal price weaknesses and the strengthening of the Canadian dollar (Mining Journal, 1996a, p. 498). In the same month, and for roughly the same reasons, Cambior closed the Langlois mine in Quebec. At both mines, ore handling and dilution were problems; the companies, however, intended reopening at such time as mining was again feasible (Mining Journal, 1996f, p. 458).

Noranda continued development of its Bell Allard zinc-copper project near Matagami in northern Quebec. After construction of surface facilities, the shaft will be sunk and underground workings undertaken. The projected startup in 1998 would coincide with exhaustion of the Noranda operations at Isle Dieu and Norita East, also in the Matagami district. Bell Allard is expected to have a capacity of 80,000 t/yr of zinc and 5,000 t/yr of copper.

Nickel.—Mine output rose to 193,059 t of contained nickel, an increase of 6% compared with the of 1995, which was up strongly from 1994, the year Inco reduced production during the first quarter of that year while coping with labor problems in the midst of soft market prices.

The biggest news in nickel continued to be the Voisey's Bay

nickel-copper-cobalt project of Diamond Fields Resources Inc. (DFR) on the coast of Labrador. Early in the year DFR entertained offers for participation or purchase, initially dealing with Falconbridge Ltd., which launched a bid for friendly takeover. This created a dilemma for Inco Ltd., which owned 7% of DFR, as well as 25% outright of the Voisey's Bay deposit. By the end of August, 1996, after much negotiation, Inco emerged as owner of DFR and in sole control of the Voisey's Bay project, where exploration drilling continued throughout the year. By October, the company was projecting a total of 150 Mt, including a proven 32 Mt in the main ("ovoid") portion of the ore body grading 2.83% nickel, 1.68% copper, and 0.12% cobalt at a total stripping ratio of 0.36:1. In another portion, the so-called Eastern Deepes, mineralization comprised 50 Mt grading 1.36% nickel, 0.67% copper, and 0.09% cobalt. About \$14.7 million is earmarked for further exploration over 4 years. Current plans propose mining 15,000 t/d from an open pit, forming a concentrate, and shipping to a smelter-refinery complex at Argentia, Newfoundland, where refinery output would be 122,500 t/yr. Total capital costs would exceed \$1 billion. This discovery will clearly affect the economics of nickel production and marketing for some time to come.

Inco's \$53 million development program at its Victor deposit near Sudbury, Ontario, included a 1,768-m exploration shaft, scheduled to be completed by 1998. Reserves are projected to be 5.4 Mt grading 2.26% nickel and 0.54% copper in an upper zone, and another 6.4 Mt grading 1.9% nickel and 5.1% copper in a lower zone. Inco has also started development work at the McCreedy East Mine near Sudbury, which is expected to produce 11,000 t/yr of contained nickel and 35,000 t/yr of contained copper by 1999.

Falconbridge Ltd. pressed development of its Raglan nickel-copper property in northern Quebec. Reserves at this property now stand at 20.5 Mt grading 3.17% nickel and 0.88% copper. The \$360 million operation is scheduled to produce about 20,000 t/yr of nickel in concentrate and about 5,000 t/yr of copper in concentrate by mid-1998. Raglan concentrates will be shipped to Quebec City and continue by rail to Falconbridge's Sudbury smelter.

Sherritt International Corp. pursued its contract with Cuba to set up an enterprise to mine, refine, and market nickel and cobalt internationally. Sherritt's Fort Saskatchewan refinery in Alberta produced 25,000 t of nickel from concentrates received from Cuba's Moa Bay nickel plant.

Platinum-Group Metals.—Mine production of platinum-group metals (PGM) decreased by 11% compared with that of 1995. Production data for these metals represent captive recovery from nickel ore rather than response to market demand. Most production has been from their Sudbury mines by Inco and Falconbridge plus a smaller amount in Manitoba from Inco's Thompson mine, and the Namew Lake mine near Flin Flon now being decommissioned by Hudson Bay Mining and Smelting Co. Ltd. and Outokumpo Mines Ltd.

As an approximation based on past experience, Inco's ratio of PGM produced worked out to about 12:7.6:1 for the group

members palladium, platinum, and rhodium, respectively. Although rhodium thus amounted to only slightly more than one-twentieth of the PGM, its prices have traditionally been significantly higher than those for other members of the group, having traded at \$4,000 per ounce at one point in the past decade. Beginning in 1995, however, rhodium prices dipped to levels only slightly higher than those of gold.

PGM recovery is expected to continue with new nickel mining in the Sudbury district. Inco's Victor discovery contains an estimated 18 Mt grading 11.6 g/t PGM plus gold. The McCreedy discovery contains 5 Mt grading 10.6 g/t PGM plus gold.

Silver.—Mine production of silver in concentrate reached 1,308 t, or 2% over that of 1995. This was the highest output since 1991, when production was 1,339 t, and reflected new mines coming on-stream more than any lasting price incentives in world markets.

Canadian silver production has been largely a coproduct of base metal or gold mining, subject to whatever mining incentive applies to the major product, whether gold, copper, or lead-zinc. Accordingly, silver output suffers when mines close or go on suspension for reasons involving supply, demand, and pricing for other major mineral commodities. Production increased significantly in 1995 when Prime Resources Group Inc.'s Eskay Creek gold mine in British Columbia came on-stream as the largest producer of silver in Canada; output of silver is expected to be 340 t/yr.

Canada ranked fifth in world silver production after Mexico, Peru, the United States, and the Commonwealth of Independent States, formerly part of the Soviet Union.

Titanium.—Output of titanium rose slightly to an estimated 825,000 t, an increase of about 1%. QIT-Fer et Titane (QIT) of Canada scheduled an investment of \$260 million in construction of a plant at Sorel, Quebec, to produce an upgraded slag, called UDS, that will contain 95% TiO₂ (titanium dioxide) compared with its present Sorelslag containing 80% titanium dioxide (Industrial Minerals, 1996, p. 9).

Uranium.—The upward trend in production of U₃O₈ (uranium oxide) continued, with an increase of 12% compared with that of 1995. As the world's leading supplier of uranium, Canada was well placed in terms of resources, reserves, mining labor experience, and technology to maintain this position amidst increasing world demand and rising spot and open market prices. As older mines were shut down in the Elliot Lake district of Ontario, newer ones were being developed and mined in the Rabbit Lake-Key Lake-Cluff Lake-Cigar Lake districts of Saskatchewan.

Industrial Minerals

Asbestos.—Canadian asbestos production dropped 8% compared with that of 1995, continuing a decrease that involved an earlier drop in output of between 2% and 3% from 1994 to 1995. Increasing concern regarding chrysotile substitutes were

expected to benefit the chrysotile industry over the near to medium term. Marginal gains were expected in Latin American consumption of Canadian chrysotile; but Asia, already a significant market taking about 58% of exports, was seen as expanding the demand for Canadian fibers.

Asbestos-cement product demand was consistent as many users continued to favor this combination over substitute fibers and steel. After their mine workers' cooperative invested \$2 million in JM Asbestos Inc. and the Government of Quebec guaranteed a \$25 million loan for the purpose, the development phase was completed and the company contemplated a change from open-pit to underground mining. With additional capital from Group Minier and Capital d' Amerique, development of a 250,000-t/yr operation began.

Cement.—Production of cement increased about 6% over that of 1995, reflecting continued strengthening of the export market in the midst of prices that have been declining since 1978 (valued in 1986 dollars). Weakening of the Canadian dollar versus the U.S. dollar since the beginning of the 1990's, especially in early 1995, has made Canadian cement prices attractive to U.S. consumers across the border at time when domestic consumption withered in the face of diminishing residential and nonresidential construction. Canada has always been the chief exporter of cement to the United States, except for a brief period in the 1980's when Mexico moderately exceeded Canadian shipments. The 1990 International Trade Commission ruling against dumping of cement by Mexican producers essentially removed them as competitors, leaving the field to Canada as the principal foreign source. For the immediate future, certainly, the success of Canadian cement producers will be based significantly on exports to the United States and, hence, upon the prospects for U.S. economic growth. Canadian growth and construction, particularly in Ontario, the largest cement market, will play the key role in determining a balance between domestic and U.S. consumption.

