MINING SECTOR

SECTEUR MINIER

1993 CANADIAN MINERALS YEARBOOK

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Preface

Each year, the Mining Sector of Natural Resources Canada (formerly the Mineral Policy Sector of Energy, Mines and Resources Canada) completes a comprehensive review of developments in the mineral industry and publishes the results as the *Canadian Minerals Yearbook*. This publication forms a continuing record from year to year, with this edition reporting on the activities of the industry during 1993.

The Yearbook contains detailed industry statistics and includes separate chapters devoted to each of the major non-fuel minerals plus coal and uranium. The subject matter spans all stages of mineral industry activity from geoscience and exploration, through mining and processing, to markets and consumption. Although domestic matters receive the greatest attention, international developments are also reviewed because of the global nature of the mineral industry and the potentially significant impact that such developments could have on the Canadian industry. Some chapters of the Yearbook are intended to be general enough to be of interest to a broad readership, while others are more technical and will appeal to individuals who are more closely associated with the industry.

Although mineral fuels are normally included when the overall value of Canada's mineral production is reported, the main focus of this publication is the non-fuel sector including coal and uranium.

Excluding the oil and natural gas industries, the mineral industry, when defined to encompass mining and concentrating, smelting and refining, as well as the minerals- and metals-based semi-fabricating and fabricating industries, accounted for approximately 2.5% of total national employment, 4% of Canada's GDP and 25% of Canada's total domestic exports in 1993.

Preliminary estimates show that the total value of production of all mineral commodities, including mineral fuels, increased from $35.4 billion in 1992 to $36.1 billion in 1993, an increase of nearly 2%. Metals showed a significant drop in the value of production of nearly 14%. While gold and the platinum group metals were able to register modest increases in value of production, the leading base metals experienced declines.

Based on value of production, the top ten commodities in 1993 were crude petroleum ($11.16 billion), natural gas ($7.25 billion), natural gas by-products ($2.79 billion), gold ($2.26 billion), coal ($1.78 billion), copper ($1.76 billion), zinc ($1.23 billion), nickel ($1.22 billion), iron ore ($1.04 billion), and potash ($0.90 billion). Nonfuel minerals, including coal, accounted for slightly more than 40% of the total value of Canada's mineral production in 1993.

The Yearbook's first chapter, entitled "General Review," highlights the importance of the industry in the context of the Canadian economy. This chapter provides a summary of the overall volume and value of Canadian mineral production in 1993, along with a brief overview and production statistics for

Canada's leading minerals. It is followed by chapters that focus on the international scene; the regional outlook; mine reserves, investment, and promising deposits; mine openings and closures; and mineral exploration. The 27 commodity chapters in this year's edition feature economic and policy developments and data specific to each commodity in respect of markets, prices, production, trade and consumption. These commodity reviews also provide an outlook of the industry's future position.

The Statistical Report at the end of the Yearbook is comprised of over 80 tables which provide a detailed statistical overview of the mineral industry. These tables are grouped according to the following topics: production; trade; consumption; prices; principal statistics; employment, salaries and wages; mining, exploration and drilling; transportation; and investment and finance. Although the tables focus on the most recent data available, many of the tables also include an historical series covering previous years.

The basic statistics on Canada's mineral and metal production, trade and consumption were collected by the Mining Sector's Modelling and Mining Statistics Division, and by Statistics Canada, unless otherwise noted. Market quotations were taken mainly from published marketing reports. Corporate data presented in the various chapters of this Yearbook were obtained by the authors directly from company officials through surveys or correspondence, or were taken from annual reports. Natural Resources Canada is grateful to everyone who has contributed information used in the preparation of this publication.

Additional copies of the 1993 Yearbook may be purchased from the Canada Communication Group – Publishing (telephone: (819) 956-4802) and associated bookstores. Previous editions of the *Canadian Minerals Yearbook* have been deposited in various libraries across Canada.

Copies of Map 900A, *Principal Mineral Areas of Canada*, as well as a directory of other Mining Sector products and services, may be obtained from:

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Note: Commodities shown in **bold** type are covered in this issue. The other commodities listed have appeared in previous editions.

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Canadian Minerals Yearbook

Review and Outlook

Note to Reader

The reader should note that a number of abbreviations for common units of measurement appear in the text:

$\mu g/cm^2$	micrograms per square centimetre
cm	centimetres
ct/t	carats per tonne
ct/y	carats per year
f/cm^3	fibres per cubic centimetre
g/cm^3	grams per cubic centimetre
g/t	grams per tonne
GJ/t	gigajoules per tonne
gpm	gallons per minute
ha	hectares
kcal/kg	kilocalories per kilogram
kg	kilograms
kg/m^3	kilograms per cubic metre
kg/t	kilograms per tonne
kg/y	kilograms per year
kgU	kilograms of uranium
km	kilometres
km^2	square kilometres
kWh	kilowatt hours
lb	pounds
lt/d	long tons per day
ltu	long ton unit
m	metres
m^3	cubic metres
mm	millimetres
MPa	megapascals
Mt	million tonnes or megatonnes
Mt/y	million tonnes per year
mtu	metric tonne unit
MW	megawatts
MWe	megawatts electric
ppm	parts per million
psi	pounds per square inch
st	short tons
t	tonnes
t/d	tonnes per day
t/h	tonnes per hour
t/m	tonnes per month
t/y	tonnes per year
tU	tonnes of uranium
tU/y	tonnes of uranium per year

General Review

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The Canadian Economy

Towards the end of 1993, evidence was building that Canada was finally pulling out of the slowest economic recovery in its history. After negative growth of nearly 2% in 1991 followed by an increase of less than 1% in 1992, preliminary estimates suggested that Canada's Gross Domestic Product (GDP) was expected to grow by about 2.5% in 1993. While falling slightly below that rate during the first half of the year, real GDP in the third quarter grew at an acceptable 0.6%. The economy was expected to record even stronger growth in the fourth quarter, largely as a result of the continued buoyancy exhibited by the U.S. economy in the latter part of the year. This trend, if sustained, would lead to Canada's best yearly performance since 1989.

Exports were a major factor fuelling growth in 1993, especially toward the end of the year. Most of the sustained export growth was provided by exports to the United States, which rose by almost 20% between October 1992 and October 1993. Over the course of 1993, total Canadian exports reached a new high, increasing by nearly 16% to $181 billion. Improvements in Canada's cost competitiveness and a lower Canadian dollar that averaged US77.5¢ in 1993 also impacted favourably on export growth. As a result of this strong export growth, Canada's merchandise trade surplus for 1993 was expected to exceed $11 billion, up from about $9 billion in 1992 and $5 billion in 1991. Merchandise trade is, however, only one component of the current account of Canada's balance of payments, the other components being service transactions, investment income and transfers. While the 1993 merchandise trade balance was positive, the current account balance for that year remained negative. In the third quarter of 1993, a $3.0 billion merchandise trade surplus was offset by a current account deficit of $6.3 billion.

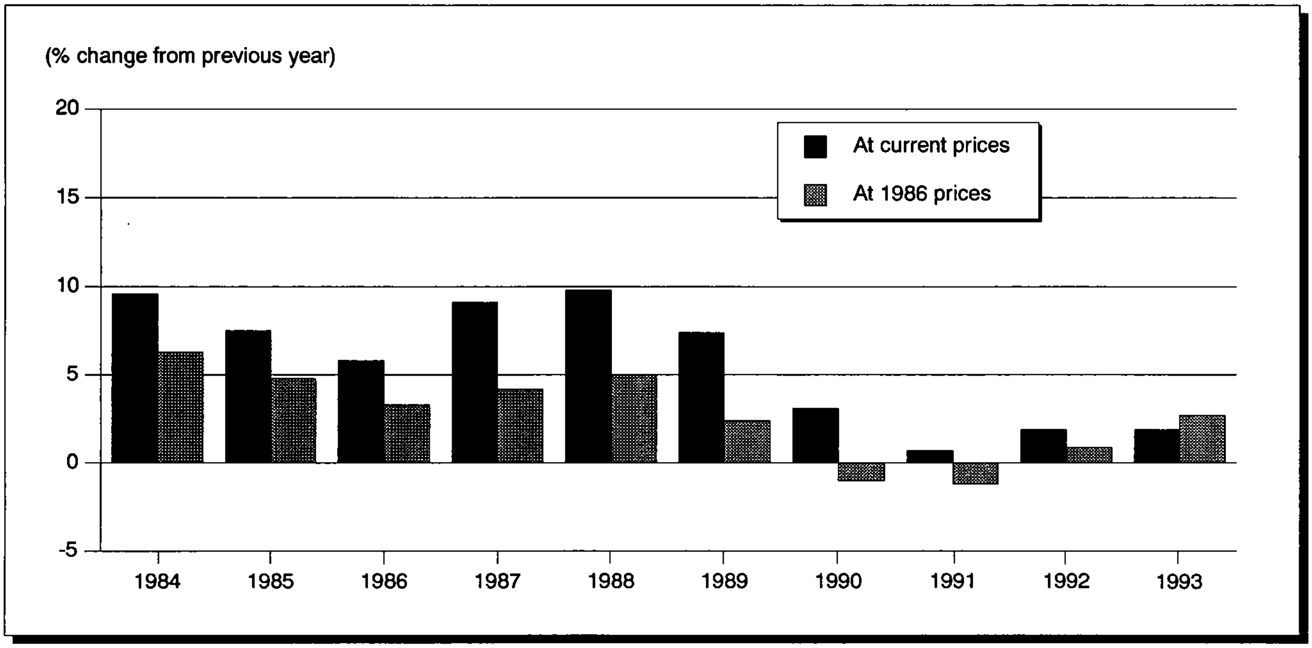
Other factors also contributed to an improved economic climate in 1993. The first half of the year saw a turnaround in corporate profitability relative to the last quarter of 1992 when overall profits had remained well below pre-recession levels. As firms saw steady improvement in their profits and liquidity, business spending became a driving force in the economy, and investment outlays accounted for all of the growth in total spending, as measured by GDP, in the first two quarters of the year. Non-residential construction recorded back-to-back gains over the first two quarters of the year, the first such result since before the recession began. In fact, business investment in machinery and equipment showed sustained growth over the first nine months of the year, increasing by 1.6%, 1.7% and 3.9% respectively on a quarter-by-quarter basis. The strong third-quarter result was largely attributable to higher spending on industrial machinery, office equipment (including computers) and other capital goods.

Also encouraging was a decline in the number of business and consumer bankruptcies. This decline occurred largely as a result of improved corporate profitability combined with lower interest rates. In the first nine months of 1993, combined business and individual bankruptcies fell by nearly 13% relative to the same period a year earlier.

An acceleration in economic activity in the United States in the third quarter of 1993 also proved positive for the Canadian economy. U.S. output rose at an annual rate of nearly 3% in the third quarter, considerably above the rate recorded in the first half of the year. Indicators at year-end pointed to a further fourth-quarter strengthening as demand accelerated. This buoyancy in the U.S. economy augured well for improved growth in Canada, whose economy in 1993 was weaker than that of her southern neighbour.

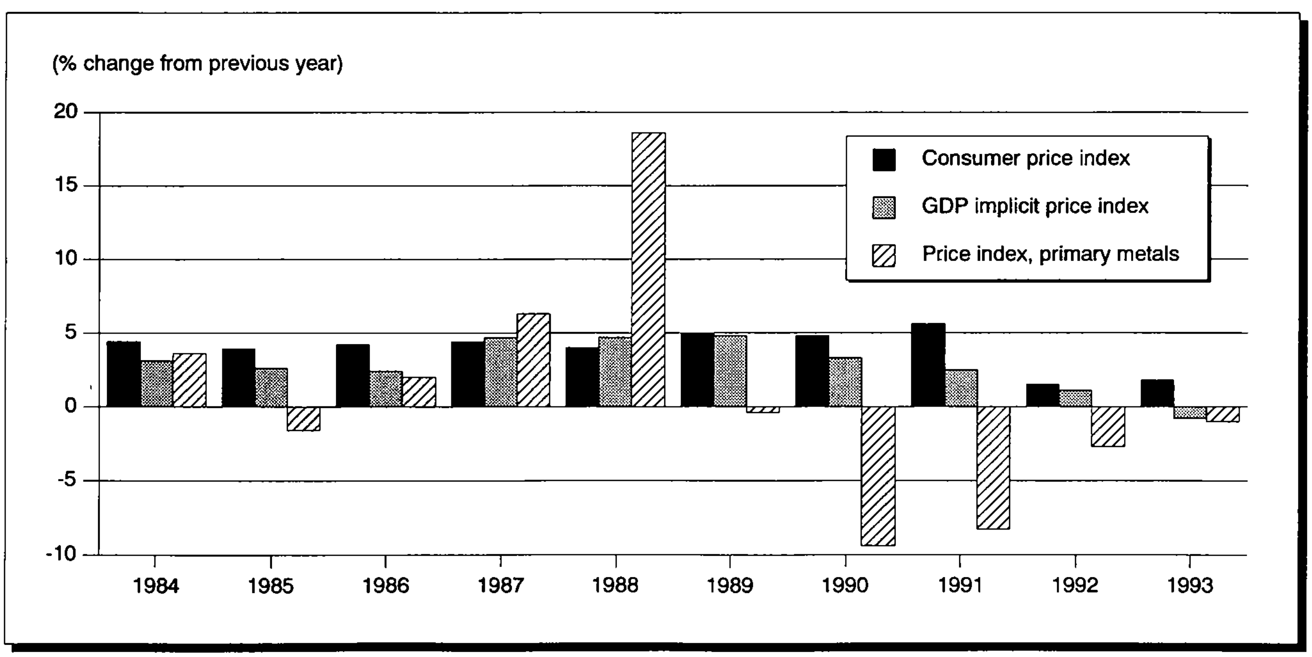
A subdued rate of inflation continued to be a feature of the economic environment in 1993. Domestically generated inflation was virtually non-existent in the third quarter, up by only 0.6% relative to the same quarter a year earlier, the lowest domestic inflation rate in 30 years. This result was largely attributable to ongoing underutilization of capacity in the economy and lower

Figure 1
Trends in Canadian Economic Activity, Percent Change in GDP, 1984-93



Source: Statistics Canada.
Note: Data for 1993 are estimated.

Figure 2
Canadian Price Trends, 1984-93



Source: Statistics Canada (based on 1986 price indexes = 100).
Note: Data for 1993 are estimated.

production costs. Wage increases in the third quarter averaged only 0.7%, productivity grew by 1.4% and, for the first time since 1962, unit labour costs were down on a year-to-year basis. In fact, the year-to-year increase in negotiated wage settlements tumbled in September to an historic low of only 0.2%, as two thirds of the negotiated agreements called for wage freezes or roll-backs. Inflation, as measured by the Consumer Price Index, grew by 1.8% on average, slightly above the 1.5% recorded in 1992. This measure of inflation reflected higher import costs associated with a falling Canadian dollar. Increased demand for credit occurred as interest rates fell to levels not seen for many years. The cost of borrowing, as measured by the prime rate established by the commercial lending establishments, fell from 6.75% in January 1993 to 5.50% in December, a 31-year low.

Several aspects of the economy in 1993 remained somewhat less than positive. In spite of low inflation and low interest rates, consumers remained cautious. Consumer spending, that had started the year with a 2.9% annualized increase over the last quarter of 1992, began to taper off as the year progressed. By the third quarter of 1993, the rate of increase had declined to 1.3%. There were signs, however, that household spending would strengthen in the fourth quarter. Motor vehicle sales were considerably above the level recorded in the third quarter and housing starts were up in October and November. On the other hand, sales of existing houses declined in the fourth quarter, failing to provide a needed impetus to sustained growth. Altogether, a somewhat inconsistent pattern of consumer spending emerged, as the stimulus of low interest rates continued to be checked by sluggish labour market conditions, and Canadians remained reluctant to borrow or to dip into savings. Low interest and inflation rates failed to lead consumers to increase discretionary spending. Instead, lack of income growth and a weak labour market continued to erode consumer confidence during the year.

While Canada's economic performance generally improved in 1993, only 43% of the employment losses incurred in 1991 and 1992 were recovered in 1993. New jobs were created and employment rose in most provinces, but the level of unemployment remained high at 11.2%, very similar to the level of 11.3% recorded in 1992. Long-term unemployment is expected to prevail for some time and, with the possible exception of the services sector, other sectors of the economy may continue to suffer.

Another negative factor was the continuing escalation of government debt at all levels. Represented as a fraction of the GDP, Canada's total public debt in 1992 was, with the exception of Italy, the worst among the G7 nations. The unavoidable cutbacks required to deal with the public debt at all levels of government clouded the economy in 1993 and will continue to do so into the foreseeable future.

THE MINERAL INDUSTRY IN 1993

The mineral industry faced another challenging year in 1993. While prices for many of the nonmetals and industrial minerals increased or remained stable, most base-metal prices slowly declined as the year progressed. In spite of production cutbacks undertaken by the former Soviet Union (FSU), economic and political turmoil led to a reduced ability of the FSU to absorb its own domestically produced metals. Excess supplies were diverted to Western countries already mired in recession, adversely affecting base-metal prices, especially those of aluminum and nickel. It is not surprising, therefore, that production cutbacks and continuing employment declines continued throughout the year in the Canadian mining industry.

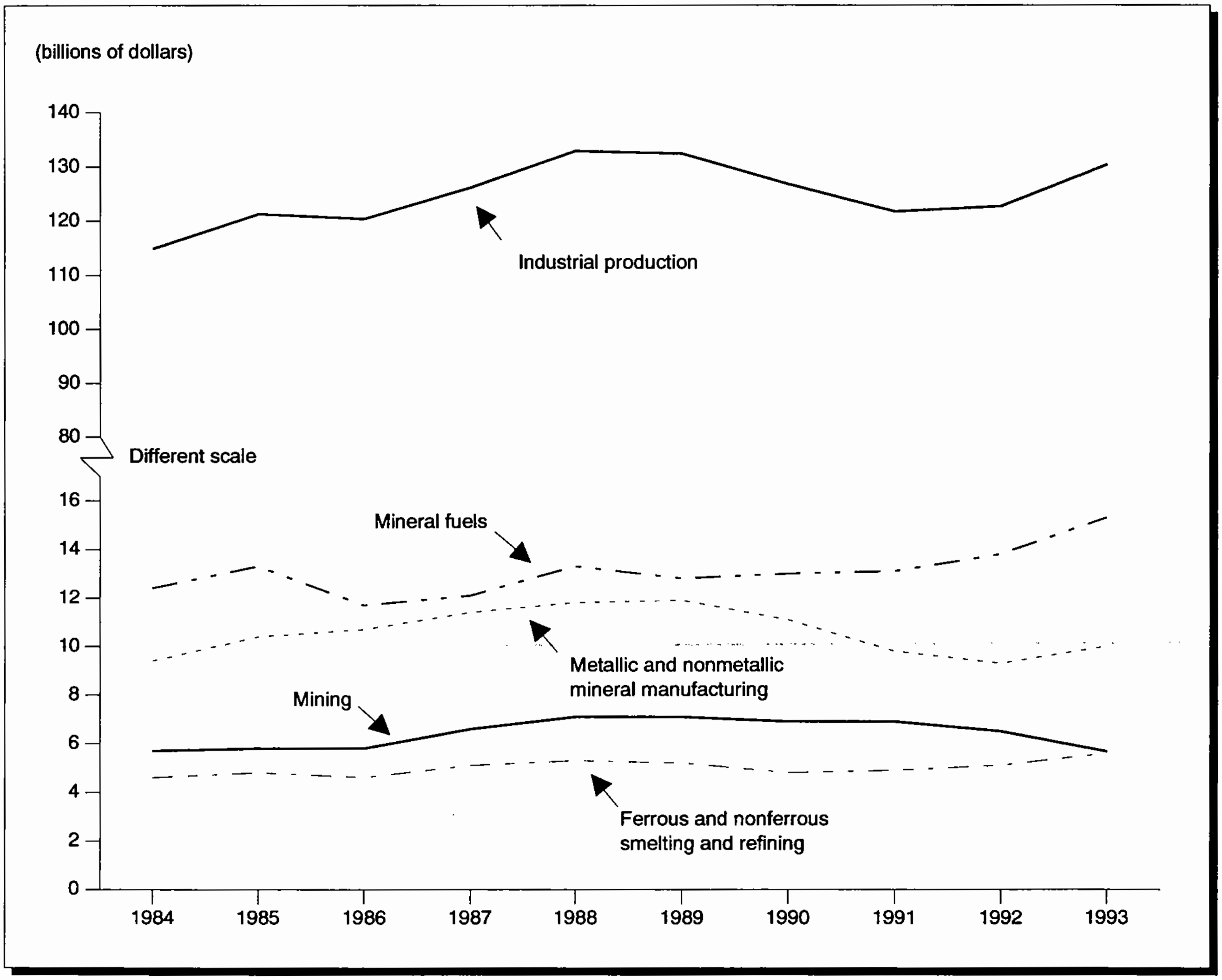
The mineral industry can be described by the following four stages of processing activity:

- Stage I: Primary Mineral Production (mining and concentrating);
- Stage II: Metal Production (smelting and refining);
- Stage III: Minerals and Metals-Based Semi-Fabricating Industries; and
- Stage IV: Metal Fabricating Industries.

Including all four stages of activity, and excluding oil and natural gas, the mineral industry accounted for about 4% of GDP in 1993.

Preliminary estimates for 1993 indicated that total employment in the industry was about 335 000, accounting for 2.5% of total national employment. This was down by 3.5% from the employment of 347 000 registered in 1992. All stages of the mineral industry experienced declines in employment in 1993 although the rate of decline seemed to be tapering off. Total employment in Stage I (metal mining, nonmetal mining, quarrying and coal mining) was estimated at 57 000, down from 61 000 in 1992, while employment in Stage II (nonferrous smelting and refining), estimated at 61 000, was down marginally from the level recorded the previous year. Employment in Stages III and IV (the semi-fabricating and fabricating mineral industries) dropped from 224 000 in 1992 to about

Figure 3
Gross Domestic Product at Factor Cost at 1986 Prices, 1984-93



Source: Statistics Canada.
Note: Data for 1993 are estimated.

217 000 in 1993, a decline of about 3%, considerably less severe than the 7.3% drop recorded in 1992.

The capacity utilization rates in mineral-based manufacturing picked up in 1993. Capacity utilization in the primary metal industries was 91.8% in the third quarter of 1993, a significant increase over the 81.7% reported in the equivalent quarter in 1992. Capacity utilization in the fabricated metal products industry showed a smaller increase, rising from 66.6% in the third quarter of 1992 to 70.5% in 1993. The increase in capacity utilization for the nonmetallic mineral products industries closely paralleled that of fabricated metals, increasing from 66.2% in the third quarter of 1992 to 71.2% in the third quarter of 1993. Good performance in the manufacturing industries was driven by rising domestic demand and increased exports of electrical and electronic products.

Operating revenues can be quite volatile in the resource-based industries as commodity prices are more sensitive to changes in the economy as a whole than are other processed or manufactured products. Revenues in the nonferrous mining and primary metals industries (Stages I, II and III) reflected the strength of metal prices in the period 1987-89. Metal prices have, however, fallen considerably since that time, resulting in a corresponding decline in revenues. In 1993, revenues in the first three quarters dropped to $11.4 billion, down from the $13.1 billion recorded over the same period in 1992.

The rate of return on total assets reflects an industry's ability to earn a return on funds supplied from all sources. The return on assets for the nonferrous metals and metal products industries peaked at about 19% in the first quarter of 1989, then declined somewhat erratically to reach a new low of –3.5% in the fourth quarter of 1992. There was, however, a slight improvement in 1993 with the third quarter showing a positive return of 2.3%.

The debt-to-equity ratio is a gauge of the solvency and capital structure of an industry, measuring the relationship between loans and borrowings on the debt side, and share capital, contributed surplus and retained earnings on the equity side. For the nonferrous and primary metals industries, the debt-to-equity ratio peaked in 1985 at 0.59, then began a long and slow decline to a low of 0.28 in the third quarter of 1990. In the fourth quarter of 1990, however, this ratio began to climb again and, by the third quarter of 1993, had climbed to a high of 0.53, nearly matching the 1985 peak of 0.59.

Capital expenditure intentions reported by the nonfuel mineral industry (including coal) in 1993 totalled $3.4 billion. This level of spending, reflecting revised investment intentions at mid-year as collected by Statistics Canada, represented a nearly 3% decrease from the $3.5 billion spent in 1992 on construction and machinery and equipment. Most of this decrease was expected to occur in the nonferrous smelting and refining industries in which capital outlays were projected to fall from $1.3 billion in 1992 to $0.9 billion in 1993. When repair expenditures are included, total investment spending planned by the mineral industry was $7.1 billion in 1993, compared with $7.2 billion in 1992. This level of spending represented 4.4% of total capital and repair expenditures within the Canadian economy, unchanged from 1992 but down from the 5.7% recorded in 1991.

Research and Development (R&D) spending intentions of the nonfuel mineral industry (including coal) totalled $292 million for 1993, a decrease from $305 million in 1992. This level of R&D spending represented 5.1% of total R&D spending planned by Canadian industries. Metal mines were expected to account for 13% ($38 million) of mineral industry R&D spending in 1993, a significant decrease from the $59 million estimated to have been spent the year before. Spending intentions of the primary metal manufacturing industries (ferrous and nonferrous) represented 66% ($192 million) of the mineral industry R&D total for 1993. This percentage was virtually unchanged from that of the previous year. When measured as a share of GDP, Canada is one of the lowest spenders on R&D among the G7 countries although Canadian R&D tax incentives are generally considered to be among the most favourable in the developed countries.

Total spending on exploration for the non-fuel mineral industry in 1993 was expected to increase marginally to about $400 million, compared with $385 million in 1992. Exploration expenditures in 1991 were considerably higher, at $532 million. Corrected for inflation, 1992 exploration expenditures were the lowest since 1967. Diamond exploration expenditures were up in 1992 to $19 million, a significant increase over the $7.1 million and $7.6 million reported in 1991 and 1990 respectively. The economic importance of diamond discoveries, including those at Lac de Gras in the Northwest Territories, have yet to be fully assessed. Mineral reserves are in a decline and substantial new discoveries of copper, zinc and lead are needed to avoid a progressive decline in Canadian output of these metals. According to the Science Council of Canada, the mining and mineral industry spends, on average, approximately 2.6% of sales on exploration, a considerable expenditure but very necessary to the survival of the industry.

MINERAL PRODUCTION

The Canadian mineral industry did achieve some growth in 1993. According to preliminary estimates, the total value of production of all mineral commodities, including mineral fuels, rose from $35.4 billion in 1992 to $36.1 billion in 1993, an increase of nearly 2%. As the accompanying table shows, this improved performance was totally attributable to an 11% gain in the value of output of natural gas and the other mineral fuels. The fuels sector includes crude petroleum, natural gas, natural gas by-products and coal. Together they accounted for nearly 64% of the total value of Canada's mineral production in 1993. The value of mineral fuels output rose from $20.7 billion in 1992 to $23.0 billion in 1993, an increase of about $2.3 billion. This gain by the mineral fuels was, however, partly offset by a decline of $1.6 billion in the total value of non-fuel mineral production, which declined by 11% from $14.7 billion in 1992 to $13.1 billion in 1993.

The value of production for the four mineral commodity groups (metals, nonmetals, structural materials and fuels) is summarized in the following table. Metals showed a significant drop in the value of production of nearly 14%. While gold and the platinum group metals were able to register modest increases in the value of production of 5.8% and 6.6% respectively, the leading base metals experienced declines. Natural Resources Canada's Metal Price Index provides a partial explanation for the declines in production values of the metals group. This index, which tracks the monthly prices of copper, nickel, lead, zinc, gold and silver, generally followed a downward trend through to October when it hit a low not recorded since 1987. However, the index began to turn up again in November and finished the year with the December level equalling the level recorded at the start of the year.

CANADIAN MINERAL INDUSTRY VALUE OF PRODUCTION, 1992 AND 1993

	1992	1993p	Change
	($ millions)		(%)
Metals	10 201.6	8 808.4	−13.7
Nonmetals	2 207.1	1 994.9	−9.6
Structurals	2 264.9	2 279.4	0.6
Total Nonfuels	14 673.6	13 082.6	−10.8
Fuels	20 730.6	22 979.6	10.8
Total	35 404.3	36 062.2	1.9

Sources: Natural Resources Canada; Statistics Canada.
p Preliminary.
Note: Numbers may not add to totals due to rounding.

Based on value of production, the top ten commodities in 1993 were crude petroleum ($11.16 billion), natural gas ($7.25 billion), natural gas by-products ($2.79 billion), gold ($2.26 billion), coal ($1.78 billion), copper ($1.76 billion), zinc ($1.23 billion), nickel ($1.22 billion), iron ore ($1.04 billion), and potash ($0.90 billion).

On a provincial basis, Alberta's contribution to total Canadian mineral output represented the largest share on a value basis, amounting to $18.6 billion, or 51.7% of the total. Ontario was second with a value of $4.4 billion or 12.4% of the total. British Columbia accounted for $3.5 billion (9.8%), Saskatchewan for $3.2 billion (8.8%), Quebec for $2.6 billion (7.1%), and Manitoba for $0.90 billion (2.5%). The remaining provinces and territories accounted for the other 7.7%. Non-fuel minerals plus coal accounted for slightly more than 40% of the total value of Canada's mineral production in 1993.

MINERAL TRADE

The mineral industry continued to make a significant contribution to Canada's merchandise trade balance. Mineral and mineral product exports, including fuels, totalled $32.3 billion for the first three quarters of 1993, an increase of nearly 11% over the corresponding period in 1992. Over the first nine months of the year, 78.4% of total mineral exports went to the United States, 6.6% to the European Community, and 5.1% to Japan. Mineral and mineral product exports represented 25% of total domestic exports.

Imports of minerals and mineral products, including fuels, for the first three quarters of the year totalled $16.5 billion, or 13% of total Canadian imports. In terms of net trade, a surplus of approximately $15.8 billion was recorded for minerals and mineral products, including fuels, for the first three quarters of 1993.

The value of exports of non-fuel minerals with coal included was estimated at $19.4 billion for the first nine months of 1993, an increase of about 5% over the corresponding period in 1992. These exports included crude minerals, smelted and refined products, and semi-fabricated and fabricated products. The United States was the destination for 66% of Canada's exports of non-fuel minerals and coal, while the European Community and Japan received 11.1% and 8.4% respectively.

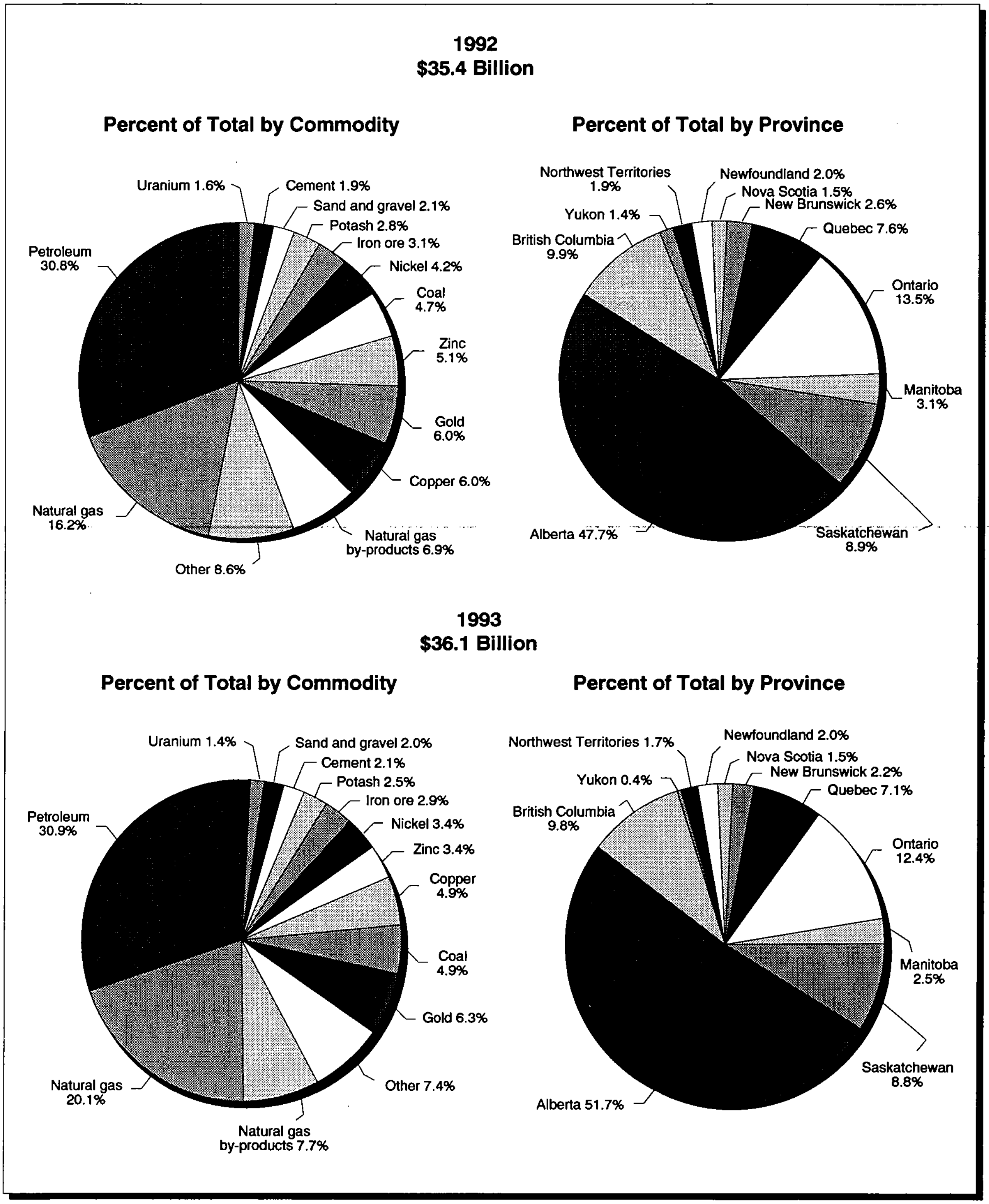
Imports of non-fuel minerals and coal for the first nine months of the year were estimated at nearly $12 billion, or 9.5% of total Canadian imports, resulting in a trade surplus for non-fuel minerals and coal of about $7.5 billion for the first three quarters of the year. The surplus for the full year was expected to be approximately $10 billion.

LEADING MINERALS

Gold

The volume of gold production fell to 153 t in 1993 from 160 t in 1992 and the record level of 176 t produced in 1991. The decrease of over 4% between 1992 and 1993 was largely a result of cutbacks in production levels at several large operations. However, by year-end, rising gold prices and new mine openings resulted in monthly production rebounding to 1992 levels. These rising prices precipitated a climb in the value of 1993 production to $2258 million, significantly higher than the $2135 million recorded in 1992 which permitted

Figure 4
Value of Mineral Production, Percent Shares by Commodity and by Province, 1992 and 1993



Sources: Statistics Canada; Natural Resources Canada.
Notes: The provincial shares may not add to 100% due to rounding. Prince Edward Island's share is excluded as it is too small to be expressed.

gold to retain its status as the leading metal produced in Canada. After starting 1993 at approximately US$330/oz, prices rose dramatically later in the year to boost the annual average to about US$360/oz. Gold prices fluctuated, reaching a peak of over $406/oz in August and a low of $326/oz in March. These price increases were triggered by heavy investor and fabrication demands, particularly from Far East countries. In 1993, Canada became the fourth-ranked world producer of gold trailing only South Africa, the United States and Australia. While two mines closed and six opened during the year, total employment in gold mines continued to decrease, dropping from 9400 in 1992 to an estimated 8700 in 1993. It is forecast that gold production will range between 160 and 170 t/y for the remainder of the decade.

Copper

In 1993, the value of production of copper declined dramatically from $2137 million in 1992 to $1760 million. Correspondingly, production volumes of copper dropped by over 8% to 699 000 t from the 762 000 t recorded in 1992. While the opening of the Louvicourt mine in Quebec will temporarily offset declining production levels, it is estimated that Canadian production levels will generally continue to decline for the remainder of the decade. Copper prices, reacting to lacklustre demand and continuing high levels of production, dropped from US$1.04/lb in 1992 to average US$0.87/lb in 1993. In the absence of any major increases in consumption or significant cutbacks in production, it is foreseen that prices may decline even further until rising consumption and slowdowns in production result in significant price increases later in the decade. Canada remains the fourth largest producer of copper behind Chile, the United States and the FSU.

Nickel

Canada and the FSU are the two largest producers of nickel in the world, producing between them almost 50% of world production. Weak demand and an oversupply of nickel in world markets signalled a continued decline in nickel prices during 1993 and cutbacks in production late in the year. Despite the fact that Canadian nickel production increased slightly in 1993, rapidly declining prices resulted in a drop in the value of production from about $1.5 billion in 1992 to $1.2 billion in 1993. Prices declined from US$2.70/lb to about US$2.00/lb later in the year, and averaged about US$2.40/lb over the full year. It is expected that stainless steel production, which accounts for over 60% of Western World primary nickel consumption, will increase by roughly 3% per year. Despite the cutbacks that affected production levels at the end of 1993, Canadian nickel production is expected to increase to the year 2000. It is anticipated that worldwide stocks of nickel will decline in 1994, giving rise to higher nickel prices in 1995.

Zinc

Canada is the world's largest producer of zinc concentrates. Production levels in 1993 dropped to 0.998 Mt in 1993 from 1.196 Mt in 1992, a decline of about 16.5%. As with other base metals, falling prices severely affected the total value of Canadian zinc production which fell from $1.79 billion in 1992 to about $1.23 billion in 1993, a drop of 31.4%. Zinc prices on the London Metal Exchange (LME), which averaged about US56¢/lb in 1992, plunged to about 44¢/lb in 1993. In 1994, the outlook for zinc is one of improving demand due to shortages of concentrates, declining stocks and corresponding increases in zinc prices. Canadian mine production is likely to rise slightly in 1994. This increased level is expected to be maintained through to the year 2000, as mine closures in Ontario and the Northwest Territories are offset by openings in Quebec, the Yukon and the Northwest Territories.

Lead

Canada has become the third largest producer of lead in the world after Australia and the United States. Large decreases in mine production, however, occurred as a result of cutbacks and closures in response to accumulated surpluses and low lead prices. Shipments of recoverable lead in ores and concentrates dropped from 337 000 t in 1992 to 187 000 t in 1993, a decrease of 44.3%. The value of those shipments declined by 61.1% from $247 million in 1992 to $96 million in 1993. The price for lead averaged just over US18¢/lb in 1993, a major decline from the 1992 average of 24.6¢/lb. This price drop reflects the large inventories available on the LME. Lead prices are expected to increase over the next few years, provided that regulatory restrictions on the use of lead are not widely adopted in industrialized and newly industrialized countries.

Silver

Silver is normally produced as a by-product or co-product of base-metal mining or gold mining in Canada. Canada ranks in the top five world producers of silver. Shipments of silver fell to 869 t in 1993 from 1169 t in 1992, a decrease of 26%. This decline was the result of a continuing pattern of mine closures and reductions in production levels. Correspondingly, the value of shipments fell by 14.5% to $153 million from the $179 million recorded in 1992. Silver prices that had been on a downward trend during much of the previous decade rebounded in 1993 to post an average annual value of US$4.30/oz for the year, well above the 1992 average price of US$3.95/oz. During the course of the year, prices approached US$5.00/oz. It is anticipated that silver production will remain at 1993 levels during 1994, but is forecast to increase to 1300 t by the year 2000.