Diamond.—Canada's first commercial production of diamond was expected to begin in 1998 by BHP-Dia Met joint venture as mine construction progressed, including extensive support facilities such as arctic living quarters and powerplant.

More than 500 companies have been exploring for diamond, especially in the Northwest Territories, but also in Alberta, British Columbia, Labrador, Manitoba, Ontario, Saskatchewan, and Quebec. The field seemed to be narrowing somewhat as various pipes proved disappointing upon testing. Observers noted that with DeBeers' departure, the leading contenders in the area were the BHP/Dia-Met project and the Aber Resources/Diavik project. BHP's Diamond Division reported that the quality of diamond recovered to date from five kimberlite pipes at its Lac de Gras property, about 300 kilometers (km) northeast of Yellowknife, compared favorably with the best pipes in other parts of the world. The company confirmed that, at current prices for rough diamond, the project to develop the pipes was economically feasible. Capital investment was to be in excess of \$360 million, but observers expected that at least \$4 billion would be spent in association

with the project over a period of time.

Near the end of the year, BHP/Dia-Met noted grades and values for their deposits. The five pipes were located under lakes bearing the same names (Panda, Koala, Misery, Fox, and Leslie) and would be mined during a 30-year period. Current results on the pipes were as follows: Panda, 0.95 carat per ton (kt/t) at \$130 per carat, resulting in an ore value of \$124 per ton; Koala, containing 0.95 kt/t, at an average of \$122 per carat resulting in an ore value of \$116 per ton; Misery, containing 4.19 kt/t at \$26 per carat with an ore value of \$109 per ton; Fox, containing 0.27 kt/t at \$122 per carat with an ore value of \$34 per ton; and Leslie, having 0.33 kt/t at a value of \$89 per carat for an ore value of \$29 per ton. The planned centralized processing plant, which was to be located southwest of the Koala pit, would receive 9,000 t/d of ore during the first 9 years of operation and 18,000 t/d thereafter. The cutoff grade would be 0.01 carat. Processing was expected to involve mainly crushing, scrubbing, and dense media separation, plus high-intensity magnetic separation, X-ray concentration, and sorting. The construction phase work force was projected to reach 1,000 at its peak; after that, about 650 workers would be employed during production.

Also in the Lac de Gras area, Diavik moved ahead with sampling of three of its pipes but had not announced mining commitments at yearend. The A-145 South pipe yielded analyses of 4.54 carat/t providing a value of \$255/t. The nearby A-154 North pipe showed 2.19 carat/t with a value of \$77.31/t. Finally, the A-418 pipe graded 4.02 carat/t providing a value of \$258/t (Northern Miner, 1996a, p. 1).

Graphite.—Shipments of graphite, estimated to be about 43,650 t, were thought to have remained flat compared with those of 1995. In early 1995, Stratmin Graphite Inc. was the only producer of natural flake graphite in North America and was probably the largest producer and exporter in the world of natural flake graphite from a single mine. In 1994, Applied Carbon Technology (ACT) ceased production in midyear at its plant near Kearney, Ontario. Later that year, Stratmin purchased 49.5% of ACT's shares and advised that the plant would open at such time as the graphite market regained its strength. Given the dominant position of Stratmin, the probabilities of success for other new graphite mines were clearly marginal.

Gypsum and Anhydrite.—Production of gypsum and anhydrite increased between 3% and 4% compared with that of 1995, continuing its overall climb from 1992. Production thus far in the 1990's, however, has not equaled the 1989 output of more than 12 Mt prior to Canada's economic recession and accompanying sag in domestic construction.

Production has been mostly by Canadian subsidiaries of United States and British companies such as USG Corp. and National Gypsum Co., governed by demand for wallboard in all building categories by consumers in the United States and Canada. Nova Scotia and Newfoundland produced the bulk of Canadian gypsum, with lesser amounts from Ontario, British Columbia, and Manitoba, in about that order of commodity

value. Although gypsum occurs widely in Canada and the world, the high unit weight, low unit cost, and vulnerability to damage of wallboard combine to give gypsum products a relatively high place value, discouraging long-distance transportation. Instead, gypsum industries tend to develop in localities that serve developing construction requirements. As with the cement industry, gypsum production in Canada and the United States tends to develop in populous areas on both sides of the border in localized cross-border competition rather than among all the Provinces or all the States.

Production data for anhydrite are combined with those for gypsum but make up only about 2% or 3% of the total for the two materials. About twice as hard and heavier than gypsum, anhydrite is produced in Nova Scotia by Fundy Gypsum Co. Ltd. at Wentworth and by Little Narrows Gypsum Co. Ltd. at Little Narrows.

A new gypsum discovery in Newfoundland, located on Exempt Mineral Land about 2 km from the coast was described as flat-lying and 93% pure; the Government of Newfoundland is inviting proposals for its exploration and development. About 17 Mt of reserves are indicated from preliminary drilling.

Tusket Mining Inc. proposed opening a gypsum mine in the Murchyville-Elderbank area of Halifax County, Nova Scotia. With projected reserves of more than 400 Mt, the Murchyville deposit is the first significant gypsum discovery in Nova Scotia since the 1970's (Nova Scotia Minerals Update, 1996, p. 2).

Potash.—Potash production declined by 11% compared with that of 1995, totaled 8.05 Mt of K_2O equivalent, mostly from mines in Saskatchewan, with a little more than 10% coming from New Brunswick. Most Canadian potash was shipped to the United States (almost 60%), Asia (about 30%), and Latin America (about 8%), with the remainder going to Oceania and Western Europe. Exports to the United States have risen steadily to satisfy agricultural needs. Some decline was noted in purchases by China and India, thought to have shifted to purchases of a good grade of potash from Russia.

Vigoro Corp., Kalium Canada's Chicago-based parent company, acquired Noranda's Central Potash Canada operation in early January 1995, at a cost of \$89 million plus \$12 million in working capital. Moreover, Vigoro and IMC Global Inc. agreed to merge in an arrangement worth \$1.4 billion, after approval by Government regulatory authority. The merged company holds 30% of potash capacity in North America, thus making it the second largest producer.

As in 1995, the International Trade Commission of the U.S. Department of Commerce indefinitely extended the suspension agreement between the United States and Canadian potash producers, although termination of this ruling had been expected. After the conclusion of its price-fixing investigations in 1996, the U.S. Department of Justice declared that no action would be taken. A Federal Magistrate recommended dismissal of a purchasers' class-action lawsuit in U.S. Federal Court in St. Paul, Minnesota. Another purchasers' action, however, with similar complaints, still stood in California State courts and showed little sign of progress by yearend.

Sulfur.—Production of all forms of sulfur increased by less than 2% to 9,153 thousand t in 1996, representing output from sour natural gas, petroleum refineries, tar sands, and smelters. Elemental sulfur, obtained from petroleum crude refining, natural-gas scrubbing, and oilsand recovery, accounted for 8,270 thousand t. Smelter gases yielded 883,000 t, most (or all) of which is converted and produced as sulfuric acid. No Canadian production is derived from Frasch mining.