Iron Ore

Production of iron ore in Canada remained relatively stable in 1993 when compared to 1992. The value of shipments decreased from $1.085 billion in 1992 to $1.036 billion in 1993. However, iron ore shipments increased in volume from 31.58 Mt in 1992 to 31.72 Mt in 1993. These levels are significantly below the 1991 shipments of 35 Mt valued at $1.228 billion. The outlook for 1994 was one of maintenance of production levels similar to 1993, with the possibility of a slight increase in response to higher steel production levels in North America. In terms of exports, it is expected that increased sales to Europe will be offset by a reduction in sales to Japan, where steel production is expected to decrease substantially.

Asbestos

Total Canadian asbestos shipments were estimated at 509 341 t in 1993, down from a 1992 production level of 586 994 t. Correspondingly, the total value of production declined from $231 million in 1992 to $213 million in 1993. These decreases can be attributed to a softening in some markets due to the worldwide recession. There have been, however, no major shut-downs or closures in the Canadian asbestos industry in 1993. Canada is the second largest producer of asbestos in the world, after the FSU. The publication of a clarification notice by the U.S. Environmental Protection Agency is expected to have a positive impact on Canadian markets in developing countries. Asbestos-cement products are still favoured by many users despite increasing competition from substitute fibres and steel. Canadian production is expected to remain relatively stable in 1994.

Potash

World production of potash declined by 11% in 1993 to about 21.3 Mt, with most of this decrease occurring in the FSU, Canada and Germany, the world's three top producers. Canadian potash shipments fell, largely due to reduced shipments to offshore markets. World consumption dropped in 1993 with about three quarters of the decline occurring in the FSU. Aside from the FSU, markets remained relatively static as reduced consumption in China was offset by higher levels of demand in both North and South America. Potash is produced in two Canadian provinces, Saskatchewan and New Brunswick, with Saskatchewan accounting for the majority of the production. Canadian potash production fell marginally from 7.040 Mt in 1992 to 6.970 Mt in 1993. Canadian potash mines operated at about 57% of capacity in 1993, down slightly from the 60% recorded in 1992, while the capacity of other major world producers reached between 75% and 95%.

Coal

Coal production rebounded to a level of 68.6 Mt in 1993, almost 5% higher than the 65.5 Mt recorded in 1992, but still substantially lower than the 1991 level of 71.1 Mt. This increase followed the resolution of financial restructuring and labour problems at three mines in southeastern British Columbia, which raised the production volume in that province by 16% from 17.7 Mt to 20.6 Mt. The value of coal produced grew to $1.78 billion, higher by over 7% than the $1.66 billion registered in 1992. Canada is a major coal exporter, ranking fourth in the world. Much of Canada's coal exports are directed to Pacific Rim countries, particularly Japan, South Korea and Taiwan for both steam and coking coal. In addition, there are expectations of strong growing demand by China for imported coal before the end of the century, despite the fact that China will remain a significant exporter of coal itself. It is expected that exports to the European Community will continue to decline. Overall coal production and trade in both Canada and the world will increase substantially throughout the current decade.

Structural Materials

The value of production of structural materials, which are defined to include sand, gravel, cement, clay products, lime and stone, reached $2.2 billion in 1993, a marginal increase over the levels achieved in the previous year. Shipments of cement increased by about 12% over 1992 to reach a level of $765 million, largely as a result of higher exports to the United States and a moderate increase in demand from western Canada. Housing starts in Canada declined by 7.5% in 1993 and both non-residential housing and engineering construction remained weak, adversely affecting shipments of structural materials. A national infrastructure renewal program, initiated in late

1993, offered some promise for the structural materials industry in the upcoming period.

CHALLENGES FOR THE INDUSTRY

Canada's mineral industry is confronted with the most daunting challenges that it has ever faced. Among the more serious concerns are depressed mineral and metal prices, declining ore reserves, low levels of exploration and mine development, mounting environmental and land use issues, changing fiscal environments, and increasingly severe competition in the world mineral economy.

There is strong and growing competition from other parts of the world that enjoy their own particular advantages such as richer orebodies, lower supply and wage costs, and cooperative governments anxious to obtain private investment for the development of their own countries. Mexico, Chile, Venezuela, Argentina and Bolivia, as well as a number of smaller South American and Central American countries, are attracting the interests of foreign mineral investors. These countries appear to be offering highly competitive investment climates that include free mineral rights, tax rate concessions, and generous depreciation and loss carry-over provisions.

Canadian mineral reserves are declining and projected mine closures over the next few years could place the industry in a critical position. This decline in the inventory of mineable base-metal ores has sharply diminished the time available for finding and developing new orebodies and, unless new reserves are discovered, will impact seriously on the sustainability of Canadian mine production in the future.

Underlying any discussion of the future of the mining industry in Canada is the question of metal prices. After peaking in 1989, metal prices have, in general, continued to decline. These lower prices are largely a reflection of reduced demand because of poor economic conditions throughout the world. If the average cost of producing metals exceeds the price for a prolonged period, production will inevitably fall and the least competitive suppliers may be permanently squeezed out. The challenge for the Canadian mining industry is to ensure that production costs are kept at a level lower than world metal prices. Accomplishing this with our natural disadvantages, such as climate and transportation distances, will not be an easy task.

The mining industry, like many other industrial sectors, has been the focus of a number of regulatory initiatives to reduce pollution-generating activities. There is, however, concern among industry officials that some of the regulations are poorly designed and inefficient, and are causing uncertainty, delay and unnecessary increases to costs, thereby inhibiting domestic mineral investment.

Also of concern to the Canadian mineral industry is the fact that some Canadian provinces, when compared with competing jurisdictions, have become less competitive from a tax perspective.

The need to develop both a vision and a process to renew Canada's minerals and metals sector was identified by The Mining Association of Canada at the Mines Ministers' Conference held in Whitehorse, Yukon Territory, in September 1992. As a result, the Whitehorse Mining Initiative (WMI) came into existence and was officially launched at the Prospectors and Developers Association of Canada conference in Toronto on March 30, 1993. The WMI established the long-term objective of moving towards a socially, economically and environmentally sustainable and prosperous mining industry, underpinned by political and community consensus. The four issue groups established under the WMI umbrella deal with Environment, Land Use, Workplace, and Finance/Taxation. The WMI is charged with identifying and developing suitable measures to resolve current issues and pave the way for a renewed minerals and metals sector.

ECONOMIC OUTLOOK FOR 1994

Leading economists are predicting moderate but steady growth in the Canadian economy in 1994 with forecasts ranging from a conservative 2.7% to a more optimistic 4%. Exports are expected to remain the main source of economic growth, largely as the result of a lower Canadian dollar, and improving productivity and strong growth in the United States, anticipated to be about 3% in 1994.

Business investment spending in machinery and equipment is expected to show robust growth in 1994, as corporations emerging from the recession replace outdated technology. Much of Canada's machinery and equipment is imported, however, and the impact of this growth on job creation is likely to be minimal. The residential sector is also expected to revive in 1994, as housing construction is forecast to rise by 6% as a result of low mortgage rates and a strengthening economy.

Because the Canadian economy is still performing well below capacity, inflationary pressures are not expected to build for several years. As a result, the Consumer Price Index should remain stable at around 1.8%. Interest rates, on the other hand, may edge up, mainly as a result of the impact of a weaker Canadian dollar that some economists believe will fall to between US72¢ and US74¢ at year-end. The possible increase in interest rates expected in the United States, where the economy is operating at close to capacity, could have an unfavourable impact on Canadian rates. There were signs at the end of 1993 that consumer spending was finally picking up but, because of higher taxes, low wage settlements and continuing high unemployment, Canadians generally believed that their financial positions are likely to remain fragile in 1994.

Unemployment is expected to remain high for several years to come and is forecast to remain at about 11% in 1994. This represents very little change from 1993, partly because production gains have not translated into employment gains. Also of concern is the ongoing impact of a large public debt that is certain to restrain the pace of economic recovery.

MINERAL INDUSTRY OUTLOOK

Factors related to the strength and timing of an economic recovery, both domestically and internationally, will continue to be of concern to Canada's mineral producers. Although the North American economy appeared to be recovering, other major economies of the world continued to exhibit weakness. Internationally, world mineral supply and demand will continue to be affected by political and economic developments in markets such as Japan, continental Europe, the former Soviet Union, China and South Africa. Canada's positioning within the global industry will depend on how well the domestic industry draws on its strengths to respond to the challenges. Canada is still one of the leading mineral producers of the world and one of the world's top exploration targets. An attractive investment climate is, however, critical to sustaining a viable mineral industry. Public policy initiatives and regulatory structures will be needed to maintain the industry as a world-class producer of mineral and metal products, and to stimulate investment in mineral exploration and development in Canada.

The WMI is viewed as an important step in uncovering ways of dealing with the challenges facing the mineral industry in the months and years ahead. The federal government has voiced its support for the mining industry as a vital part of the Canadian economy and intends to articulate a national strategy for sustainable development based on consultation and the recommendations of the WMI.

A critical period lies ahead but, with a sustained effort on the part of all stakeholders, tough challenges can be met. As a result, Canada's mineral industry should continue to make a significant contribution to Canada's economy.

Note: Information in this review was current as of March 31, 1994.

TABLE 1. CANADA, PRODUCTION OF LEADING MINERALS, 1992 AND 1993

		Volume		Percent Change	Value		Percent Change
		1992	1993p	1993/1992	1992	1993p	1993/1992
		(000 tonnes except where noted)			($ millions)		
METALS							
Gold	kg	159 858.2	152 578.3	–4.6	2 134.6	2 258.0	5.8
Copper		761.7	698.8	–8.3	2 137.0	1 759.7	–17.7
Zinc		1 195.7	998.2	–16.5	1 791.2	1 228.8	–31.4
Nickel		177.6	180.8	1.8	1 502.1	1 216.0	–19.0
Iron ore		31 582.0	31 720.5	0.4	1 084.8	1 036.6	–4.4
Uranium	tU	9 114.1	9 015.4	–1.1	566.4	509.0	–10.1
Silver	t	1 169.0	868.7	–25.7	178.7	152.9	–14.5
Platinum group	kg	11 311.3	13 116.4	16.0	130.2	138.8	6.6
Lead		336.9	187.6	–44.3	247.3	96.2	–61.1
Cobalt		2.2	2.4	6.6	131.4	89.8	–31.6
NONMETALS							
Potash (K_2O)		7 039.6	6 969.8	–1.0	980.9	901.5	–8.1
Salt		11 088.0	11 371.4	2.6	266.4	279.8	5.0
Asbestos		587.0	509.3	–13.2	231.0	215.1	–6.9
Peat		827.9	820.0	–1.0	116.9	119.2	2.0
Sulphur, in smelter gas		783.4	797.0	1.7	88.1	95.0	7.9
Gypsum		7 294.7	7 835.9	7.4	71.8	83.1	15.7
STRUCTURALS							
Cement		8 598.2	9 841.6	14.5	682.4	764.6	12.0
Sand and gravel		240 616.0	229 940.5	–4.4	760.4	736.5	–3.1
Stone		89 337.7	79 208.6	–11.3	516.5	469.6	–9.1
Lime		2 384.3	2 446.6	2.6	191.3	200.7	4.9
Clay products		. .	. .	. .	114.3	108.1	–5.4
FUELS							
Petroleum, crude	000 m^3	93 255.8	97 249.3	4.3	10 907.8	11 155.0	2.3
Natural gas	million m^3	116 663.5	129 245.1	10.8	5 718.6	7 248.6	26.8
Natural gas by-products	000 m^3	26 734.5	28 462.6	6.5	2 434.9	2 793.0	14.7
Coal		65 612.0	68 600.0	4.6	1 669.3	1 783.0	6.8

Sources: Natural Resources Canada; Statistics Canada.
. . Not available; p Preliminary.
Note: Numbers have been rounded.

TABLE 2. CANADA, EXPORTS OF MINERAL COMMODITIES BY COUNTRY AND BY COMMODITY AS DEFINED BY THE HARMONIZED SYSTEM (HS), 1993 (9 MONTHS)

HS Chapter[1]	Description	United States		EC[2]		Japan		Mexico		Other		Total	
		($000)	(%)	($000)	(%)	($000)	(%)	($000)	(%)	($000)	(%)	($000)	(%)
25	Salts; sulphur; earths or stone, plastering materials, lime and cement	388 951	53.8	50 397	7.0	44 472	6.2	13 699	1.9	225 522	31.2	723 041	100
26	Ores, slag and ash	283 308	19.1	634 194	42.8	362 841	24.5	19 683	1.3	182 704	12.3	1 482 730	100
27	Mineral fuels, oils and products of their distillation; bituminous substances; mineral waxes[3]	12 855 047	89.4	72 688	0.5	891 221	6.2	12 117	0.1	540 227	3.8	14 371 300	100
28	Inorganic chemicals; compounds of precious metals, radioactive elements, etc.	1 114 828	86.0	79 101	6.1	37 137	2.9	846	0.1	64 980	5.0	1 296 892	100
31	Fertilizers	849 168	69.2	10 660	0.9	47 628	3.9	5 747	0.5	314 723	25.6	1 227 926	100
68	Articles of stone, plaster, cement, asbestos, mica or similar materials	312 172	91.5	11 155	3.3	2 811	0.8	73	–	14 804	4.3	341 015	100
69	Ceramic products	32 254	81.1	1 957	4.9	617	1.6	7	–	4 957	12.5	39 792	100
70	Glass and glassware	341 846	84.0	43 464	10.7	1 473	0.4	218	0.1	19 999	4.9	407 000	100
71	Natural/cultured pearls, precious stones and metals, coins, etc.	1 851 009	70.8	144 678	5.5	6 504	0.2	52	–	611 048	23.4	2 613 291	100
72	Iron and steel	1 955 338	91.3	11 436	0.5	4 609	0.2	30 723	1.4	138 728	6.5	2 140 834	100
73	Articles of iron or steel	1 448 772	90.9	21 120	1.3	1 691	0.1	7 014	0.4	115 383	7.2	1 593 980	100
74	Copper and articles thereof	767 056	64.8	248 579	21.0	4 460	0.4	45	–	163 899	13.8	1 184 039	100
75	Nickel and articles thereof	356 732	32.5	330 731	30.2	38 229	3.5	5 419	0.5	365 292	33.3	1 096 403	100
76	Aluminum and articles thereof	2 241 806	73.7	451 209	14.8	194 152	6.4	688	–	155 327	5.1	3 043 182	100
78	Lead and articles thereof	60 872	81.2	1 324	1.8	511	0.7	–	–	12 266	16.4	74 973	100
79	Zinc and articles thereof	449 466	84.3	6 231	1.2	8 816	1.7	–	–	68 431	12.8	532 944	100
80	Tin and articles thereof	7 838	82.8	620	6.5	174	1.8	–	–	835	8.8	9 467	100
81	Other base metals; cermets; and articles thereof	60 142	35.6	30 501	18.1	17 192	10.2	401	0.2	60 500	35.9	168 736	100
	Total mineral exports	25 376 605	78.4	2 150 045	6.6	1 664 538	5.1	96 732	0.3	3 059 625	9.5	32 347 545	100
	Total domestic exports	104 275 804	80.5	7 467 155	5.8	6 298 346	4.9	545 467	0.4	11 019 328	8.5	129 606 100	100
	Percentage, mineral to domestic	24.3		28.8		26.4		17.7		27.8		25.0	

Source: Statistics Canada, catalogue no. 65-003 (Quarterly).
– Nil.
[1] Chapter refers to a group of commodities covered in a specified chapter of the "Harmonized Commodity Description and Coding System," as of January 1, 1988. Canadian external trade statistics are classified according to the Harmonized System. [2] EC: European Community. [3] Total value of coal exports included in Chapter 27 is $1440 million.

International Scene

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Uruguay Round of Multilateral Trade Negotiations

In December 1993, after more than seven years of negotiations, the *Final Act Embodying the Results of the Uruguay Round of Multilateral Trade Negotiations* was adopted. The agreement was signed in Marrakesh in mid-April 1994 by more than 120 countries. This important achievement will result in a more fair, effective and transparent multilateral trading system. The agreement has:

- strengthened the rules and procedures governing international trade;
- expanded market access by lowering or eliminating tariffs and other barriers to trade;
- brought intellectual property, trade-related investment, and services under world trade rules;
- improved dispute settlement procedures and enforcement mechanisms; and
- created a World Trade Organization (WTO).

The WTO, which will be responsible for implementing the agreement, is expected to come into effect on January 1, 1995. The WTO will be a single institution with responsibility for the General Agreement on Tariffs and Trade (GATT) as modified by the Uruguay Round (UR), all agreements and arrangements concluded under its auspices, and the complete results of the UR. WTO membership will entail accepting all the results of the UR without exception. The WTO, which will have status equal to the International Monetary Fund and the World Bank, will be the forum for future world trade negotiations on issues unresolved by the UR, including some aspects of market access, and trade and environment issues. There will be a ministerial conference of the WTO at least once every two years. The WTO's General Council will function as a dispute settlement body and a trade policy review mechanism covering all trade issues covered by the WTO. In addition, there will be subsidiary bodies, including a Goods Council, a Services Council and a Trade-Related Aspects of Intellectual Property Rights Council. It is likely that there will also be a WTO Committee on Trade and Environment to integrate environmental objectives and world trade rules.

The agreement includes a protocol containing the commitments by participants to eliminate or reduce tariff rates and non-tariff measures applicable to trade in goods. Canada had pressed to achieve tariff elimination on all nonferrous metals. While this was not possible, some gains on market access have still been achieved.

According to some estimates, the agreement is expected to boost global income by between US$200 billion and $300 billion a year (more than 1% of world Gross National Product) over 10 years from 1995. The growth will arise from the reduction of global tariffs to an average 3% from the current 5% and from the removal of many non-tariff barriers.

The Final Act includes a number of agreements, some of which are discussed below.

The **Agreement on Technical Barriers to Trade** extends and clarifies the earlier Tokyo Round agreement. It has the objective of ensuring that technical negotiations and standards, as well as testing and certification procedures, do not create unnecessary obstacles to trade. Under the agreement, countries have the right to establish protection at levels they consider appropriate for human, animal or plant life or health, or the environment. However, it provides that technical regulations should not be maintained if the objective can be addressed in a less trade-restrictive manner.

The **Agreement on Implementation of Article VI (Anti-Dumping)** addresses many areas in which the current agreement lacks precision and detail. It requires the automatic sunsetting of sanctions after five years.

The **Agreement on Subsidies and Countervailing Measures** contains a definition of subsidy. This definition will be particularly useful for Canada in the context of the Canada-U.S. Free Trade Agreement (FTA) and the North American Free Trade Agreement (NAFTA). The agreement provides that there are three categories of subsidies:

- prohibited subsidies;
- actionable subsidies; and
- non-actionable subsidies.

The agreement also provides that regional development subsidies, research assistance subsidies and environmental subsidies are non-actionable provided the prescribed criteria are satisfied. It sets out rules governing the initiation of countervailing duty cases, investigation by national authorities, and rules of evidence.

The **Agreement on Trade-Related Aspects of Investment Measures (TRIMs)** recognizes that certain investment measures restrict and distort trade and provides that no contracting party shall apply any TRIMs inconsistent with GATT provisions on national treatment and prohibition of quantitative restrictions. The agreement requires mandatory notification of all non-conforming TRIMs and their elimination within two years for developed countries, within five years for developing countries, and within seven years for the least-developed countries.

LAW OF THE SEA

On November 16, 1994, the United Nations Convention on the Law of the Sea (LOS) will enter into force. The Convention governs a wide range of ocean matters (e.g., 200-mile exclusive economic zones, protection of the marine environment, navigation rights on the high seas, etc.), including provisions governing the exploitation of deep seabed mineral resources. One of the key features of the LOS is the principle that the resources of the deep seabed represent the common heritage of mankind and should be developed to the benefit of all nations.

Although 159 states, including Canada, signed the Convention in 1982, its entry into force has been delayed by a lack of international support. Iceland is the sole developed nation among the 60 ratifying states. While most of the Convention is universally accepted, it is the deep seabed mining provisions that have prevented other industrialized nations, including Canada, from ratifying it.

In an effort to promote the universal adherence to the Convention before it enters into force, the United Nations' (UN) Secretary-General invited a select group of countries in 1990, including Canada, to undertake informal consultations on outstanding seabed mining issues. The consultations were not meant to be negotiations but, rather, a re-examination of the issues in light of current circumstances (i.e., commercial deep seabed mining is no longer expected to commence in the near future). This process led to the identification of the areas which render the Convention unacceptable to developed countries.

Although there are many concerns with this part of the Convention, some of the developed countries' main concerns relate to the costs that will be incurred once the LOS enters into force. The Convention was drafted on the assumption that seabed mining was imminent and foresees the immediate creation of an extensive UN bureaucracy to regulate seabed mining. However, countries are understandably reluctant to fund immediately a bureaucracy designed to regulate an industry that will not exist for at least 20 more years. The LOS also requires countries to contribute to a fund which would compensate developing countries for the adverse impacts on their economies of seabed mining. As the LOS is currently drafted, there are no assurances that these funds would be used to support time-limited structural adjustment programs and the closing of uneconomic mines. These two concerns are also reflected in a broader debate over the rules under which UN regulatory authorities will make decisions. Developed countries are concerned that the current decision-making procedures will inhibit their abilities to protect their financial and economic interests.

Other concerns relate to the "parallel" system of development. Reflecting the common heritage of mankind principle, this system allows for mining by the UN, through its own seabed mining company known as the Enterprise, in parallel with mining by the private sector and state mining companies. Most countries accept the parallel system, but there are disagreements over the level of support that should be provided to the Enterprise. Under the terms of the LOS, countries which ratify the Convention would have to provide the start-up funds for the Enterprise and finance its first mine site. In addition to this free source of capital, the

Enterprise would not be required to pay royalties, placing it in a privileged position relative to private sector mining companies.

The consultations have thus far been successful. They have evolved into a negotiating forum open to all countries with the tacit objective of substantially altering the LOS Convention. The differences of opinion across nations have narrowed and it is now likely that a deal can be reached to amend the Convention before it enters into force. Most of the issues appear close to resolution. For example, there is general agreement that the Enterprise will have to raise its own funds, pay royalties and acquire mining technology through commercial transactions or joint venture agreements. Some difficult issues are not yet resolved, but it is likely that agreement can be reached by June 1994 to allow countries sufficient time to exercise the option of ratifying the LOS before it enters into force.

Regional Arrangements

The trend for regional arrangements has continued, including **European developments** such as the establishment of a **European Economic Area**, the **Maastricht Treaty**, and **integration** occurring in Central and Eastern Europe; the **North American Free Trade Agreement** and developments in Latin America; and continued integration efforts taking place through the **Asia-Pacific Economic Cooperation Council**.

North American Free Trade Agreement (NAFTA)

There is more trade between Canada and the United States than any other two countries in the world. Two-way trade in goods and services between Canada and the United States amounted to over $300 billion in 1992, the final preparatory year before Canada's entry into NAFTA. Under NAFTA, Canada:

- gains better access to the Mexican market of 85 million people;
- preserves and improves the original FTA with the United States; and
- ensures that Canada remains an attractive location for investment in North America.

NAFTA brings positive developments for the Canadian mineral sector. Canada obtained immediate elimination of Mexican tariffs on coal, nickel, magnesium, and some copper and aluminum ingots, all of which are Canadian export interests.

In the **Rules of Origin Chapter**, there are a number of improvements over those in the FTA. Not only have definitions been clarified, but Canada has also been successful in adopting a number of origin rules based on "**tariff transformations**." Such rules clarify what level of transformation is required in order to qualify for duty-free access such as, for example, copper produced from material containing waste and scrap, including spent anodes.

On the **environmental** front, the **North American Agreement on Environmental Cooperation** sets out specific obligations with respect to environmental policies and laws, including the effective enforcement by each country of their domestic environmental laws. Canada, Mexico and the United States each retain the right to adopt the standards necessary to achieve their desired level of environmental protection. Canada will work with Mexico and the United States to further enhance environmental regulations on a continental basis.

Turning to commodity-related trade action activity with the United States, 1993 brought notable developments in **magnesium, potash and sulphur.**[1]

We begin with the **anti-dumping and countervailing duties** imposed against pure and alloy **magnesium** produced by Norsk Hydro Canada Inc. In October 1993, the first panel's review on dumping maintained the anti-dumping duty on pure magnesium exports to the United States, but at a lower rate than in 1992. The panel affirmed a determination of a 21% duty (down from the original 31%) and found that the U.S. Department of Commerce (DOC) had correctly determined the costs of Norsk Hydro Canada Inc. In December 1993, the second panel accepted a DOC decision to impose a 7.61% countervailing duty against both pure and alloy magnesium exported to the United States.

Concerning **sulphur**, an administrative review of the anti-dumping order by the U.S. DOC on Canadian sulphur exports was undertaken early in the year. A comprehensive investigation was done during the summer of 1993 and results of the preliminary determination will be known in the course of 1994.

[1] Refer to the specific commodity chapter for additional details.

Finally, on **potash**, the 1988 five-year suspension agreement negotiated between the United States and Canada's potash producers under the supervision of the DOC was to be terminated in early 1993. However, the suspension agreement was extended for one more year.

Commodity-related trade actions with the United States are not expected to be eliminated by the implementation of NAFTA alone. Nevertheless, NAFTA will promote the efficient use of minerals and metals in the North American region as a whole, encouraging economies of scale and promoting intra-industry specialization. As a result, Canadian firms will benefit from lower costs and higher productivity, helping them compete more effectively not only in the North American market, but also in world markets.

European Developments

Within the European Union (EU), the **Maastricht Treaty** entered into force in November 1993, calling for:

- the establishment of an economic and monetary union;
- the implementation of a common foreign and security policy;
- greater cooperation in justice and home affairs; and
- new social policy principles.

The agreement creating the **European Economic Area (EEA)** entered into force in January 1994. The EEA consists of Liechtenstein, Austria, Finland, Iceland, Norway, Sweden and Switzerland, and all of the countries of the EU. The agreement extends the EU's "four freedoms" (free movement of capital, goods, services and people) to the non-EU member countries. The effect is to link the countries in a single huge market.

Negotiations for the accession of Austria, Norway, Finland and Sweden were completed in early 1994. Depending on the results of referenda in those countries and approval by the European Parliament, those countries are expected to become full members of the EU in January 1995.

The EU also recently advised six Eastern European countries that they could join the EU when they meet certain criteria and offered encouragement to other former Soviet Union (FSU) countries, including Russia, seeking free trade agreements with the EU. Poland, Hungary, the Czech Republic, the Slovak Republic, Romania and Bulgaria already have association agreements with the EU, pursuant to which they will achieve early elimination of all customs duties in the industrial sector. Their accession to the EU would take place as soon as they can assume the obligations of EU membership by satisfying the economic and political conditions required. They would need to demonstrate that they met a number of criteria for membership, including:

- capacity to adhere to EU laws and regulations; and
- having a market economy able to compete with EU market forces.

The GATT Working Group on Environmental Measures and International Trade

The interconnected issues in the area of trade and environment and possible approaches to resolving potential conflicts are being considered in a number of fora. In view of the significance of exports to the Canadian economy, improving the multilateral system to maintain an open, rule-based trading environment is vitally important to Canada and especially the Canadian minerals and metals sector.

The GATT Working Group on Environmental Measures and International Trade has three items in its standing agenda: trade provisions contained in multilateral environmental agreements; the need for multilateral transparency of national environmental regulations; and the use of domestic packaging and labelling regulations with environmental objectives. The UNCED had underlined the need for GATT to fully incorporate into its activities a consideration of trade and environment issues.

Note: Information in this review was current as of April 25, 1994.

Regional Outlook

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The Canadian mining industry continued to suffer the effects of the global recession as the estimated value of production of metals, nonmetals, structural materials and coal for 1993 is $14.86 billion, a decrease of $1.4 billion, or 8.8% from 1992. Significant declines were recorded for copper, lead, nickel, zinc and elemental sulphur. When natural gas, natural gas by-products and crude petroleum are included, the value of Canada's mineral production is $36.1 billion, an increase of 2.0% over 1992.

Prices for the major metals had varying behaviours: zinc remained flat at US$0.40-0.50/lb; nickel dropped to US$1.80/lb in September before rebounding to US$2.40/lb at year-end; copper gradually declined to US$0.80/lb, falling some 25% over the year; and gold and silver, on the other hand, peaked in July before declining temporarily although, at US$380/oz and over US$5.00/oz respectively, the prices of both metals in December were significantly higher than at the start of the year.

Estimated total employment in mining and mineral manufacturing, including coal, was approximately 335 000, down 3.5% from 1992. Estimated employment in metal and nonmetal mining, quarrying and coal mining was 57 000, down 6.5% from 1992, whereas estimated employment in nonferrous smelting and refining was 61 000, down marginally from 1992.

New mine development remained slow due in large part to poor market conditions, difficulties arranging financing, and the lengthy times required for most environmental regulatory processes. Several mines either opened or re-opened in 1993; most were gold mines located in Ontario and Quebec. Exploration continued to decline across the country with the only real bright spot being diamonds.

In addition to the Northwest Territories, there was significant diamond exploration in Alberta, Saskatchewan, and some areas of northern Ontario and northern Quebec.

Among the significant events in 1993 were: the announcement by the province of British Columbia of the creation of a wilderness park in the Alsek-Tatshenshini basin, which precluded any development of the Windy Craggy copper project (see section on British Columbia); continued exploration by Dia Met Minerals and BHP Minerals Canada, and Kennecott Canada Inc. in the Lac de Gras region of the Northwest Territories, which established their diamond properties as potential producers (see section on Northwest Territories); the launch of the Whitehorse Mining Initiative (WMI); and the launch of the "Keep Mining in Canada" campaign by a common front of industry groups.

The WMI sprang from the 49th Annual Mines Ministers' Conference held in Whitehorse, Yukon, in September 1992. A steering committee of three ministers was given the responsibility of developing an action plan for the WMI. In March, this action plan was launched at the Annual Convention of the Prospectors and Developers Association of Canada in Toronto. The WMI is a collaborative effort and differs from traditional, government-led consultations in that no single sector is "leading" the process.

The WMI was initiated by the mining industry, and its aim is to address a range of issues which affect industry competitiveness. However, the WMI is seeking to meet the needs of all stakeholders who have come to the WMI table. Together, representatives from aboriginal and environmental groups, labour, industry and government are developing recommendations on how the industry should look from a human resource, financial, environmental and land-use planning perspective. Four Issue Groups have been formed to deal with Environmental, Land Access, Workforce/Workplace/Community, and Finance and Taxation issues. Currently these Issue Groups are drafting recommendations for working documents, which will be discussed in detail during 1994. The Issue Groups expect to present their final reports to the WMI Leadership Council at the 1994 Mines Ministers' Conference in Victoria.

In September, The Mining Association of Canada launched a national campaign to "Keep Mining in Canada," expressing its concerns about mining's future in Canada. "Keep Mining in Canada" is a ten-point plan of action to raise awareness of the importance of mining and the key issues facing the sector; to communicate positive industry efforts which address the key issues; and to use communications to help foster a more favourable climate for government policies conducive to the industry's growth and prosperity.

This Regional Outlook is the result of the combined effort of Mining Sector staff in Halifax, Ottawa and Saskatoon, without whom its preparation would not have been possible. This assistance is gratefully acknowledged.

NEWFOUNDLAND AND LABRADOR

For 1993, the estimated value of mineral production from Newfoundland and Labrador is $727 million, an increase of 3.0% from 1992. Shipments of nonmetals (such as asbestos, gypsum, dolomite, gemstones, slate, pyrophyllite and peat) and structural materials (such as cement, stone, and sand and gravel) accounted for approximately $47 million; metals, including iron ore products and gold, accounted for the remainder of mineral production. Mineral production should rise in 1994 due to increased production of gold and limestone aggregates.

Exploration in Newfoundland and Labrador increased slightly in 1993 with estimated expenditures of $11.1 million. There is guarded optimism for 1994 because forecasted expenditures are $12 million-$15 million. Other major exploration indicators, such as claims staked, claims in good standing, and diamond drilling, also reflect increased activity. In particular, diamond drilling increased from 21 873 m in 1992 to approximately 45 000 m in 1993. Seven thousand new claims were staked, an increase of 37% from 1992.

In 1993, the Iron Ore Company of Canada shipped 13.4 Mt of pellets and concentrate and is forecasting shipments of 14.0 Mt in 1994. Total employment at Carol Lake was 1520 in 1993. Wabush Mines Ltd. shipped 4.5 Mt of iron concentrate in 1993 and the company forecasts the same level of shipments in 1994. This company employs 383 people in Labrador.

The Hope Brook Gold mine, owned by Royal Oak Mines Inc., produced an estimated 96 000 oz of gold in 1993; production is forecast to rise to 120 000 oz in 1994. In 1993, the company constructed and operated a copper recovery circuit designed to produce 7000-10 000 t/y of concentrate grading 22% copper and 31.24 g/t gold.

Teranov Mining Corp. operates a wet mill to reprocess tailings at the former Baie Verte asbestos mine. In 1993 the mill produced approximately 15 300 t of reprocessed fibre. In December, Black Hill Minerals Ltd. purchased 50% of Teranov from Princeton Mining Corp. and has an option, until December 1, 1994, to purchase the remaining 50%.

Domtar Inc. produced 350 000 t of gypsum from its Flat Bay mine in 1993. Domtar has announced that, in 1994, it will supply its Newington, New Hampshire, wallboard plant with gypsum from Nova Scotia, resulting in reduced production at Flat Bay.

Newfoundland Resources & Mining Co. Ltd. shipped approximately 400 000 t of limestone aggregates from Lower Cove on the Port au Port Peninsula in 1993. Increased infrastructure spending in the United States and the start of the Prince Edward Island Fixed Link should improve market conditions, and shipments in 1994 are forecast to exceed 1.0 Mt.

Gold deposits at Pine Cove, Nugget Pond, Hammerdown and Glover Island are all in various stages of advanced assessment.

On January 1, 1993, the provincial corporate income tax rate was reduced from 17% to 16%. Further, in the March budget, the following changes were made to the Newfoundland mining tax regime: provincial corporate taxes paid to the province will now be creditable against mining taxes payable for the first 10 years a new mine is in operation; the depreciation schedule, which allowed for assets to be written off over 10 years, will now allow accelerated write-offs; and the processing allowance will be increased to 8% of the processing asset base or 15% of taxable income, whichever is greater, up to a maximum of 65% of net income.

On June 17, 1993, the Government of Newfoundland announced the new Newfoundland Exploration Assistance Program for the junior mining sector. With a 1993 budget of $500 000, the program provides financial assistance to companies with no current income from mining operations. This financial assistance can cover up to 50% of eligible costs incurred for advanced exploration programs on known mineral prospects. To date, nine projects have been funded, chiefly for gold, with one each for antimony, slate and marble.

The current $17.5 million ($12.3 million federal, $5.2 million provincial) Canada-Newfoundland Cooperation Agreement on Mineral Development (1990-94) will cease funding new activities on March 31, 1994; however, a wrap-up fiscal year will see reduced activity as projects are finished.

NEW BRUNSWICK

For 1993 the estimated value of mineral production including coal is $782 million, a decrease of about 14% from 1992. In 1993 there were 16 033 mineral claims and 5695 claim equivalents in good standing in the province. Approximately $16.6 million was spent on exploration in 1993, with the Bathurst mining camp being the focus of much of this activity.

During the year there were production cutbacks at the Brunswick zinc-lead mine of Brunswick Mining and Smelting Corp. (BMSC), in line with similar cutbacks at mines worldwide. These cutbacks reduced the availability of lead concentrates for the Belledune smelter. Consequently, BMSC shut the smelter for six weeks beginning November 22, 1993. Approximately 400 workers were affected by this shut-down. BMSC is planning to cut 112 jobs in a three-part program in 1994, and approximately 60 employees have already accepted an early retirement or severance package. BMSC imposed the cuts to ensure its long-term survival in the face of continued low prices for zinc, lead, copper and fertilizer. The Heath Steele lead-zinc mine operated by BMSC ceased production in July due to the low price of metals.

In October, the operations of the Potash Company of America in the Sussex region were sold to the Potash Corporation of Saskatchewan (PCS). Starting December 22, 1993, 200 non-unionized workers at the Penobsquis mine were laid off for six weeks as a result of a worldwide surplus of potash. Although potash production will be suspended, production of salt will be maintained. PCS has indicated that the mine will resume full production on February 1, 1994. This is the first inventory adjustment shut-down at the mine since it opened 10 years ago.

In late December, Lac Minerals Ltd. and Billiton Metals Canada Ltd. sold the former Mount Pleasant tin mine in Charlotte County to Toronto-based Piskahegen Resources Ltd. The mine could re-open in the next two to three years, depending on the rate of the economic recovery, with the potential for 200 new jobs when the mine reaches full production.

The East-West Caribou lead-zinc mine belonging to Breakwater Resources Ltd., located 50 km west of Bathurst, continues to be kept on care and maintenance until metal prices improve.

NOVA SCOTIA

For 1993, the estimated value of mineral production including coal is $398 million, down approximately 7% from 1992. Of this total, coal accounted for $222 million. Including petroleum and natural gas, the total value of production is estimated at $530 million, up 1.3% from 1992.

In 1993, mineral exploration and development expenditures in Nova Scotia decreased to $1.5 million from $3.1 million in 1992. Approximately 9700 new and re-issued claims were staked in 1993. The amount of exploration drilling decreased in 1993 to approximately 7000 m, compared with 12 450 m in 1992.

Nova Scotia had no producing metal mines in 1993. However, the Gays River lead-zinc mine belonging to Westminer Canada Ltd. and the Tangier gold mine, which has been in receivership for some time, were being examined by interested investors. The province and private sector have been promoting the mineral investment opportunities that these mines represent.

The closing of the Lingan Colliery in November 1992 and production problems at the Phalen Colliery during 1993, both owned by the Cape Breton Development Corporation (CBDC), caused the province's coal sales to drop by almost 20% from 1992 levels. On a more positive note, CBDC began shipping from its new Panamax shiploading installation located at the International Coal Pier in Sydney in October 1993. The new installation, which can handle Panamax-type vessels of 50 000-60 000 t, will enable CBDC to reduce transportation costs for foreign customers.

Minor amendments clarifying the terminology used in the *Mineral Resources Act*, which was proclaimed in March 1991, are expected to be implemented in 1994.

The Nova Scotia Department of Natural Resources embarked on the development of a "Mineral Policy for Nova Scotia" to guide it and the government of Nova Scotia in matters affecting the mineral industry. With the preparation and circulation of a discussion document, the Mines and Minerals Branch will be seeking comments from a variety of stakeholders about mineral policy. The Department would like to have this mineral policy ready in early 1995.

In order to stimulate mineral exploration and development in Nova Scotia, the province started a Prospectors Assistance Program, funded through the Canada-Nova Scotia Cooperation Agreement on Mineral Development, to provide direct financial aid to individual prospectors and exploration geologists. The province has also made limited funding available to assist individual residents in Nova Scotia with out-of-province travel expenses related to the promotion of mineral properties and mineral exploration.

In his acceptance speech, the 1994 President of the Chamber of Mineral Industries of Nova Scotia, John Hopkinson, suggested that industry activity in 1994 need not be as slow as some forecasters anticipate. He noted the mineral industry in the province, because of access to tidal waters, has some of the best transportation costs to market of all producers and, because of the move of investment money this year from interest accounts into mutual funds, a previously unequalled amount of investment capital exists in Canada for good mineral industry investment opportunities.

The Canada-Nova Scotia Cooperation Agreement on Mineral Development (1992-95) is in its second year. It is valued at $10 million ($7 million from Canada and $3 million from Nova Scotia) and emphasizes exploration and mine reclamation. Other programs under the Agreement include mineral resources development, coal bed methane development, mineral investment stimulation, prospectors assistance, communications and planning/evaluation.

QUEBEC

Mineral production from Quebec continued its downward trend in 1993, amounting to about $2.6 billion, a fall of 5.2% from the previous year. The decline was felt in metallic minerals (4%), nonmetallic minerals (8.5%) and construction materials (5%). In the metals sector, gold, silver and copper production decreased, whereas zinc production increased.

According to preliminary data, investment by the mining industry was maintained at the same level as in 1992. Exploration expenditures increased by 23.2% to $125 million. Capital expenditures also grew by more than 30%. However, investment in the development of new deposits fell by nearly 18%, reflecting low metal prices and a decline in exploration compared with that of the preceding years.

In the Chapais-Chibougamau region, MSV Resources Inc. re-opened the Copper Rand and Portage mines in March 1993. Through the Special Program for the Mining Sector of the Chapais-Chibougamau Region, the company was able to carry out a major exploration program. To date, the exploration has doubled the mineable reserves at the two mines, which now approach four years of operation. The company also undertook the construction of a 175-km winter road between Témiscamie and the Eastmain gold deposit to allow transportation of the ore from this mine to the concentrator at the Copper Rand mine. Development work at the Joe Mann mine of Meston Resources Inc. is continuing on the lower levels. Metall Mining Corporation is continuing the feasibility and environmental impact studies for the Troilus project. A decision to start production is expected early in 1994.

In the Joutel–Matagami–Lebel-sur-Quévillon region, the Isle-Dieu and Norita-East mines of Noranda Minerals Inc. have reserves for four more years of operation. However, Noranda is strongly emphasizing exploration on the Bell Allard-Sud and Orchan zinc-copper-silver deposits. At Joutel, the planned halt of operations at the Joutel Division of Agnico-Eagle Mines Limited and the closure, by Billiton Metals Canada Inc., of the underground mine (Zone B) of Les Mines Selbaie took place. An exploration program commenced at the Joutel Division in an effort to discover new reserves which would allow the resumption of production. Agnico-Eagle also has high hopes for the Vezza deposit near Matagami, where the company has outlined, by underground exploration, geological reserves of 2.5 Mt grading 5.0 g/t gold. Development work is also continuing on the Grevet zinc-copper-silver deposit (Cambior inc./Serem Québec Inc.) near Lebel-sur-Quévillon.

Various companies continued exploration on their 1992 discoveries in the Joutel–Matagami–Lebel-sur-Quévillon region. These discoveries are the Verneuil gold-bearing zone of Freewest Resources Inc. located in Verneuil Township, and the Douay 53 gold-bearing zone held by Société d'exploration minière Vior Inc. in Douay Township.

In the southern part of the Abitibi region, Agnico-Eagle will sink a second production shaft in its LaRonde Division near Cadillac. In 1993, production began at the Granada mine (KWG Resources

Inc./SEG Exploration Inc.) near Rouyn-Noranda, and operations resumed at the Sleeping Giant mine (Cambior inc./Aurizon Mines Ltd.) 80 km north of Amos. Aur Resources Inc. continued development at its Louvicourt Project and production start-up is scheduled for mid-1994. Audrey Resources Inc. is continuing exploration work on the 1100 lens of the Mobrun deposit. Other projects should be coming into production soon, including the Beaufort property (Aurizon Mines Ltd./St-Geneviève Ressources Ltd.), the Donalda property (Thunderwood Resources Inc./Metall Mining Corporation), and the Astoria property (Deak Resources Corporation/Yorbeau Resources Inc.).

On the North Shore, iron ore production was halted for a few weeks during the summer. In addition, several hundred jobs were lost in 1993 in this industry because of prices that were even lower than in 1992. On the other hand, there was increased exploration in the Labrador Trough in 1993.

In the Ottawa Valley, the diamond rush prompted the staking of more than 7000 mineral claims. About 160 micro-diamonds were discovered in alluvial samples in the Fort-Coulonge region. A micro-diamond was also found in the Lebel-sur-Quévillon region.

In 1994, it is expected that exploration expenditures will increase slightly. The continuation of exploration on the Grevet deposit and on the 1100 lens of the Mobrun deposit, and possible development of the Troilus deposit, should have a positive effect on exploration in 1994. There will be a slight reduction in the amount of gold produced in 1994. Mine closures in 1993 and further possible closures in 1994 should be offset to some extent by production start-ups in 1993. The start of mining of the Louvicourt deposit will contribute significantly to an increase in zinc and copper production in Quebec.

Total forecast expenditures for 1993/94 under the Canada-Quebec Subsidiary Agreement on Mineral Development were $12.25 million. Expenditures under the Financial Assistance Program for Prospecting in Eastern Quebec totalled $1.2 million, while, under the Special Program for the Mining Sector of the Chapais-Chibougamau Region, expenditures amounted to $6.2 million.

ONTARIO

For 1993, the estimated value of Ontario's non-fuel mineral production is $4.39 billion, down 7% from 1992. Metals contributed $3.12 billion, down 15% from 1992; nonmetals contributed $261 million, up 12% from 1992; and structural materials contributed $944 million, up 4% from 1992. The drop in the value of production can be attributed to low metal prices, as production levels were similar to 1992. Although gold production decreased this year, it could increase in 1994/95 if the potential new mines open. On the other hand, Inco Ltd. plans to reduce production in 1994, involving an eight-week shut-down at its Ontario Division, which will have an impact on Ontario's nickel and copper production.

In 1993, there were continued layoffs at mines across the province. Inco Ltd. suspended production at its Levack mine, which is not economic at the prevailing nickel price, and Deak Resources Corp. temporarily closed the Kerr and Cheminis mines, although both mines re-opened late in the year. Production at the Macassa mine of Lac Minerals Ltd. was suspended in November to allow the recovery of two miners killed by a rockburst.

Total exploration expenditures for 1993 are estimated at $79.2 million, approximately $2 million more than in 1992. Using assessment work as an indicator, exploration increased by 7.5% over 1992, with marked increases in the Sudbury, Porcupine and Sault Ste. Marie districts and substantial declines in southern Ontario and the Patricia district. Diamond exploration continued to be important, particularly in the Kirkland Lake area. The discovery of two alluvial diamonds in the Wawa area created a lot of interest and may signal another target area.

During the year Inco sold its 62% interest in TVX Gold Inc., which operates mines in Quebec and Chile, to a group of Canadian underwriters. Falconbridge sold its 56.6% interest in Falconbridge Gold Corp., which operates the Hoyle Pond gold mine near Timmins, to Kinross Gold Corp. for $22 million. Placer Dome Inc. sold its Dona Lake mine property near Pickle Lake to Ross-Finlay of Val-d'Or for $2 million. The mine has reserves for six to twelve months' production, and exploration is continuing. Placer Dome retains responsibility for reclamation of the tailings.

Inco started production from its Lower Coleman mine in early 1993, and announced that it would be spending $40 million to re-open its Garson mine, which is one of its higher-grade orebodies in Sudbury and which should be in full production by 1995. Falconbridge started production at its Craig mine, which is scheduled to supply over 50% of the company's nickel production in Sudbury. North American Palladium Ltd. started production from its Lac-des-Îles mine (platinum group metals) in northwestern Ontario. This mine has a planned production rate of 2700 t/d, and shipped its first commercial concentrate to Falconbridge in Sudbury in November. Jarvis Resources Ltd. started production of marble tiles and slabs from its plant near Sudbury.

Noteworthy among advanced exploration projects and expansion projects are the following: Placer Dome Canada Ltd. is studying a $40 million expansion of its Campbell mine to access ore below the existing workings; it is also conducting a feasibility study on a "super pit" at its Dome mine, is developing its Paymaster property for production in 1994, and is continuing to explore its Musselwhite gold property with partner TVX Gold, which will see major exploration in 1994. American Barrick Resources Corp. started deepening the shaft at its Holt-McDermott mine to access reserves at depth, extending the mine's life by two to three years; Hemlo Gold Mines Ltd. carried out an underground exploration program on its Holloway gold property as part of a feasibility study, which should be completed in early 1994; Inco is proceeding with development of its McCreedy East mine, and a five-year underground program to explore its Victor property, which has resources of 20-40 Mt at depths exceeding 5000 feet; and Falconbridge announced a significant extension to its Kidd Creek orebody, estimated at 10 Mt, and spectacular grades at its Nickel Rim property, which is near the Victor property of Inco.

The Government of Ontario continues to encourage mineral exploration through the Ontario Prospectors Assistance Program and the Ontario Mineral Incentive Program. With a combined budget of nearly $5 million, both programs were fully subscribed in 1993. Financial assistance for advanced exploration is newly available through the Resource Diversification and Development Program of the Northern Ontario Heritage Fund Corporation (NOHFC). The NOHFC assistance is in the form of non-repayable contributions equal to 30% of approved costs up to a maximum of $300 000. Assistance for mining access roads is available through the Northern Ontario Resources Transportation Program.

The Government of Ontario served two orders on Denison Mines Ltd. to clean up the sites of its former uranium mining operations at Elliot Lake. Under the *Environmental Protection Act*, the company was ordered to decommission its properties according to the results of a federal review of the company's plans. In addition, Denison has been ordered to post a $100 million bond.

"Save our North," a Northern Ontario-based lobby group, continued to pressure both levels of government to support and promote mining. The group has approached the federal government with its proposal for an "Orebodies as Infrastructure Program." This incentive program is being supported by national mining groups as part of the "Keep Mining in Canada" campaign.

Activities under the Canada-Ontario Northern Ontario (NODA) Minerals Program continue apace. In 1993, there were 61 active projects covering all facets of the program. This year saw the start of many projects under the Mining and Minerals Technology, and the Information Transfer and Technology components. In addition to the technical projects, considerable effort has been placed on public education and communications, and liaison with First Nations across Northern Ontario.

MANITOBA

For 1993, the estimated value of mineral production including fuels is $912 million, a decrease of 15.7% from 1992. This decrease mainly reflects declining base-metal prices. Production of copper, lead and zinc actually increased while nickel production declined slightly; a decline in the production of platinum group minerals was offset by higher gold and silver production. The value of industrial minerals production rose by 3.4%, whereas petroleum and natural gas value fell by 8.3%. Mine employment decreased by 4.6% to approximately 4300. One new gold mine opened (see below); there were no mine closures.

Exploration in 1993 continued to focus on base metals and, to a lesser extent, on precious metals; however, new commodities, mainly diamonds, are increasing in importance. Mineral exploration expenditures are projected at $32 million, the same as in 1992. However, the amount of land covered by mineral dispositions was up dramatically; by the end of November three million hectares were acquired, an increase of 16% over 1992, largely attributable to the growing interest in diamonds. Staking and exploration for diamonds occurred in the Flin Flon-Snow Lake belt, in the Nelson House area, in the Wakuska and Wimapedi areas, and in southern Manitoba. Exploration in Manitoba was stimulated by the province's "Mining Tax Exploration Incentive." During 1993, 16 companies had 21 projects, with a total value of $6.5 million, approved under this program; $222 000 in incentives on $1.14 million in exploration expenditures was paid out.

Mineral production, exploration activity and employment are projected for the next few years to remain at near present levels with the value of production to rise slightly as metal prices slowly rise from historic low levels.

The Government of Manitoba signalled its commitment to the minerals industry when it withdrew the southern portion of the Thompson Nickel Belt, including the Little Limestone Lake area, from consideration as a site for a national park. Under the Mineral and Energy Resource Assessment program of Natural Resources Canada and Parks Canada, a study by the Geological Survey of Canada (GSC) showed the area to have very high mineral potential. Falconbridge Ltd. is exploring a significant nickel discovery at William Lake in this area.

Hudson Bay Mining and Smelting Co., Ltd. (HBMS) completed construction and installation of the new two-stage zinc pressure leach plant at Flin Flon. This plant, the first of its kind in the world, uses two stages of pressure leaching for all of its zinc production. The new plant, in operation since August 1993, has operated above design levels extracting 98%-99% of the zinc in concentrate and has reduced sulphur dioxide emissions by 25% and particulate emissions by 50%. Work on the new copper smelter, which was also part of the modernization process, has been indefinitely postponed.

At Thompson, Inco Ltd. continued underground development of the I-D nickel orebody from which production is planned in 1994, with full production of 17 000 t/y planned for 1997; production on the I-C orebody increased to 1400 t/d. For 1994, Inco announced a four-week shut-down and a reduced work week at its Manitoba Division as part of its planned production cutback.

Granduc Mining Corp. (formed by an amalgamation of Granduc Mines Ltd. and Cazador Explorations Ltd.) opened the Burnt Timber gold mine at Lynn Lake. The first gold bar was poured on October 1 and the milling rate had reached 1000 t/d by December. Two other potential gold mines were nearing the final decision stage: the Puffy Lake property of Pioneer Metals Corp., northeast of Flin Flon, and the former San Antonio mine property belonging to Rea Gold Corp., at Bissett.

Continuing the cooperative government geoscientific activities established in previous years, 1993 marked the fourth year of the Canada-Manitoba Partnership Agreement on Mineral Development (1990-95). Federal-provincial geoscience programs in the Snow Lake-Lynn Lake area, aimed at assisting industry locate prospective zones and deposits to replace rapidly dwindling base- and precious-metal ore reserves, continued to receive very positive responses from both the mining industry and northern communities.

SASKATCHEWAN

For 1993, the estimated value of mineral production including oil and gas is $3.17 billion, up slightly from 1992. The 1993 values of the province's five major minerals are: crude petroleum, $1.50 billion; potash, $744 million; uranium, $310 million; natural gas, $339 million; and coal, $104 million. Excluding oil and gas, the province's mineral production of metals and nonmetals is estimated at $1.36 billion.

Other minerals produced in the province during 1993 included gold, sodium sulphate, potassium sulphate, salt, sand and gravel, clay products and bentonite. Base metals were not produced in Saskatchewan during the year due to the shift in mining away from the Callinan North Zone in the operations of Hudson Bay Mining and Smelting Co., Ltd. (HBMS) and Consolidated Callinan Flin Flon Mines Ltd. at Flin Flon. Mine employment (excluding oil and gas) during the period is estimated to have decreased by 2% to 4946.

Mineral exploration and development, with the exception of diamond exploration, were restricted mainly to the northern part of the province. In 1993, projected exploration expenditures are $22 million, identical to those in 1992. Exploration was mainly focused on uranium (45%), diamonds (27%), gold (14%), and base metals (14%). Estimated gold and uranium mine development expenditures were $81 million, an increase of 42% over 1992.

Total lands covered by mineral dispositions increased by 49% to a total of 4.1 million ha during 1993, while staking in off-shield areas (mainly for diamond exploration) increased by 45% to a total of 1.4 million ha.

Over the next few years, employment and mineral production are projected to rise with the coming on line of the three new uranium mines; exploration should continue at present levels with the emphasis being placed on diamond exploration, and the value of mineral production should remain at near present levels.

Saskatchewan's potash production in 1993 was estimated at 5.41 Mt; sales of potash for the same period were 5.64 Mt, representing a slight draw-down of inventory. The provincial potash industry continues to suffer from over-capacity and high inventories; the industry operated at approximately 55% of capacity in 1993. Producers hope to increase exports in 1994, largely due to the industry's market development efforts supported by the federal Department of Western Economic Diversification.

HBMS completed construction of the new zinc pressure leach plant at Flin Flon, Manitoba; since start-up in August, it has operated at above design levels and has reduced plant sulphur dioxide emissions by 25% and particulate emissions by 50%.

Saskatchewan again remained the focus of uranium production and exploration in Canada, and Cameco Corp. remains the key player with 47% of currently identified reserves. Ten companies are presently involved in uranium mining and exploration joint ventures; however, funding for major exploration efforts was difficult during the year as a result of the low price of uranium and the excellent established reserves of high-grade ore. During 1993 three uranium mines operated: the Collins Bay B zone and Deilmann belonging to Cameco and Uranerz Exploration and Mining Ltd., and the Cluff Lake mines belonging to Cogema Resources Inc. and Corona Grande Exploration Corp. During 1993 there was no open-pit mining at Cluff Lake; production came from the Dominique-Peter underground mine and stockpiled ore. Ore from the Cameco/Uranerz-owned Eagle Point deposit underwent stoping and mill testing at the Rabbit Lake mill.

Late in the year, the industry was encouraged when the federal and provincial governments approved the Dominique-Janine mine extension at Cluff Lake, mine development of the McClean Lake deposit belonging to Total Minatco Ltd., and full production at the Eagle Point deposit. However, the governments did not approve development of the Collins Bay A and D zones belonging to Cameco/Uranerz, and the Midwest Lake property of the Midwest joint venture.

Precious metal production came from the La Ronge belt where Claude Resources Inc. continued to operate the Seabee mine. Cameco and Uranerz began underground test mining of the Contact Lake gold deposit, and Golden Rule Resources Ltd. started mining a 10 000-t bulk sample from the Komis gold deposit belonging to Waddy Lake Resources Inc.

Diamond exploration continued to centre on the Fort à la Corne kimberlite field where exploration of over 70 individual targets has, to date, led to drill sampling of 25 kimberlites. Drilling geophysical anomalies within the Molanosa Arch has detected kimberlites, and kimberlite indicator minerals have been extensively sampled in the south-central and southwestern portions of the province. Diamond recovery has only been possible from drill core, resulting in unreliable grade determinations; however, the evidence of significant un-eroded kimberlitic crater facies present in the Molanosa and Fort à la Corne areas suggests the potential for large tonnage deposits. Companies actively exploring for diamonds include Cameco, Uranerz, Monopros Ltd., Rio Algom Exploration Inc., Rhonda Mining Corp. and Aaron Oil Corp.

The fourth year of the five-year Canada-Saskatchewan Partnership Agreement on Mineral Development proceeded smoothly, with a variety of active projects under Geoscience, Technology, Economic Development and Communication Program and Investigations.

ALBERTA

For 1993, the estimated value of mineral production including coal, oil and gas is $18.6 billion, an increase of 10.4% from 1992. Fossil fuels accounted for approximately 96% of the total value of production. The most important minerals in order of production remained crude petroleum, natural gas, natural gas by-products, coal and sulphur.

The value of non-fuel mineral production, including coal and sulphur, was approximately $882 million, down 10% from 1992 and down 33.8% from 1991. At present, metallic and industrial minerals account for less than 3% of total mineral production, in spite of the substantial geological potential in Alberta. Approximately 7700 people were employed in the Alberta mining and quarrying sector during 1993.

Alberta is the major source of sulphur production and accounts for approximately 81% of Canada's production. For 1993, the value of sulphur production in Alberta is estimated at $113 million, a decrease of only 1.9% from the previous year, but a decrease of 64% from 1990, reflecting a continuing drop in world sulphur market prices. Sulphur is recovered as a by-product from three different sources: natural gas processing plants (88%), oil sands plants (9%), and oil refineries (3%). Furthermore, sulphur is also the major industrial mineral in Alberta, accounting for about 32.5% of Alberta's total industrial mineral production value for 1992.

Mineral exploration during the year continued to be focused on diamonds. Of Alberta's total land area of 660 000 km^2, of which only 520 000 km^2 are available for exploration, 102 600 km^2 were covered by new metallic and industrial mineral permits in 1993, bringing total permit coverage to 322 600 km^2. Provincial estimates are that 85%-90% of exploration activity is diamond-related. Companies involved in diamond exploration include Prime Equities International Corp., Golden Ring Resources Ltd., and Dia Met Minerals Ltd. in partnership with Cameco Corp. and Uranerz Exploration and Mining Ltd.

The total area now covered by permits represents 62% of the area available for exploration and development and occupies much of the Peace River area of northwestern Alberta, a belt stretching southeastward along the Foothills and the Sweet Grass Hills in the southeastern corner of the province. Several small gem-quality diamonds were recovered in this latter area in 1992; however, information on the exact location of this discovery is lacking.

Mineral production and value are projected to increase slightly over present levels in the next few year due to increased coal sales; however, the depressed sulphur market is expected to continue to lower mineral production and value below historic levels. Exploration expenditures, mainly for diamonds, are expected to continue to grow slowly.

The Metallic and Industrial Minerals Regulations were promulgated in early 1993. They regulate the exploration, development and operation of the non-hydrocarbon minerals within the province and were developed with input from industry. Reaction from industry to these new regulations, which are seen as creating a simple mineral tenure system, has been very positive.

The second year of the five-year Canada-Alberta Agreement on Mineral Development proceeded smoothly, with a variety of active projects under Geoscience, Technology, Economic Development and Communication Program and Investigations.

BRITISH COLUMBIA

For 1993, the estimated value of British Columbia's mineral production including coal is \$2.41 billion, a decrease of 6% from 1992. Including petroleum and natural gas, the estimated value of production in British Columbia is \$3.53 billion, virtually the same as for 1992. The small decline in forecast production value masks a more serious reality that the value of metals declined by 21.5% (from \$1.50 billion to \$1.18 billion), whereas coal increased by 20% and industrial minerals by 4.9%. Coal production increased because three mines were re-opened. Coal production should rise in 1994 as Canada's coal exports are expected to continue rising. Employment for 1993 declined by 5.5% from 14 187 to 13 400.

The British Columbia and Yukon Chamber of Mines (BCYCM) estimated exploration expenditures for 1993 at \$45 million, a decrease of 18% from 1992 and a decrease of 48% from the \$87 million spent in 1991. The BCYCM figure for 1993 also includes an estimated \$8.5 million in property development costs by Lac Minerals Ltd. on its Red Mountain deposit.

Mineral production levels, production value, employment, and mineral exploration expenditures are expected to continue the negative trend established over the last few years. Increased base-metal prices and a significant change in the regulatory and taxation environment could reverse this trend; however, this is considered unlikely within such a short time frame.

The industry has continued to express concerns about the province's declining mineral reserves and a perceived lack of support from the provincial government. The findings of Price Waterhouse's 1992 financial report on the B.C. mining industry and the Coal Association of Canada's 1993 tax study of the Canadian coal industry supported these concerns. The industry also expressed concern about Bill 65, *The Employment Standards Act*; Bill 32, *The Environmental Assessment Act*; and Bill 26, *The Waste Management Amendment Act*.

Industry confidence in the government's desire for a healthy minerals industry was further shaken in June 1993 when the Premier announced that the Alsek-Tatshenshini watershed area, which included the very large Windy Craggy deposit of Geddes Resources Ltd., would become a Class A provincial park and the government would apply to designate the area as a World Heritage Park. This announcement also effectively stopped discussion on the recommendations of the Commission on Resources and Environment (CORE) on the Alsek-Tatshenshini watershed.

In March 1993, in an attempt to address industry concerns, the Minister of the British Columbia Ministry of Energy, Mines and Petroleum Resources (BCMEMPR) released a discussion paper, *A Mineral Strategy for British Columbia*, which began by stating: "At current exploration levels, mining could virtually disappear in this

Province early in the 21st century . . ." The Premier established the Premier's Forum on Mining, consisting of representatives of labour, government and industry; the policy group in BCMEMPR was reorganized; regionally based management and land use positions were established; the BCMEMPR and the B.C. Trade Development Corp. developed a new initiative to stimulate and accelerate the production of industrial minerals and to assist marketing these products in the Pacific Rim; and BCMEMPR and B.C. Lands signed an internal administrative agreement to establish a system to grant land tenure and quarrying rights for industrial minerals, removing a significant hurdle for the development of these minerals.

International Skyline Gold Corp. re-opened its Johnny Mountain mine and mill from August to November and is expected to re-open it again in 1994; Wheaton River Minerals Ltd. purchased a controlling interest in the Golden Bear mine, resumed underground mining and started a $3.5 million exploration program on the property; Candorado Operating Company Ltd. began a two-year program of heap-leaching tailings from the old Mascot Gold mine at Hedley; and Davy International was awarded the contract to develop the Eskay Creek gold-silver mine project.

Teck Corporation began production at its Elkview coal mine (formerly the Balmer mine of Westar Mining Ltd.); Global-Tex Industries Inc. completed designs for the Willow Creek open-pit coal mine at Chetwynd and received permission to extract a 10 000-t bulk sample; the Quinsam mine of Hillsborough Resources Ltd. was expected to produce 750 000 t of coal; and the Greenhills coal mine of Westar Mining was bought by Fording Coal Ltd. and operated at reduced levels in 1993.

The Lussier 4J gypsum mine of Domtar near Canal Flats was given certification by the province, as was the Mount Milligan copper-gold project of Placer Dome Canada Ltd.; Taseko Mines Ltd. announced that it is proceeding with a pre-feasibility study for its Fish Lake copper-gold deposit at Williams Lake, the largest bulk tonnage gold deposit in British Columbia with the potential to be one of North America's lowest-cost gold producers; and Lac Minerals Ltd. is spending $8.5 million on access to, and underground development of, its Red Mountain gold deposit.

The United Steelworkers at the Trail smelter of Cominco Ltd. ratified a new contract which included a business plan by Cominco. This plan, recommended by a provincial job protection commissioner and involving unions and suppliers, is intended to ensure the survival of the Trail operation. A strike by BC Rail employees severely disrupted the coal industry. By mid-August the Ridley Island coal terminal had run out of coal and coal stockpile capacity had been reached at the Quintette mine, resulting in the two-day suspension of production. There was an extended lock-out of workers at the H-W mine and layoffs at the Lynx mine of Westmin Resources Ltd. In October, limited mining operations by non-unionized staff began.

A major negative story was the failure and abandonment of the Trail QSL lead smelter belonging to Cominco. The federal and provincial governments had also invested $150 million in the QSL process. The QSL process could not handle the heavy load of zinc residues forming a substantial part of the smelter feed. The Russian Kivcet process, which has been successfully demonstrated at a commercial scale, is now being investigated.

Placer Dome shut down the roaster at the Endako molybdenum mine in September for repairs, which resulted in a two-week shut-down of both mining and milling operations. The Bank of Nova Scotia appointed Coopers and Lybrand as receiver for the Stronsay property of Curragh Inc. The Similco mine of Princeton Mining Corp. and the Gibraltar mine of Gibraltar Mines Ltd. closed due to low copper prices. The Dome Mountain mine (Habsburg Resources Inc./Timmins Nickel Inc.) shut down, failing to meet a series of BCMEMPR work orders; after complying with the orders, the mine re-opened briefly, only to shut again due to disputes between the joint venture partners. The Sylvana mine of Treminco Resources Ltd. was shut down due to low lead, zinc and silver prices. North American Metals Corp. could not justify the expenditure to expand the Golden Bear open-pit mine and, when stockpiled ore is depleted, will place it on care and maintenance while attempting to find a buyer.

YUKON TERRITORY

For 1993, the estimated value of mineral production including natural gas is $135.8 million, down 73% from 1992. This decrease reflects a dramatic reduction in lead and zinc production due to the closure of the mines belonging to Curragh Resources Inc. Although gold production was down by 9%, its value increased slightly due to increased gold prices.

Yukon now has no operating hard rock mines. Early in 1993, Curragh Resources Inc., which operated lead-zinc-silver mines at Faro and Watson

Lake, went into receivership after encountering financial difficulties as a result of falling zinc prices and rising inventory levels. Cominco Ltd. and Teck Corp. have joined up with Korea Zinc and Samsung Corp. to purchase some of Curragh's former assets, including the Sa Dena Hes zinc-lead mine property near Watson Lake. However, resumption of production at the Sa Dena Hes mine will depend on higher metal prices.

Spending on exploration in 1993 increased to $20 million. Much of this was spent on the Casino copper-gold-molybdenum property of Pacific Sentinel Gold Corp., 300 km northwest of Whitehorse. Here, a large drilling program has outlined preliminary reserves of 27 Mt of low-grade copper-molybdenite and gold in a leached cap zone, with an additional 99 Mt of similar mineralization beneath the leached cap. Other advanced projects currently being evaluated in the Yukon are the Williams Creek copper property of Western Copper Holdings Ltd., and the Brewery Creek gold property of Loki Gold Corp. However, all these properties are dependent on favourable feasibility studies, and 1995 would be the earliest that any development could begin. Consequently, the low level of mineral production in the Yukon could last several more years.

Negotiations continued on the Council for Yukon Indians (CYI) land claim, involving agreements and implementation plans with four native bands within the CYI. Hopefully, these agreements will pave the way for settlements with the other bands in the CYI in 1994.

During the CYI land claims negotiations, the Nacho Nyak Dun requested that the Bonnet Plume River be named a Heritage River. A nomination to designate this river as a Canadian Heritage River was completed early in 1993. Subsequently, the Yukon government and the federal Department of Indian Affairs and Northern Development signed an agreement to nominate the entire Bonnet Plume drainage basin as a Heritage River.

The Bonnet Plume drainage basin has significant mineral potential for coal, base metals, precious metals, and uranium. However, during the nomination process, there was no consultation with the minerals industry. The management regime, which is currently under development and which will be imposed on the area, may have a serious impact on any future mineral development. Any management plan for a Heritage River would likely make it difficult to develop and operate a mine.

In 1993, work began on the creation of the Vuntut National Park (Old Crow Flats), as the next phase of Ivvavik National Park, which is also tied in to the CYI land claim. Work has continued on the modernization of the *Yukon Quartz Mining Act* and the *Yukon Placer Mining Act*. Revisions to these acts will address environmental concerns during exploration, development, closure and abandonment of Yukon's hardrock and placer mines. In association with, and required by, the CYI land claim, work is continuing on the *Surface Rights Act*, which is expected to be proclaimed in 1994. Under this act, which will implement provisions of the CYI land claim agreement, a Surface Rights Board will be established to mediate disputes over access to the sub-surface in areas where the surface rights are privately owned.

The $9 million Canada-Yukon Mineral Resources Cooperation Agreement, signed in May 1991, is well under way with the completion of the second full year of field programs. Ten projects were conducted under the Geoscience Program, and five projects were carried out under the Technology Program. In addition, several information projects were carried out, including assistance to produce displays and exhibits for museums and schools.

NORTHWEST TERRITORIES

For 1993, the estimated value of mineral production including oil and gas is $607 million, down 11% from 1992. The estimated value of metals production is $389 million, down 17% from 1992. Gold production dropped slightly, but its value increased by 7%; however, production of lead and zinc dropped 26% and 15% respectively, with their combined value dropping 32%. Five gold mines and two lead-zinc mines were in operation in 1993. One of the gold mines, the Mon mine near Yellowknife, is a seasonal operation that operated for approximately four months in 1993.

The Northwest Territories saw an increase in exploration during 1993. Staking during the year covered over 11 million ha, with a record 148 prospecting permits issued in February 1993. High levels of exploration in the Northwest Territories should continue, as indicated by the issue of a record 309 permits in February 1994. Exploration drilling exceeded 250 000 m, the highest amount since 1979, with most drilling concentrated on gold and base-metal targets in the Slave Province.

Diamonds continued to occupy the spotlight in Northwest Territories exploration. Approximately

19 million ha have been staked since 1991, following the discovery of diamonds in the Lac de Gras area. The most advanced project remains the Lac de Gras property of Dia Met Minerals Ltd. and BHP Minerals Canada Ltd., where the partners have discovered 26 diamondiferous kimberlites on the property. Bulk sampling continued, with plans to extract bigger samples by large-diameter drilling and from underground. During 1993, valuations made on samples from three pipes gave mean values of US$112, US$81 and US$81 per carat, respectively. Kennecott Canada Inc., which holds a 65% interest in the DHK properties in the Lac des Gras area, is also bulk-testing its main target, the Tli Kwi Cho pipes. A $10 million underground program, now under way, is intended to provide information on the grade and the quality of diamonds within the pipes.

San Andreas Resources Corp. made significant additions to the drill indicated reserves at its Prairie Creek silver-lead-zinc deposit in the Backbone Ranges of the Mackenzie Mountains. The Athabaska Gold Resources Ltd./Consolidated Ramrod Gold Corp./ Gitennes Exploration Inc. joint venture continued exploration at its Damoti Lake property some 150 km north of Yellowknife. Here, drilling of a gold-mineralized iron formation, discovered earlier in the year, produced an intersection of 9.5 m with 11.5 g/t of gold.

Continuing work on the Coronation Gulf transportation route constituted another bright spot for the minerals industry in the Northwest Territories. This corridor is designed to support mineral development by increasing access to the central Northwest Territories. This region has several deposits, such as the Izok Lake zinc-copper-lead deposit, that could benefit directly from the proposed transportation route. A hydrographic survey in the Coronation Gulf was completed during the year; however, the survey is not sufficient to answer all the questions about ship access, and additional funding will be required to expand the survey.

Miramar Mining Corp. acquired the Con gold mine in Yellowknife from Nerco Minerals Co. The mine will operate under the new name of Miramar Con Mine Ltd. The lengthy and sometimes violent labour dispute that, since May 1992, affected the Giant gold mine belonging to Royal Oak Mines Inc. in Yellowknife, came to an end in November, with a back-to-work protocol enforced by the Canada Labour Relations Board. Royal Oak Mines also announced plans to spend $6.6 million to re-open the Colomac gold mine located 230 km north of Yellowknife. Pre-stripping of the open pit is scheduled to begin in April 1994, with the first gold to be poured in June 1994. Through its takeover of Minnova Inc., Metall Mining Corp. acquired the Izok Lake deposit, located 80 km west of the Lupin gold mine, and continued exploration and in-fill drilling during the year.

The Nunavut Final Land Claim Agreement was signed in May 1993 in Iqaluit. The Agreement received Royal Assent in June and the *Nunavut Final Land Claim Agreement Act* came into force in July. The federal government is committed to introduce legislation, by 1999, creating the Territory of Nunavut and a new territorial government. The Sahtu Dene and Metis Comprehensive Land Claim Agreement was signed in September 1993 in Fort Norman. This Agreement gives the Sahtu Dene and Metis ownership of about 41 000 km^2 of land in the western Arctic, as well as a share of resource royalties from the south Mackenzie Valley, including those from Norman Wells' oil and gas. In the North Slave region, the federal government tabled a draft Comprehensive Land Claim Agreement with the Dogrib, and negotiations will start early in 1994. The North Slave region contains numerous third-party interests, including large tracts of ground staked for diamond exploration.

A review of the *Nunavut Surface Rights Bill* and the *Mackenzie Valley Surface Rights Bill* continued and both are expected to be passed in 1994. Under these acts, surface rights boards will be established, having jurisdiction over surface property rights in Nunavut Territory and the western Arctic, respectively.

The $8.2 million Canada-Northwest Territories Economic Development Cooperation Agreement, signed in February 1991, had 17 projects operating under the Geoscience Initiative. Several of the Geoscience projects have already produced important economic impacts: the discovery of a new iron-formation-hosted gold showing at Damoti Lake, which has led to the definition of a significant gold-rich zone by Athabaska Gold Resources Ltd.; the high potential of diabase intrusions in the western Arctic to host Russian Noril'sk-Talnakh-type nickel-copper-platinum group element deposits, which have become important exploration targets; the potential for stratabound copper deposits in Proterozoic sediments of the western Arctic; and a micro-diamond discovery, resulting from work in the Gibson Lake area, Keewatin District, which will likely extend the area of diamond exploration eastward to Hudson's Bay.

Note: Information in this review was current as of February 25, 1994.

Canadian Reserves, Mine Investment, New Projects and Promising Deposits

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RESERVES

In January 1993, Canadian reserves of copper, nickel, lead, zinc, molybdenum, silver and gold in ore were all lower than a year earlier (Table 1).

Canadian reserves are derived from the responses of individual mining companies to the Federal-Provincial Survey of Mines and Concentrators and from information contained in annual and other corporate reports. Reserves reported here include only metal contained in ores that are classified by companies as "proven" or "probable" (or their equivalents) at producing mines and in deposits that are committed to production. Metal contained in mineralized material classified by companies as "possible" is not included in national totals, nor is metal contained in deposits that have not advanced beyond the exploration stage. Where available, only metal in mineable ore reserves is included in the Canadian totals so as to exclude losses inherent in the mining process.

Reserves at most mines change slightly from year to year. It is a relatively small number of mines with large changes that usually affects the overall direction of national trends.[1]

Reserves by Commodity

Gold

In January 1993, there were more than 1300 t of gold contained in Canadian mine reserves. Compared with revised totals for January 1992, this represents a decrease of about 70 t, or some 5%.

Canadian mine reserves of gold have now decreased for the fourth consecutive year. Overall, mine-site exploration and additions to reserves resulting from new mines committed to production did not replace all of the gold produced during 1992. In contrast, during the 1980s, when substantial amounts were being spent for gold exploration, Canadian gold reserves showed strong and sustained growth.

The gold reserves of four new mines for which production decisions were made during 1992 were included for the first time in Canadian totals (Table 2). These mines are Deak Resources Corporation's Astoria mine and Western Quebec Mines Inc.'s Joubi-Dubuisson Est mine, both in Quebec, and Deak and Northfield Minerals Inc.'s Cheminis mine and Royal Oak Mines Inc.'s Nighthawk Lake (Porcupine Peninsular) mine, both in Ontario.

The largest single gross addition to Canadian reserves (8 t) occurred at Homestake Mining Company's Nickel Plate mine in British Columbia where reserves were more than doubled during 1992. Other notable additions to reserves during 1992 were the result of the first-time inclusion in Canadian totals of the Astoria and Nighthawk Lake mines, a substantial upgrade of possible ore to the probable category at Hemlo Gold Mines Inc.'s and Cambior inc.'s Silidor mine in Quebec and, based on new information, an upward reassessment of reserves at Royal Oak Mines Inc.'s Giant mine in Yellowknife.

A number of operations reported notable reductions in gold reserves from January 1992 to January 1993. Among these were: 1) Hemlo's Golden Giant mine (15 t), and Placer Dome Canada Limited's Campbell mine and Teck Corporation's David Bell mine, all in Ontario, because 1992 production at each of these mines was not replaced with new-found ore, and 2) Lac Minerals Ltd.'s Bousquet No. 2 mine in Quebec and American Barrick Resources Corporation's Holt-McDermott mine in Ontario where, on the basis of new information, reserves were reduced by more than the amount of gold mined.

There are several projects under way in Canada that will soon have a positive impact on Canadian gold reserves. In January 1994, Placer Dome announced that it would expand, at a cost of $150 million, the open pit at its Dome operations in Timmins, Ontario; that pit has estimated reserves of 53 t of gold (1.7 million oz), comparable to the current reserves of the present underground operation, which has been in production since 1910. The company has also discovered new mineralized zones at its Detour Lake mine, also in Ontario, and is proceeding with the construction of a $10 million underground conveyor and crushing system which is expected to lower cash production costs by $10/oz. The company is also considering a $40 million project at its Campbell mine to develop additional ore reserves below the 27th level.