With a 22% share, Canada maintained its position as the world's second largest producer, after the United States, of elemental sulfur and remained the leading exporter with a 38% slice of world trade in sulfur. In January 1995, Husky Oil Operations Ltd., Shell Canada Ltd., and Amoco Canada Petroleum Co. Ltd., three major members of the PRISM Sulfur Corp., an export organization, to begin exporting independently, thus increasing the number of major Canadian exporters from two to five. In July 1995, the U.S. Department of Commerce released preliminary results of its antidumping administrative review of sulfur sales from December 1991 to November 1992 by Canada to the United States, as requested by Pennzoil Sulfur Co., a former U.S. Frasch producer. The Department set a preliminary dumping margin of 5.66% for three active exporters, a 28.9% rate for nonrespondents, and a 5.56% rate for other exporters who were not listed in petitions or who received revocation. Final determination was anticipated in 1996, but instead a new antidumping margin of 7.17% was imposed on the three leading exporters by the Department's International Trade Administration (Green Markets, 1996, p. 1).

Mineral Fuels

Coal.—Coal production reached another record high of 75.9 Mt, surpassing the previous high of 74.9 Mt in 1995. The total value of production was \$1.43 billion, about 3% higher than that of 1995. At least part of the incentive for this new record was provided by increased coal prices. Overall, production was up in the western Provinces of Alberta, British Columbia, and Saskatchewan and in the eastern Province of Nova Scotia; it was down slightly in New Brunswick. Domestic coal consumption in 1995 (the latest information available) was about 53 Mt, with 47 Mt for the generation of electricity, 4 Mt for steelmaking, and 2 Mt for other industrial uses.

In eastern Canada, domestic supplies of coal generally have to be augmented by imports, mostly thermal coal from the United States, putting Canada in the unusual position of being a major exporter and a major importer of coal. This paradox reflects transportation costs between mines and consumers and is one more example of the natural integration of United States and Canadian interests in mineral commodities; others include cement and gypsum.

Although Canada accounts for only about 2% of the world's coal production, it exports about one-half of its production, making it the world's fourth largest exporter after Australia, the United States, and South Africa. During 1995, Canada shipped 34 Mt of coal to 23 countries; much of it went to the Pacific Rim countries and Brazil. Traditionally, more than 80% of Canadian coal exports has been coking coal, sold mostly to Japan; about

70% of Canadian thermal coal was exported to Japan and the Republic of Korea.

Imports of coal into Canada during 1995 were about 11.7 Mt, almost 30% above the level of the year before. The United States furnished more than 8 Mt of this coal, and Colombia furnished the remainder.

Natural Gas.—Canada ranked third in the world, after Russia and the United States, in output of natural gas. Increasingly, the production of natural gas has played a major role in the mineral economy of Canada and has had a palpable effect on the GDP. Gross output increased to 198 billion cubic meters (Gm^3) from 193 Gm^3 in 1995. Production of marketable gas was 154 Gm^3 ; marketable gas is gross production minus reinjected gas and producer consumption. About 80.4 Gm^3 (2.84 trillion cubic feet) of natural gas was exported to the United States, which was roughly 10% of the U.S. supply. Gas exports to the United States were expected to increase to about 100 Gm^3 by 2006, anticipating the increasing inability of U.S. domestic production to meet demand. At the beginning of 1996, the Alberta Energy and Utilities Board projected the Province's natural gas reserves to be 1.489 trillion (52.5 trillion cubic feet), a net decline of 0.1% from the preceding year.

Opposition to natural gas exploration, production, and transmission has grown in recent years. Environmental groups opposed construction of proposed pipelines to feed demand in the United States, and the Rocky Mountain Ecosystem Coalition attempted to slow the expansion of natural gas exploration and production activities in northern Alberta.

Petroleum Crude.—Production of crude reached a record high of 675 million barrels (Mbbbl), 2% higher than that of 1995 and 20% higher than that of 1991. Canada exported 405 Mbbbl of crude to the United States in 1996.

After selling 30% of the integrated oil company Petro-Canada (PC) in 1991, the Government continued with privatization in 1995 by offering much or most of the other 70%, with the aim of reducing its share to perhaps 20%. PC was lauded as a model for state-owned oil company privatization and appeared to be expanding its operations after upgrading in terms of cost cutting and restructuring. PC owned a 25% share of the immense Hibernia petroleum prospect offshore Newfoundland and a 25% share in Terra Nova field in the Jeanne d'Arc basin adjacent to Hibernia, for which PC can claim discovery. In 1996, PC moved to purchase Amerada-Hess's oil-and-gas unit, which would make PC Canada's second-largest gas producer after Amoco Corp.

The Hibernia Field, 75 m of water, is thought to contain 615 Mbbbl of light waxy oil. The field was being developed in a \$6.5 billion project by PC plus a consortium of companies, including Mobil, Chevron, and Murphy Oil, plus large subsidies from the Canadian Government. Production is scheduled to begin in 1997, with peak production estimated as to be high as 125,000 barrels per day. The offshore platform, which should be in place by mid-1997, uses new and unique technical design features to resist damage by icebergs.

The Athabasca oil sands north of Fort McMurray, Alberta,

played an increasingly important role in Canadian oil production. In 1995, output in the form of a light sweet crude was 25% of the total for the year. Technological development and increased operating efficiencies have steadily reduced production costs by the two major operators, Suncor Inc. and Syncrude Canada Ltd., at their sites in Alberta and northern Saskatchewan. Suncor's operating costs at the Suncor oil sands plant in Alberta dropped from \$15 per barrel in 1992 to below \$12 per barrel in 1995 and may drop to a projected \$9 per barrel in 1997. Hence, the crude from the Athabasca sands has sold for \$6 or \$7 more than the cost of production. Canada's National Energy Board predicted that the oil sands could contribute 50% of national production by 2010.

The Athabasca, Peace River, and other bitumen and heavy oil deposits in Alberta amount to 2.5 trillion barrels of oil in place, which is about 40% of the world's known bitumen. The 300 billion barrels presently considered recoverable exceeds the 265 billion-barrel reserves of Saudi Arabia, but the latter can be extracted for less than \$1 per barrel. The Province of Alberta lowered its royalty on oil sand crude late in 1995, stipulating that it be 1% on all production until companies pay off capital costs and earn a return that matches interest rates for long-term bonds. They would then pay a 25% royalty on each barrel produced.

Reserves

Table 3 shows the levels of Canadian reserves of copper, gold, lead, molybdenum, nickel, silver, and zinc on or about January 1, 1996. Reserves of the remaining commodities are shown as of January 1, 1995 (the most recent data available). Data are shown in terms of metal contained in ore for the base and precious metals or in terms of recoverable quantities of other mineral commodities such as industrial minerals and mineral fuels (Natural Resources Canada, 1996a, p. 3.19). These mineral reserves represent "proven" and "probable" categories and exclude quantities reported as "possible." Reserves were defined as being well-delineated and economically minable ore from mines committed to production.

Yearly changes in assessment of reserves are, in simplest terms, the arithmetic result of additions to reserve, deletions from reserves, and production. One further complication in Canada is that a large number of mines are polymetallic, thus necessitating close attention to market price and processing costs for two, or several, mineral commodities simultaneously to enable production as coproducts.

Other than for gold, reserves of major metals have fallen steadily from 1977 to 1995. During this period, gold reserves trebled from about 500 to more than 1,500 t as rising prices and the possibility of new price increases provided strong incentive to exploration. Silver reserves, however, fell by one-third from about 31,000 to less than 20,000 t during the same period.

From 1977 to 1995, reserves of the leading base metals decreased conspicuously. The decline was led by molybdenum, which fell 60%. Other base metals also declined—lead, 57%; zinc, 46%; copper, 44%; and nickel, 31%. In each case the downtrend was not monotonic, but varied positively as well as

negatively. From 1980 to 1982, the absolute high values showed a clustering at a time when successful exploration had increased rapidly and extraction had not kept pace.

Reserves of major metals were distributed unevenly throughout Canada, influenced mostly by mineralization of the Precambrian shield, the Rockies (Cordillera), and the Coast Ranges. New Brunswick had more than one-half of the lead reserves and roughly 40% of the zinc and silver. Ontario had three-quarters of the nickel, about 57% of the gold, and slightly less than one-half of the copper. British Columbia had 100% of the molybdenum and about one-third of the copper. New reserves in discoveries yet to be made will alter the overall reserves relation.