Silver

In early 1993, Canadian reserves of silver stood at over 16 000 t, down by more than 10% from the previous year. In aggregate, more silver was either mined or is no longer counted in company reserves than was found in operating mines or was added as a result of production decisions made during 1992.

Zinc

All of the large Canadian zinc producers – Brunswick Mining and Smelting Corporation Limited's No. 12 mine in New Brunswick, Curragh Inc.'s Faro and Sa Dena Hess[2] (Mount Hundere) operations in the Yukon, Falconbridge Limited's Kidd Creek mine in Ontario, and Cominco Limited's Polaris mine in the Northwest Territories and Sullivan mine in British Columbia – reported decreases in reserves during 1992. Some mineralized material previously classified as reserves appears to have been written off at most mines. Overall, Canadian reserves of zinc decreased to slightly more than 15 000 000 t in January 1993, down by 1 380 000 t, or about 8% less than in the previous year.

There were few noteworthy gross additions to Canadian reserves of zinc during 1992. The largest occurred at Westmin Resources Limited's Myra Falls operations in British Columbia as a result of the inclusion in mine reserves of ore from the high-grade Battle and Gap zones which were discovered in 1991 and are being developed for production.

There are a number of significant developments in zinc that should help to ameliorate Canada's reserves position. Deep underground exploration conducted by Falconbridge Limited is reported to have discovered an extension to the Kidd Creek orebody in Timmins, Ontario, that is equivalent to an additional three to four years of output at current production rates. At Brunswick No. 12, at Bathurst, preliminary trials were held to provide the information needed to design a system for the recovery of sill pillars; this will likely result in additions to mineable ore.

Lead

Canadian reserves of lead fell to 4 300 000 t in January 1993, down by about 600 000 t, or 12%, compared with revised totals for 1992.

Most of the lead contained in Canadian reserves occurs in conjunction with zinc; as a result, the trend in lead reserves tends to parallel that of zinc. Only a few mines replaced the lead-bearing ore which they produced during 1992; most appeared to write off some of the lead mineralization which they previously counted as reserves.

Copper

In January 1993, Canadian reserves of copper were estimated at about 10 800 000 t, down by 3% from a revised figure of 11 100 000 t a year earlier. With the exception of Inco, most producers appear to have reduced their reserves by an amount greater than their 1992 production.

During 1992, Inco Limited added 6.2 Mt of proven and probable ore from the McCreedy East deposit to its Ontario reserves. This ore grades a remarkable 9.9% copper (over 600 000 t of contained copper metal), 0.9% nickel and 13 g/t precious metals. More reserves are likely to come from McCreedy East, which is not yet fully developed.

Molybdenum

Canadian reserves of molybdenum stood at over 160 000 t in early 1993, or about 10% less than in early 1992. Four Canadian mines, all located in British Columbia, mined ore containing molybdenum during 1992. At two of these operations, new reserves were added to replace a portion of the ore mined during 1992; at the other two, reserves were down by more than the amount mined.

Nickel

In January 1993, there were some 5 600 000 t of nickel contained in Canadian mine reserves, down by about 1.5% from the level of 1992.

Falconbridge Limited's Thayer Lindsley deposit in the Sudbury district of Ontario was committed to production in early 1992 and contributed more than 45 000 t of nickel to Canadian totals, one of the few apparent gross additions to Canadian mine reserves of nickel during that year.

At the beginning of 1993, Inco Limited had some 5 075 000 t of nickel reserves, more than 90% of the Canadian total. Inco appears to have replaced about one fifth of the nickel that it mined during 1992. Inco's aggregate reserves in the Sudbury area of Ontario and at Thompson, Manitoba, decreased by about 150 000 t during that year, but considerable potential remains for additions to reserves.

Significant developments have occurred that will eventually have a positive impact on the levels of Canadian reserves of nickel. Inco is planning a $60 million exploration program for its Victor deposit in the Sudbury district where there appears to be some 36 Mt of high-grade nickel, copper and platinum group mineralization. In December 1993, Falconbridge intersected, at its Nickel Rim property, an exceptionally high-grade horizon which contains copper, nickel, platinum and palladium; this horizon may be the down-dip extension of the Victor deposit.

Canadian Reserves by Province and Territory

At the beginning of 1993, three provinces held dominant positions in terms of Canada's proven and probable reserves of major metals (Table 3). New Brunswick had 52% of the lead, 38% of the zinc and 40% of the silver; Ontario had 74% of the nickel, 55% of the gold and 46% of the copper; and British Columbia had all of the molybdenum and 34% of the copper.

Compared to revised figures for the previous year, copper reserves increased by about 5% in Ontario and, as a result, Ontario's share of total Canadian copper reserves increased slightly. Zinc reserves increased by about 6% in Manitoba, in part because Hudson Bay Mining and Smelting Co., Limited and its partners found several new ore zones at the Trout Lake mine and, as a result, more than replaced 1992 production. Consideration is being given to deepening the Trout Lake mine. Reserves of the metals considered here fell in all other provinces and territories.

Canadian Reserves by Standard Industrial Classification

Canadian mines are, to a large extent, polymetallic, a complexity that the current standard industrial classification tends to simplify (Table 4). Almost 80% of current mine reserves of gold in Canada is contained in the ores at gold mines; the balance is contained in base-metal ores. Because of the current mix of gold mines and base-metal mines which contain by-product gold, the expected long-term recovery in concentrates of current Canadian gold reserves is about 85%. The expected long-term recovery in concentrates of both copper and zinc reserves is about 90%; for nickel, about 85%; for lead, close to 80%; for silver, over 70%; and for molybdenum, almost 65%.

Life Index of Canadian Reserves

At current production rates, the apparent life (life index) of Canadian reserves of nickel is about 24 years; it is 12 years for copper, 10 years for zinc and molybdenum, 9 years for lead and silver, and 8 years for gold.

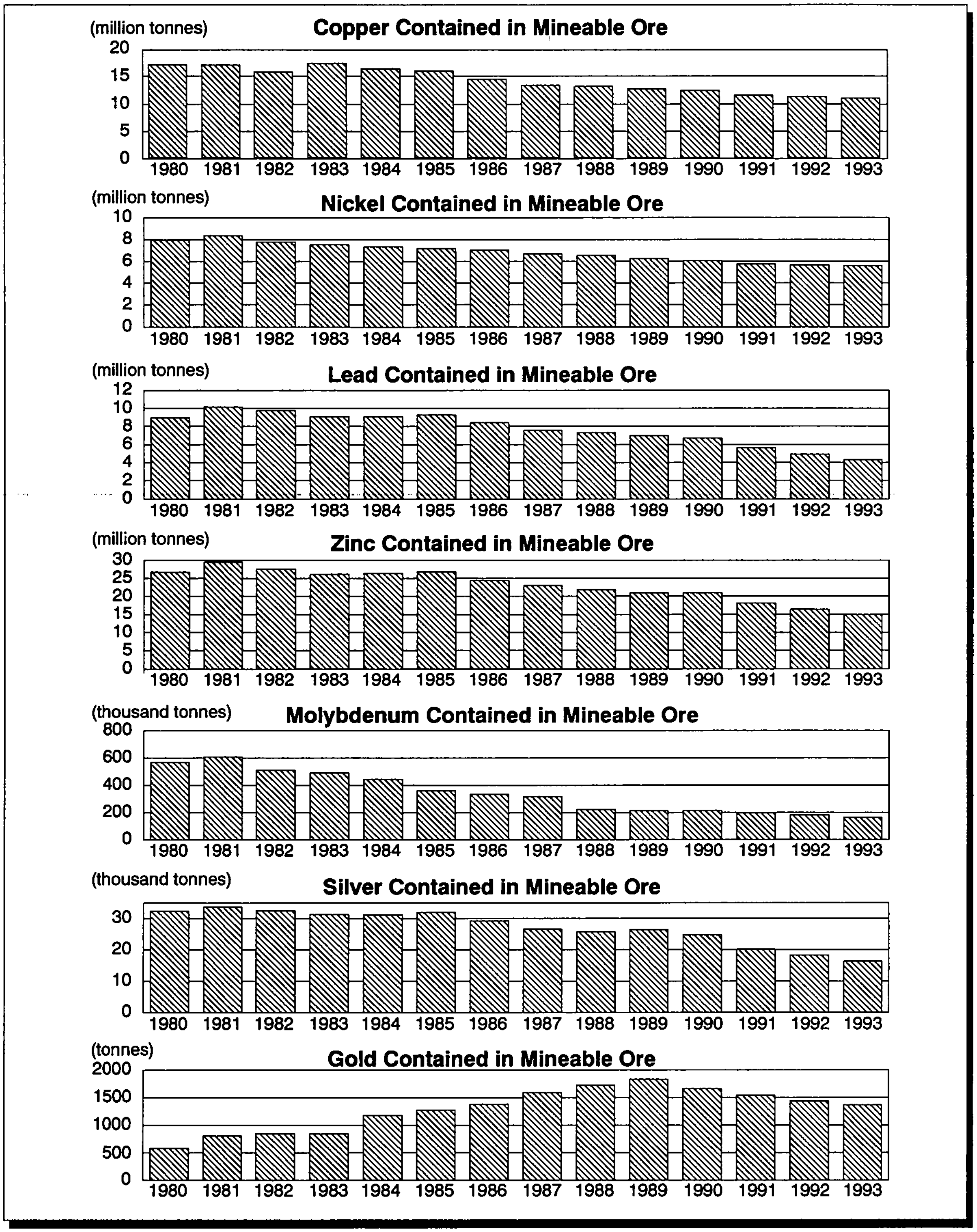
The life index of Canadian mine reserves was calculated by dividing the total amount of metals contained, at the beginning of 1993, in proven and probable mineable ore by the corresponding amount of metals contained in the ores mined during 1992. On a mine-by-mine basis, there are many more mines with apparent short lives than there are mines with apparent long lives.

Life indices are a very rough measure of the expected life of aggregate mine reserves. This type of statistic does not take into account inferred extensions to reserves at current mines, gross additions that will accrue to current reserves from the likely development, in the foreseeable future, of known orebodies for which a production decision has yet to be made, or expected changes in production rates. Life indices do not take into account the fact that large mines last much longer than smaller mines and that, as a consequence, production will carry into the future much longer than suggested by this statistic alone. As well, life indices tend to overstate the aggregate lives of reserves when, for example, annual production is abnormally low due to strikes at large establishments or due to industry-wide cutbacks during periods of oversupply or recession.

Reserve Trends

From the mid-1970s to the early 1980s, Canadian reserves of gold, molybdenum, silver and nickel generally rose while those of copper, zinc and lead held relatively constant (Figure 1). However, since the beginning of the 1980s, reserves of these metals, with the exception of those of gold, have been on a general downtrend. This has occurred as a result of unreplaced mine production, write-offs of unprofitable portions of orebodies, the closure of uneconomic mines, the focus, during the mid-1980s, of exploration programs on gold, and lower levels of re-investment in new mines than was experienced in the early 1980s. In contrast, gold

Figure 1
Canadian Reserves, 1980-93
Metal Contained in Proven and Probable Mineable Ore in Operating Mines and Deposits Committed for Production, as at January 1 of Each Year



Source: Mining Sector, Natural Resources Canada.

reserves kept on rising until 1989 as exploration and investment responded to record high gold prices (corrected for inflation) that prevailed through the 1980s. However, since 1989, Canadian reserves of gold in ore have also been falling.

Compared with the levels of early 1981, reserves of copper and nickel were down by about one third at the beginning of 1993; those of zinc and silver were down by over 40%; those of lead were down by about half; and those of molybdenum were down by almost three quarters. Although gold reserves have decreased in each of the last four years, their level in early 1993 was still 70% higher than in 1981.

MINE INVESTMENT

In 1992, mine investment (including uncapitalized repairs) in Canada was $3.1 billion, roughly 90% of the $3.5 billion (Figure 2) spent in total at all mines and on all exploration projects in the country during that year. Compared with revised estimates for 1991, mine investment in 1992 (corrected for inflation) was down by 18%.

Investment by Commodity

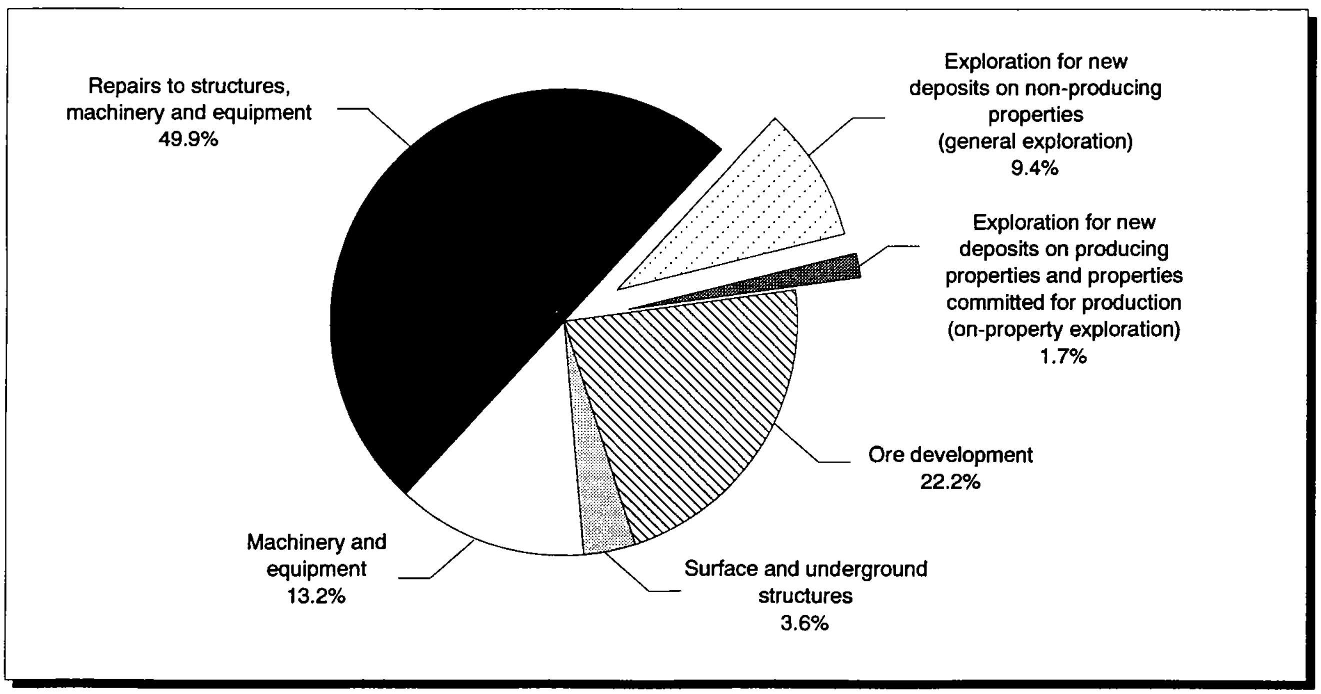
In 1992, coal ranked first in terms of mine investment on a commodity basis. Producers of coal spent almost $550 million on mine investment (Figure 3), half of what was spent by all producers of nonmetallic mineral commodities, and almost one fifth of what was spent in total by the non-petroleum mineral industry in Canada during that year. However, in 1991, coal producers had spent over $800 million.

Producers of gold invested $446 million, down from $556 million in 1991. Gold had been the leading commodity between 1987 and 1990. Together, producers of all metallic mineral commodities invested almost $2 billion, of which $1.1 billion was invested by producers of base metals.

Investment by Province and Territory

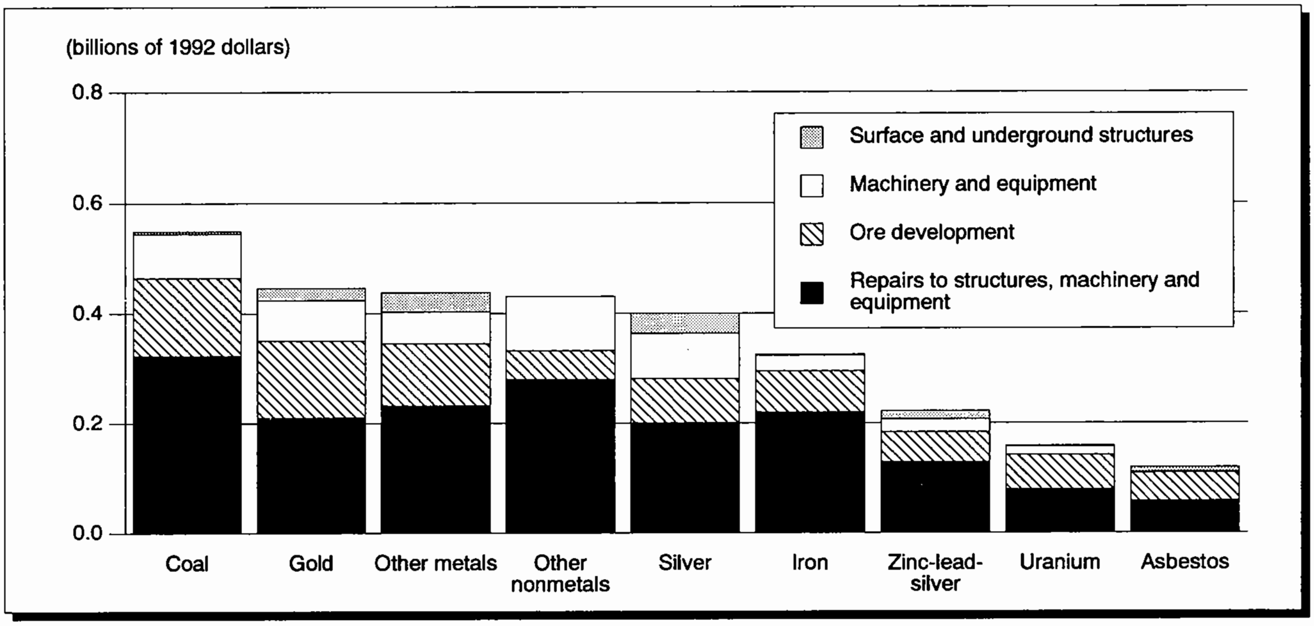
Almost $1.9 billion, or more than 60%, of the total mine-site investment made in Canada during 1992 occurred in Ontario, British Columbia and Quebec (Figure 4). These three provinces are the country's leading producers of non-petroleum mineral commodities. In 1992, they accounted for 24%, 20%

Figure 2
Mine and Exploration Investment in Canada, 1992
$3.5 Billion



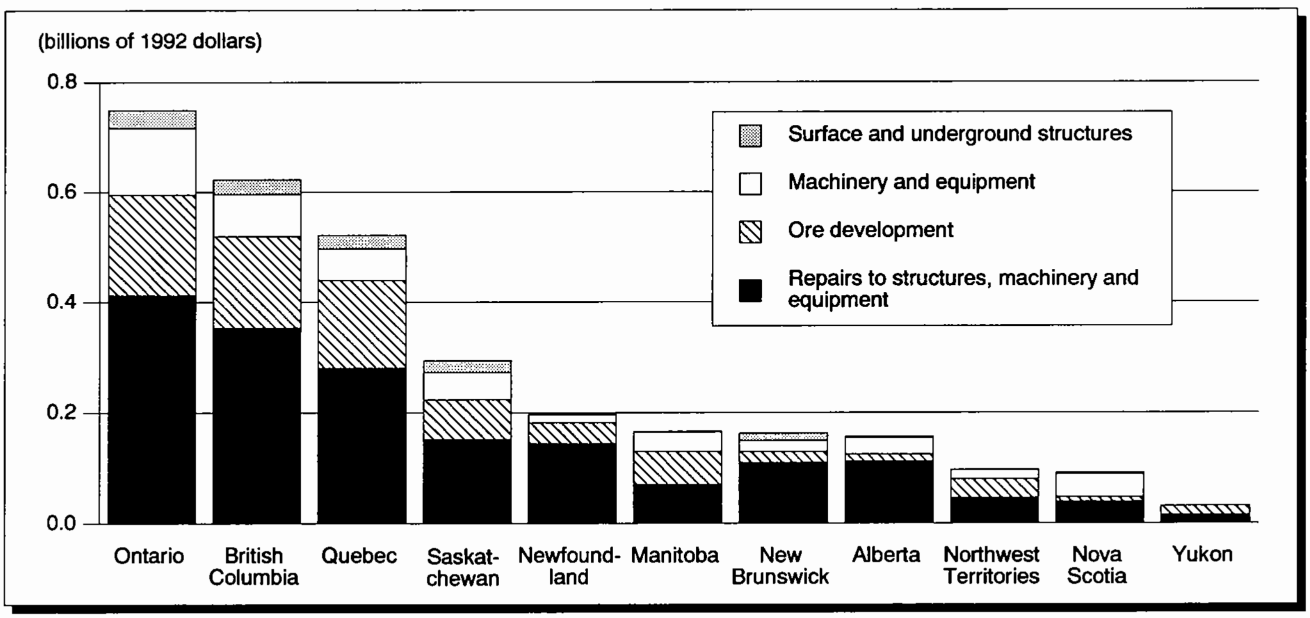
Source: Natural Resources Canada, based on Statistics Canada, "Exploration, Development and Capital Expenditures for Mining," catalogue no. 61-216.

Figure 3
Mine Investment in Canada, 1992, by Industry Groups
$3.1 Billion



Source: Natural Resources Canada, based on Statistics Canada, "Exploration, Development and Capital Expenditures for Mining," catalogue no. 61-216.
Notes: Other nonmetals include potash, gypsum, salt, stone, sand and gravel. Other metals include nickel-copper.

Figure 4
Mine Investment in Canada, 1992, by Province and Territory
$3.1 Billion



Source: Natural Resources Canada, based on Statistics Canada, "Exploration, Development and Capital Expenditures for Mining," catalogue no. 61-216.

and 17% respectively of total mine-site investment, and for 28%, 12% and 16% respectively of the total value of production.

Investment by Category

Four categories are used to record mine-site investment in Canada: i) surface and underground structures, ii) machinery and equipment, iii) ore development, and iv) repairs (uncapitalized) to existing structures, machinery and equipment.

The repairs category, which encompasses investment made to maintain the operating efficiency of existing capacity is, by far, the largest of the four mine-site investment categories (Figure 2). In 1992, repairs amounted to $1.7 billion, almost 60% of total mine-site investment made in Canada and the highest proportion in at least 20 years.

Ore development, which includes expenditures to prove up additional ore reserves at operating mines, fell to less than $770 million in 1992 from more than $1 billion in 1991. The last time that annual development expenditures (corrected for inflation) were less than $1 billion was in 1979. Investment in new machinery and equipment stood at $460 million in 1992; investment in structures, which includes buildings, tailings disposal systems and roads, was less than $130 million.

Investment Ratios

In 1992, the value of Canada's non-petroleum mineral production amounted to $16.3 billion. For each dollar of non-petroleum mineral production during that year, the mineral industry invested about 19 cents at mine sites; of this amount, almost 11 cents was for repairs, almost 5 cents for development, almost 3 cents for machinery and equipment, and almost 1 cent for structures. Revised statistics for 1991 indicate that the industry invested about 22 cents at mine sites for each dollar of non-petroleum mineral production during that year, slightly more than in 1992.

Investment Trends[3]

Total annual mine-site investment in Canada (corrected for inflation) was generally on a cyclical rise from at least 1969 to 1981 when it reached over $6.7 billion. Since then, it has generally been on a cyclical downward trend.

Type of Investment

In 1992, the aggregate level (corrected for inflation) of mine-site investment in Canada was roughly half of the peak level reached in 1981. This has occurred largely because annual investment in new structures, as well as in machinery and equipment, which is characteristic of the construction of new mines and expansion to existing capacity, has generally been decreasing since the early 1980s (Figure 5a). Annual investment in structures, machinery and equipment is at the lowest level in more than 20 years.

Annual investment in structures (corrected for inflation) last peaked during the years 1980-83. It reached more than $1.7 billion in 1981, but has generally been falling since. Annual investment in machinery and equipment has been more cyclical than investment in structures, but less variable from year to year. Nonetheless, it too has decreased gradually each year from the last annual peaks of over $1 billion in the early 1980s, although there was a temporary rise to over $900 million during the period 1988-89.

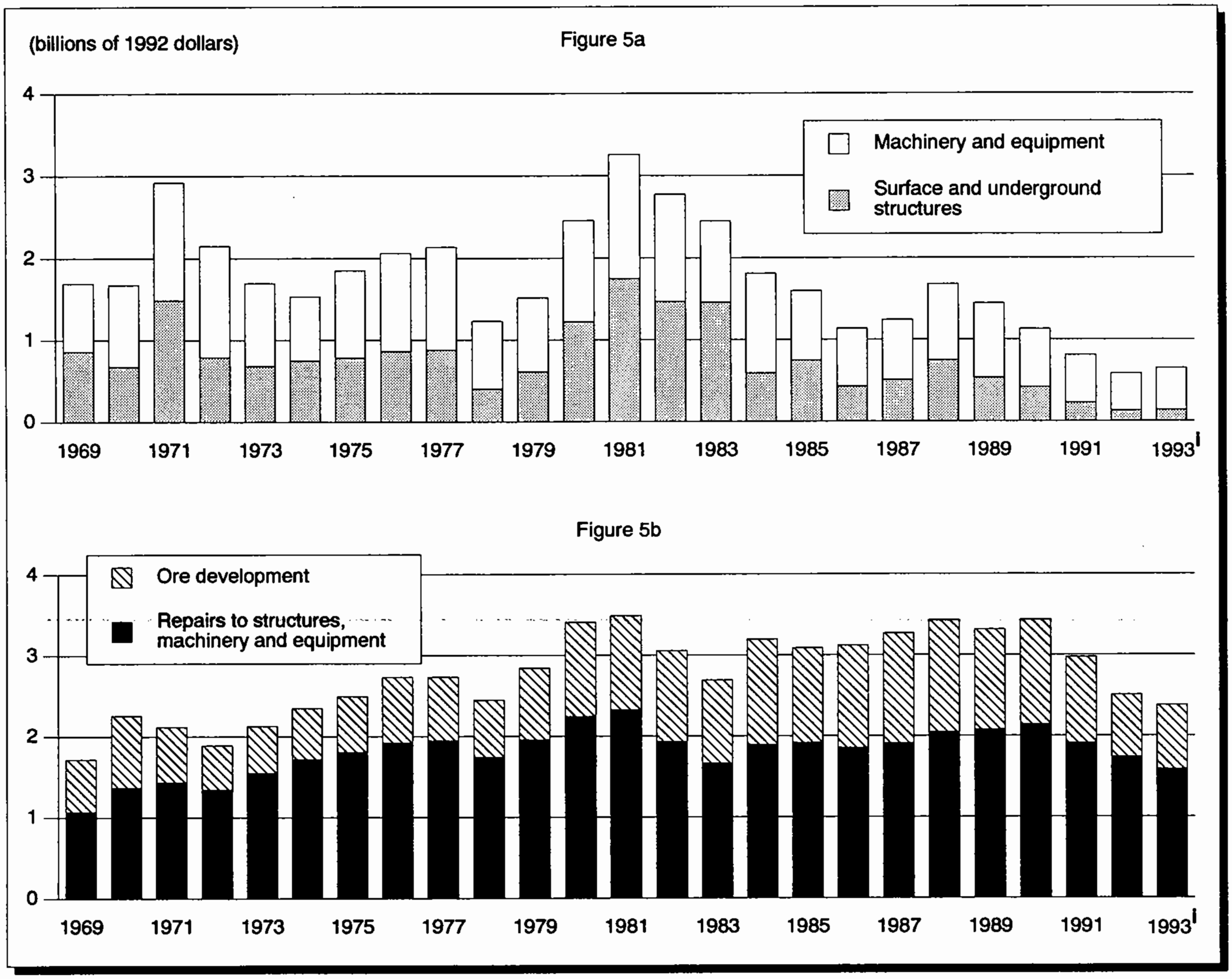
Corrected for inflation, investment in repairs and investment in development, both of which are more characteristic of ongoing mining operations, grew from at least 1969 until 1981 (Figure 5b). Between 1981 and 1991, these types of investment have stayed relatively constant at about $3 billion annually, but they too have since been falling. Development expenditures grew gradually from the early 1970s until 1990; repairs grew relatively quickly between 1969 and 1981 and subsequently levelled off during the following 10 years.

Nonmetallic Minerals

A considerable amount of investment in nonmetallic mineral commodities took place in Canada during the early 1980s (Figure 6a). Corrected for inflation, investment in these commodities was more than $2 billion annually in the period 1981-84 due, in part, to increasing demand from Japan for Canadian coal. Several new coal mines came on stream in the period 1983-84: Quintette ($750 million) and Bullmoose ($300 million) in northeastern British Columbia; Line Creek (coking coal) and Greenhills in southeastern British Columbia; and Gregg River and Obed Marsh in southcentral Alberta. About $3 billion (only part of which is counted in mine-site investment statistics) was spent to build the Quintette and Bullmoose mines, the new town of Tumbler Ridge and related infrastructure in northeastern British Columbia, as well as associated railway and port facilities elsewhere in the province.

Potash capacity also increased in the early 1980s. More than $600 million was spent in New Brunswick to build two mines in the Sussex area, one that came into production in 1983 and the

Figure 5
Mine Investment in Canada, by Investment Category, 1969-93



Source: Natural Resources Canada, based on Statistics Canada, "Exploration, Development and Capital Expenditures for Mining," catalogue no. 61-216.
I Intentions.

other in 1985; a further $400 million was spent to complete, in 1985, a three-fold expansion of the Lanigan mine in Saskatchewan.

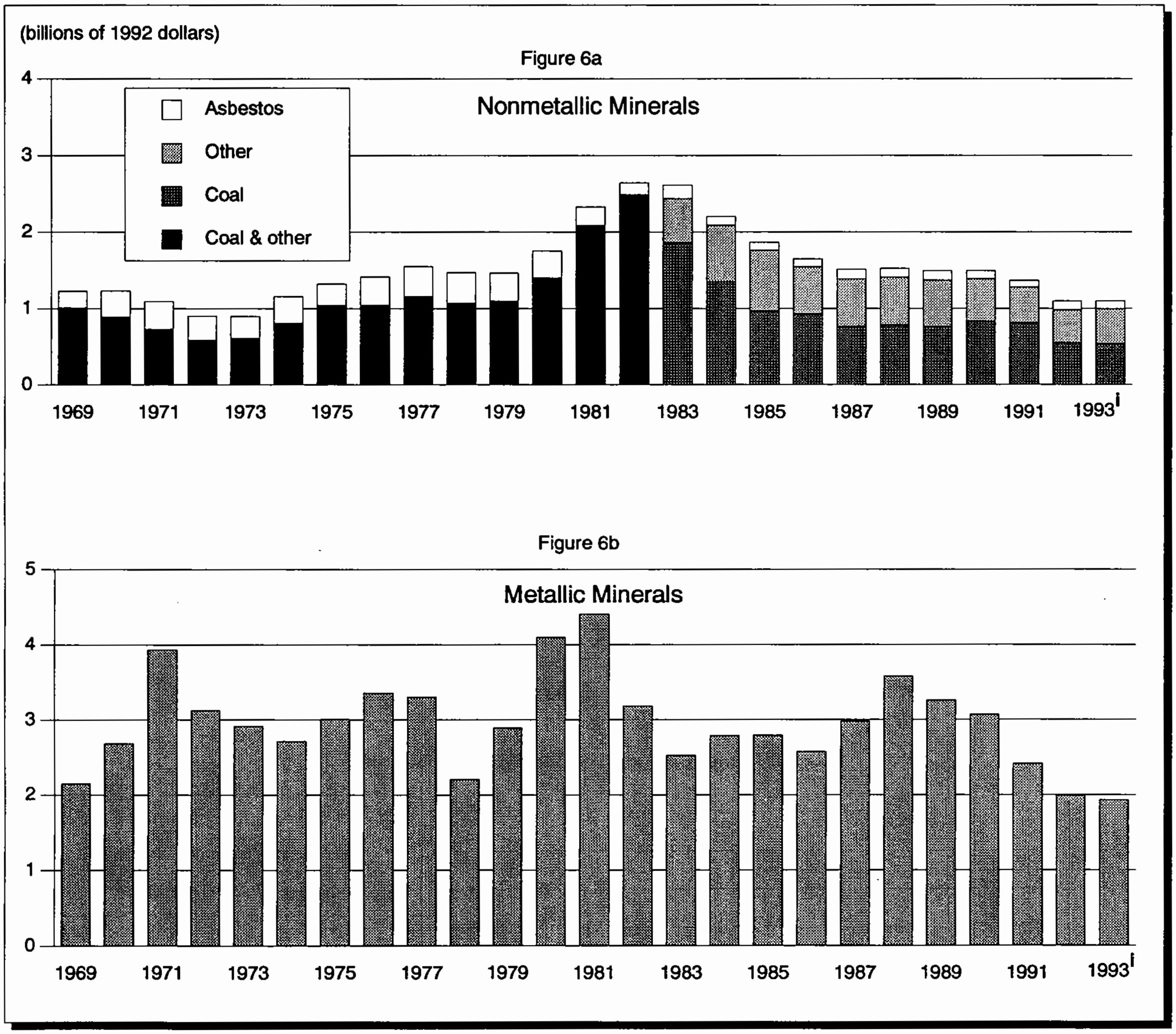
Metallic Minerals

Investment in metallic minerals as a group has been much more cyclical than investment in non-metallic minerals (Figure 6b), and there has been considerable variation in investment size and timing on a commodity-by-commodity basis.

Annual investment in gold mines (Figure 7a) started to increase in 1979-80, seven or eight years behind the initial growth in the price of gold. Such investment (corrected for inflation) grew to roughly $700 million per year during the period 1981-86 from $100 million or less annually in at least each of the previous 10 years; it later peaked at about $1.5 billion in 1988, but is now at less than $500 million.

The early to mid-1980s gave rise to some of Canada's largest gold mines: Lupin in 1982 in the Northwest Territories; and Detour Lake in 1983, and Williams, Golden Giant and David Bell in 1985 at Hemlo, all in Ontario. The late 1980s saw the development of Casa Berardi (Golden Pond) in Quebec, Snip in British Columbia, and dozens of small mines throughout Canada.

Figure 6
Mine Investment in Canada, by Main Commodity Groups, 1969-93



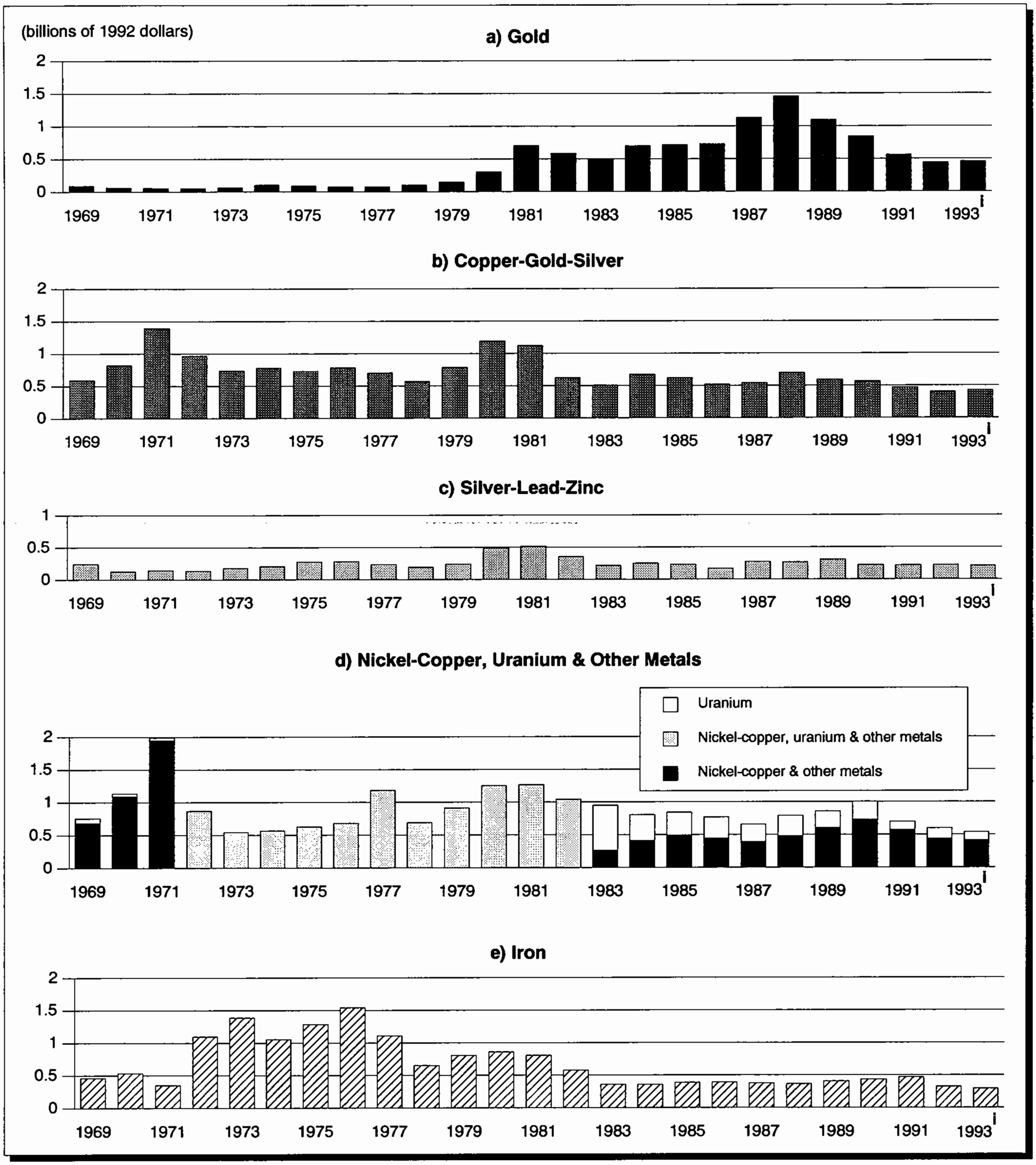
Source: Natural Resources Canada, based on Statistics Canada, "Exploration, Development and Capital Expenditures for Mining," catalogue no. 61-216.
i Intentions
Note: Other includes potash, salt, gypsum, stone, sand and gravel.

Annual investment in copper-gold-silver mines (Figure 7b) has been fairly steady since 1969, punctuated by periods of unusually high investment in each of the early 1970s and the early 1980s, particularly in copper capacity in British Columbia. Investment in the early 1970s included Brenda, Island Copper, Gibraltar, Lornex, Bell and Similco (Copper Mountain); the beginning of the 1980s saw the construction of the Highmont mine ($150 million) and a $160 million expansion at the Lornex mine.

Investment in zinc-lead-silver mines (Figure 7c) has also been relatively constant since at least 1969 at under $300 million annually; the period 1980-81 was exceptional with investment of about $500 million. Canada's most northerly mine, Polaris, on Little Cornwallis Island in the Northwest Territories, came into production in 1982 at a cost of $160 million.