Infrastructure

With a total land area of about 9,221,000 square kilometers, slightly larger than the United States, Canada has networks of highly developed infrastructure as well as other vast areas of trackless wilderness. The country had 884,272 kilometers (km) of roads, comprising 250,023 km of paved highway, 462,913 km of gravel or other loose surface, and 171,336 km of earth surface tracks, the latter not graded or drained in many places. Bulldozed temporary roads have been established for mining exploration in many out-of-the-way places, but these deteriorate quickly where not maintained.

A total of 78,148 km of railroads included two main systems, the Canadian National and the Canadian Pacific. The country also had about 3,000 km of inland waterways, including the St. Lawrence Seaway, one of the busiest in the world, leading into the Great Lakes and marking the boundary with the United States in many places. Principal ports were Halifax, Montreal, Quebec, St. John (New Brunswick), St. John's (Newfoundland) Toronto, and, on the west coast, Vancouver. Canada's merchant marine comprised about 75 ships of 1,000 or more gross registered tons.

The country had 1,386 airports. Among these, 964 had permanent-surface runways; 17 had runways longer than 3,047 m; 16 had runways 2,438 to 3,047 m long; and 215 had runways 1,524 to 2,437 m in length, of which 69 were unpaved. Civil aviation included about 636 major transport aircraft, with Air Canada as the major carrier.

Canada generated electrical power from coal, natural gas, and nuclear fuels, as well as massive hydroelectric facilities. Total capacity was roughly 110 gigawatts. About 535 net terawatt hours, significantly less than capacity, was produced in 1995, the last year for which complete data are available. More than 62% of Canada's electricity has been generated by hydroelectric plants, about 17% by nuclear reactors, 15% by coal, and 6% by oil and gas. Quebec and Ontario produced the most electricity, 154 and 141 megawatt hours respectively. Nearly 97% of Quebec's electricity came from hydroelectric plants, with the remaining 3% produced mainly by nuclear facilities. In contrast, about 61% of Ontario's electric power was derived from nuclear plants, with the remainder from hydroelectric and coal-fired plants. The majority of Canada's electricity exports originated in the eastern Provinces of Quebec, Ontario, and New

Brunswick and were sold to consumers in New England and New York. The western Provinces of British Columbia and Manitoba also exported large amounts of electricity, mainly to Washington, Minnesota, California, and Oregon. Except for Alberta, all Canadian Provinces bordering the United States had transmission links to the neighboring systems. Canadian electricity exports to the United States surged in late 1993 and early 1994, largely the result of favorable hydrological conditions. In November 1994, Québec announced cancellation of the controversial \$10 billion Great Whale hydroelectric power project. Under discussion since the mid-1970's, Great Whale was dealt a severe setback when New York's Power Authority, a major Hydro-Quebec customer, announced cancellation of a \$5 billion power contract, citing environmental concerns and decreased power needs.

An extensive system of pipelines connected oil-producing (mostly western Canada) and oil-consuming (mostly central and eastern Canada and the United States) areas. This system was dominated by two major pipelines: the Interprovincial Pipe Line, which delivered oil from Edmonton east to Montreal, Quebec, and the U.S. Great Lakes region; and the TransMountain Pipe Line, which delivered oil mainly from Alberta west to refineries and terminals in the Vancouver area, as well as to the Puget Sound area of Washington. Canadian natural gas was transported largely by TransCanada PipeLines Ltd. of Calgary, which owns 13,600 km of mainline gas pipelines in Canada, along with 56 compressor stations, linking western Canadian gas producers with consumers in eastern Canada and the United States. In 1993, the TransCanada system shipped a record 60 Gm³ of natural gas, up from 40 Gm³ in 1989, including 25 Gm³ to the United States. Total Canadian pipeline network included about 25,000 km for crude oil and refined products and 75,000 km for transmission of natural gas. Alberta's network represents the greatest length for any Province.

Outlook

Canada's mineral industry has been influenced by several positive factors in 1996. First, the national economy turned around after the failed Quebec secession vote, with new life in the credit markets, strengthening of the currency, increasing exports, and a better tone to equity markets. Second, demand for base metals in world markets was steady, particularly for aluminum, lead, nickel, tantalum, zinc, and the energy metal, uranium.

Third, but no less significantly, the Canadian petroleum industry just keeps growing. Exploration and production reached new levels of activity, and Canada became an expanding exporter to the United States of crude, natural gas, and refinery products. After years of questions concerning the feasibility of the Hibernia offshore oil project, it was moving ahead with an implied promise of rich payoffs to come; comparisons continue to be heard between the Canadian offshore and the development of the now-legendary North Sea fields.

Fourth, and more important to the long view within the mineral industry, the huge nickel-copper-cobalt discovery at

Voisey's Bay made an impressive case for more exploration in Canada, no matter how attractive the situation in Latin America, Asia, or Australia. Furthermore, new prospects were found for gold in many parts of Canada, even though market pricing seemed to ignore the many predictions of great increases to come.

Fifth, the concerted effort to reconcile conflicting interests in the formulation of policy concerning ownership, aboriginal issues, mining development, environmental constraints and remediation, social instabilities, and economic necessity in furthering the concept of sustainable development has been difficult to assess or predict. Active engagement of these issues may help provide outcomes that would support the future of the mining industry.

Canada is well positioned in terms of its mineral-resource base and its access to markets in the United States and the rest of the world. Its mineral industry is primarily export oriented, with as much as 90% of the production of some commodities going to foreign purchasers. The United States should continue to be a major market for Canada's metals and minerals. In this regard, the industry's export capability is enhanced significantly by a lower exchange rate for the Canadian dollar.

Some issues facing Canada's mineral industry remain complex. Many of them are international in nature and may lie beyond Canada's direct industrial or market influence, such as those involving China or Russia.

No country can escape the realities of growing international competition, especially from mineral-rich developing countries that have liberalized economic and political systems to attract foreign investment. But Canada's greatest long-term asset may be its achievement of a popular consensus in support of sustainable development.

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United Nations, Energy Statistics Yearbook, annual.

The Wall Street Journal, newspaper, daily.

TABLE 1
CANADA: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Commodity	1992	1993	1994	1995	1996
METALS					
Aluminum:					
Alumina, gross weight	1,104	1,182	1,170	1,064	1,060 e/
Primary: Metal	1,971,843	2,308,868	2,250,000	2,171,992	2,281,979
Antimony 3/	948	673	643 r/	684 r/	1,716
Arsenic trioxide e/	250	250	250	250	250
Bismuth 3/	224	144	129	187 r/	185
Cadmium:					
Mine output, Cd content 3/	1,630	1,340	1,500	1,942 r/	1,829
Metal, refined	1,963	1,944	2,173	2,349 r/	2,537
Calcium	W	W	W	W	W
Cobalt:					
Mine output, Co content 3/	5,102	5,108	4,265	5,339 r/	5,803
Metal:					
Shipments 4/	2,223	2,150	1,846	2,016 r/	2,190
Refined, including oxide	2,210	2,695	2,950	3,269 r/	3,552
Columbium and tantalum:					
Pyrochlore concentrate:					
Gross weight	5,100	5,320	5,130	5,230	5,160
Cb content	2,295	2,393	2,310	2,353	2,320
Tantalite concentrate:					
Gross weight	193	102	144	130 r/	190
Ta content	48	25	36	33 r/	48
Cb content	10	5	7	7 r/	10
Copper:					
Mine output, Cu content 3/	765,482	730,906	588,563	726,078	686,393
Electrowon	3,100	2,700	2,300	2,600	2,500
Total	768,582	733,606	590,863	728,678	688,893
Metal:					
Smelter:					
Primary, blister	515,028	518,301	515,088	522,761 r/	529,349
Secondary and scrap	37,408	44,059	45,445	90,929	83,344
Total	552,436	562,360	560,533	613,690 r/	612,693
Refined:					
Primary	539,302	561,580	549,869	479,100 r/	477,500
Secondary	31,100	41,600	45,000	93,500 r/	81,700
Total	570,402	603,180	594,869	572,600 r/	559,200
Gold, mine output	161,402	152,929	146,428	152,032 r/	165,805
Iron and steel:					
Ore and concentrate:					
Gross weight	33,167	31,830	37,703	38,560	36,030
Fe content	21,183	19,990	24,235	24,561	22,950
Metal:					
Pig iron	8,621	8,633	8,106 r/	8,464	8,638
Direct reduced iron	639	758	770	1,010 r/	1,417
Ferrous alloys, electric arc furnace: e/					
Ferrosilicon	55	55	55	56	56
Silicon metal	20	20	20	22	22
Ferrovandium	2	2	2	1	1
Total	77	77	77	79	79
Crude steel	13,933	14,387	13,897	14,415	14,500 e/
Lead:					
Mine output, Pb content	343,808	182,234	167,584	210,826 r/	256,674
Metal, refined:					
Primary	151,252	147,907	153,035	178,019 r/	194,031
Secondary	101,633	69,107	98,605	103,372 r/	115,348
Total	252,885	217,014	251,640	281,391 r/	309,379
Lithium: Spodumene e/	18,500	18,900	20,000	41,900	54,000
Magnesium metal, primary e/	25,800	23,000	28,900	41,900	54,000
Molybdenum, mine output, Mo content	9,405	9,699	9,188	9,522 r/	8,169
Nickel:					
Mine output, Ni content 3/	186,384	188,080	149,886	181,820 r/	193,059
Refined 5/	135,200	123,139	105,144	121,523	126,593
Platinum-group metals, mine output	11,907	12,441	14,313	16,068 r/	14,234
Selenium, refined 6/	294,057	500,000 e/	566,000	561,000 r/	670,000

See footnotes at end of table.

TABLE 1--Continued
CANADA: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Commodity		1992	1993	1994	1995	1996
METALS -- Continued						
Silver:						
Mine output, Ag content	kilograms	1,215,388	895,837	767,842	1,284,757 r/	1,307,611
Refined	do.	1,027,965	1,011,956	915,128	1,040,866 r/	1,403,258
Tellurium, refined 6/	do.	21,776	24,000	42,000	102,000 r/	62,000
Tin: Metal, smelter, secondary e/		200	200	200	--	--
Titanium: Sorel slag 7/		753,000	653,000	764,000	815,000	825,000 e/
Uranium oxide (U ₃ O ₈)		10,965	10,795	11,372	12,337 r/	13,826
Zinc:						
Mine output, Zn content		1,324,675	1,004,367	1,010,712	1,121,174 r/	1,235,274
Metal, refined, primary		671,702	659,881	690,965	720,346 r/	715,553
INDUSTRIAL MINERALS						
Asbestos		590,641	522,967	531,000	524,000 r/	483,000
Barite		37,000	59,000	55,000	67,000 r/	61,000
Cement, hydraulic 8/	thousand tons	8,590	9,390	10,584	10,440 r/	11,050
Clay and clay products 9/	value, thousands	\$117,326	\$120,000 e/	\$120,000 e/	\$95,675 r/	\$117,148
Diatomite e/		10,000	10,000	10,000	10,000	10,000
Gemstones, amethyst and jade		1,335	3,680	1,212	459 r/	336
Graphite (exports)		17,400	18,800	21,711	43,615	43,650 e/
Gypsum and anhydrite	thousand tons	7,566	7,880	8,500	8,055 r/	8,333
Lime 8/	do.	2,380	2,380	2,390	2,398 r/	2,491
Magnesite, dolomite, brucite e/		180,000	180,000	180,000	180,000	180,000 e/
Mica, scrap and flake e/		17,500	17,500	17,500	17,500	17,500
Nepheline syenite		554,000	550,000	602,000	618,000 r/	620,000
Nitrogen: N content of ammonia		3,104,119	3,410,000	3,474,000 r/	3,773,000	3,839,600
Potash, K ₂ O equivalent	thousand tons	7,270	6,841	8,517	9,066 r/	8,050
Pyrite and pyrrhotite, gross weight e/		5,000	5,000	5,000	5,000	5,000
Salt	thousand tons	11,171	10,900	11,700	10,875 r/	12,126
Sand and gravel	do.	238,134	237,000	247,148	228,163 r/	217,898
Silica (quartz) 10/	do.	1,754	1,600 e/	1,600 e/	1,689 r/	1,668
Sodium compounds, n.e.s.:						
Sodium carbonate (soda ash) e/	do.	305	305	300	300	300
Sodium sulfate, natural 11/	do.	282	320	317	315 r/	323
Stone 12/	do.	104,549	106,000	110,411	120,660 r/	113,887
Sulfur, elemental byproduct:						
Metallurgy	do.	931	900	870	886 r/	883
Natural gas	do.	5,769	6,600	7,000	7,100	7,200
Petroleum e/	do.	235	340	350	380	400
Tar sands	do.	552	590	630	670	670
Total	do.	7,487	8,430	8,850	9,036 r/	9,153
Talc, soapstone, pyrophyllite	do.	104	108	130	108 r/	75
MINERAL FUELS AND RELATED MATERIALS						
Carbon black e/		161,218 13/	161,000	160,000	165,000	165,000
Coal:						
Bituminous and subbituminous	thousand tons	55,600	59,000	62,700	64,176	65,006
Lignite	do.	10,027	10,000	10,100	10,740	10,854
Total	do.	65,627	69,000	72,800	74,916	75,860
Coke, high-temperature	do.	3,711	3,657	3,684	3,283	3,357
Gas, natural:						
Gross	million cubic meters	158,067	171,000	183,000	192,530	198,107
Marketed	do.	117,000	129,000	139,000	148,204	153,576
Natural gas liquids:						
Pentanes plus	do.	48,069	50,500	55,900	56,450	61,832
Condensate	do.	1,396	1,430	1,730	2,323	950,000 e/
Total	do.	49,465	51,930	57,630	58,773	64,171
Peat		740,000	801,000	914,000	877,000 r/	783,000 e/
Petroleum:						
Crude 14/	thousand 42-gallon barrels	585,076	610,000	636,000	662,110	674,670
Refinery products:						
Liquefied petroleum gas, propane, butane, and naphtha	do.	17,293	15,800	14,900	13,745	26,454
Gasoline:						
Aviation	do.	706	824	835	846	789
Other	do.	229,316	234,000	239,000	243,455	245,618
Petrochemical feedstocks	do.	30,721	29,400	28,200	33,554	33,137
Jet fuel	do.	24,668	26,600	26,800	29,315	32,048

See footnotes at end of table.

TABLE 1--Continued
CANADA: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Commodity	1992	1993	1994	1995	1996	
MINERAL FUELS AND RELATED MATERIALS--Continued						
Refinery products--Continued:						
Kerosene	thousand 42-gallon barrels	2,015	3,670	2,690	5,470	18,446
Distillate fuel oil, diesel and light	do.	163,159	178,000	186,000	183,597	184,738
Lubricants including grease	do.	5,363	5,360	6,250	5,807	6,344
Residual fuel oil, heavy	do.	50,131	48,500	44,200	41,352	41,999
Asphalt	do.	15,221	17,800	20,400	20,048	19,586
Petroleum coke	do.	6,310	7,220	6,660	6,961	7,416
Unspecified	do.	30,322	28,900	28,100	24,271	21,144
Refinery fuel and losses 15/	do.	29,140	24,800	25,100	37,583	25,172
Total	do.	604,365	620,874	629,135	646,004 r/	662,891

e/ Estimated. r/ Revised. W Withheld to avoid disclosing company proprietary data.