Changes to Statistics Canada's method of aggregating investment by commodity (essentially to

Figure 7
Mine Investment in Canada for Metallic Minerals, 1969-93



Source: Natural Resources Canada, based on Statistics Canada, "Exploration Development and Capital Expenditures for Mining," catalogue no. 61-216.
I Intentions.
Note: Other metals include cobalt-silver.

preserve the confidentiality of individual company data) make it difficult to identify separately, before 1983, investment made for nickel-copper mines from that made for uranium mines (Figure 7d). However, in 1973, world demand for uranium was expected to grow five- to nine-fold over the next 20 years. By 1974, Canadian uranium producers had projects in place to more than double Canadian uranium capacity. Canadian investment in uranium mines increased significantly after the mid-1970s, especially in Saskatchewan. Rabbit Lake, Canada's first new uranium producer since the 1950s, came into production in late 1975 at a cost of $50 million and was subsequently expanded in the period 1983-85 at a further cost of $100 million. The world-class Key Lake mine was built during the period 1980-83 ($500 million) and the Cluff Lake mine during the period 1979-84 ($180 million).

Inco invested more than $1 billion in Canada during the period 1967-72 to increase mine, concentrator, smelter and refinery capacity for ores and concentrates of nickel and copper from which cobalt, gold, iridium, osmium, palladium, rhodium, ruthenium, platinum, selenium, silver and tellurium are also recovered as by-products. Coleman, Copper Cliff North, Copper Cliff South, Creighton No. 9, Frood-Stobie No. 9, Kirkwood, Levack West, Little Stobie, Murray open-pit and Shebandowan in Ontario, as well as Birchtree, Pipe (No. 1 and No. 2) and Soab (North and South) in Manitoba, are some of the many mine projects undertaken during that period.

The iron ore industry in Quebec and Labrador underwent considerable expansion in the early 1970s. Construction included the doubling, in 1973, of capacity at the Carol Lake concentrator in Labrador, as well as a new concentrator and pellet plant at Sept-Îles, Quebec (total cost $400 million); a new concentrator, in 1975, at Mount Wright as well as a railway extension and the new town of Fermont in Quebec ($700 million spent by U.S. Steel); and, in 1976, a new mine and related infrastructure at Fire Lake in Quebec (total cost $630 million). Total annual mine investment for iron ore (Figure 7e) increased to over $1 billion starting in 1972 and remained at that level until 1977. It was at least $500 million annually until 1982 and about $400 million annually thereafter.

Preliminary investment intentions published in March 1993 suggest that the amount of mine-site investment made in Canada in 1993 was somewhat less than what was made in 1992 (Figure 5).

PROJECTS ANNOUNCED DURING 1993

Nine new precious-metal mine projects and one base-metal mine project were announced in Canada during 1993 (Table 5); the majority of the gold projects involve reactivation of previous operations. The reactivation by Inco of the Garson mine in Ontario is the only large base-metal project announced during 1993. The Garson mine, which was previously in operation from 1907 to 1986, has reserves of 17.7 Mt grading 1.31% copper and 1.8% nickel.

PROMISING DEPOSITS

Future mineral production will draw, not only on current reserves, but also on: 1) likely extensions to orebodies which are presently being mined; 2) some of the hundreds of known, but as yet undeveloped, deposits that occur throughout Canada; 3) known, but currently marginal or uneconomic mineralized material; and 4) discoveries yet to be made.

In January 1994, there were some 4900[4] active mineral properties in Canada, up from about 4600 in late 1992 due, in part, to the rise in exploration activity that has taken place in Canada following the discovery, in November 1991, by Dia Met Minerals Ltd. and BHP Minerals Canada Ltd. of diamonds at Lac de Gras in the Northwest Territories. The expensive and lengthy process of exploration and evaluation that provides the information required to assess economic viability is progressing at many mineral properties in Canada. Compared with the total number of active mineral properties, those properties on which a mineral deposit has been discovered are substantially fewer in number.

In early 1994, 102 Canadian deposits containing copper, nickel, lead, zinc, molybdenum, silver and gold appeared particularly promising for possible development into mines in the foreseeable future (Table 6). This assessment was made on the basis of the results of recent exploration programs reported by companies. Such an assessment is inherently subjective, and it may be biased in favour of those companies that are the most informative. Implicit in this assessment of promise is the assumption that companies are focusing a good portion of their current resources on those properties that they believe have the best prospect for production in the foreseeable future. Apart from the deposits considered promising here, there are hundreds of others in Canada for which there are no recent public reports of exploration progress.[5] Some of these deposits as well are likely to be developed into mines in the future.

Of the 102 deposits assessed as promising in early 1993, British Columbia accounts for 30, Quebec for 25, and Ontario for 17. The number of deposits assessed as promising for possible future production increased each year from 98 in early 1982 to 268 in early 1990 (Figure 8). Since 1991, the number of such deposits has fallen gradually because some companies are finding it more difficult to raise the funds needed to continue exploration programs on all their properties. The decrease in the number of promising deposits appears to have decelerated between early 1993 and early 1994.

Deposits containing copper, nickel, lead, zinc, molybdenum, silver and gold are classified here as base-metal deposits when more than half of their estimated contained in-situ value at metal market prices prevailing at the beginning of the year is accounted for by base metals; otherwise, they are classified as precious-metal deposits.

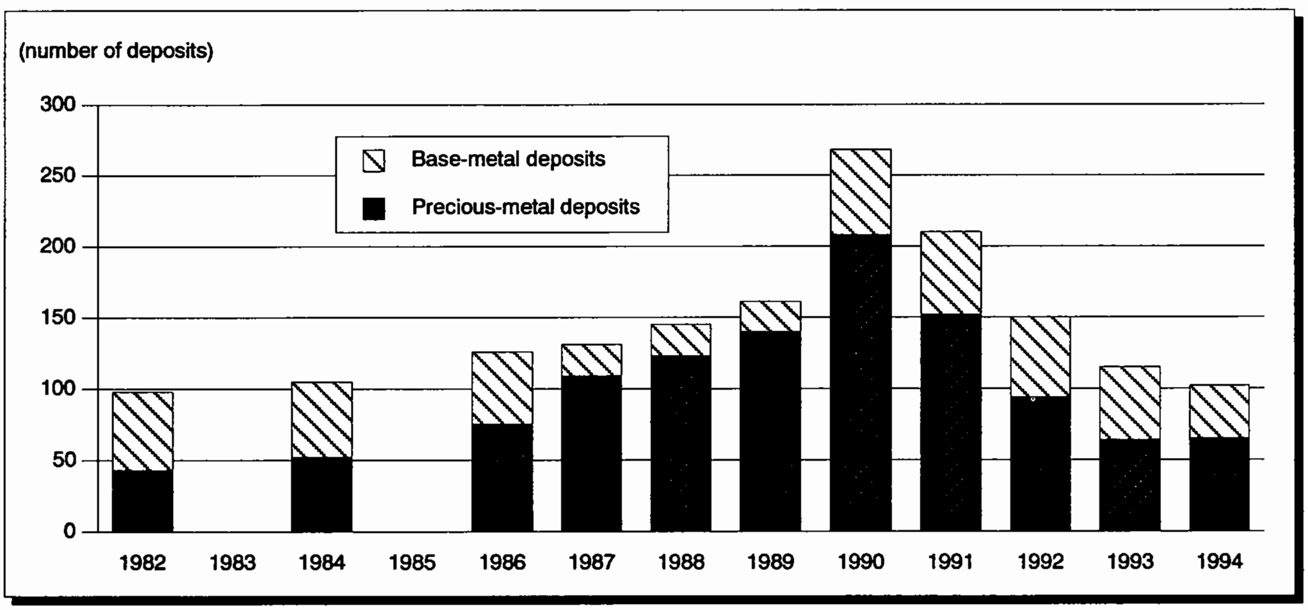
In-situ value is a very rough indicator of potential economic viability. It does not take capital or operating costs into account, nor does it make any allowance for losses that are inherent in mining, concentrating, smelting and refining, all of which have a significant bearing on the potential viability of mineral deposits.

On the basis of in-situ values of the 102 deposits considered, in January 1994, promising for future production, 37 were base-metal deposits, down from 51 in early 1993 and from a high of 60 in early 1990; in each of the previous three years, there had only been about 20, down from a high of 55 in early 1982.

Almost 60% of all promising deposits in early 1982 were base-metal deposits. This proportion fell to a low of 13% in early 1989 following the unprecedented high level of gold exploration activity in Canada. Since then, the trend has reversed: the proportion of base-metal deposits rose to a high of 44% of all promising deposits in early 1993; in early 1994, it was 37%, about the same level as in the early 1980s.

There were 65 promising precious-metal deposits in Canada in early 1994, about the same as in early 1993. The number of these deposits increased steadily each year from early 1982 to early 1990 when it reached a high of 208. During the late 1980s, precious-metal deposits constituted 80% or more of all promising deposits. However, as a result of declining exploration activity, the

Figure 8
Canadian Precious-Metal and Base-Metal Deposits Considered Promising for Future Production, as at January 1 of Each Year



Source: Natural Resources Canada, based on company reports.
Note: Data for 1983 and 1985 are not available.

number of promising precious-metal deposits has generally been falling each year since early 1991; nonetheless, it is currently still at a level above that of the early 1980s.

Based on average metal prices prevailing in January 1994, copper and gold each account for roughly one third of the gross in-situ value of the estimated mineral inventory reported in the 102 deposits considered promising; zinc accounts for about 15% and nickel for about 10%.

Based on the in-situ value (or, where available, on the mineable value) of contained copper, nickel, lead, zinc, molybdenum, silver and gold, the largest promising Canadian metallic mineral deposits are, in **British Columbia**: Fish Lake (gold, copper), Cirque, also known as Stronsay (zinc, lead, silver), Mt. Milligan (gold, copper), Kemess South (gold, copper), Kerr (copper, gold, silver), Expo, Hushamu Zone (copper, gold, molybdenum), Eskay Creek (gold, silver, zinc, lead, copper), Tulsequah Chief (zinc, gold, copper, silver, lead), Kemess North (gold, copper), Huckleberry (copper), Mt. Polley S19 pit (gold, copper), J&L (gold, zinc, lead, silver), Driftpile (zinc), and Red Mountain, Marc Zone (gold); in **Ontario**: Victor (nickel, copper, precious metals), Moss Lake (gold), Hemlo Interlake (gold, silver), Dome super pit[6] (gold, silver), Holloway, Lightning Zone (gold, silver), and Musselwhite (gold, silver); in **Quebec**: Raglan (nickel, copper), Grevet (zinc, copper, silver), and Troilus, also known as Lac Frotet (gold, copper, silver); in the **Northwest Territories**: Izok Lake and Inukshuk (zinc, copper, lead, silver, gold), Prairie Creek (zinc, lead, silver, copper), and High Lake (copper, zinc, gold); in the **Yukon**: Casino (copper, gold, molybdenum), and DY underground (zinc, lead, silver, gold); in **Manitoba**: Minago (nickel); in **Saskatchewan**: Hanson Lake, also known as McIlvenna Bay (zinc, copper, gold, silver); and in **New Brunswick**: Half-Mile Lake (zinc, lead, silver, copper).

These 32 properties jointly account for 90% of the almost $100 billion estimated in-situ value of all base-metal and precious-metal deposits considered, in January 1994, promising for future production. Each of these deposits has an estimated in-situ value ranging from $500 million to almost $11 billion. Deposits with an in-situ value of over $2 billion are exceptional, and 10 of the 102 deposits considered promising are in that category (Figure 9).

The in-situ value of the metals contained in deposits, per tonne of mineralized material, is another rough measure of possible economic viability. Based on January 1994 prices, most of the promising deposits have an in-situ value of less than $200/t. However, 12 of the 102 deposits have exceptional unit values that range from $200 to over $1700/t (Figure 10).

Outlook

Compared with the beginning of the 1980s, reserves of base metals are down by one third to three quarters, depending on the metal. However, company interest in evaluating polymetallic base-metal deposits appears to have risen appreciably in 1990, and to have continued through early 1994.

Several mining projects, not yet counted in Canadian reserves, are going ahead. These will improve Canada's current reserves position. In addition, production decisions will eventually be made on some of the hundreds of deposits that are currently being evaluated. This could significantly change the mineral investment outlook over the next few years and contribute to the maintenance of Canadian mineral production, which is currently at high levels.

References

1 For an example of how gold reserves change mine-by-mine in a given year, see: A. Lemieux, "Canadian Reserves, Mine Investment, New Projects and Promising Deposits" in *Canadian Minerals Yearbook 1989*, Energy, Mines and Resources Canada, p. 5.25.

2 Sä Dena Hess was purchased in February 1994 by Teck Corporation and Cominco Ltd. from Coopers and Lybrand Limited, the court-appointed receiver and manager of this mine, which previously was owned by Curragh Inc. and Hillsborough Resources Limited.

3 Unless stated otherwise, investment figures for individual mining projects have not been corrected for inflation. Rather, figures are quoted as they were reported by companies at the time that investments were made. However, all figures quoted for investment trends are corrected for inflation and expressed in 1992 dollars.

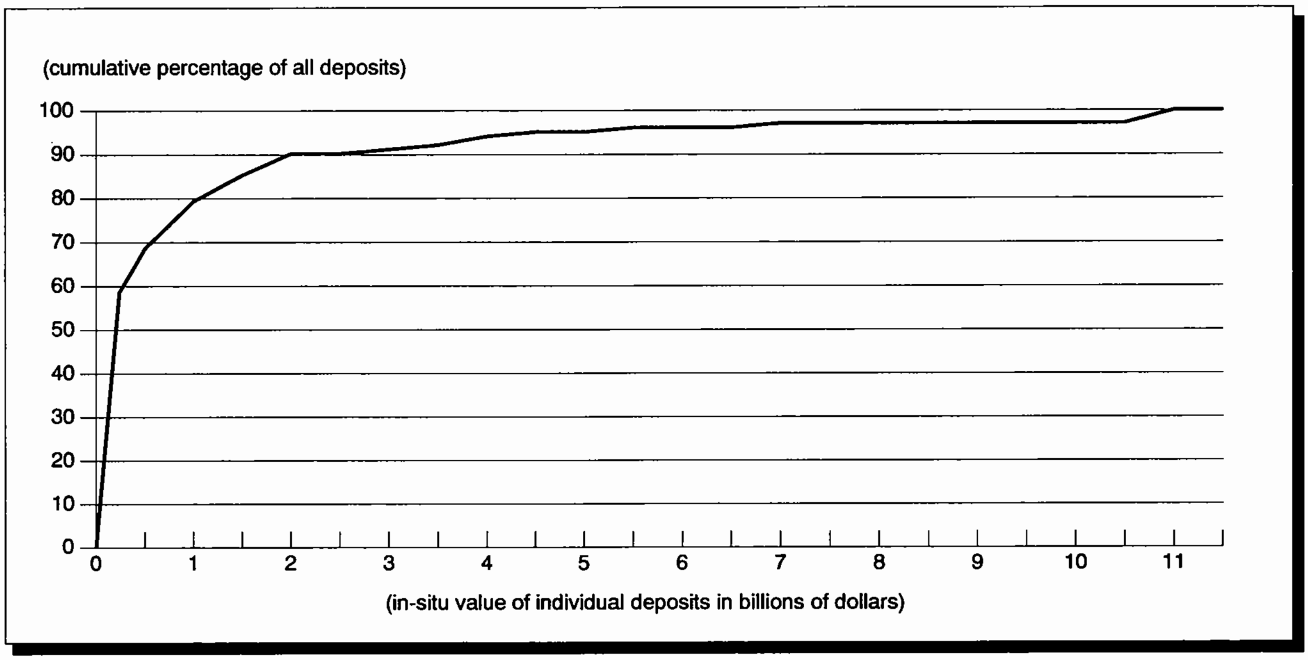
4 MIN-MET CANADA database, January 14, 1994, A.MacG. ROBERTSON INFODATA Inc., Vancouver, British Columbia. Used under License.

5 See, for example, *Canadian Mineral Deposits Not Being Mined in 1989*, Mineral Bulletin MR 223, Energy, Mines and Resources Canada, 1990, Ottawa.

6 The Dome super pit was committed to production in Feburary 1994.

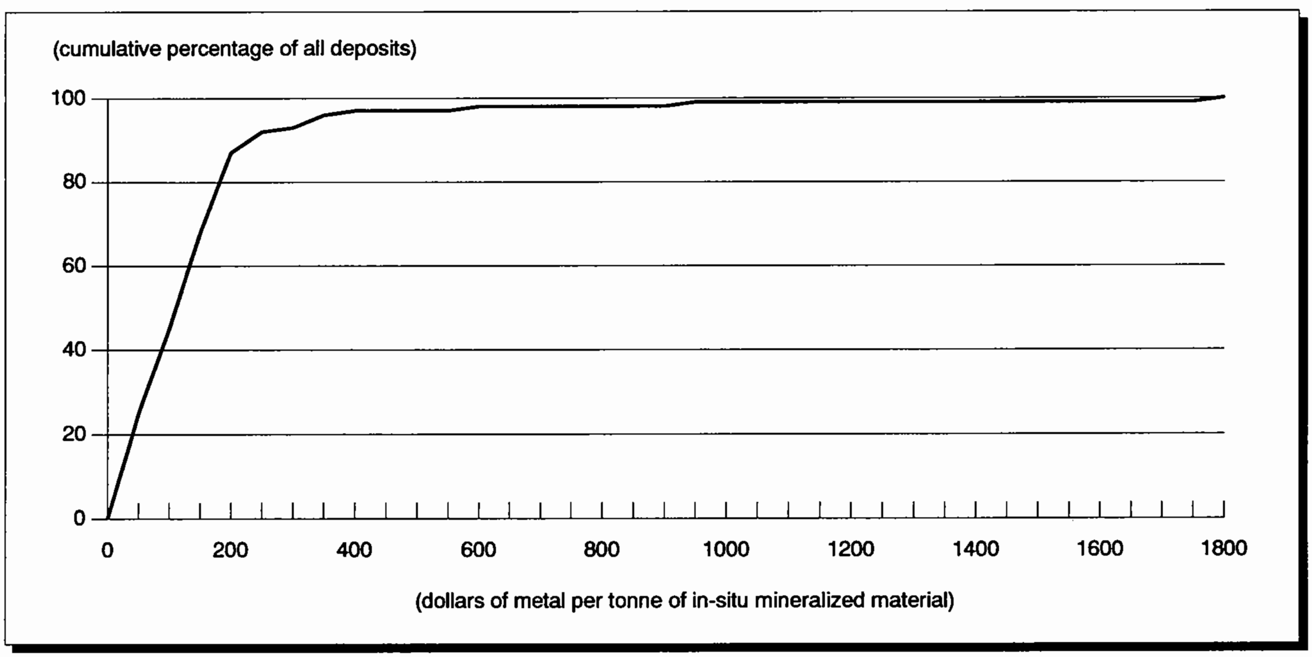
Note: Information in this review was current as at February 15, 1994.

Figure 9
Value of Promising Base-Metal and Precious-Metal Deposits in Canada, January 1994



Source: Natural Resources Canada.
Notes: Data are based on 102 deposits and January 1994 market prices. Ten percent of deposits each have an in-situ value of $2 billion or more.

Figure 10
Unit Value of Promising Base-Metal and Precious-Metal Deposits in Canada, January 1994



Source: Natural Resources Canada.
Notes: Data are based on 102 deposits and January 1994 market prices. More than 10% of deposits have an in-situ value greater than $200 per tonne.

TABLE 1. CHANGE IN CANADIAN RESERVES FROM JANUARY 1992 TO JANUARY 1993

Metal	Units	Opening Metal Balance, January 1992	Metal in Ore Mined During 1992	Metal Apparently Written Off During 1992	Metal in New Reserves Found During 1992	Net Change	Closing Metal Balance, January 1993
Copper	000 t	11 113	–873	–369	946	–296	10 818
Nickel	000 t	5 691	–231	–21	166	–86	5 605
Lead	000 t	4 947	–466	–171	37	–599	4 348
Zinc	000 t	16 448	– 1 552	–511	682	–1 380	15 067
Molybdenum	000 t	182	–16	–5	2	–18	163
Silver	t	18 217	–1 841	–865	790	–1 916	16 300
Gold	t	1 438	–182	–34	145	–71	1 367

Source: Natural Resources Canada.
Note: May not balance due to rounding.

TABLE 2. NEW MINING OPERATIONS AND COMMITMENTS TO PRODUCTION ADDED TO CANADIAN RESERVE TOTALS AS AT JANUARY 1, 1993

Operators and Major Partners	Operation	Province	Metals
NovaGold Resources Inc.	Murray Brook (Heap leach)	N.B.	Copper
Deak Resources Corporation	Astoria	Que.	Gold, silver
Western Quebec Mines Inc.	Joubi-Dubuisson Est	Que.	Gold, silver
Cambior inc. and Aurizon Mines Ltd.	Sleeping Giant[1]	Que.	Gold, silver
Deak Resources Corporation and Northfield Minerals Inc.	Cheminis	Ont.	Gold, silver
Falconbridge Limited	Lindsley (Thayer Lindsley)	Ont.	Nickel, copper, precious metals
Placer Dome Canada Ltd.	Paymaster[2]	Ont.	Gold, silver
Royal Oak Mines Inc.	Nighthawk Lake (Porcupine Peninsular)	Ont.	Gold, silver
Equity Silver Mines Limited	Equity Silver (Underground)	B.C.	Silver, gold, copper

Source: Natural Resources Canada, based on company reports.
[1] The Sleeping Giant mine was previously in operation from May 1988 to May 1991. [2] The Paymaster mine last produced in the mid-1960s.

TABLE 3. CANADIAN RESERVES BY PROVINCE AND TERRITORY, JANUARY 1, 1993
(Metal Contained in Proven and Probable Mineable Ore[1] in Operating Mines[2] and Deposits Committed for Production)

Metal	Units[3]	Nfld.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	B.C.	Y.T.	N.W.T.	Canada[5]
Copper	000 t	–	–	234	1 503	4 960	421	–	3 699	–	–	10 818
Nickel	000 t	–	–	–	–	4 160	1 445	–	–	–	–	5 605
Lead	000 t	–	–	2 264	20	53	11	–	786	856	358	4 348
Zinc	000 t	–	–	5 738	1 710	1 819	938	–	1 835	1 502	1 524	15 067
Molybdenum	000 t	–	–	–	–	–	–	–	163	–	–	163
Silver	t	3	–	6 456	2 008	4 106	398	–	2 098	1 119	113	16 300
Gold[4]	t	27	–	42	319	746	29	2	88	18	97	1 367

Source: Natural Resources Canada.
– Nil or less than one unit.
[1] No allowance is made for losses in milling, smelting and refining. Excludes material classified as "possible." Includes "geological reserves" for some mines that do not report mineable ore. [2] Includes metal in mines where production has been suspended temporarily. [3] One tonne (t) = 1.1023113 short tons = 32 150.746 troy ounces. [4] Excludes metal in placer deposits because reserves data are generally unavailable. [5] May not balance due to rounding.

TABLE 4. CANADIAN RESERVES BY STANDARD INDUSTRIAL CLASSIFICATION (SIC), JANUARY 1, 1993
(Metal Contained in Proven and Probable Mineable Ore[1] in Operating Mines[2] and Deposits Committed for Production)

	Units[3]	Gold Mines	Copper, Copper-Zinc Mines	Nickel-Copper Mines	Zinc-Lead-Silver Mines	Molybdenum Mines	Canada[5]
		SIC no. 0611	0612	0613	0614	0615	
Copper	000 t	38	6 466	4 001	313	–	10 818
Nickel	000 t	–	–	5 605	–	–	5 605
Lead	000 t	–	123	–	4 224	–	4 348
Zinc	000 t	–	4 223	–	10 844	–	15 067
Molybdenum	000 t	–	64	–	–	99	163
Silver	t	298	5 566	1 910	8 526	–	16 300
Gold[4]	t	1 081	126	87	72	–	1 367

Source: Natural Resources Canada.
– Nil or less than one unit.
[1] No allowance is made for losses in milling, smelting and refining. Excludes material classified as "possible." Includes "geological reserves" for some mines that do not report mineable ore. [2] Includes metal in mines where production has been suspended temporarily. [3] One tonne (t) = 1.1023113 short tons = 32 150.746 troy ounces. [4] Excludes metal in placer deposits because reserves data are generally unavailable. [5] May not balance due to rounding.

TABLE 5. PRECIOUS-METAL AND BASE-METAL MINING PROJECTS ANNOUNCED IN CANADA DURING 1993

Companies	Projects	Metals	Start-Up Year	Incremental Project Budget
				($ milllions)
PRECIOUS METALS				
Norbec Manitou Inc.	New tailings reprocessing operation, Manitou-Barvue mine, Val-d'Or area, Quebec	Gold	1993	. .
KWG Resources Inc. and SEG Resources Inc.	Reactivation at 1000 t/d of Granada mine,[1] Rouyn-Noranda area, Quebec	Gold, silver	1993	. .
North American Palladium Ltd.	New 3000-t/d open-pit Lac-des-Îles mine, Thunder Bay area, Ontario	Palladium, platinum, gold, copper, nickel	1993	. .
St. Andrew Goldfields Ltd.	Reactivation, at 540 t/d, of Hislop East[2] mine, Matheson area, Ontario	Gold, silver	1993	. .
Granduc Mining Corporation and Black Hawk Mining Inc.	New 1 500-t/d BT (Burnt Timber) open-pit mine, Lynn Lake area, Manitoba	Gold, silver	1993	8.2
International Skyline Gold Corp.	Reactivation of Johnny Mountain[3] (Reg) mine to produce 20 000 t of ore, Stewart area, British Columbia	Gold, silver, copper	1993	0.3e
Candorado Operating Company Ltd.	Reactivation of Nickel Plate[4] (Hedley) tailings operation, Hedley area, British Columbia	Gold, silver	1993	. .
Royal Oak Mines Inc.	Reactivation of Colomac[5] open-pit mine, Indin Lake area, Northwest Territories	Gold, silver	1994	6.6
Cusac Industries Ltd.	Reactivation at 270 t/d of Table Mountain mine (Erickson Creek), Cassiar area, British Columbia	Gold, silver	1994	2.6
BASE METALS AND BY-PRODUCTS				
Inco Limited	Reactivation, at 1800 t/d, of Garson mine,[6] Sudbury area, Ontario	Nickel, copper, precious metals	1994-95	40.1

Source: Natural Resources Canada, based on company reports.
. . Not available.
[1] The Granada mine was in production between 1930 and 1935. [2] Hislop East was in production during 1990 and 1991. [3] The Johnny Mountain mine produced from August 1988 to September 1990. [4] Nickel Plate tailings was active from 1988 to 1991. [5] The Colomac mine operated during 1990 and 1991. [6] The Garson mine was in operation from 1907 to 1986. It has reserves of 17.7 mt grading 1.31% copper and 1.8% nickel.

TABLE 6

TONNAGE AND GRADE OF BASE-METAL AND PRECIOUS-METAL DEPOSITS CONSIDERED, IN JANUARY 1994, PROMISING FOR FUTURE PRODUCTION
(The metal in these deposits is not counted in Canadian reserves.)

- DEPOSITS: Individual deposits have been selected on the basis of public information available during 1993. Deposits committed for production as at January 1, 1994, are not included.
- TONNAGE and GRADE: As reported by companies or, where necessary, from the secondary source that appeared to be the most reliable. Imperial units reported were converted to metric units and rounded. Tonnage and grade descriptions such as "probable and possible" are those reported by companies.
- COMPANIES: Where two or more companies are identified with a deposit, the first is usually the operator.

Deposits	Companies	Tonnage and Grade Description	Tonnage[1]	Grade[2] Cu	Ni	Pb	Zn	Mo	Ag	Au	Comments
			(tonnes)	(%)	(%)	(%)	(%)	(%)	(g/t)	(g/t)	
NEWFOUNDLAND											
Pine Cove (Vat leach)	NovaGold Resources Inc.	Mineable	1 641 000	–	–	–	–	–	–	3.62	Environmental and construction permits issued during 1992. Company seeking production financing.
Rendell-Jackman - Hammerdown	Major General Resources Ltd.	Mineable	363 000	..	–	–	..	–	–	12.5	Reported, in January 1994, that Roscoe Postle Associates Inc. had been retained to undertake reserves study.
NOVA SCOTIA											
Touquoy (Moose River)	NovaGold Resources Inc. Corner Bay Minerals	Drill indicated resource	1 900 000	–	–	–	–	–	–	2.09	In January 1994, planned to conduct bulk sample test.
NEW BRUNSWICK											
Half-Mile Lake	Noranda Minerals Inc. Conwest Exploration Company Limited Brunswick Mining and Smelting Corporation Limited	–	7 780 000	0.09	–	3.66	10.5	–	44.	–	Pre-feasibility study under way, in early 1993, of tonnage required for viable operation.
Murray Brook Copper (Flotation)	NovaGold Resources Inc.	Mineable	385 600	2.96	–	–	–	–	–	–	Company examining, in July1993, possibility of milling at Heath Steele.
QUEBEC											
Abitibi Copper	Aur Resources Inc. Consolidated Abitibi Resources Limited	–	1 200 000	0.75	–	–	–	–	–	–	
Aldermac	Deak Resources Corporation	Diluted inventory	1 373 000	1.8	–	–	4.6	–	35.0	0.55	Potential feed for Kerr Addison mill in Ontario.
Arntfield	Deak Resources Corporation Noranda Minerals Inc. Nova-Cogesco Resources Inc.	Diluted inventory	633 000	–	–	–	–	–	–	4.83	Down-dip extension of Francoeur mine.
Beaufor	Aurizon Mines Ltd. Louvem Mines Inc.	Proven and probable	309 400	–	–	–	–	–	–	7.6	Planned to complete in-house feasibility study by first quarter 1994.

Benoît Twp. (Lac Pusticamica)	Metall Mining Corporation Freewest Resources Inc.	Geological inventory	2 976 716	0.14	–	–	–	–	7.30	2.59	Looking, during 1993, for extension of deposit. Proximal to Lac Shortt mill.
Casa Berardi - North	TVX Gold Inc. Golden Knight Resources Inc.	Geological resource	360 000	–	–	–	–	–	–	6.2	New discovery, during 1992, on north side of Casa Berardi fault.
Casa Berardi - Principal (including Domex claims)	TVX Gold Inc. Golden Knight Resources Inc.	Mineable	2 188 000	–	–	–	–	–	–	6.2	Considering, during 1993, underground exploration program.
Chevrier (Obatogamau)	Metall Mining Corporation Fancamp Resources Ltd.	Geological resource	8 305 996	–	–	–	–	–	–	2.28	Open in all directions.
Corner Bay - Main zone	Société québeçoise d'exploration minière (SOQUEM) Corner Bay Minerals	Drill indicated resource	1 400 000	4.4	–	–	–	–	–	–	Definition drilling in early 1993.
Donalda	Orco Resources Inc. Metall Mining Corporation Thunderwood Resources Inc.	In-situ	660 000	–	–	–	–	–	–	8.9	Decision with respect to production expected in March 1994.
Douay - 531 zone	Société d'Exploration Minière Vior Inc.	Drill indicated	538 000	–	–	–	–	–	–	4.8	
Douay - Main zone	Société d'Exploration Minière Vior Inc.	Probable and possible	220 000	–	–	–	–	–	–	9.6	
Douay - West zone	Société d'Exploration Minière Vior Inc.	Probable and possible	583 000	–	–	–	–	–	–	9.9	
Eastmain	MSV Resources Inc.	Mineable	863 988	–	–	–	–	–	11.[e]	12.	Potential feed for Copper Rand mill in Chibougamau.
Grevet	Cambior inc.	Probable mineable reserves	11 700 000	0.48	–	–	8.55	–	36.7	–	Commercial production planned for 1995, subject to approval of feasibility study.
Hebecourt (New Insco)	Deak Resources Corporation Noranda Minerals Inc.	Diluted inventory	658 000	2.70	–	–	–	–	–	–	
Lac Yasinski - copper, nickel	Ressources Minières Platinor Inc. Ressources Minières Augyva Inc.	Geological potential	357 000	0.28	0.55	–	–	–	–	–	
Lac Yasinski - gold	Ressources Minières Platinor Inc. Ressources Minières Augyva Inc.	Geological potential	92 000	–	–	–	–	–	–	3.11	
Magusi (West, East, FW zones)	Deak Resources Corporation	Diluted inventory	2 459 777	1.9	–	–	2.85	–	34.	0.98	
Noyon	Cyprus Canada Inc. T & H Resources Ltd. Northway Explorations Limited	–	18 200 000	–	–	–	–	–	–	1.48	Planned, in January 1994, to resume drilling during the year.
Philbert	Exploration Cambiex Inc.	Geological	1 500 000	–	–	–	–	–	–	5.2	Released, in July 1993, results of surface drilling program.
Raglan (several deposits)	Falconbridge Limited	–	18 000 000	0.9	3.1	–	–	–	–	–	Feasibility study in progress for the production of 20 000 t/y of nickel by the late 1990s.
Troilus (Lac Frotet)	Metall Mining Corporation	Probable and possible mining reserve	40 200 000	0.12	–	–	–	–	1.5	1.4	Feasibility study completed. Seeking financing for infrastructure and mine development.

TABLE 6 (cont'd)

Deposits	Companies	Tonnage and Grade Description	Tonnage[1]	Grade[2] Cu	Ni	Pb	Zn	Mo	Ag	Au	Comments
			(tonnes)	(%)	(%)	(%)	(%)	(%)	(g/t)	(g/t)	
QUEBEC (cont'd)											
Vezza	Agnico-Eagle Mines Limited	Preliminary	1 940 000	–	–	–	–	–	–	5.04	Potential feed for the Eagle mill in Joutel.
West MacDonald (Gallen)	Deak Resources Corporation Noranda Minerals Inc.	Diluted inventory	1 105 000	0.20	–	–	6.81	–	30.	1.0	Produced during the periods 1955-59 and 1981-85.
ONTARIO											
Beatty Hislop	Hemlo Gold Mines Inc. Glimmer Resources Inc.	Preliminary	1 200 000	–	–	–	–	–	–	11.4	Planned, in September 1993, additional surface drilling.
Buffonta (Kerr open pit)	Gwen Resources Ltd. Deak Resources Corporation	Drill indicated	363 000	–	–	–	–	–	–	5.1	
Dome (open pit)	Placer Dome Canada Ltd.	Open pit	22 500 000	–	–	–	–	–	–	2.3	Production decision made in January 1994.
Duport (Shoal Lake)	Consolidated Professor Mines Limited	Geological	1 800 000	–	–	–	–	–	–	12.	Permits received in early 1993 to proceed with feasibility study.
Goldlund	Locke Rich Minerals Ltd.	–	709 000	–	–	–	–	–	–	4.8	Planned, in April 1993, a $50 000 feasibility study.
Hemlo Interlake	Franco-Nevada Mining Corporation Limited	In-situ	10 000 000	–	–	–	–	–	..	6.34	Down-dip extension of Hemlo orebody.
Hislop	Hemlo Gold Mines Inc. Glimmer Resources Inc.	Geological	983 699	–	–	–	–	–	–	11.6	Planned, in December 1993, additional surface drilling in early 1994.
Hislop - Creek and Main zones	Stroud Resources Ltd.	Drill proven and drill indicated	1 014 465	–	–	–	–	–	–	6.31	Planned, in October 1993, to conduct pre-feasibility study to decide whether or not to explore from underground.
Holloway (Lightning zone)	Hemlo Gold Mines Inc. Freewest Resources Inc. Teddy Bear Valley Mines Ltd.	Geological	5 200 000	–	–	–	–	–	–	8.4	Awaiting results of feasibility study. Production decision expected in early 1994.
Madsen mine	Madsen Gold Corp.	Mineable	523 600	–	–	–	–	–	–	11.4	Feasibility study in progress as at April 1993.
Marshall Lake	Challenger Minerals Ltd. Aur Resources Inc.	Geological	1 111 000	0.94	–	–	3.20	–	70.6	0.41	Planned, in January 1994, additional surface drilling.
Moss Lake	Hemlo Gold Mines Inc. Central Crude Ltd. Storimin Exploration Limited Tandem Resources Ltd.	Probable and possible	74 583 172	–	–	–	–	–	–	1.1	Planned, in June 1993, additional surface drilling.

Musselwhite (Opapimiskan Lake)	Placer Dome Canada Ltd. TVX Gold Inc.	Measured and indicated resource	4 245 000	–	–	–	–	–	–	9.52	Updating, in December 1993, resource estimate based on drilling program of summer 1993.
Robertson Twp.	Queenston Mining Inc. Strike Minerals Inc.	Preliminary	363 000	1.1	–	–	3.8	–	–	–	
Springpole - Portage zone	Akiko-Lori Resources Ltd. Gold Canyon Resources Ltd.	–	607 826	–	–	–	–	–	–	7.2	Surface drilling as at January 1994.
Victor	Inco Limited	Geological	36 000 000	6.•	2.•	–	–	–	..	1.•	Planning, in January 1994, a $60 million exploration program. Also contains platinum and palladium.
MANITOBA											
Farley Lake	Granduc Mining Corporation Manitoba Mineral Resources Ltd. Mingold Resources Inc.	Open-pit mineable	2 200 000	–	–	–	–	–	–	3.4	Part of Keystone project.
Fer	Canmine Resources Corporation	Geological	1 700 000	0.68	–	0.34	3.21	–	15.4	1.	Surface drilling as at January 1994.
Minago	Black Hawk Mining Inc.	Geological	10 502 000	–	1.19	–	–	–	–	–	Viability sensitive to price of nickel.
MacLellan mine	Black Hawk Mining Inc.	Proven, probable and possible	1 061 600	–	–	–	–	–	–	6.3	Part of Keystone project.
Puffy Lake mine	Pioneer Metals Corporation	Recoverable proven and probable	855 100	–	–	–	–	–	–	6.7	Planned, in December 1993, infill drilling starting January 1994.
San Antonio	Rea Gold Corporation	Diluted proven, probable and possible	1 361 000	–	–	–	–	–	–	7.61	Pre-feasibility study started in fall 1993.
Snow Lake (Nor-Acme)	High River Gold Mines Ltd.	Proven, probable and possible geological	3 816 889	–	–	–	–	–	–	6.40	Drilling as at August 1993.
SASKATCHEWAN											
Bigstone Lake	Granges Inc. Cameco Corporation	–	3 583 000	1.8	–	–	1.1	–	–	–	$300 000 exploration program planned for 1993.
Contact Lake (Preview Lake) - Bakos zone	Cameco Corporation Uranerz Exploration and Mining Limited Westward Explorations Ltd.	Geological	1 619 000	–	–	–	–	–	–	9.6	Planned, in November 1993, to sample and test mine.
Contact Lake (Preview Lake) - Pap zone	Cameco Corporation Uranerz Exploration and Mining Limited Westward Explorations Ltd.	Geological	365 000	–	–	–	–	–	–	12.1	
Hanson Lake	Cameco Corporation Billiton Metals Canada Inc.	Geological	13 080 000	1.26	–	–	4.95	–	24.3	0.52	Planned, in July 1991, additional drilling.
Komis	Waddy Lake Resources Inc. Golden Rule Resources Ltd.	Mineable	272 547	–	–	–	–	–	–	16.	Planned, in January 1994, to mine a 10 000-t bulk sample. Commercial production expected in late 1994.