1/ Data previously published for 1992 through 1994 were rounded by the U.S. Bureau of Mines to three significant digits. With very few exceptions, data in the present table have been unrounded to their original state.

2/ Table includes data available through July 1997.

3/ Metal content of concentrates produced.

4/ Cobalt content of all products derived from Canadian ores, including cobalt oxide shipped to the United Kingdom for further processing and nickel-copper-cobalt matte shipped to Norway for refining.

5/ Nickel contained in products of smelters and refineries in forms which are ready for use by consumers. Natural Resources Canada has revised all nickel refined figures to conform with International Nickel Study Group guidelines.

6/ From all sources, including imports and secondary sources. Excludes intermediate products exported for refining.

7/ Refined Sorel slag contains 80% titanium dioxide.

8/ Producers' shipments and quantities used by producers.

9/ Includes bentonite products from common clay, fire, stoneware clay, and other clays. Values are in current Canadian dollars.

10/ Producers' shipments of quartz.

11/ Excludes byproduct production from chemical plants.

12/ Crushed, building, ornamental, paving, and similar stone.

13/ Reported figure.

14/ Including synthetic crude (from oil shale and/or tar sands).

15/ Refinery fuel represents total reported production of still gas, including a small amount sold.

TABLE 2
CANADA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1996

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Aluminum	Alcan Aluminum Ltd.	Smelter, Laterriere, Quebec	204.
Do.	do.	Smelter, Isle-Maligne, Quebec	73.
Do.	do.	Smelter, Beauharnois, Quebec	48
Do.	do.	Smelter, Shawinigan, Quebec	84.
Do.	do.	Smelter, Grande-Baie, Quebec	180.
Do.	do.	Smelter, Arvida, Quebec	232.
Do.	do.	Smelter, Kitimat, British Columbia	272.
Do.	Aluminerie de Becancour Inc. (Pechiney Corp., 25%; Quebec Government, 24.95%)	Smelter, Becancour, Quebec	360.
Do.	Canadian Reynolds Metals Co. Ltd. (Reynolds Metals Co., 100%)	Smelter, Baie-Comeau, Quebec	400.
Do.	Aluminerie Alouette Inc. (Vereinigte Aluminium-Werke AG, Germany, 20%; Hoogovens Groep BP, Netherlands, 20%; Metall Aktiengesellschaft, Austria, 20%; SGF, Alunor, 20%; Marubeni, Italy, 16.3%; Kobe Steel, Japan, 3.7%)	Smelter, Sept-Iles, Quebec	215.
Do.	Aluminerie Luralco Inc. (Alumax Inc. of the U.S.)	Deschambault, Quebec	215.
Asbestos	Lac d'Amiante du Quebec, Ltee (LAQ) (Jean Dupere, President of LAB Chrysotile, Inc.; Connell Bros. Co. Ltd.)	Black Lake, Quebec	160 (fiber).
Do.	Asbestos Corp. Ltd. (Mazarin Mining Exploration Inc.)	British Canadian Mine, Black Lake, Quebec	70 (fiber).
Do.	Bell Operations (Mines D'Amiante Bell)	Thetford Mines, Quebec	70 (fiber).

See footnote at end of the table.

TABLE 2--Continued
CANADA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1996

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Asbestos--Continued:	JM Asbestos Inc.	Jeffrey Mines, Asbestos, Quebec	250 (fiber).
Do.	Teranov Mining Corp. (Black Hill Minerals Ltd., 50%; Cliff Resources, 50%)	Baie Verte, Newfoundland	20 (fiber).
Cement	Lafarge Canada Inc.	Bath, Ontario	1,045 (dry-process).
Do.	do.	Exshaw, Alberta	1,029 (dry-process).
Do.	do.	Kamloops, British Columbia	194 (dry-process).
Do.	do.	Richmond, British Columbia	474 (wet-process).
Do.	do.	St. Constant, Quebec	991 (dry-process).
Do.	do.	Brookfield, Nova Scotia	527 (dry-process).
Do.	St. Lawrence Cement Inc. (Independent Cement Inc.)	Joliette, Quebec	991 (dry-process).
Do.	do.	Mississauga, Ontario	1,876 (wet and dry).
Do.	do.	Beauport, Quebec	611 (wet-process).
Do.	ESSROC Canada Inc.	Picton, Ontario	1,124 (dry-process).
Do.	North Star Cement Ltd.	Corner Brook, Newfoundland	152 (dry-process).
Do.	Ciment Quebec Inc.	St. Basile, Quebec	1,074 (wet and dry).
Do.	Federal White Cement Ltd.	Woodstock, Ontario	170 (dry-process).
Do.	St. Marys Cement Co.rp.	Bowmanville, Ontario	1,550 (dry-process).
Do.	do.	St. Marys, Ontario	645 (dry-process).
Do.	Inland Cement Ltd. (S.A. Cimenteries CBR)	Edmonton, Alberta	726 (dry-process).
Do.	Tilbury Cement Ltd. (S.A. Cimenteries CBR)	Delta, British Columbia	1,040 (dry-process).
Coal	Quinsam Coal Corp. (Hillsborough Resources Ltd., 63%; Marubeni Corp., 33%; remainder unknown, 4%)	Quinsam Coal Mine, Campbell River, British Columbia	14,400 (open pit and underground).
Do.	Cape Breton Development Corp. (Government of Canada, 100%)	Sydney, Nova Scotia	22,000 (longwall).
Do.	Luscar, Ltd.	Obed Mountain Mine, Hinton, Alberta	3,500.
Do.	Gregg River Resources Ltd. (Gregg River Coal, 60%; 7 Japanese Co's., 40%)	Gregg River Mine, Hinton, Alberta	3,960 (open pit).
Do.	Manalta Coal Ltd. (Transalta Utilities Corp.)	Highvale Mine, Seba Beach, Alberta	11,610 (open pit).
Do.	Smoky River Coal Ltd. (Smoky River Holdings Ltd., 100%)	Grande Cache, Alberta	3,600 (open pit and underground).
Copper	Broken Hill Proprietary Co. Ltd. (BHP Holdings Inc., 100%)	Island Copper Mine, Port Hardy, British Columbia	16,200.
Do.	Cassiar Mining Corp. (Princeton Mining Corp., 100%)	Similco Mine, Princeton, British Columbia	9,000.
Do.	Falconbridge Ltd. (Noranda Inc. 50%; Trelleborg AB, 50%)	Sudbury Operations, Sudbury, Ontario Strathcona and Timmins Operations, Timmins, Ontario	4,250. 4,860.
Do.	do.	Smelter, Timmins, Ontario	440.
Do.	Gibraltar Mines Ltd.	McLease Lake, British Columbia	13,070.
Do.	Highland Valley Copper (Cominco, 50%; Rio Alom Ltd., 33.6%; Teck Corp., 13.9%; and Highmont Mining Co., 2.5%)	Logan Lake, British Columbia	4,500.
Do.	Inco Ltd.	Sudbury and Shebandowan, Ontario Thompson District, Manitoba	20,250 (mine).
Do.	do.	Smelter, Sudbury, Ontario	500.
Do.	do.	Refinery, Sudbury, Ontario	170.
Do.	Noranda Inc.	Bell Copper Mine, Babine Lake, British Columbia	5,550 (mine).
Do.	do.	Smelter Horne, Noranda, Quebec	770.
Gold	Barrick Gold Corp.	Holt-McDermott Mine, Harker Twp., Ontario	405 (ore).
Do.	do.	Bosquet Mines 1 and 2, NW Quebec	954 (ore).
Do.	do.	Doyon Mine, NW Quebec	1,323 (ore).
Do.	do.	Golden Patricia Mine, Pickle Lake, Ontario	156 (ore).
Do.	do.	Macassa Mine, Teck Twp. N. Ontario	473 (ore).
Do.	Princeton Mining Corp.	Similco Mine, Princeton, British Columbia	450 (kilograms metal).
Do.	Echo Bay Mines Ltd.	Lupin Mine, Contwoyo Lake; Northwest Territories	612.
Do.	Royal Oak Mines Inc.	Giant Mine, Yellowknife, Northwest Territories	407 (ore).
Do.	do.	Giant Mill--tailings, Yellowknife, Northwest Territories	3,265 (ore).
Do.	do.	Pamour, Ontario	945 (ore).