TABLE 6 (cont'd)

Deposits	Companies	Tonnage and Grade Description	Tonnage[1]	Grade[2] Cu	Ni	Pb	Zn	Mo	Ag	Au	Comments
			(tonnes)	(%)	(%)	(%)	(%)	(%)	(g/t)	(g/t)	
SASKATCHEWAN (cont'd)											
Weedy Lake - B zone	Tyler Resources Inc. Golden Rule Resources Ltd. Cameco Corporation	Inferred geological	314 000	–	–	–	–	–	–	4.8	
Weedy Lake - Golden Heart	Tyler Resources Inc. Golden Rule Resources Ltd. Cameco Corporation	Geological	687 010	–	–	–	–	–	–	10.	Planned, in July 1993, a $400 000 drilling program.
BRITISH COLUMBIA											
Bralorne Pioneer mine	Avino Mines & Resources Limited	Proven, probable and possible	965 000	–	–	–	–	–	–	9.2	Surface and underground exploration in progress during 1993.
Cirque (Stronsay)	Curragh Inc.	Drill indicated	52 200 000	–	–	2.	8.	–	42.[e]	–	Mine development certificate issued in 1992. Cominco Ltd., Teck Corporation, Korea Zinc Co. Ltd. and Samsung Corp. offered to purchase, subject to court and regulatory approval, the Cirque deposit.
Debbie	Westmin Resources Limited	Probable and possible geological	471 956	–	–	–	–	–	–	6.27[e]	Optioned high-grade zone to contractor for mining.
Driftpile Creek	Teck Corporation	Geological resource	20 000 000	–	–	–	2.38[k]	–	–	–	Found a new zone in late 1993.
Eskay Creek	Prime Resources Group Inc. Stikine Resources Ltd.	Proven and probable	1 100 000	0.77	–	2.9[e]	5.6	–	2950.	65.	Feasibility study completed during fall 1993. Looking at possibility of shipping ore directly to smelter.
Expo - Hushamu zone	Jordex Resources Inc. Moraga Resources Ltd. BHP Minerals Canada Ltd.	Mineable open pit	172 000 000	0.28	–	–	–	0.009	–	0.3	Proceeding, in August 1993, with a $450 000 pre-feasibility study.
Fish Lake	Taseko Mines Limited Cominco Ltd.	Diluted mineable	870 000 000	0.23	–	–	–	–	–	0.429	Results of detailed pre-feasibility study conducted by Kilborn Engineering expected in early 1994.
Frasergold	Eureka Resources, Inc. Sirius Resource Corporation	Drill indicated reserve base	11 000 000	–	–	–	–	–	–	2.[e]	Planned, in August 1993, additional drilling and metallurgical testing.
Gibraltar North	Newcoast Silver Mines Ltd. and Gibraltar Mines Limited	Mineable	45 000 000	0.4	–	–	. .	–	. .	. .	Proximal to Gibraltar mill.
Huckleberry	New Canamin Resources Ltd. Kennecott Canada Inc.	Drill indicated and drill inferred	69 000 000	0.57	–	–	–	–	–	–	Tonnage and grade recalculated in late 1993.

J&L - Main and Yellowjacket zones	Equinox Resources Ltd. Pan American Minerals Corp.	Probable and possible geological	4 604 000	–	–	2.7	4.7	–	76.	5.7	Planned, in August 1993, additional drilling.
Kemess-North	El Condor Resources Ltd.	Geological	157 000 000	0.18	–	–	–	–	–	0.38	
Kemess-South	St. Philips Resources Inc. El Condor Resources Ltd.	Mineable	195 921 000	0.23	–	–	–	–	–	0.62	Seeking provincial mine development certificate.
Kerr	Placer Dome Canada Ltd.	Mineral-bearing material	125 700 000	0.62	–	–	–	–	2.4e	0.3	Planned to calculate new resource estimate by early 1993.
Kli Yul	Hemlo Gold Mines Inc. Vital Pacific Resources Ltd. Kennecott Canada Inc.	Drill indicated	1 000 000	0.45	–	–	–	–	–	2.	Planned, in March 1993, additional drilling.
Mets	Golden Rule Resources Ltd. Manson Creek Resources Ltd.	Probable geological	53 300	–	–	–	–	–	–	12.	Option to mine extended one year.
Mt. Milligan	Placer Dome Canada Ltd.	Mineable	298 000 000	0.22	–	–	–	–	–	0.45	Mine development and energy project certificate issued in late 1993.
Mt. Polley (S-19 Pit)	Imperial Metals Corporation	Mineable	49 000 000	0.383	–	–	–	–	–	0.556	Mine development certificate issued in 1992.
QR	CMP Resources Ltd.	Preliminary	1 200 000	–	–	–	–	–	–	5.22	Amended mine development certificate issued early 1994. Construction could start early 1994.
Red Mountain - Marc and AV zones	Lac Minerals Ltd.	Indicated and inferred geologic resource	2 500 000	–	–	–	–	–	–	13.	Planned, in March 1993, to spend $5 000 000 on exploration during 1993.
SB (Silver Butte)	Westmin Resources Limited Tenajon Resources Corp.	Possible geological	37 200	–	–	–	–	–	–	20.6	Underground exploration and test milling during 1993.
Similco Mine - Alabama	Princeton Mining Corporation	Possible	9 000 000	0.32	–	–	–	–	–	. .	Proximal to Similkameen mill.
Siwash North (Elk)	Fairfield Minerals Ltd.	Drill indicated	122 000	–	–	–	–	–	25.	54.5	Bulk sample test carried out during 1993.
Spectrum	Columbia Gold Mines Ltd. Norcal Resources Ltd. International Northair Mines Ltd.	Drill indicated	499 000	–	–	–	–	–	–	9.6	Drilled during 1993.
Tillicum Mountain - Heino Money and East zones	Columbia Gold Mines Ltd.	Drill indicated and mineable	450 000	–	–	–	–	–	–	10.	Provincial approval received in fall 1993 to conduct a 9000-t bulk sample test.
Tulsequah Chief	Redfern Resources Ltd.	–	8 498 190	1.48	–	1.17	6.85	–	104.	2.6	Infill drilling during 1993.
Vine	Consolidated Ramrod Gold Corporation Cominco Ltd.	Proven and probable	545 000	0.1e	–	4.65	2.39	–	51.83	1.82	In 1993, planned further surface drilling to expand resources to justify a dedicated concentrator.

TABLE 6 (cont'd)

Deposits	Companies	Tonnage and Grade Description	Tonnage[1]	Grade[2]							Comments
				Cu	Ni	Pb	Zn	Mo	Ag	Au	
			(tonnes)	(%)	(%)	(%)	(%)	(%)	(g/t)	(g/t)	
YUKON TERRITORY											
Brewery Creek	Loki Gold Corporation Hemlo Gold Mines Inc.	Geological	14 739 600	–	–	–	–	–	–	1.9	Planned, in November 1993, to prepare updated resource estimate.
Casino	Pacific Sentinel Gold Corp.	Preliminary	378 000 000	0.30	–	–	–	0.025	–	0.3	In September 1993, expected to continue drilling into 1994.
DY (underground)	Curragh Inc.	Probable	9 390 000	–	–	5.50	6.62	–	66.30	0.68	
Williams Creek (oxide)	Thermal Exploration Company Western Copper Holdings Limited	Mineable (open pit)	11 300 000	1.15	–	–	–	–	–	0.51	In 1993, a pilot plant produced 360 kg of copper cathode from a bulk metallurgical test.
NORTHWEST TERRITORIES											
Con mine - tailings	Miramar Mining Corporation	–	4 620 000	–	–	–	–	–	0.3[e]	1.	No plans to produce have been announced.
High Lake	Aber Resources Ltd. Kennecott Canada Inc.	–	4 500 000	3.5	–	–	2.5	–	–	0.79	Drilled new targets during 1993.
Izok Lake (including Inukshuk)	Metall Mining Corporation	Mineable	16 600 000	2.2	–	2[e]	11.5	–	60.	0.1[e]	Feasibility study in progress at year-end 1993.
Nicholas Lake - main showing	Athabasca Gold Resources Ltd. Royal Oak Mines Inc.	Probable and possible	907 000	–	–	–	–	–	–	13.	
Prairie Creek mine	San Andreas Resources Corp.	Proven, probable and possible	3 856 000	0.4[e]	–	13.01	14.65	–	202.	–	Updated mineral inventory in January 1994.

Source: Natural Resources Canada, based on public company reports.
– Nil; . . Not available; [e] Author's estimate; [k] Combined lead and zinc grade.
[1] One tonne = 1.1023113 short tons. [2] One gram per tonne (g/t) = 0.02916668 troy ounces per short ton.

Canadian Mineral Exploration

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The Federal-Provincial Exploration Survey

The year 1992 is the fourth year in which Natural Resources Canada (NRCan) has coordinated the collection of all statistics for expenditures on general exploration (off-property), while Statistics Canada has coordinated the collection of statistics for mine-site (on-property) exploration, which are required for the preparation of Canada's National Accounts. Both federal agencies cooperate with the provinces to assemble and publish the comprehensive national exploration statistics presented here.

Activity

Exploration Expenditures, 1992 and 1993

About 600 companies were operators of Canadian non-petroleum mineral exploration projects in 1992, down from 732 companies in 1991. Exploration expenditures in 1992 (general exploration plus mine-site exploration) totalled $385 million, down from $532 million in 1991. General exploration totalled $326 million in 1992, a 30% decrease from 1991. The amount spent on mine-site exploration (the search for new mines on the properties of producing mines or on the properties of deposits firmly committed to production) was $59 million, down by 12% from 1991. In 1992, expenditures by senior companies were $305 million, compared to $415 million in 1991; junior companies spent $80 million in 1992, compared to $117 million the previous year.

Company forecasts early in 1993 suggest a possible increase in total exploration expenditures for 1993 to $435 million. Expenditures by senior companies are expected to be $299 million while expenditures by junior companies are forecast to be $136 million. Results for the Preliminary 1993/Intentions 1994 exploration survey are expected to be available by late March 1994.

The proportion of Canadian exploration expenditures accounted for by junior (exploration) companies (Table 7, Figure 1) rose sharply after the introduction of the Mining Exploration Depletion Allowance (MEDA) in 1983, peaked in 1987 and 1988, and subsequently declined in spite of the replacement of MEDA by the Canadian Exploration Incentive Program (CEIP) on January 1, 1989. CEIP, which offered incentives about equivalent to MEDA, was cancelled effective March 1, 1991. In 1992, exploration expenditures by junior companies reached the lowest level since 1979 (corrected for inflation).

Flow-Through Shares as a Source of Exploration Financing, 1993

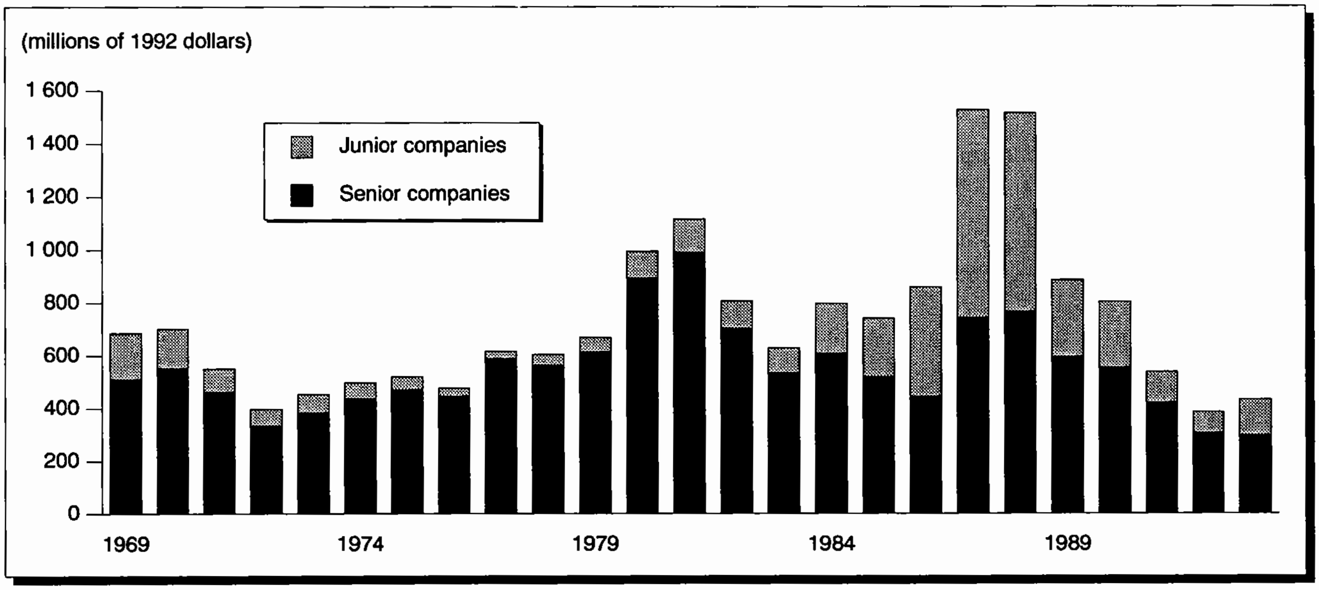
NRCan estimates that companies listed on Canadian stock exchanges sold about $70 million of flow-through shares in 1993, an increase of $25 million from 1992 (Table 1). In 1992, the $45 million raised through the issue of flow-through shares financed close to 12% of total Canadian exploration. In 1993, flow-through shares would have provided about 16% of total exploration, based on the forecast of $435 million expressed in early 1993.

Claim Staking, 1993

The area of mineral claims staked in Canada in 1993 (Figure 2, Table 2) was 27 million hectares (ha), down by 18% compared to the all-time annual record of 33 million ha in 1992.

Compared to 1992, the area staked in 1993 increased in Quebec, Newfoundland and, most significantly, in the Northwest Territories (64%), in Saskatchewan (2.5 times as large) and in Manitoba (3.5 times as large). The increased staking in Saskatchewan and Manitoba is largely due to the growing interest in diamond exploration. The area staked in the Northwest Territories (44% of the Canadian total), Alberta (38%) and

Figure 1
Exploration Expenditures in Canada, by Junior and Senior Companies, 1969-93



Sources: Natural Resources Canada; Federal-Provincial Survey of Mining and Exploration Companies.
Notes: Total exploration expenditures for 1975 to 1981 are overstated by an average of about 17% relative to earlier and later years because of changes to the methodology used by Statistics Canada over the years. The 1993 data are intentions. Overhead expenditures are included.

Saskatchewan (8%) represents a combined area of 24 million ha, or 90% of the total area staked in Canada in 1993.

Areas staked were down by about 15% in Ontario, British Columbia and the Yukon; they were also down by 32% in New Brunswick and by 54% in Alberta. Despite the 54% decrease in Alberta, the area staked represents the second largest area ever staked in that province.

Exploration Activity by Type of Work, 1992

In 1992, Canadian field exploration expenditures consisted of drilling (46%), geology (18%), airborne plus ground geophysics (10%), rock work, including trenches, pits and underground workings (6%), geochemistry (5%), and unspecified field work (15%). These percentages are for fieldwork only and do not take into account land costs, field administration and exploration-related head office costs. When recalculated to reflect such costs, the above percentages decline to drilling, 38%; geology, 15%; airborne plus ground geophysics, 8%; rock work, 5%; geochemistry, 4%; and unspecified field work, 13%. Figure 3 shows the breakdown of those activities for general exploration and for mine-site exploration separately.

In Canada as a whole, 1992 exploration expenditures for airborne geophysics exceeded those for rock work for the first time since 1984 or earlier (such statistics were not gathered prior to survey year 1985). In the Northwest Territories, 1992 airborne geophysical expenditures of $3.6 million considerably exceeded the $0.5 million spent in 1991. This likely reflects the increased use in 1992 of airborne magnetometer surveys in the search for kimberlite intrusions.

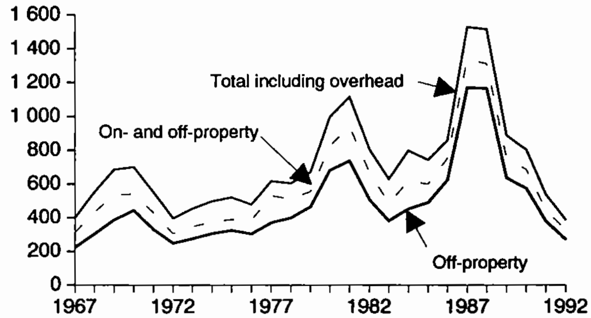
Exploration Drilling, 1992

In 1992, 1 517 886 m of surface exploration holes were drilled in Canada (Table 3, Figure 2), down by 28% from the 2 094 843 m drilled in 1991. Diamond drilling (1 381 006 m) constituted 91% of total metres drilled from the surface. In decreasing order of importance, Quebec, Ontario, British Columbia, Manitoba and the Northwest Territories were the busiest, jointly accounting for 70% of total surface drilling activity. Underground exploration drilling (both diamond drilling and other types of underground exploration drilling) totalled 510 752 m, a slight increase from the 480 166 m drilled in 1991. Quebec (with 197 023 m) and Ontario (with 132 915 m) together accounted for 65% of underground exploration drilling.

Figure 2
Selected Measures of Exploration Activity

Field Expenditures on Mineral Exploration, 1967-92
(all minerals except oil and gas)

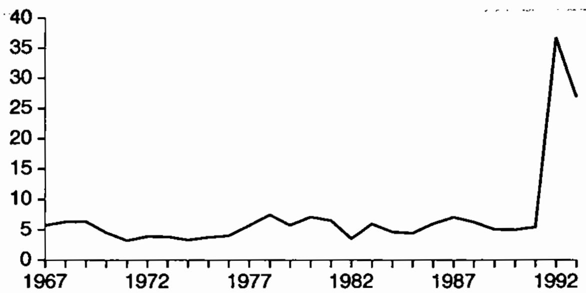
($ millions = 1992 dollars)



Sources: 1967-87, Statistics Canada, Exploration, Development and Capital Expenditures for Mining and Petroleum and Natural Gas Wells, Intentions (cat. 61-216, formerly cat. 61-007); 1988-92, Federal-Provincial Survey of Mining and Exploration Companies.
Note: Adjusted to 1992 dollars using Gross National Product deflator series.

Area of Mining Claims and Claim Blocks Recorded, 1967-93

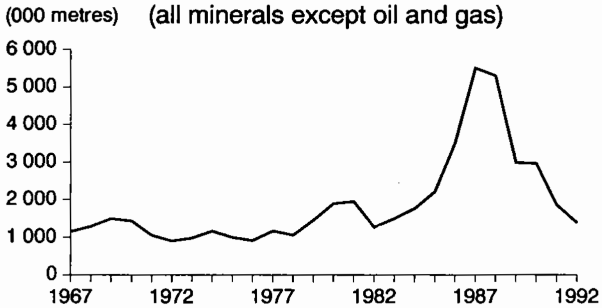
(ha millions)



Source: Information gathered annually by Natural Resources Canada from Provincial and Territorial Mining Recorders.

Surface Diamond Drilling, 1985-92
(all minerals except oil and gas)

(000 metres)



Source: 1967-84, Statistics Canada (cat. 26-201); 1985-92, Federal-Provincial Exploration Survey.
Note: Drilling statistics for 1967-84 are not strictly comparable to and may be understated relative to those for 1985-92.

Exploration Expenditures by Province and Territory, 1992

Measured in terms of exploration expenditures, the most active exploration provinces in 1992 (Tables 8 and 15, Figure 4) were Quebec ($94 million), Ontario ($77 million) and British Columbia ($72 million). These three provinces jointly accounted for 63% of total Canadian mineral exploration expenditures in 1992 (72% in 1991). Taking expenditures in the Northwest Territories into account ($43 million), this territory and the three provinces together accounted for 74% of total Canadian exploration expenditures in 1992.

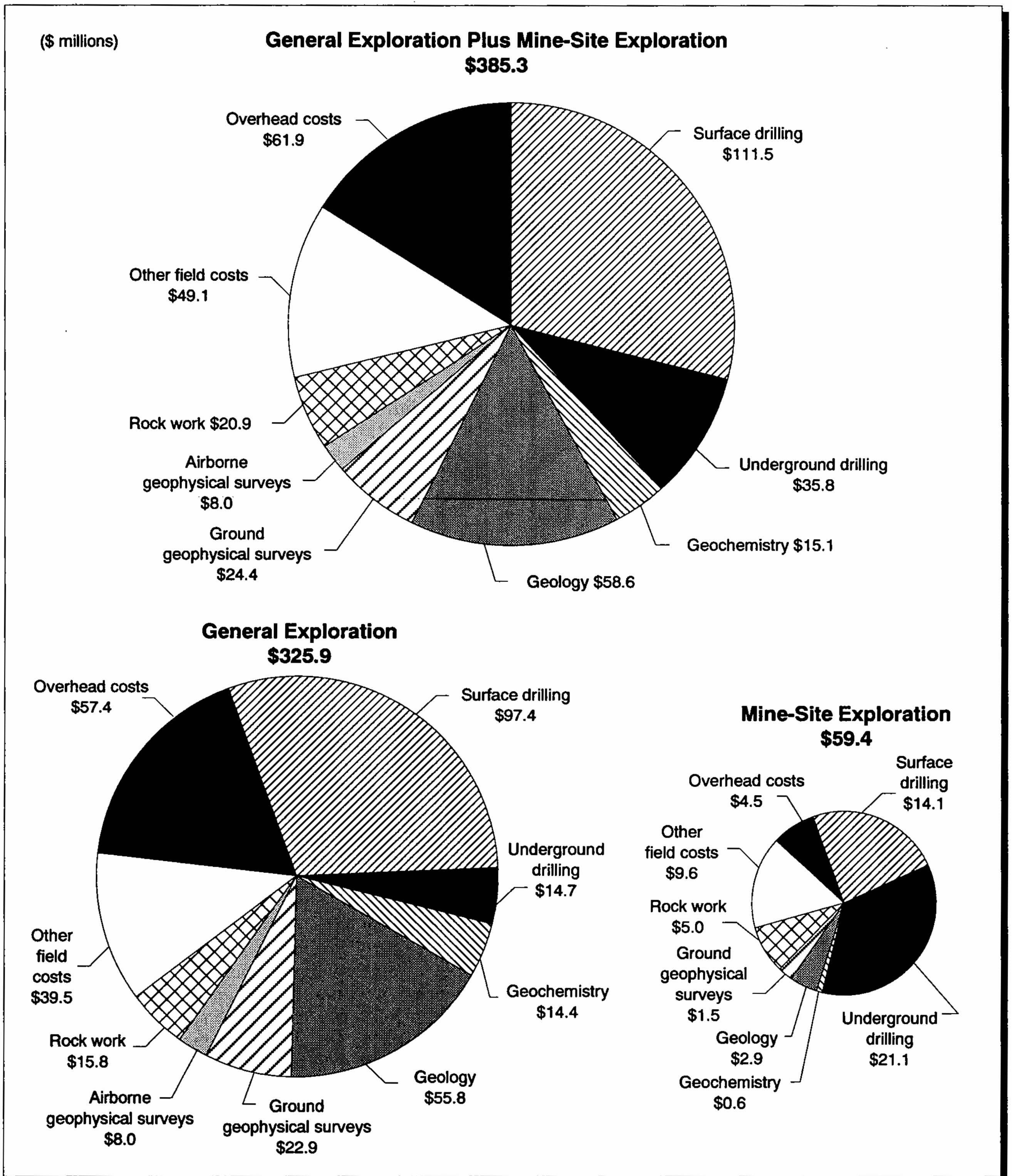
Exploration expenditures decreased in all provinces and territories except in Manitoba and the Northwest Territories. In Manitoba, exploration expenditures increased by $2 million, to $32 million. In the Northwest Territories, expenditures increased by 35% to $43 million as a result of the diamond exploration rush. The most significant exploration decreases occurred in British Columbia and in the Yukon where, compared to 1991, expenditures fell by 47% and 41%, respectively.

General exploration accounted for at least 80% of exploration expenditures in all provinces and territories, except in Manitoba where 30% of exploration expenditures were for mine-site exploration.

Expenditures by Commodity Sought, 1992

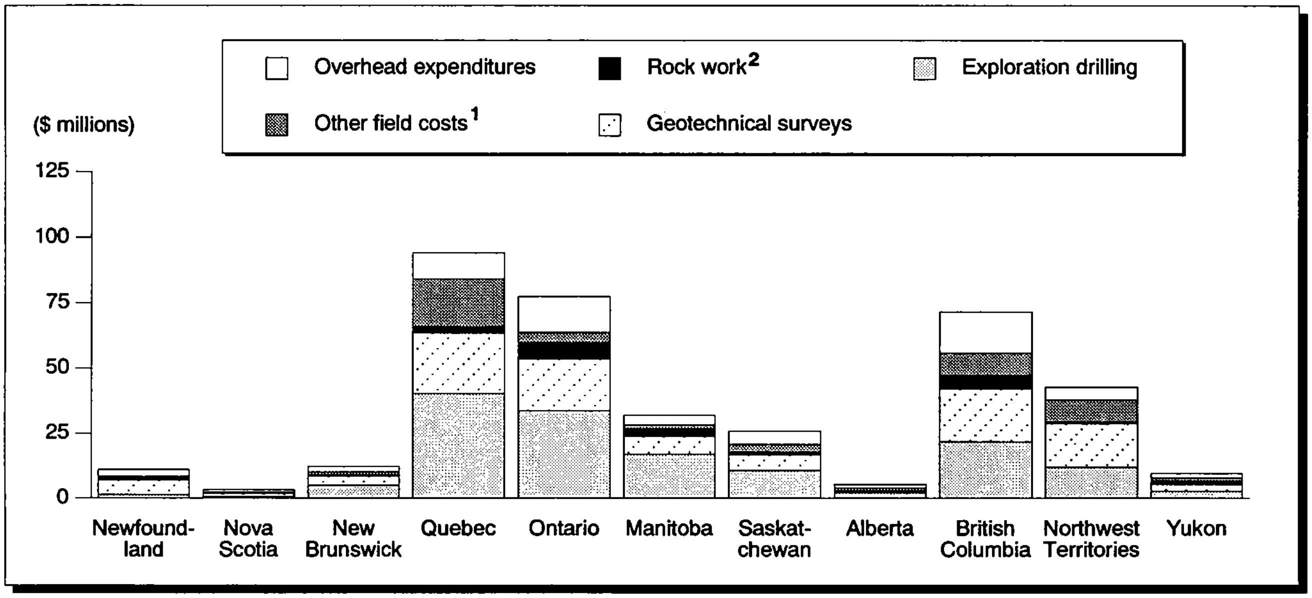
Base metals and precious metals remained the principal Canadian exploration targets in 1992 (Tables 4 and 6, Figure 5). Expenditures for base-metal exploration decreased by 16% to $180 million in 1992, compared to $214 million in 1991 (all expenditures quoted in this paragraph for individual commodities and commodity groups include a pro-rated portion of "commodity not specified" expenditures). Exploration for precious metals decreased by 45% in 1992 to $151 million, compared to $274 million in 1991. As precious-metal exploration was down much more than base-metal exploration, expenditures for base metals exceeded those for precious metals for the first time since 1983 or 1984. In 1992, base-metal exploration accounted for 47% of total Canadian exploration expenditures, compared to 40% in 1991; precious-metal exploration accounted for 39% in 1992 compared to 51% in 1991. Exploration expenditures for platinum group metals (included in precious metals) declined to $3.4 million in 1992 from $7.8 million in 1991.

Figure 3
Canadian Mineral Exploration Expenditures for 1992, with Expenditures by Category



Source: Federal-Provincial Survey of Mining and Exploration Companies.

Figure 4
Exploration Expenditures, by Province and Territory, 1992
Physical Work and Surveys



Source: Federal-Provincial Survey of Mining and Exploration Companies.
[1] Such as field supervision and line cutting. [2] Such as stripping, trenching, shaft-sinking and underground work.

Exploration expenditures for nonmetals totalled $27 million, about $19 million of which was incurred for diamond exploration. As a result, in 1992, exploration expenditures for the nonmetals ranked third after those for base metals and for precious metals. An increased interest in exploration for wollastonite ($CaSiO_3$), a mineral with increasing industrial uses, is evident, with some $1.3 million spent on exploration for this mineral in 1992 compared to $143 000 in 1991 (Table 5). A few Canadian wollastonite deposits are potential producers.

There was also increased interest in exploration for marble with $1.2 million spent during 1992 compared with $404 000 in 1991. Exploration expenditures for potash declined significantly during 1992 to only $882 000 compared to $4.7 million a year earlier.

Exploration expenditures for uranium in 1992 were about the same as in 1991, but coal exploration expenditures continued to decline to $7.3 million in 1992, down from $9.2 million in 1991.

Regional Expenditures by Commodity Sought, 1992

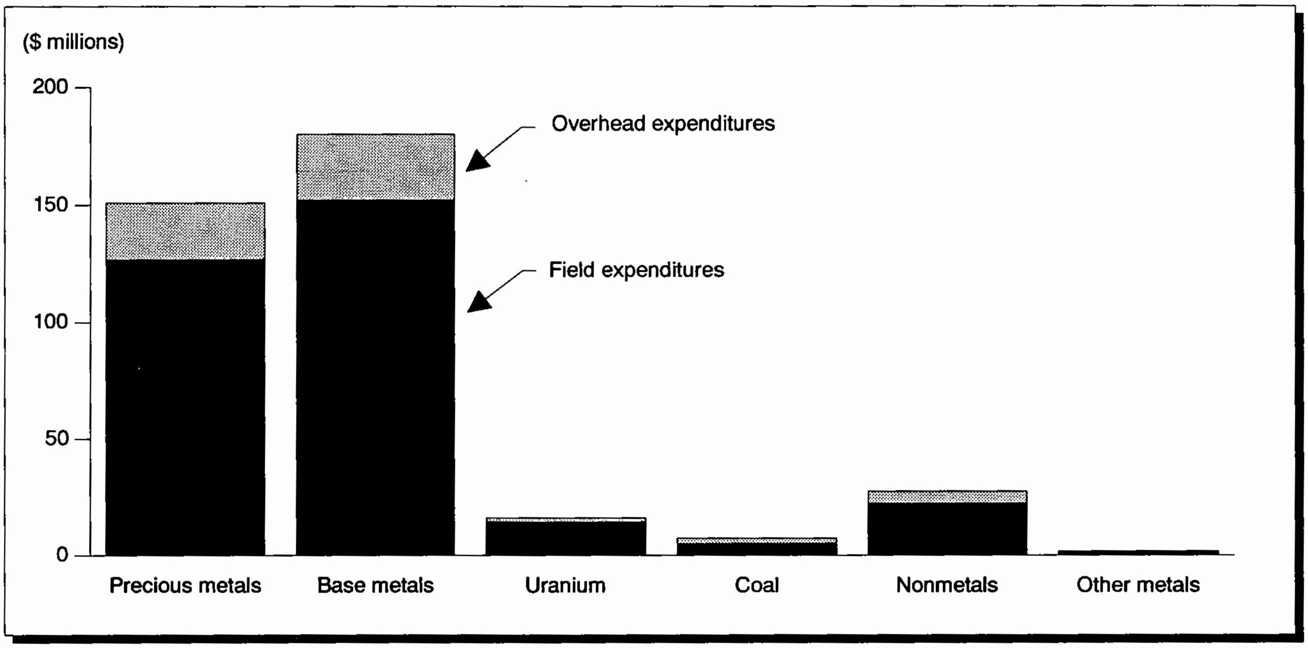
Diamonds were an important exploration target in the Northwest Territories, where they accounted for 31% of total N.W.T. exploration expenditures. Precious metals, almost entirely gold, were the main targets of exploration in Quebec, British Columbia, and the Northwest Territories, where they accounted for 31%, 26% and 9%, respectively, of the Canadian total for precious metals (Table 10, Figure 6). Base metals were the principal commodities explored for in Ontario, Manitoba, New Brunswick, Newfoundland, the Yukon Territory and Nova Scotia. Uranium remained the principal exploration target in Saskatchewan in 1992, but base metals replaced diamonds as the second-most-sought commodity. Exploration expenditures for potash in Saskatchewan were only $755 000 compared to the $4.5 million spent during 1991. Coal remained the principal exploration target in Alberta, followed by diamonds (which have held second place since 1990 when they first surpassed uranium).

Regional Expenditures by Type of Company, 1992

Companies exploring in Canada are classified into six groups, as follows:

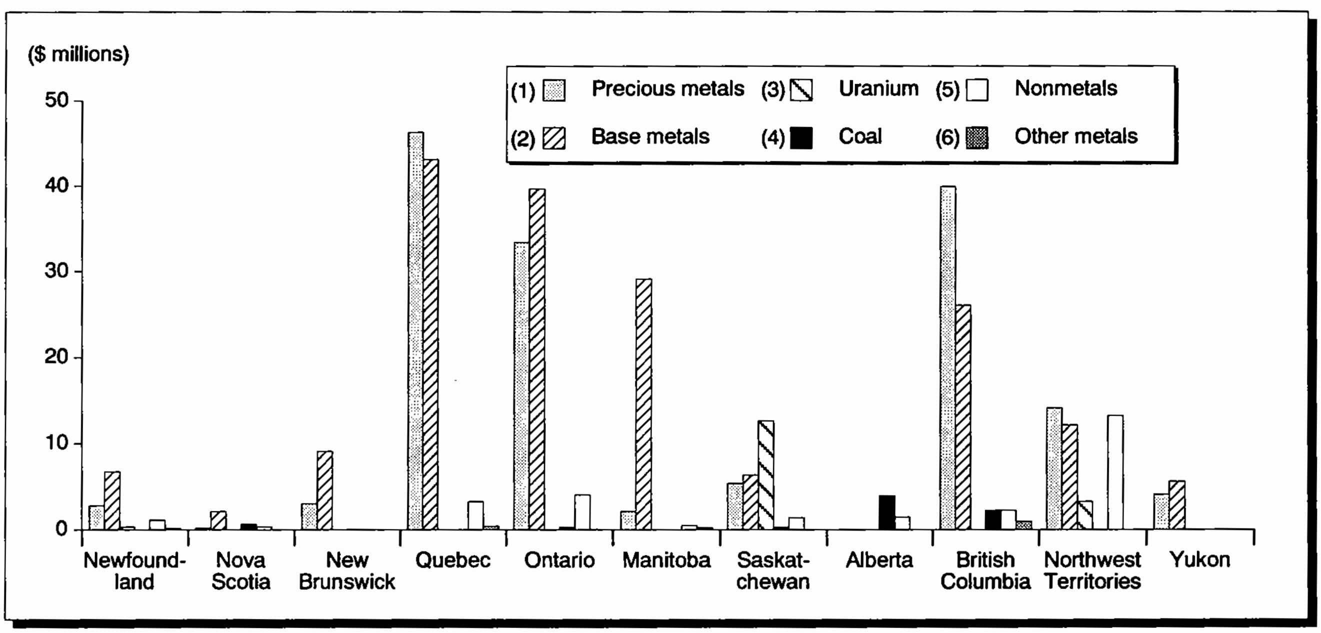
1) **Producers**: Companies with a producing mine or part-ownership in a producing mine in Canada; companies that own more than 50% of the shares of a producing mining company.

Figure 5
Exploration Expenditures, by Commodity Sought, 1992[1]



Source: Federal-Provincial Survey of Mining and Exploration Companies.
[1] Some $3.4 million of expenditures were for unspecified commodities. This amount has been pro-rated among the six commodity groups shown here.

Figure 6
Regional Exploration Expenditures, by Commodity Sought, 1992[1]



Source: Federal-Provincial Survey of Mining and Exploration Companies.
[1] Some 3.4 million of exploration expenditures were for unspecified commodities. This amount has been pro-rated among the six commodity groups shown here.

Also includes oil companies or foreign companies with a producing Canadian mine.

2) **Affiliates of producing mining companies**: Wholly owned or majority-owned incorporated subsidiaries of producers.

3) **Oil companies**: Oil companies, both domestic and foreign, with non-petroleum exploration projects in Canada. Oil companies with producing mines are included with producers.

4) **Foreign companies**: This group excludes foreign oil companies and foreign companies with a producing mine in Canada.

5) **Junior companies and prospectors**.

6) **Other companies**: Canadian-owned companies engaged in mineral exploration such as forestry, construction and consulting firms, and government-owned mining companies that do not own a producing mine.

A company is classified to the first of these groups it fits. For example, exploration statistics reported by an oil or foreign company with a producing Canadian mine is included in producers, rather than in Category 3 (oil companies) or Category 4 (foreign companies). Exploration by a foreign-owned oil company appears in Category 3 (oil companies), and not in Category 4 (foreign companies).

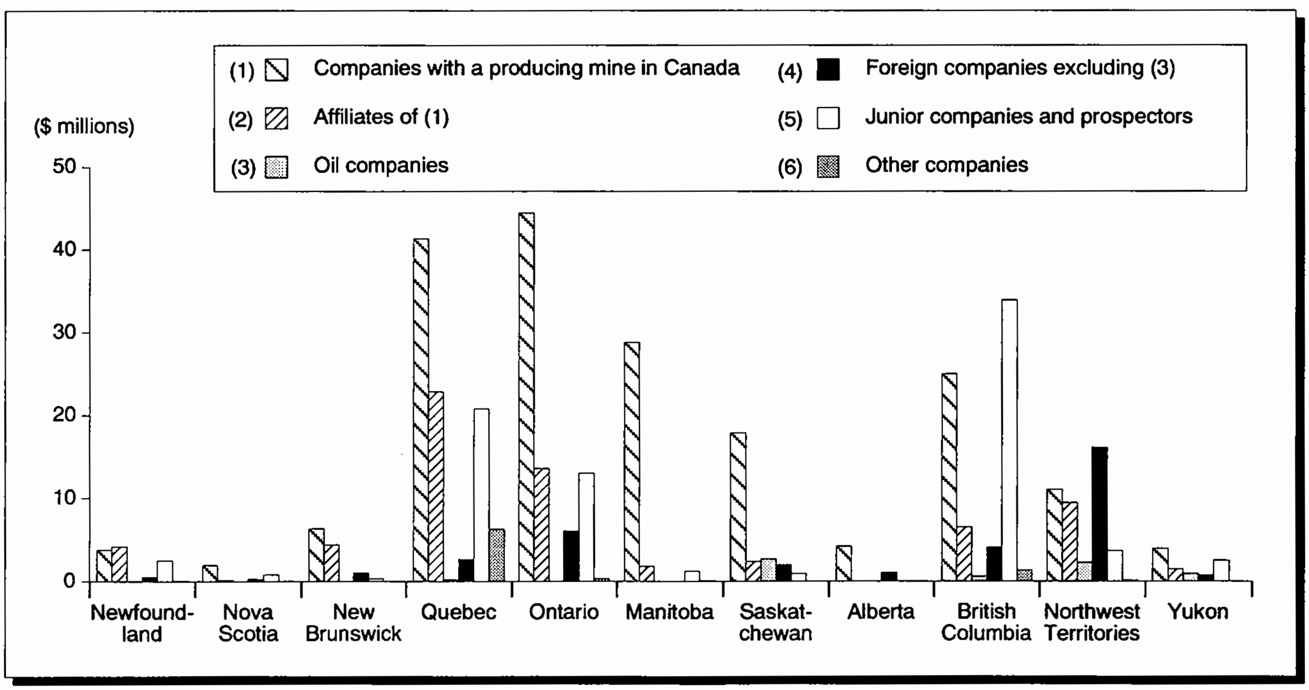
In 1992, as in the previous three years, producing companies and their affiliated companies were, by far, the principal exploration spenders in all provinces and territories except for British Columbia, where junior companies accounted for 47% of exploration expenditures in 1992 (Table 14, Figure 7).

Foreign companies were the most active in the Northwest Territories, where they spent $16 million in 1992 compared to $6 million in 1991. The amount spent by foreign companies in the Northwest Territories represents nearly half of the $35 million they spent in Canada in 1992. They spent $31 million in 1991.

Expenditures by Type of Company and Commodity, 1992

Junior companies directed 27% ($22 million) of their exploration expenditures at base metals and 58% ($47 million) at precious metals in 1992, compared to 24% ($28 million) at base metals and 72% ($83 million) at precious metals in 1991 (Table 11, Figure 8). Producing companies and their

Figure 7
Regional Exploration Expenditures, by Type of Company, 1992



Source: Federal-Provincial Survey of Mining and Exploration Companies.

affiliates directed 57% ($145 million) of their exploration expenditures at base metals and 34% ($88 million) at precious metals in 1992, compared to 47% ($172 million) at base metals and 46% ($168 million) at precious metals in 1991.

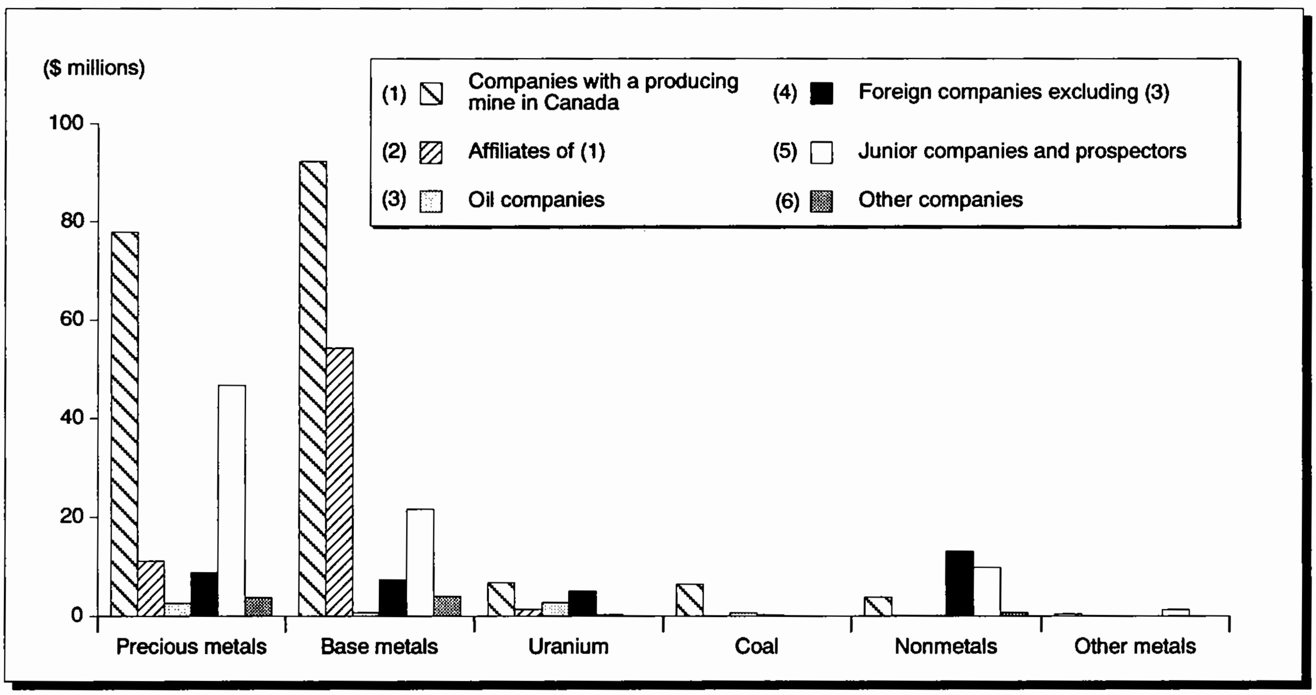
In 1992, foreign companies directed 25% ($8.8 million) of their exploration expenditures at precious metals, 21% ($7.4 million) at base metals, 15% ($5.0 million) at uranium, and 38% ($13.1 million) at nonmetallic minerals (chiefly diamonds). Relative to 1991, foreign companies significantly increased their expenditures on exploration for the nonmetals (diamonds), while significantly decreasing their expenditures on exploration for precious metals.

EXPLORATION FOR DIAMONDS

Diamond exploration expenditures in 1992 totalled about $19 million, up from $7.0 million in 1991, $7.6 million in 1990 and $5.1 million in 1989 (Table 5). Companies spent $13.2 million on diamond exploration in the Northwest Territories, $2.6 million in Ontario, and about $2 million in Alberta. Foreign-based companies accounted for 70% of total Canadian diamond exploration expenditures and Canadian juniors accounted for 21%. Dia Met Minerals and BHP Minerals Canada released evaluations from kimberlite pipes sampled near Exeter Lake (Pipes 1, 3 and 4), located 25-30 km northwest of the original Point Lake discovery, on their Lac de Gras property in the Northwest Territories (Table 16). These companies also obtained evaluations for the diamonds recovered from the Point Lake and Pipe 2 kimberlites, but Dia Met has said that values obtained for those two pipes are too low to justify further exploration.

A heavy media bulk-sample plant was constructed at the Lac de Gras site, reportedly to test bulk samples from Pipes 3 and 4. The latest information is that the Fox Lake and Koala Lake kimberlite pipes are to be tested, but it is not clear whether these pipes are the same ones as Pipes 3 and 4. A decline, started at Fox Lake in September 1993, to a vertical depth of 250 m will yield a 5000-t bulk sample, with a further 3500 t to be taken from the Koala Lake Pipe using a 36-inch diameter drill operating from lake ice. In 1993, BHP spent some $11 million in the Lac de Gras area. By September, 26 kimberlite intrusions had

Figure 8
Exploration Expenditures, by Type of Company and Commodity, 1992[1]



Source: Federal-Provincial Survey of Mining and Exploration Companies.

[1] Some $3.4 million of exploration expenditures were for unspecified commodities. This amount has been pro-rated among the six commodity groups shown here.

been identified on the property. Several others of these are also diamondiferous and have yielded encouraging drill results. Bulk samples of drill core, each about 200 t, are being taken to better assess their diamond contents. Using available information, brokerage firms have calculated that Pipe 4 contains in the range of 80-150 Mt grading an average of 124.7 carats of diamonds per hundred tonnes; the average value per carat is US$112.

A total of some 100 kimberlite intrusions have already been confirmed by drilling in the Lac de Gras region, at least 25 of which contain diamonds.

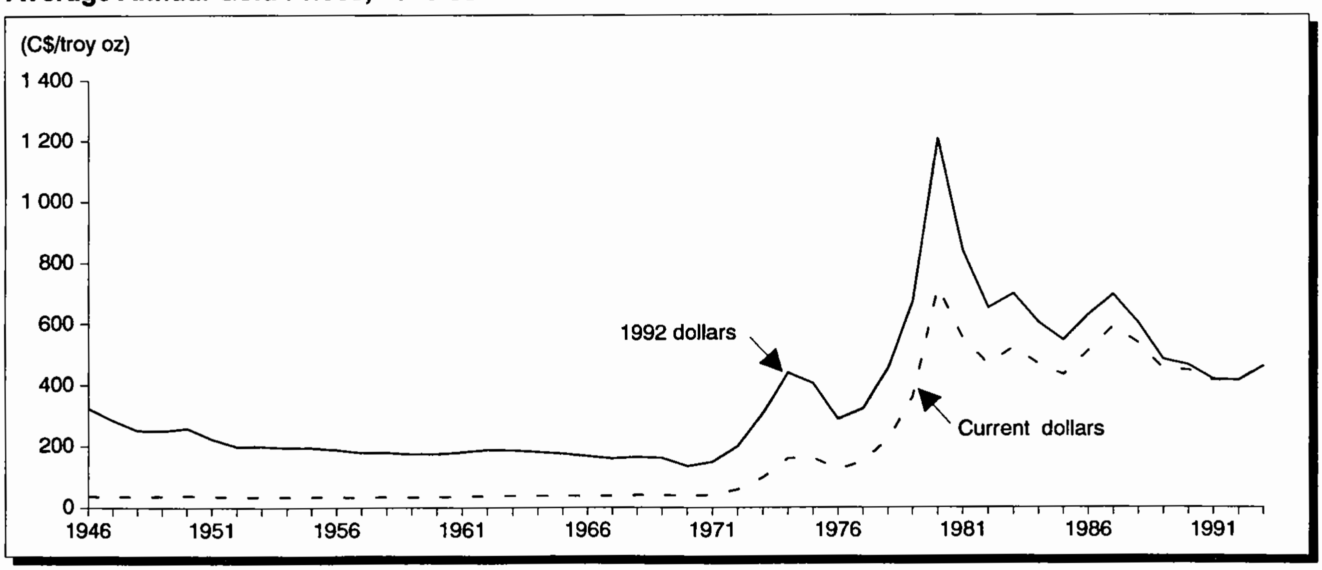
About 35 km to the southeast of Point Lake, drilling by Kennecott Canada Inc., with its partners Aber Resources Limited, SouthernEra Resources Limited and Commonwealth Gold Corporation, intersected two closely adjacent diamondiferous intrusions named the Tli Kwi Cho discovery on the property of DHK Resources (DHK is one third owned by each of Dentonia Resources Ltd., Horseshoe Gold Mining Inc. and Kettle River Resources Ltd.). Public information concerning diamond content is limited but appears encouraging because Kennecott is taking a 5000-t bulk sample from the kimberlites using an underground decline; the sample will be trucked by winter road to a pilot plant located at the Con mine at Yellowknife.

Diamond exploration is also going on elsewhere in Canada: further to the east in the Northwest Territories; in Alberta, where at least 16 diamonds, some of them gem-quality, with the largest 0.8 carats but of poor quality, have been discovered in glacial drift and in stream gravels; in southeastern British Columbia; near Fort à la Corne, Saskatchewan; and in Manitoba, Ontario, Quebec, and Labrador. As yet, no discoveries of economic importance, other than those at Lac de Gras, have been announced.

Analysis of Gold Discoveries

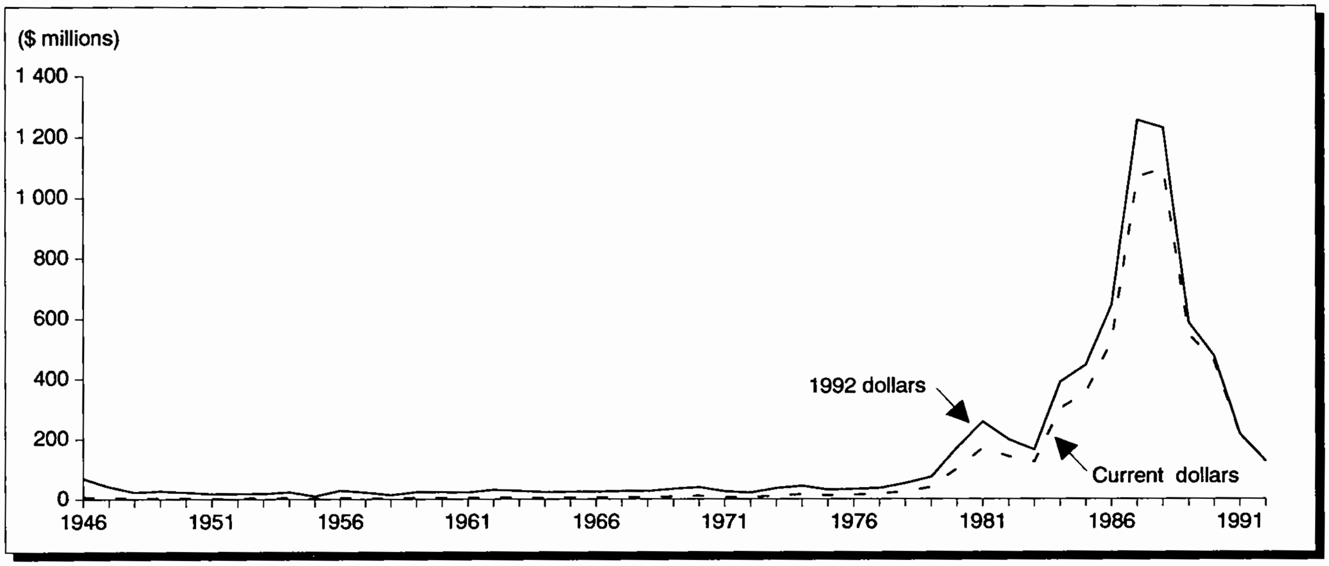
An analysis undertaken by NRCan concerning discovery rates and discovery costs for gold deposits in Canada over the period 1946-90 shows that, between 1983 and 1990, the combination of flow-through shares, improved MEDA, CEIP, and favourable gold prices (Figure 9) led to an increase in exploration activity in Canada, a major increase in gold exploration expenditures (Figure 10), and to the discovery of substantial quantities of gold relative to the amounts discovered in the period 1946-79 (Figure 11). Over the period 1983-90, exploration expenditures for gold totalled some $5 billion (1992 dollars), or almost two thirds of all exploration expenditures in Canada for non-petroleum minerals. Because of the discovery in 1981 of the very large Hemlo gold deposit in Ontario, the period 1980-82 is atypical.

Figure 9
Average Annual Gold Prices, 1946-93



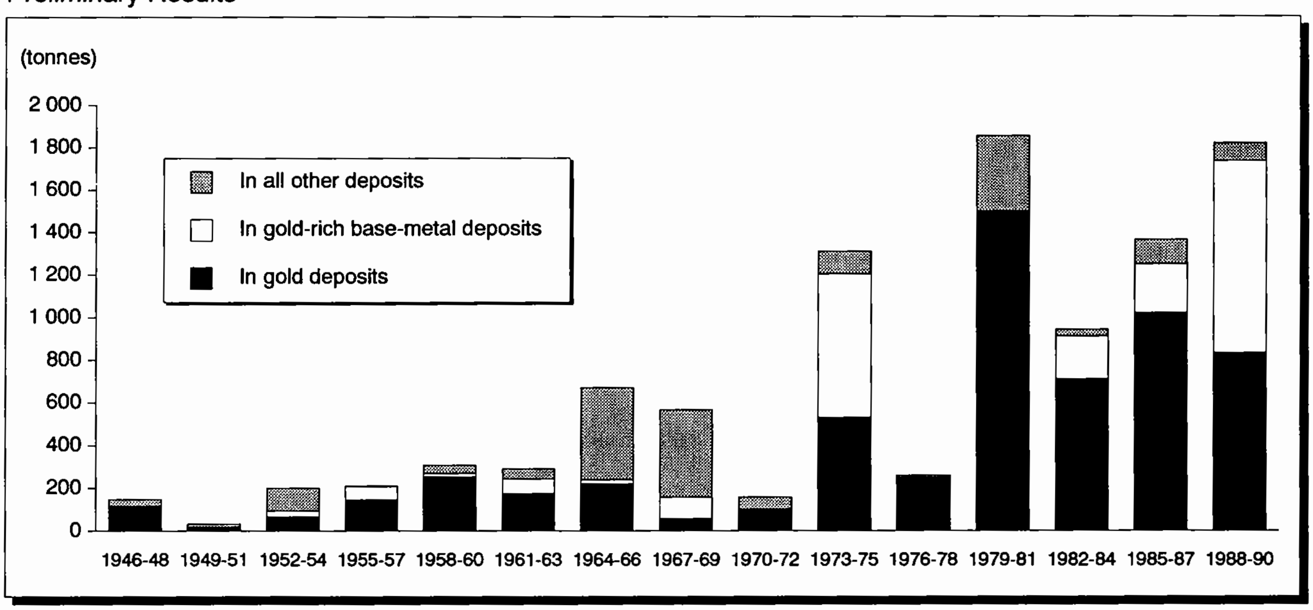
Source: Natural Resources Canada, based on average annual London Gold Market prices.

Figure 10
Exploration Expenditures in Canada for Gold, 1946-92



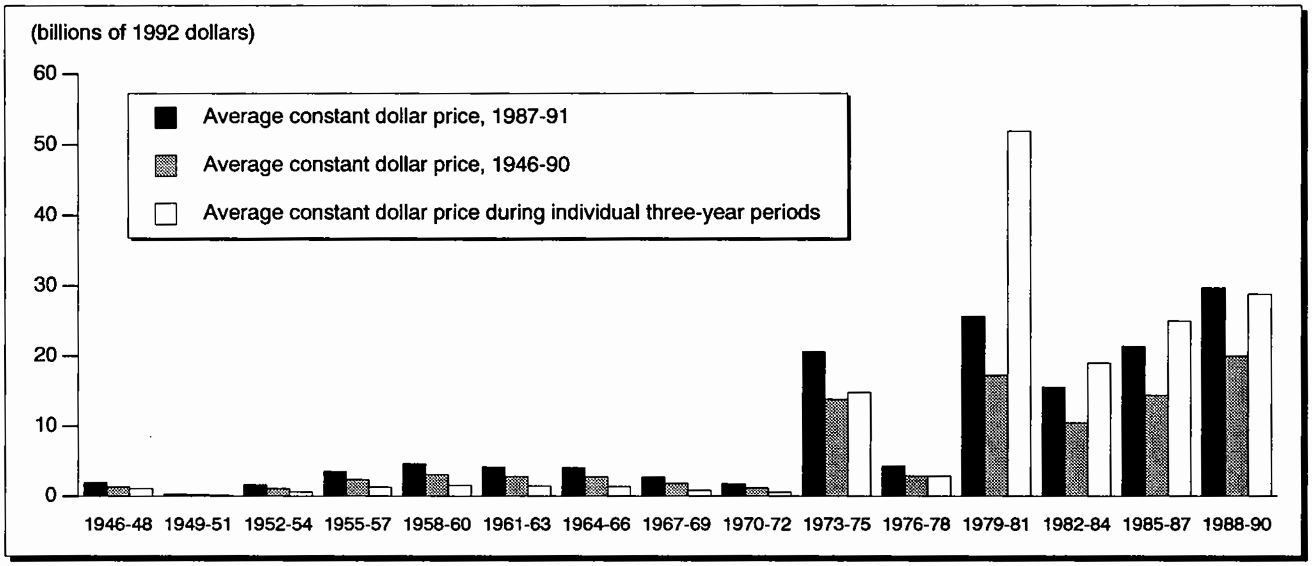
Source: Natural Resources Canada.

Figure 11
Amount of Gold Discovered in Canada,1946-90
Preliminary Results



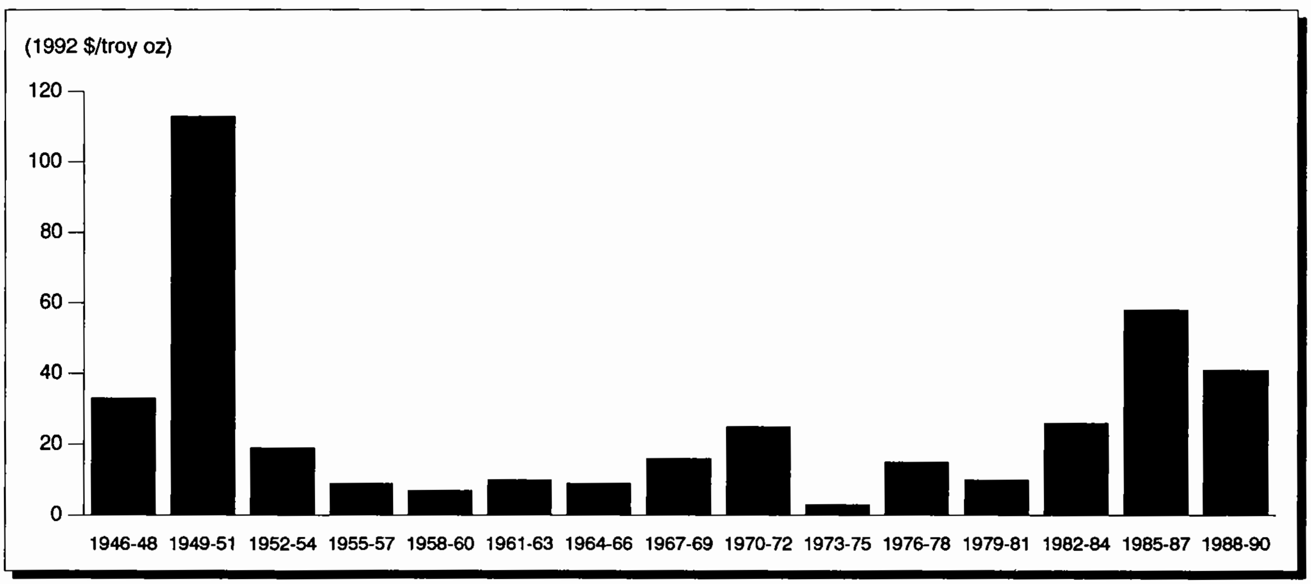
Source: Natural Resources Canada.

Figure 12
Value of Gold Discovered in Canada in Gold and Gold-Rich Deposits,1946-90
Preliminary Results



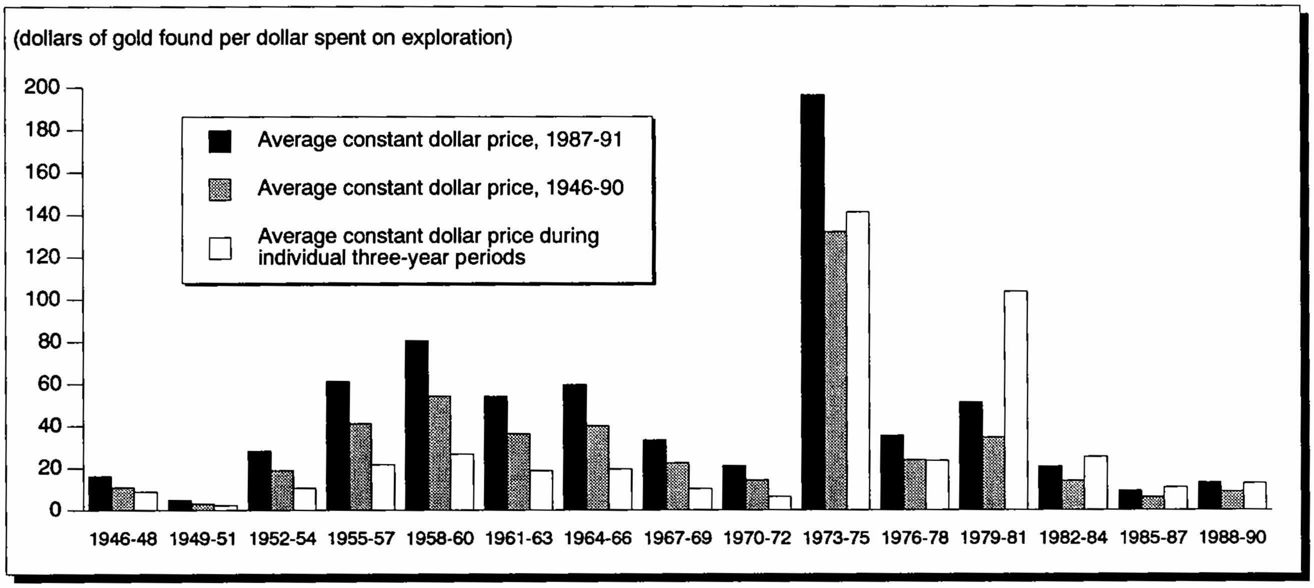
Source: Natural Resources Canada.

Figure 13
Unit Cost of Gold Discovered in Canada in Gold and Gold-Rich Deposits, 1946-90
Preliminary Results



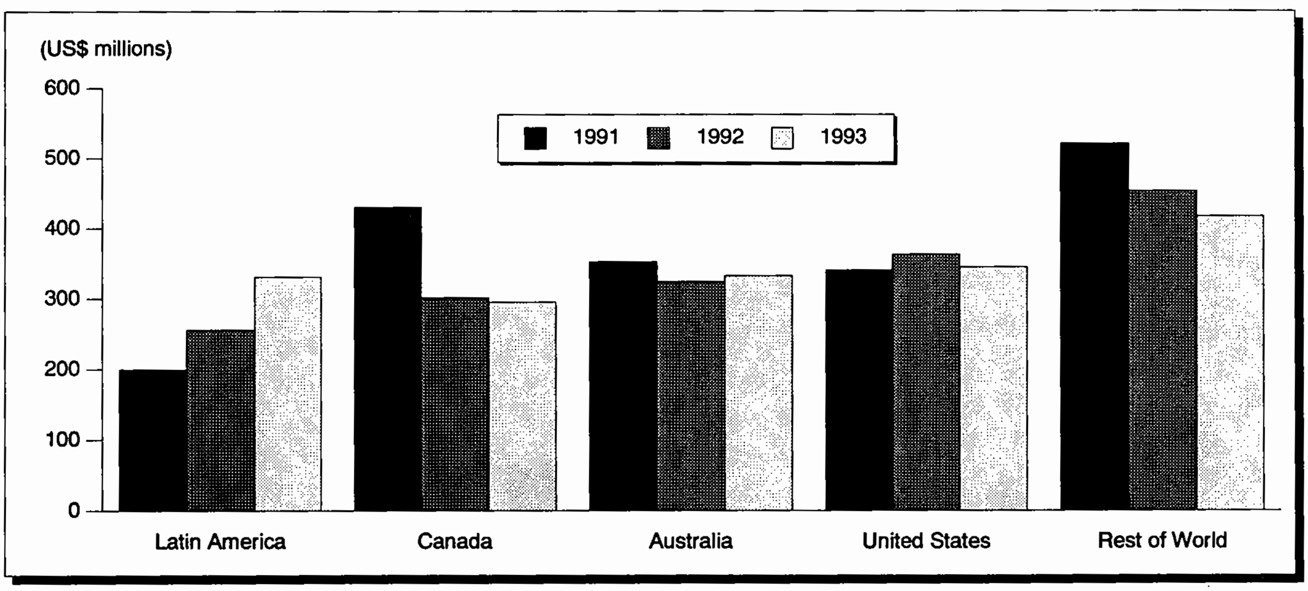
Source: Natural Resources Canada.

Figure 14
Value of Gold Discovered in Canada in Gold and Gold-Rich Deposits Per Dollar Spent on Exploration, 1946-90
Preliminary Results



Source: Natural Resources Canada.

Figure 15
Worldwide Exploration Expenditures, 1991-93



Source: Natural Resources Canada, based on data from Metals Economics Group (MEG), and used with permission.
Notes: 1991 survey, 159 companies; 1992 survey, 154 companies; 1993 survey, 141 companies.
Excludes exploration for iron ore, aluminum, coal, oil and gas, most exploration for industrial minerals, and exploration by most companies with exploration budgets less than US$1 million. Surveys are said to cover at least 80% of all worldwide spending on exploration for nonferrous metals.

However, most of the gold deposits discovered in Canada in the period 1983-90 were small. This may reflect a concentration of exploration efforts on already-known, but less-promising mineral occurrences and deposits to meet the short-term objective of flow-through share investors of claiming income tax deductions for the taxation year in which investments were made.

Exploration activity in Canada decreased after 1988, especially for gold. This relates not only to the above reasons, but also to: the market losses suffered by the majority of flow-through share investors after 1987, the declining price of gold after 1987, and the changes in the taxation rules on income and capital gains that took place in 1987.

As a result of the sharp decrease in exploration activity that started after 1988, many of the follow-up programs that, under more favourable conditions, would have been expected to take place on some of the promising deposits and showings discovered between 1983 and 1990 have yet to be initiated. This distorts evaluation of the results of this period because it is shorter than the usual full cycle of mineral exploration that encompasses initial exploration, deposit discovery, deposit appraisal and mine development. Typically, successful exploration programs take about 10 years from the start of exploration to mine production; it takes an average of about 6 years to bring a mine to production following the discovery of a deposit. In the future, more gold mines and additional gold production will result from discoveries made during the period 1983-90. Additional discoveries of gold deposits and prospective gold mines are likely to ensue from a number of the showings and anomalies also found during that period, and the same is also true for deposits, showings and anomalies of base metals found during the period.

As of early 1994, about 13% of the total number of gold or gold-rich base-metal discoveries made during the period 1983-90 have been brought to production. A significant number of these new mines have closed, some of them because the price of gold has failed to regain the levels that prevailed at the time production decisions were made. More gold was discovered during the three-year period 1988-90 (Figure 11) than in any other period of the interval 1946-90, except for the exceptional period 1979-81 that saw the major discovery at Hemlo. The improved results of the period 1988-90 may stem partly from earlier gold exploration programs that came to fruition then. Also, as the amount of exploration funding was more limited in 1989 and 1990, companies became much more selective in choosing projects for funding; therefore, in general, the quality of exploration targets was higher in these years.

Substantial quantities of gold were discovered in Canada in the periods 1973-75, 1979-81, 1982-84, 1985-87 and 1988-90 (Figure 11). As a result, the value of the gold discovered in gold deposits and in gold-rich base-metal deposits is exceptional in each of these three-year periods (Figure 12).

In this study, as in other studies of this type conducted by NRCan, the size of most deposits has been scaled up by means of "metal multipliers." These factors are based on the historical relationship between the amounts of metals reported at individual Canadian mines when production began and the amounts of metals ultimately known (extracted plus remaining in place).

Despite the exceptional amount of gold discovered between 1985 and 1990, the unit cost of discovering gold (Figure 13) in gold deposits and gold-rich base-metal deposits combined was more than double that of the two most recent typical periods (1976-78 and 1982-84). The value of gold discovered in gold and gold-rich base-metal deposits per dollar spent on gold exploration is another measure of exploration success. This ratio was evaluated (Figure 14) using the three sets of constant-dollar gold prices used to evaluate discovery values (Figure 12). The periods 1973-75 and 1979-81 (Figures 11 to 14) are anomalous. The first one saw the discovery of the large Doyon and Bousquet gold deposits in Quebec and the Detour Lake gold deposit in Ontario, all found at a time when expenditures for gold exploration in Canada were very low. The period 1979-81 saw the highest quantity of gold discovered over the entire period 1946-90 because of the discovery of the very large Hemlo gold zone (three mines). Hemlo is probably the second largest gold concentration ever discovered in Canada; the largest was the Hollinger-McIntyre ore zone (two mines) discovered in Timmins, Ontario, in 1909. The so-called "Golden Mile," discovered in 1911 at Kirkland Lake, Ontario, and mined from several separate operations, probably does not equal in total the gold contained in the Hemlo gold zone.

CANADIAN EXPLORATION FROM A GLOBAL PERSPECTIVE[1]

For more than two decades, Canada, Australia, the United States and, to a lesser extent, South Africa were the main targets of world mineral exploration. Exploration expenditures in Canada have been declining following the unprecedented levels of 1987 and 1988, but there has also been a general decline in most other countries over the same period. The Metals Economics Group (MEG) of Halifax, Nova Scotia, has conducted three surveys of the exploration budgets of companies (excluding any companies based in present or former communist countries) that had annual expenditure plans of US$1 million or more (US$ 500 000 in 1992). Results published in September 1991[2] indicate that some 23% of worldwide exploration expenditures in 1991 was expected to be made in Canada (Figure 15), making Canada the world's principal exploration target for metals that year. MEG results for 1992[3] and 1993[4] indicate that Canada has likely fallen to third place in both years. In 1992, Canada was expected to account for 19% of worldwide expenditure intentions, behind the United States (23%) and Australia (20%). Exploration in Latin America was expected to constitute 16% of 1992 world exploration expenditures. In 1993, Canada was again in third place. Worldwide intentions of US$1.9 billion were expected to be allocated as follows: the United States, 20%; Australia, 19%; Canada, 17%; and Latin America, 19%. Of the 1993 Latin American budgets, about one half were intended for Chile, one fifth for Mexico, significantly smaller portions for Brazil and Peru, and still smaller portions for other countries.

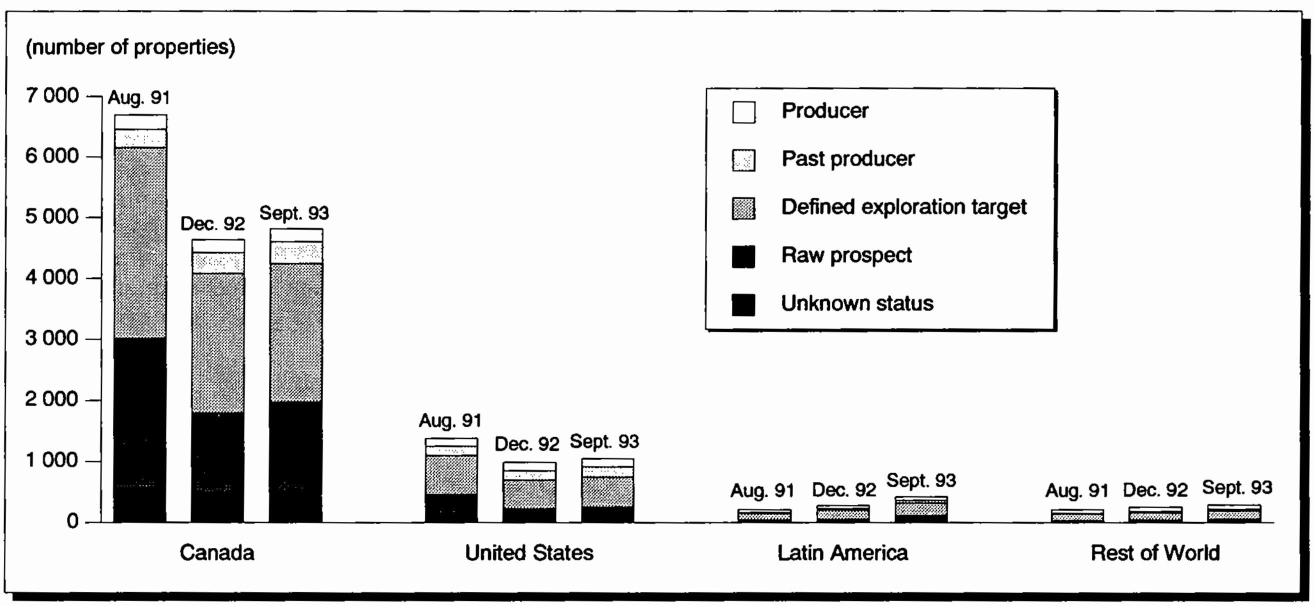
CANADIAN EXPLORATION ABROAD[5]

In September 1993, Canadian mining companies had a worldwide portfolio of at least 6600 mining properties.[6] Almost 70% of this portfolio was in Canada; the rest was distributed among 86 countries around the world. Some 60% of the foreign property portfolio of Canadian companies was in the United States and almost one quarter was in Latin America. Canadian mining interests in Latin America have grown over the past three years (Figure 16), especially in Mexico and Chile.

During 1993, Canadian-based companies with exploration budgets exceeding $1 million planned to spend over C$530 million on both exploration in Canada and exploration abroad.[7] This budget cutoff excludes many of Canada's numerous junior companies. Nonetheless, depending on the criteria used to allocate corporate affiliations to specific countries, Canada had, for 1993, either the largest or the second largest worldwide exploration budget of any country in the world. Canada continues to be a driving force in mineral exploration, both at home and abroad.

Seven corporate groups based in Canada were among the 25 corporate entities with the largest worldwide exploration budgets for 1993. Placer Dome, with planned expenditures of $78 million,

Figure 16
Mining Properties of Companies Listed on Canadian Stock Exchanges
Geographical Distribution by Property Status



Source: Natural Resources Canada, based on MIN-MET CANADA database.

held 7th place; the others included Noranda Minerals ($67 million, 8th place); Inco ($44 million, 15th place); Cambior ($41 million, 16th place); Cameco ($40 million, 19th place), Metall Mining ($37 million, 24th place) and Falconbridge ($33 million, 25th place). The budgets of these Canadian groups accounted for almost $340 million, or about 15% of planned worldwide mineral exploration expenditures for 1993.

Canadian companies with budgets exceeding $1 million planned to spend close to $260 million on exploration outside Canada during 1993, almost half of their total budgets, or roughly the same proportion as companies of the same size based in the United States. In 1992, these Canadian companies may have spent only about 40% of their global exploration budgets abroad, while those based in the United States spent about one third.

The main foreign exploration targets of Canadian companies in 1993 were the United States ($110 million) and Latin America ($97 million). Canadian companies planned to spend almost as much, if not more, on mineral exploration in Latin America as the local companies. In additional to exploration, Canadian companies have substantial stakes in some of the major mine development projects in Latin America.

Chile and Mexico were the world's principal mineral exploration targets in Latin America in 1993 where Canadians planned to spend at least $40 million in Chile and at least $12 million in Mexico. This does not include an undisclosed amount that Placer Dome planned to spend in these two countries. Canadian companies could account for 40% of the amount expected to be spent by all exploration companies in both Chile and Mexico in 1993. Canadians also intended to explore in Bolivia, Brazil, Cuba, Ecuador, Guatemala, Guyana, Panama, Peru, Surinam, Uruguay, Venezuela and elsewhere, but to spend smaller amounts there.

In Canada, almost 60% of domestic and foreign company budgets for 1993 were in search of base metals. In contrast, in Latin America, almost half of total foreign and domestic exploration budgets for 1993 were for gold; however, Canadian companies in Latin America planned to spend almost 60% of their budgets on exploration for base metals, as much as in Canada. This strategy appears to differ somewhat from that of their competitors in Latin America.

Mineral Exploration in Canada and the Rest of the World[8]

An ongoing program of mineral exploration is essential if any mineral-producing nation is to maintain its mineral output in the long term. Canada is no exception. Over the years both Canadian and foreign companies have made Canada one of the world's principal targets for mineral exploration. A large number of mineral deposits have been discovered in Canada, including many world-class deposits of metals and other minerals. Substantial quantities of most metals continue to be discovered.

Over the past few years, many Canadian mining and exploration companies have claimed that rates of Canadian taxation are too high, environmental regulations are too stringent, too much land has been withdrawn from mineral exploration, Canadian labour is too expensive, there are better mineral deposits in other countries just waiting to be acquired cheaply and placed into production, and the exploration and discovery potential in other countries is higher than that of Canada. They claim that, for such reasons, they are shifting the focus of their exploration activities to other countries. Chile and Mexico are mentioned as principal targets, but other countries are also mentioned as promising, mostly in South America and Central America. Canada is not the only major mining country about which the mineral industry is complaining. Similar complaints are made, for example, about Australia, and could also be made regarding many of the world's other major mining countries.

Canadian taxation levels vary from province to province. Some provinces are very competitive from an international point of view; others are less so. This is something that Canada is concerned about, and initiatives have been undertaken to investigate industry complaints with a view to recommending improvements. Preservation of the environment should be the aim of every country. Policies that are in place will leave, by the turn of the century, some 88% of Canada's 10 million km^2 of landmass open for exploration and mining. Canadian miners may be well paid, but they are also highly efficient and highly productive. Although some countries (Chile, in the case of copper) may offer high potential for the discovery of deposits containing a single mineral commodity or a small group of mineral commodities, Canada produces more than 60 mineral commodities, many of them in major quantities. Therefore, there are many reasons to seriously question much of the recent pessimism concerning the attractiveness of Canada for mineral exploration and development.