See footnote at end of the table.

TABLE 2--Continued
CANADA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1996

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual Annual capacity
Gold--Continued:	do.	Hope Brook Mine, Conseau Bay, Newfoundland	1,090 (ore).
Do.	Hemlo Gold Mines Inc. (Noranda Inc., 44.1%)	Golden Giant Mine, Hemlo, Ontario	1,080 (ore).
Do.	Placer Dome Inc.	Campbell Mine, Red Lake, Ontario	400 (ore).
Do.	do.	Detour Lake Mine, Northeast Ontario	900 (ore).
Do.	do.	Dome Mine, South Porcupine, Ontario	1,300 (ore).
Do.	do.	Sigma Mine, Val d'Or, Quebec	500 (ore).
Do.	do.	Kiena Mine, Val d'Or, Quebec	500 (ore).
Do.	Teck-Corona Corp. (Teck Corp., 100%)	David Bell Mine, Hemlo, Ontario	456 (ore).
Gypsum	Domtar Inc.	Flat Bay, Newfoundland	1,300.
Do.	Georgia-Pacific Corp.	River Denys, Sugar Camp, Nova Scotia	1,460.
Do.	Little Narrows Gypsum Co. Ltd. (USG Corp., 100%)	Little Narrows, Nova Scotia	1,640.
Do.	National Gypsum (Canada) Ltd. (Aancor Holdings Corp., 100%)	Milford, Nova Scotia	3,300.
Do.	Westroc Industries Ltd.	Windermere, British Columbia	1,170.
Iron and steel	Iron Ore Co. of Canada (Dofasco, 6.9%)	Carol Lake, Labrador	8,800 (concentrate), 10,300 (pellets).
Do.	Quebec Cartier Mining Co. (Dofasco Inc., 50%)	Mount Wright, Quebec	16,950 (concentrate), 7,500 (acid pellets).
Do.	The Algoma Steel Corp. Ltd. (Dofasco Inc., 100%)	Sault Ste. Marie, Ontario	2,478 (pig iron), 3,135 (crude steel), 657 (sinter).
Do.	Dofasco Inc.	Hamilton, Ontario	3,642 (pig iron), 4,500 (crude steel).
Do.	Stelco, Inc.	do.	2,733 (pig iron), 7,990 (crude steel), 560 (sinter).
Do.	Wabush Mines Ltd. (Inland Steel Co., 15.1%; Acme Steel, 15.1%; Stelco Inc., 37.9%; Dofasco Inc., 24.2%; Cliffs Mining Co., 7.7%)	Wabush, Labrador, and Pointe Noire, Quebec	6,200 (concentrate).
Lead	Brunswick Mining and Smelting Corp. Ltd. (Noranda Inc., 63.3%)	No. 12 Mine, Bathurst and smelter in Belledune, New Brunswick	72 (Pb contained).
Do.	Hudson Bay Mining and Smelting Co., Ltd. (Minorco, 100%)	Flin Flon and Snow Lake, Manitoba	60 (Pb-Zn contained).
Do.	Cominco Ltd. (Teck Corp. 36.34%)	Trail, British Columbia	95 (refined lead).
Do.	do.	Sullivan Mine, Kimberly, British Columbia	3,600 (ore).
Do.	do.	Polaris Mine, Cornwallis Island, Northwest Territories	1,000 (ore).
Do.	Conwest Exploration Co. Ltd.	Nanisivik Mine, Baffin Island, Northwest Territories	785 (ore).
Do.	Anvil Range Mining Corporation	Faro Mine, Yukon Territory	184 (Pb-Zn contained).
Limestone	Lafarge Canada Inc.	Steep Rock, Manitoba	906 (quarry).
Do.	Scotia Limestone Ltd.	Iris Cove, Sydney, Nova Scotia	720 .
Do.	Inland Cement Ltd. (CBR Materials Corp.)	Cadomin, Alberta	2,160 .
Do.	do.	Cadomin, Alberta	2,160 (quarry).
Do.	Havelock Co. (Kickenson Mines Co., 100%)	Havelock, New Brunswick	864 (limestone).
Do.	Continental Lime Ltd.	Faulkner, Manitoba	1,440 (crushed stone) .
Nickel	Falconbridge Ltd. (Noranda Inc., 46.4%; Underwriting syndicate, 28.3%)	East, Fraser, Lockerby, Onaping, Strathcona, and Craig in Sudbury	30 (metal contained).
Do.	do.	Smelter, Falconbridge	45 (rated capacity).
Do.	Inco Ltd.	Sudbury, Ontario, district mines: Frood, Stobie, Little Stobie, Creighton, Copper Cliff North and South, Garson-Offsets, Levack, McCreedy East and West, Coleman, Crean Hill, Murray, and Totten in Sudbury area, Ontario; also Shebandowan Mine in Western Ontario	106 (metal contained).
Do.	do.	Smelter, Sudbury, Ontario	110 (metal contained).
Do.	do.	Refinery, Sudbury, Ontario	57 (metal contained).
Do.	do.	Refinery, Port Colborne, Ontario	30 (metal contained).
Do.	do.	Thompson, Pipe, Birchtree Mines in Manitoba	62 (metal contained).
Do.	do.	Smelter, Thompson, Manitoba	82 (metal contained).
Do.	Sherritt Gordon Ltd.	Refinery, Fort Saskatchewan, Alberta	24 (metal contained).

See footnote at end of the table.

TABLE 2--Continued
CANADA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1996

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Petroleum: 1/				
Gas	million cubic meters	BP Canada Inc. (The British Petroleum Co. PLC London, 100%)	Noel Area, North Alberta; Chauvin, Sibbald, North Pembina, Alberta	47.
Crude	million 42-gallon barrels	do.	do.	12.
Do.	do.	Gulf Canada Corp. (Olympia & York Developments, 80%; Gulf, 20%)	Fenn-Big Valley, Swan Hills, Goose River, Peerless, and Sene, Alberta	18.
Do.	do.	Home Oil Co. Ltd. (Interhome Energy Inc., 100%)	Red Earth, Garrington, Cherhill, Medicine River, and Swan Hills, Alberta	11.5.
Gas	billion cubic meters	do.	do.	1.8.
Crude	thousand 42-gallon barrels	Imperial Oil Ltd. (Exxon Corp., USA, 70%; others, 30%)	Judy Creek, Cold Lake, Alberta, Mackenzie Delta, Beaufort Sea, Yukon and Northwest Territories	670.
Gas	million cubic meters	do.	do.	36.4.
Crude	million 42-gallon barrels	Mobil Oil Canada Ltd. (Mobil Corp., United States, 100%)	Hibernia, Grand Banks, Southeast of Newfoundland and Sable Island, Nova Scotia, and others in Alberta	26.1.
Gas	billion cubic meters	do.	do.	3.0.
Crude	million 42-gallon barrels	Norcen Energy Resources Ltd. (Hollinger Inc., 59%; Hees International, 41%)	Pembina, Bodo, Majorville, Alberta	12.1.
Do.	do.	Oakwood Petroleum Ltd. (Sceptre Resources Ltd., 100%)	Grantham, Hays Ronalane, Peace River, Normandville, Randell, Alberta, and Grizzly Valley, British Columbia	24.6.
Crude	million 42-gallon barrels	PanCanadian Petroleum Ltd. (Canadian Pacific Enterprises, 87%; others, 13%)	Rycroft, Wembley, Elk Point, Rio Bravo, Alberta	19.7.
Gas	billion cubic meters	do.	do.	3.53.
Crude	million 42-gallon barrels	Shell Canada Ltd. (Shell Investments, 79%; others, 21%)	Dimsdale, Little Smoky Lake, Sousa, Alberta, Midale, Benson, Saskatchewan	22.2.
Gas	billion cubic meters	do.	do.	6.53.
Crude	million 42-gallon barrels	Suncor Inc. (Sun Co. Inc., United States, 75%; Ontario Energy Resources, 25%)	Kidney, Zama Lake, Cosway, Albersun Prevo, and Medicine River, Alberta, and Leitchville, Unwin, Saskatchewan	4.1.
Crude	thousand 42-gallon barrels	Texaco Canada Petroleum Inc. (Texaco Inc., United States, 78%; others, 22%)	Eaglesham, Virgo, Alberta, and Desan, British Columbia	158.
Gas	million cubic meters	do.	do.	67.3.
Crude	million 42-gallon barrels	UNOCAL Canada Ltd. (UNOCAL Corp., United States, 100%)	Calgary, Alberta	14.7.
Potash (K ₂ O equivalent):		Potash Corp. of Saskatchewan Inc. (Private, 37%; Provincial government, 63%)	Lanigan, near Lanigan Saskatchewan	3,400 (KCl).
Do.		do.	Rocanville, southeast Saskatchewan	1,750 (KCl).
Do.		International Minerals & Chemical Corp. (Canada) Ltd. (IMC Fertilizer Corp., 100%)	Esterhazy, southeast Saskatchewan	1,814 (KCl).
Do.		Kalium Chemicals (Kalium Canada Ltd., The Canadian Salt Co.)	Potash Mine, Moose Jaw, Saskatchewan Pugwash, Nova Scotia	2,040 (KCl). 1,400 (rock salt and brine salt).
Salt and brine operations		do.	Iles-de-la-Madeleine, Quebec	1,625 (rock salt).
Do.		do.	Ojibway, Ontario	2,600 (rock salt).
Silver		Prime Resources Group	Eskay Creek Mine, British Columbia	227.
Do.		Equity Silver Mines Ltd. (Placer Dome Inc., 58.8%)	Houston, British Columbia	2,970 (Ag-Au-Cu concentrate).
Do.		Faro Mine (Anvil Range Mining Corp. 100%)		4,745 (Pb-Zn-Ag-Au mill feed).
Do.		LAC Minerals Ltd.	Macassa Mine, Ontario	165 (mill feed).
Do.		do.	Bousquet Mine, Quebec	580 (mill feed).
Do.		Similco Mines Ltd.	Princeton, British Columbia	8,250 (Ag-Au-Cu concentrate).
Sodium chlorate production using salt		Dow Chemical Canada Inc. (The Dow Chemical Co. Michigan, United States, 100%)	Fort Saskatchewan, Alberta	524 (caustic soda).
Do.		do.	Sarnia, Ontario	350 (caustic soda).
Do.		General Chemical Canada Ltd.	Amherstburg, Ontario	363 (sodium carbonate).
Sulfur:				
Petroleum refinery capacities		Consumer's Cooperative Refineries Ltd. (Federated Cooperatives Ltd., 100%)	Regina, Saskatchewan	54.
Do.		Esso Petroleum Canada	Sarnia, Ontario	50.
Do.		Sulconam Inc. (Petro Canada, 7.6%)	Montreal, Quebec	108.

See footnote at end of the table.

TABLE 2--Continued
CANADA: STRUCTURE OF THE MINERAL INDUSTRY FOR 1996

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Sulfur--Continued:			
Main sulfur extraction plants (sour gas and oil sands)	Amoco Canada Petroleum Co., Ltd. (Amoco Corp. USA, 100%)	East Crossfield-Elkton, Alberta	650.
Do.	Canadian Occidental Petroleum, Ltd.	East Calgary-Crossfield, Alberta	610.
Do.	Chevron Canada Resources Ltd. (Chevron Corp. USA, 100%)	Kaybob South III, Alberta	1,281.
Do.	Husky Oil Ltd.	Ram River, Ricinus, Alberta	1,646.
Do.	Shell Canada Ltd.	Waterton, Alberta	1,120.
Principal SO ₂ and H ₂ SO ₄ production capacities	Canadian Electro Zinc Ltd. (CEZ) (Noranda Inc., 90.17%)	Valleyfield, Quebec	430 (H ₂ SO ₄).
Do.	INCO Ltd.	Copper Cliff, Ontario	950 (H ₂ SO ₄).
Do.	Falconbridge Ltd. (Noranda Inc., 50%; Trelleborg AB, 50%)	Kidd Creek, Ontario	690 (H ₂ SO ₄).
Do.	ESSO Chemical Canada (Imperial Oil, Ltd., 100%)	Redwater, Alberta	910 (H ₂ SO ₄).
Uranium	Stanleigh Mine (Rio Algom Ltd. 100%)	Elliot Lake, Ontario	815 (metal).
Do.	Cameco Corp. (Province of Saskatchewan, 61.5%; Government of Canada, 38.5%)	Key Lake, Saskatchewan	4,976 (metal).
Zinc	Brunswick Mining and Smelting Corp. Ltd. (Noranda Inc., 63.3%)	Bathurst, New Brunswick	232 (Zn in concentrate).
Do.	Falconbridge Ltd. (Noranda Inc., 50%; Trelleborg AB, 50%)	Timmins Operations, Ontario	212 (Pb-Zn contained).
Do.	do.	Smelter, Timmins, Ontario	133 (slab zinc).
Do.	Hudson Bay Mining and Smelting Co., Ltd. (Minorco, 100%)	Snow Lake concentrator, Manitoba	1,125 (Pb-Zn ore).
Do.	do.	Flin Flon Mine and smelter, Manitoba	85 (slab zinc).
Do.	Cominco Ltd. (Teck Corp, 36.34%)	Sullivan Mine, Kimberley, Brit. Columbia	70 (Pb-Zn contained).
Do.	do.	Smelter, Trail, British Columbia	300 (slab zinc).
Do.	Anvil Range Mining Corp. (100%)	Faro Mine, Yukon Territory	184 (Pb-Zn contained).

1/ Projections of annual capacity involve matching decline curves against later discoveries and are generalized extrapolations only, based on data presented in "Canadian Oil and Gas Handbook, 1991" and subsequent years. Ownership of various companies and proportionate participation in various leaseblocks and/or joint ventures change continually. The ownership proportions shown here must be considered to be illustrative only.

TABLE 3
CANADA: RESERVES OF MAJOR MINERALS IN 1996

(Thousand metric tons unless otherwise specified) 1/

Commodity	Reserves
Abestos, fiber	39,000 e/
Coal, all types	6,365,000 e/
Copper, metal content	9,250
Gold, metal	metric tons 1,540 2/
Gypsum	500,000 e/ 4/
Iron ore, iron content	1,305,000 e/
Lead, metal content	3,660
Molybdenum, metal content	129
Natural gas	billion cubic meters 2,100 e/
Nickel, metal content	5,832
Petroleum crude	million barrels 6,775 e/
Potash, K ₂ O equivalent	million tons 14,500 e/
Salt	315,000 3/
Silver, metal	metric tons 19,073
Sodium sulfate	91,500 3/
Sulfur	145,000 e/
Uranium	280 4/
Zinc, metal content	14,712

e/ Estimated.

1/ 1995 and 1996 "Canadian Minerals Yearbook," Natural Resources Canada, unless noted.

2/ Excludes metal in placer deposits.

3/ Data in thousand short tons.

4/ Recoverable at prices of \$100 per kilogram of U, or less.