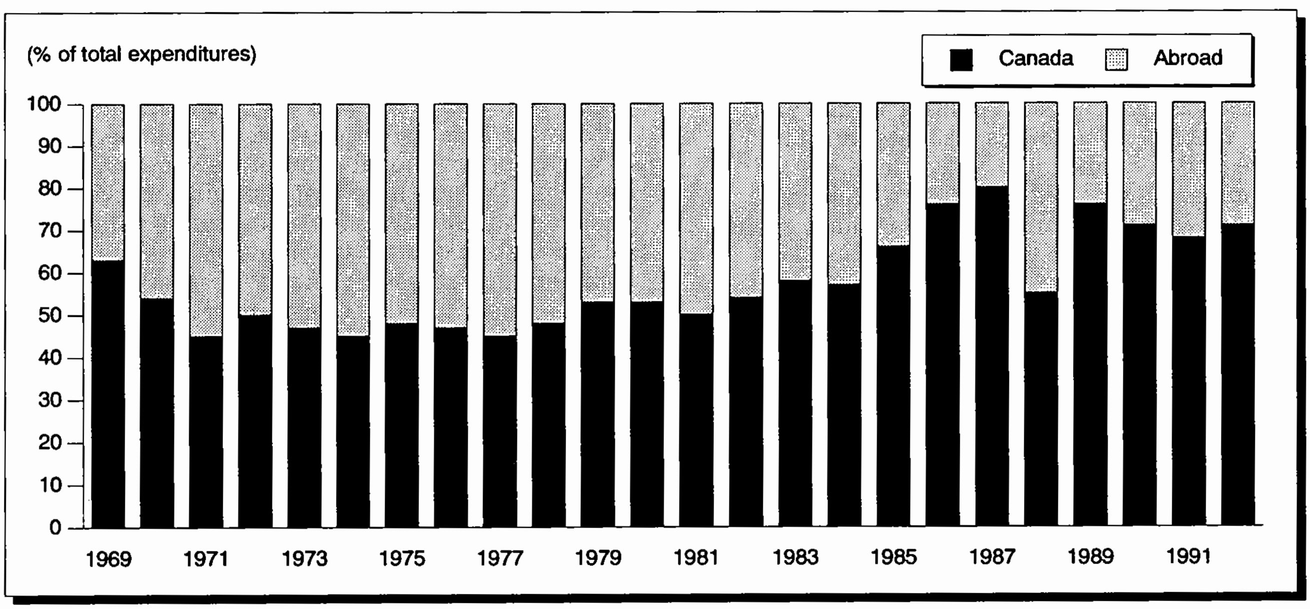
The fact that Canadian exploration expenditures have been declining is cited as proof that a shift of exploration activity to other countries must be occurring. There is no question that Canadian non-petroleum mineral exploration expenditures have been declining sharply since their all-time highs of 1987 and 1988. Those peaks were largely the result of the special MEDA which offered investors an extra 33 1/3% tax deduction for flow-through share investments in Canadian mineral exploration. Many people question whether a major portion of the very high expenditures in 1987 and 1988 were directed in the most cost-effective way. Therefore, in making comparisons of current Canadian exploration expenditures with those of the past, it is probably better to compare them with those of years prior to 1984, keeping in mind that expenditures in 1980, 1981 and 1982 represent previous all-time highs in Canada prior to the MEDA program. These high expenditures in 1980, 1981 and 1982 were driven largely by the high prices for gold, silver, copper and other metals that prevailed in the late 1970s and early 1980s.

Exploration expenditures in 1992 and 1993 have been particularly low, probably because of exceptionally low metal prices that have been caused, at least in part, by the current world economic downturn and, in the case of some metals (for example, nickel and uranium), by large quantities of surplus metal originating, at very low prices, from the former Soviet Union. Until there is a marked improvement in the metal prices that currently prevail, there is unlikely to be a significant increase in the current level of exploration in Canada, or in the level of exploration efforts in most other countries.

How are claims that exploration activity is shifting from Canada to other countries supported by the available facts? Is the shift sufficient that it will significantly affect Canada's future position as an exporter of copper, zinc and lead concentrates?

The phenomenon of Canadian mining companies carrying out major exploration programs in other countries is not new. An examination of annual reports of the larger Canadian mining companies indicates that, as early as the 1960s, a considerable portion (in some cases more than 50%) of their exploration budgets was directed at foreign countries. Figure 17 provides an example of the

Figure 17
Regional Distribution of Exploration Expenditures of the Noranda Group of Companies, 1969-92



Source: Natural Resources Canada, from data supplied by Noranda Inc.
Note: 1992 figures are company estimates.

geographical distribution of exploration expenditures of one major Canadian mining entity, the Noranda Group of companies. A similar pattern can be shown for other major Canadian mining companies such as Placer Dome Inc. and Cominco Ltd.

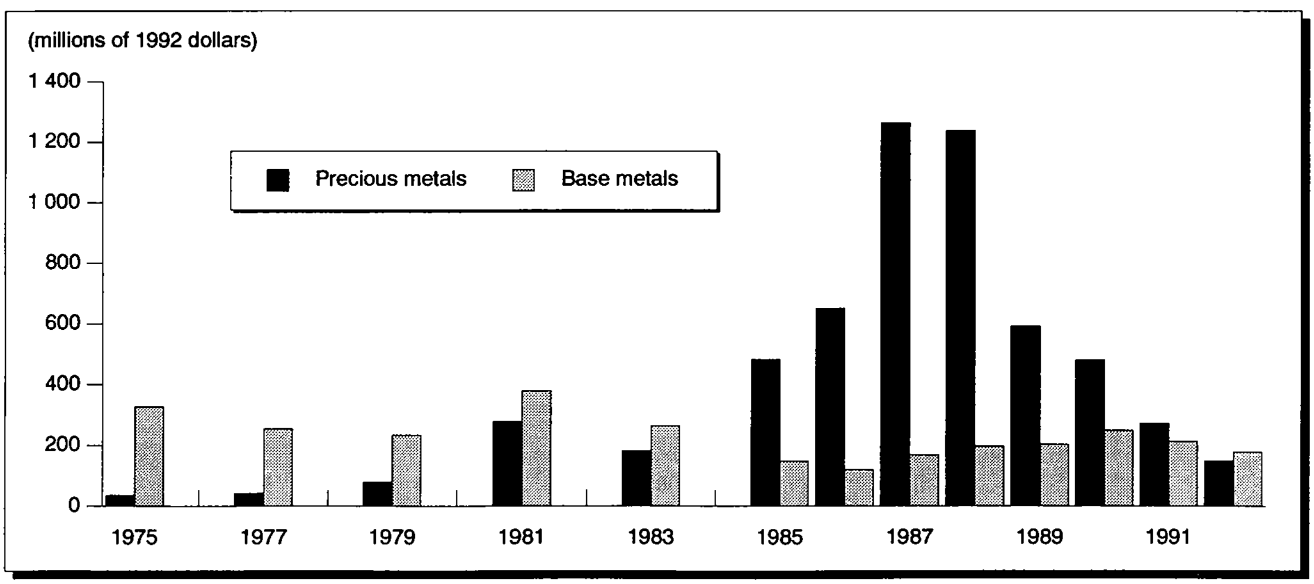
By the mid- to late-1980s, most of the large Canadian mining companies were directing a much higher proportion of their exploration budgets at Canadian projects than in previous years. Following the decline in metal prices and profits in the early 1980s, many major Canadian companies, other than gold producers, could not afford to finance much exploration. However, major companies took advantage of government exploration incentives under the flow-through share program available to all Canadian companies; this encouraged them to explore more in Canada during the mid-to-late 1980s. Major companies obtained funds through the sale of their own flow-through shares or, in the case of joint ventures, from flow-through funds contributed by junior companies.

Not only is Canada a major mineral-producing nation, it has also been one of the world's leading countries in terms of mineral exploration activity. Mineral exploration expenditures have declined significantly in Canada over the past few years, but they have also declined in most other major Western mineral-producing countries. As a consequence, Canada remains one of the world's most important targets for mineral exploration. Although some parts of Canada have been intensively explored, there are large areas that have not yet received the attention that they deserve. Therefore, it cannot be said that Canada's discovery potential has been exhausted. Furthermore, the development of new exploration techniques and of new geological models has opened, and will undoubtedly continue to open, new areas to exploration; this will result in discoveries, even in areas which have previously been extensively explored using older technology.

Canadian Exploration Efforts for Base Metals, 1950-92[8]

Reliable information concerning Canadian exploration expenditures for base metals and precious metals is available only for the period 1975-91 (Figure 18). It indicates a strong focus on precious metals (95% of precious-metal exploration on gold) during the second half of the 1980s. In contrast, exploration for base metals predominated from 1975 until about 1984. This was probably also the case during the 1950s, 1960s and the first half of the 1970s, although no unequivocal statistics are available for that period.

Figure 18
Exploration Expenditures in Canada for Base Metals and Precious Metals, 1975-92



Source: Natural Resources Canada, based on Federal-Provincial Survey of Mining and Exploration Companies.
Note: Data have not been compiled by commodity for the years 1976, 1978, 1980, 1982 and 1984.

It is clear that exploration for base metals in Canada was at relatively low levels during the second half of the 1980s. There was a gradual recovery in exploration for the base metals beginning in 1987. Low exploration expenditures for base metals have undoubtedly resulted in fewer base-metal deposits being discovered in Canada. With significantly lower expenditures in 1991, 1992 and 1993, exploration for base metals remains below normal at a time when increased levels of base-metal exploration are needed to help reverse the persistent decline in reserves of base metals at Canadian mines. However, with lower exploration expenditures worldwide, it is likely that exploration for base metals is down almost everywhere, and not only in Canada.

Figure 19, which presents an analysis of the relationship between Canadian exploration expenditures and metal prices, indicates that there has been a fairly good correlation between Canadian exploration expenditures and world metal prices. The exception to this was in 1987 and 1988 when many non-producing exploration companies were able to raise many hundreds of millions of dollars for exploration because of the special tax incentives available to purchasers of flow-through shares. If current low prices persist, we can continue to expect relatively low levels of exploration activity in Canada.

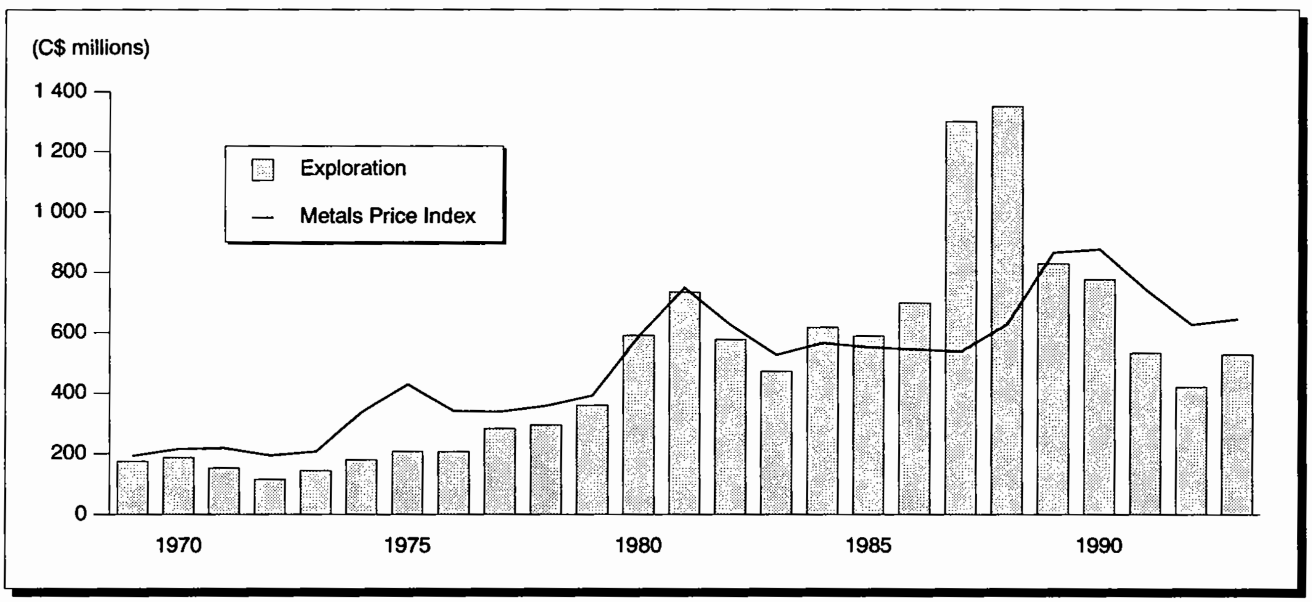
Metal Prices: Past, Present and Future, and Their Likely Impact on Mineral Exploration Expenditures[8]

Average annual metal prices for nickel, copper, zinc and lead over the period 1965-92 are shown in Figures 20a to 20d. Base-metal prices were exceptionally low in constant dollar terms in 1993 and early 1994. The low was struck in October 1993. For example, on October 4, 1993, London Metal Exchange (LME) prices were as follows: nickel, US$1.87/lb; copper, US$0.755/lb; zinc, US$0.398/lb; and lead, US$0.165/lb.

Metal price statistics indicate that, in constant dollars, the base-metal prices of October are the lowest ever for each of these four metals. Such prices are unlikely to continue for long because they are below the average cash production costs of most of the world's producers.

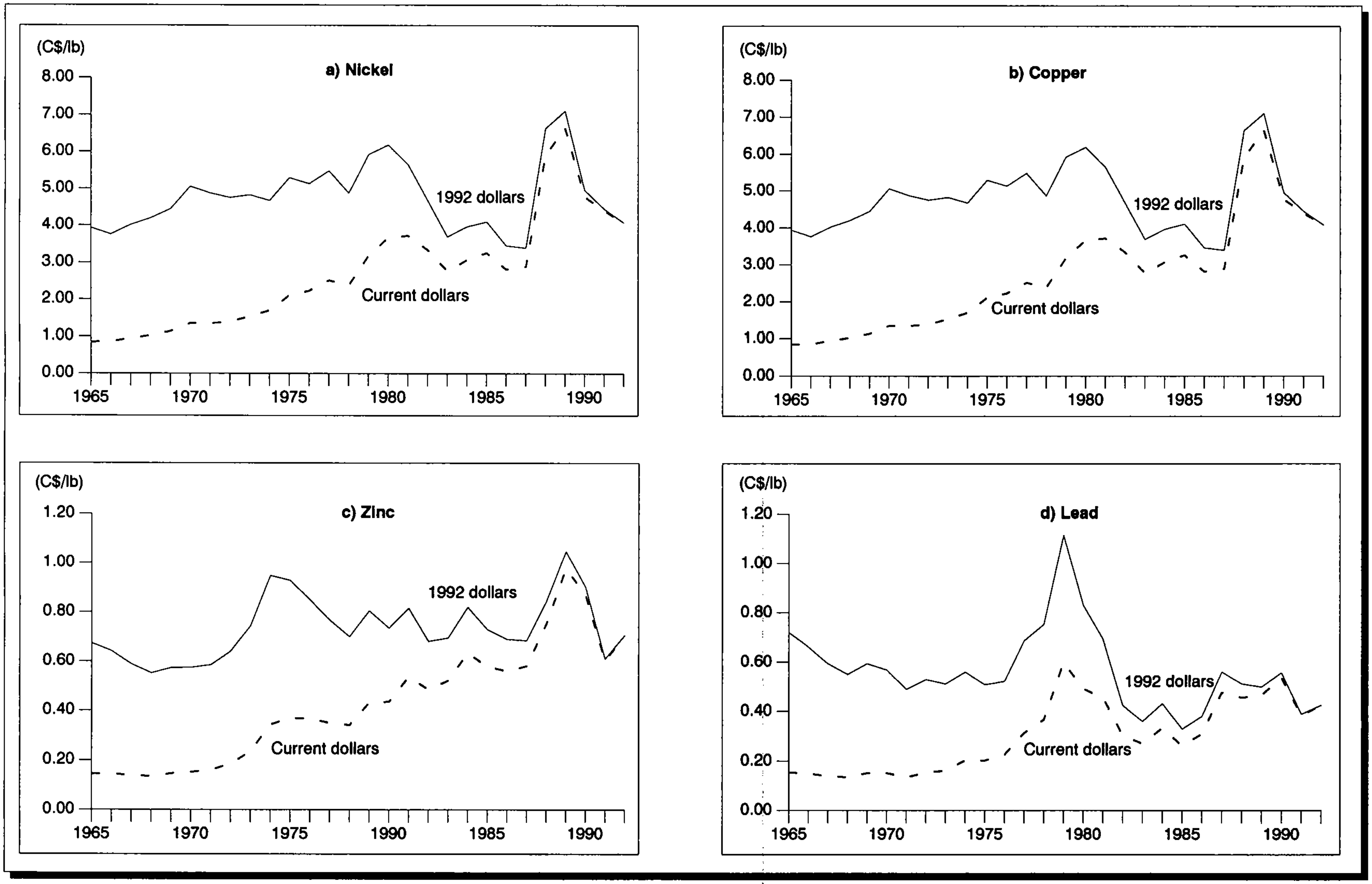
The low base-metal prices appear to have been induced by both the depressed world economy and the failure of base-metal producers to cut their production levels sufficiently to compensate for large stocks of metals and for depressed demand. The situation is further complicated, especially for

Figure 19
Total Exploration Expenditures and Metals Price Index Lagged One Year, 1969-93



Sources: Statistics Canada catalogue nos. 61-007 and 61-216 for 1969-92 exploration data; Natural Resources Canada (NRCan) for Metals Price Index.
Note: 1993 exploration forecast by NRCan model.

Figure 20
Prices, 1965-92
(Nickel, Copper, Zinc and Lead)



nickel, because of exports of substantial quantities from Russia. Nickel metal appears to have become available because of declining domestic consumption in the countries of the former Soviet Union and because of a desperate need there for foreign exchange.

It would appear that, unless there is a marked increase in base-metal prices, many of the world's producers will encounter difficulties. There have been many times in the past when we have gone through periods of depressed base-metal prices. Hopefully, the current period of depressed prices will soon come to an end, which should lead to greater availability of exploration funding in Canada and in other countries.

Postscript: On February 1, 1994, the LME prices had risen to: nickel, US$2.63/lb; copper, US$0.844/lb; zinc, US$0.444/lb; and lead, US$0.229/lb. In comparison with the historical price graphs (Figures 20a to 20d), which are in 1992 Canadian dollars, approximate 1992 Canadian dollar equivalents of the October 4, 1993 (and February 1, 1994) LME metal prices are: nickel, $2.49 ($3.44)/lb; copper $1.00 ($1.10)/lb; zinc $0.53 ($0.58)/lb; and lead, $0.22 ($0.30)/lb. Although there was a distinct improvement in base-metal prices by February 1, 1994, these prices were still very low by historical standards. Without substantial additional price improvements, the availability of exploration funding in Canada seems likely to remain depressed.

REFERENCES

[1] Extracted from "Canadian Exploration and Mine Investment in the Global Context" by Donald Cranstone, André Lemieux and Marcel Vallée, prepared for Prospectors and Developers Association of Canada publication *Exploration and Development Highlights*, March 1994.

[2] Metals Economics Group, Halifax, Nova Scotia, September 1991, *Corporate Exploration Strategies: Current Trends and the Costs of Finding Gold*, 244 pp. Used with permission.

[3] Metals Economics Group, Halifax, Nova Scotia, September 1992, *Corporate Exploration Strategies: A Worldwide Analysis*, 313 pp. Used with permission.

[4] Metals Economics Group, Halifax, Nova Scotia, September 1993, *Corporate Exploration Strategies: A Worldwide Analysis*, 433 pp. Used with permission.

[5] Extracted from: "Canadian Exploration and Mine Investment in the Global Context" by Donald Cranstone, André Lemieux and Marcel Vallée, prepared for Prospectors and Developers Association of Canada publication *Exploration and Development Highlights*, March 1994.

[6] MIN-MET CANADA database, September 1993, A. MacG. ROBERTSON INFO-DATA Inc., Vancouver, British Columbia. Used under License.

[7] Metals Economics Group, September, 1993, op. cit.

[8] Extracted from: "Canada's Future as a Supplier of Base Metals and Base-Metal Concentrates" by Donald Cranstone, presented at 4th Base Metals Conference, Melbourne, Australia, October 31-November 3, 1993.

Note: Information in this review was current as of March 15, 1994.

TABLE 1. FUNDS RAISED BY COMPANIES LISTED ON CANADIAN STOCK EXCHANGES THROUGH THE ISSUE OF FLOW-THROUGH SHARES, 1983-93

Year	Value of Funds Raised	
	(current $ millions)	(1993 $ millions)
1983	34	46
1984	139	181
1985	274	347
1986	703	870
1987	1 183	1 398
1988	850	960
1989	350	377
1990	250	261
1991	40	41
1992	45	45
1993	70e	70e

Sources: Mining Sector, Natural Resources Canada, from Montréal, Toronto and Vancouver Stock Exchange records.
e Estimated.

TABLE 2. AREA[1] OF NEW MINERAL CLAIMS STAKED IN CANADA, 1987-93

	1987		1988		1989		1990		1991		1992		1993	
	(hectares)	(%)	(hectares)	(%)	(hectares)	(%)	(hectares)	(%)	(hectares)	(%)	(hectares)	(%)	(hectares)	(%)
Newfoundland	376 362	5.4	419 184	6.7	275 040	5.4	163 568	3.3	127 748	2.4	96 423	0.3	127 282	0.5
Nova Scotia	624 508	8.9	423 019	6.7	174 456	3.4	176 609	3.5	126 833	2.3	205 941	0.6	87 350	0.3
New Brunswick	72 748	1.0	110 976	1.8	139 776	2.8	69 776	1.4	73 136	1.4	55 104	0.2	37 616	0.1
Quebec	890 977	12.7	537 217	8.6	823 452	16.3	483 289	9.7	456 810	9.2	555 323	1.5	691 915	2.3
Ontario	949 231	13.5	598 632	9.6	390 619	7.7	419 259	8.4	317 568	5.9	497 800	1.4	426 416	1.6
Manitoba	212 139	3.0	162 264	2.6	209 483	4.1	127 342	2.5	127 935	2.4	140 379	3.8	486 148	1.8
Saskatchewan	700 459	10.0	741 944	11.8	418 832	8.3	184 939	3.7	274 242	5.1	897 315	2.4	2 257 219	8.4
Alberta	9 408	0.1	20 757	0.3	50 240	1.0	807 910	16.2	4 400	0.1	22 300 000	71.1	10 260 000	38.1
British Columbia	2 269 925	32.4	2 212 125[a]	35.3	1 946 000[a]	38.4	2 014 250	40.3	1 510 850[b]	28.0	824 200[b]	2.2	702 250[b]	2.6
Yukon	357 576	5.1	301 713	4.8	178 683	3.5	195 202	3.9	128 081	2.4	135 854	0.4	114 817	0.4
Northwest Territories	552 385	7.9	739 928	11.8	456 987	9.0	355 346	7.1	2 213 337	41.0	7 178 000	19.6	11 812 417	43.9
Total	7 015 718	100.0	6 267 755	100.0	5 063 568	100.0	4 997 490	100.0	5 398 340	100.0	32 886 339	100.0	27 003 430	100.0

[a] Excludes placer leases. [b] Not strictly comparable to 1990 and earlier years because the total is the area of claims recorded, not the area of claims staked. [c] Not yet final.
[1] Excludes coal.
Note: May not balance due to rounding.

TABLE 3. GENERAL EXPLORATION PLUS MINE-SITE EXPLORATION[1] EXPENDITURES, 1991 and 1992, AND DRILLING ACTIVITIES BY PROVINCE AND TERRITORY, 1992

Province/Territory	1992 Field Expenditures	1992 Overhead[2] Expenditures	1992 Total Expenditures	1991 Total Expenditures	1992 as % of 1991 Total Expenditures	1992 Surface Drilling Diamond Drilling	1992 Surface Drilling Other Drilling	1992 Surface Drilling Total
	($ millions)				(%)	(metres)		
Newfoundland	8.4	2.8	11.1	12.1	92.3	21 923	–	21 923
Nova Scotia	2.4	0.9	3.3	4.5	71.9	11 724	–	11 724
New Brunswick	10.1	2.1	12.2	15.8	77.2	64 948	–	64 948
Quebec	84.2	9.9	94.1	138.1	68.1	449 512	–	449 512
Ontario	63.8	13.7	77.4	109.7	70.6	290 777	3 891	294 668
Manitoba	28.3	3.7	32.0	29.7	107.6	141 171	–	141 171
Saskatchewan	20.8	8.1	25.9	31.5	82.2	63 392	10 283	73 675
Alberta	4.0	1.4	5.4	6.6	81.2	250	72 710	72 960
British Columbia	55.8	15.8	71.6	135.7	52.8	214 906	32 847	247 753
Northwest Territories	37.8	5.4	42.7	31.6	135.1	104 231	7 614	111 845
Yukon Territory	7.9	1.8	9.7	16.5	58.7	18 172	9 535	27 707
Total	323.5	61.9	385.3	531.8	72.5	1 381 006	136 880	1 517 886

Source: Federal-Provincial Survey of Mining and Exploration Companies.
– Nil.
1 Exploration activity includes only the search for new mines; it does not include exploration for extensions to deposits already being mined or committed to production. 2 Overhead expenditures include land costs, field administration costs and exploration-related head office expenses.
Note: May not balance due to rounding.

TABLE 4. GENERAL EXPLORATION PLUS MINE-SITE EXPLORATION[1] EXPENDITURES, INCLUDING OVERHEAD,[2] BY COMMODITY SOUGHT, 1992

Commodity Groups	Expenditures	Percentage of Canadian Total	1992 as % of 1991 Expenditures
	($ millions)	(%)	(%)
Base metals (Cu, Ni, Pb, Zn)	178.4	46.3	84.0
Precious metals (Ag, Au, Pt group)	149.6	38.8	54.9
Iron ore	1.4	0.4	329.4
Uranium	16.1	4.2	99.0
Other metals	1.7	0.5	55.6
Nonmetals	27.5	7.1	182.6
Coal	7.3	1.9	79.1
Unspecified commodities	3.4	0.9	115.4
Total	385.3	100.0	

Source: Natural Resources Canada, from the Federal-Provincial Survey of Mining and Exploration Companies.
[1] Exploration activity includes only the search for new mines; it does not include exploration for extensions to deposits already being mined or committed to production. [2] Overhead expenditures include land costs, field administration costs and exploration-related head office expenses.
Note: May not balance due to rounding.

TABLE 5. EXPLORATION EXPENDITURE SERIES FOR SOME MINERALS COMMODITIES OF INTEREST

Year	Diamonds	Platinum Group Elements	Potash	Wollastonite	Granite	Marble
			($000)			
1988	..	19 500	..	..	..	..
1989	5 135	7 740	2 497	203	272	86
1990	7 566	5 049	3 633	503	1 192	36
1991	7 048	7 705	4 655	143	22	404
1992	18 550	3 308	882	1 332	430	1 178

.. Not available.

TABLE 6. PERCENTAGE OF GENERAL EXPLORATION PLUS MINE-SITE EXPLORATION[1] EXPENDITURES DIRECTED AT THE SEARCH FOR BASE METALS AND PRECIOUS METALS, 1975-92

Year	Base Metals[2]	Precious Metals[3]
	(percent)[4]	
1975	63	7
1977	42	7
1979	35	12
1981	34	25
1983	42	29
1985	20	65
1986	14	76
1987	11	83
1988	13	82
1989	23	68
1990	31	60
1991	40	52
1992	47	39

Sources: 1975-83 compiled by Natural Resources Canada (NRCan) from individual company responses to Statistics Canada exploration questionnaires; 1985-92 compiled by NRCan from the Survey of Federal-Provincial Mining and Exploration Companies.
[1] Exploration activity includes only the search for new mines; it does not include exploration for extensions to deposits already being mined or committed to production. [2] Nickel, copper, zinc and lead. [3] Gold, silver and platinum group metals. In recent years, gold exploration has accounted for 95% of exploration expenditures on precious metals. [4] Includes a prorated portion of expenditures for unspecified commodities.

TABLE 7. GENERAL EXPLORATION PLUS MINE-SITE EXPLORATION,[1] INCLUDING OVERHEAD,[2] BY TYPE OF COMPANY, 1990-92

Type of Company	1990 Exploration Expenditures		1991 Exploration Expenditures		1992 Exploration Expenditures	
	($ millions)	(% of Canadian total)	($ millions)	(% of Canadian total)	($ millions)	(% of Canadian total)
1. Producing companies (those with a producing mine in Canada and their affiliates)	459.7	59.3	367.2	69.1	255.7	66.3
2. Oil companies (excluding group 1 above)	8.7	1.1	9.9	1.9	6.7	1.7
3. Foreign companies (excluding groups 1 and 2 above)	43.3	5.6	31.1	5.9	34.6	9.0
4. Junior companies and prospectors	241.0	31.1	116.1	21.8	79.9	20.7
5. Other companies	22.0	2.8	7.4	1.4	8.5	2.2
Total	774.7	100	531.8	100	385.3	100

Sources: Natural Resources Canada and Statistics Canada, from Federal-Provincial Survey of Mining and Exploration Companies.
[1] Exploration activity includes only the search for new mines; it does not include exploration for extensions to deposits already being mined or committed to production. [2] Overhead expenditures include land costs, field administration costs and exploration-related head office expenses.
Note: May not balance due to rounding.

TABLE 8. GENERAL EXPLORATION PLUS MINE-SITE EXPLORATION[1] ACTIVITIES BY PROVINCE AND TERRITORY, BY TYPE OF WORK, 1992

Province/Territory	Drilling (Surface and Underground)				Surveys - Other Exploration Work						Total Field Expenditures	Total, Including Overhead[2]
	Diamond		Other				Geophysical			Other Field Costs		
	Metres	Cost	Metres	Cost	Geochemical	Geology	Ground	Airborne	Rock Work			
	(000)	($000)	(000)	($000)	($000)							
Newfoundland	22	1 447	–	–	586	3 327	1 153	488	387	995	8 384	11 141
Nova Scotia	12	688	1	30	162	393	469	6	290	335	2 373	3 258
New Brunswick	65	4 900	–	–	535	2 107	931	71	313	1 238	10 095	12 207
Quebec	647	40 326	–	–	2 108	14 893	5 249	956	2 281	18 396	84 209	94 095
Ontario	424	32 882	4	722	1 564	12 213	4 748	1 357	6 345	3 925	63 758	77 445
Manitoba	204	17 035	–	–	797	2 581	3 225	159	2 827	1 651	28 274	31 959
Saskatchewan	122	9 812	10	864	1 004	2 953	1 440	615	1 011	3 131	20 829	25 875
Alberta	–	32	73	2 117	105	88	69	–	403	1 183	3 997	5 377
British Columbia	260	20 413	34	1 337	4 091	12 196	3 344	749	5 132	8 545	55 808	71 585
Northwest Territories	110	11 437	8	545	3 530	6 171	3 453	3 600	609	8 477	37 821	42 718
Yukon Territory	23	1 792	10	929	593	1 706	318	45	1 253	1 271	7 908	9 671
Total Canada	1 889	140 765	139	6 544	15 075	58 627	24 400	8 046	20 851	49 149	323 456	385 330

Source: Natural Resources Canada, from the Federal-Provincial Survey of Mining and Exploration Companies.
– Nil.
[1] Exploration activity includes only the search for new mines; it does not include exploration for extensions to deposits already being mined or committed to production. [2] Overhead expenditures include land costs, field administration costs and exploration-related head office expenses.
Note: May not balance due to rounding.

TABLE 9. GENERAL EXPLORATION PLUS MINE-SITE EXPLORATION[1] ACTIVITIES BY TYPE OF COMPANY, 1992

Type of Company	Drilling (Surface and Underground)				Surveys - Other Exploration Work					Other Field Costs	Total Field Expenditures	Total, Including Overhead[2]
	Diamond		Other				Geophysical					
	Metres	Cost	Metres	Cost	Geochemical	Geology	Ground	Airborne	Rock Work			
	(000)	($000)	(000)	($000)				($000)				
1. Companies with a producing mine in Canada	1 172	78 642	105	3 808	6 488	26 016	12 021	2 022	10 033	22 836	161 867	188 776
2. Affiliates of group 1	250	26 414	4	727	1 848	12 741	4 104	918	799	8 410	55 961	66 883
3. Oil companies	30	3 164	–	–	281	515	156	130	45	1 021	5 311	6 728
4. Foreign companies (excluding group 3)	70	5 740	6	193	1 239	6 382	1 218	3 014	95	7 542	25 424	34 565
5. Junior companies and prospectors	333	24 760	23	1 565	5 113	11 066	6 130	1 683	9 507	7 673	67 497	79 912
6. Other companies	35	2 046	–	250	106	1 907	771	278	371	1 667	7 396	8 466

Source: Natural Resources Canada, from the Federal-Provincial Survey of Mining and Exploration Companies.
– Nil.
[1] Exploration activity includes only the search for new mines; it does not include exploration for extensions to deposits already being mined or committed to production. [2] Overhead expenditures include land costs, field administration costs and exploration-related head office expenses.
Note: May not balance due to rounding.

TABLE 10a. GENERAL EXPLORATION PLUS MINE-SITE EXPLORATION[1] EXPENDITURES, NOT INCLUDING OVERHEAD,[2] BY PROVINCE AND TERRITORY, BY COMMODITY SOUGHT, 1992

Province/Territory	Metals					Nonmetals	Coal	Commodity Not Specified	Total Field Expenditures
	Base	Precious	Iron	Uranium	Other				
					($000)				
Newfoundland	5 949	1 286	–	339	144	643	–	23	8 384
Nova Scotia	1 379	148	–	–	–	310	536	–	2 373
New Brunswick	7 423	2 609	–	–	–	22	41	–	10 095
Quebec	38 504	41 725	1 108	–	348	2 523	–	–	84 209
Ontario	31 501	28 332	–	–	21	3 771	133	–	63 758
Manitoba	25 962	1 605	–	–	204	352	–	151	28 274
Saskatchewan	4 633	3 928	–	11 125	–	1 126	17	–	20 829
Alberta	–	3	–	–	–	1 154	2 841	–	3 997
British Columbia	19 618	29 854	127	–	783	1 905	1 357	2 164	55 808
Northwest Territories	11 541	12 967	–	2 832	–	10 480	–	–	37 821
Yukon Territory	4 537	3 319	–	–	–	–	–	52	7 908
Total Canada	151 046	125 777	1 235	14 296	1 500	22 286	4 925	2 391	323 456

Source: Natural Resources Canada, from the Federal-Provincial Survey of Mining and Exploration Companies.
– Nil.
[1] Exploration activity includes only the search for new mines; it does not include exploration for extensions to deposits already being mined or committed to production. [2] Overhead expenditures include land costs, field administration costs and exploration-related head office expenses.
Note: May not balance due to rounding.

TABLE 10b. GENERAL EXPLORATION PLUS MINE-SITE EXPLORATION[1] EXPENDITURES, INCLUDING OVERHEAD,[2] BY PROVINCE AND TERRITORY, BY COMMODITY SOUGHT, 1992

Province/Territory	Metals					Nonmetals	Coal	Commodity Not Specified	Total, Including Overhead
	Base	Precious	Iron	Uranium	Other				
	($000)								
Newfoundland	6 692	2 777	22	339	178	1 095	–	38	11 141
Nova Scotia	2 108	175	4	1	–	340	626	4	3 258
New Brunswick	9 096	3 026	–	–	4	40	41	–	12 207
Quebec	43 068	46 262	1 108	–	401	3 256	–	–	94 095
Ontario	39 639	33 392	65	–	25	4 045	279	–	77 445
Manitoba	28 942	2 124	–	–	220	489	–	184	31 959
Saskatchewan	6 254	5 295	–	12 504	–	1 354	269	199	25 875
Alberta	4	3	–	4	–	1 442	3 924	–	5 377
British Columbia	25 126	38 473	151	–	917	2 170	2 163	2 584	71 585
Northwest Territories	12 141	14 115	5	3 240	–	13 216	–	1	42 718
Yukon Territory	5 365	3 918	–	–	–	25	–	363	9 671
Total Canada	178 435	149 561	1 354	16 088	1 745	27 471	7 302	3 373	385 330

Source: Natural Resources Canada, from the Federal-Provincial Survey of Mining and Exploration Companies.
– Nil.
[1] Exploration activity includes only the search for new mines; it does not include exploration for extensions to deposits already being mined or committed to production. [2] Overhead expenditures include land costs, field administration costs and exploration-related head office expenses.
Note: May not balance due to rounding.

TABLE 11a. GENERAL EXPLORATION PLUS MINE-SITE EXPLORATION[1] EXPENDITURES, NOT INCLUDING OVERHEAD,[2] BY TYPE OF COMPANY AND BY COMMODITY SOUGHT, 1992

Type of Company	Metals					Nonmetals	Coal	Commodity Not Specified	Total Field Expenditures
	Base	Precious	Iron	Uranium	Other				
					($000)				
1. Companies with a producing mine in Canada	78 167	66 558	1 088	5 890	382	2 800	4 791	2 190	161 867
2. Affiliates of group 1	45 124	9 401	–	1 304	37	44	–	52	55 961
3. Oil companies	546	2 452	–	2 314	–	–	–	–	5 311
4. Foreign companies (excluding group 3)	4 657	5 580	–	4 449	–	10 586	133	18	25 424
5. Junior companies and prospectors	18 918	38 601	146	339	1 081	8 283	–	129	67 497
6. Other companies	3 635	3 186	–	–	–	573	–	3	7 396

Source: Natural Resources Canada, from the Federal-Provincial Survey of Mining and Exploration Companies.
– Nil.
1 Exploration activity includes only the search for new mines; it does not include exploration for extensions to deposits already being mined or committed to production.
2 Overhead expenditures include land costs, field administration costs and exploration-related head office expenses.
Note: May not balance due to rounding.

TABLE 11b. GENERAL EXPLORATION PLUS MINE-SITE EXPLORATION[1] EXPENDITURES, INCLUDING OVERHEAD,[2] BY TYPE OF COMPANY AND BY COMMODITY SOUGHT, 1992

Type of Company	Metals					Nonmetals	Coal	Commodity Not Specified	Total, Including Overhead
	Base	Precious	Iron	Uranium	Other				
					($000)				
1. Companies with a producing mine in Canada	90 896	76 728	1 184	6 641	426	3 741	6 354	2 806	188 776
2. Affiliates of group 1	53 923	11 054	–	1 368	63	85	28	363	66 883
3. Oil companies	692	2 613	–	2 701	–	106	616	–	6 728
4. Foreign companies (excluding group 3)	7 375	8 801	–	5 038	–	13 067	266	18	34 565
5. Junior companies and prospectors	21 554	46 597	171	339	1 257	9 772	38	183	79 912
6. Other companies	3 994	3 768	–	–	–	700	–	4	8 466

Source: Natural Resources Canada, from the Federal-Provincial Survey of Mining and Exploration Companies.
– Nil.
[1] Exploration activity includes only the search for new mines; it does not include exploration for extensions to deposits already being mined or committed to production.
[2] Overhead expenditures include land costs, field administration costs and exploration-related head office expenses.
Note: May not balance due to rounding.

TABLE 12. GENERAL EXPLORATION PLUS MINE-SITE EXPLORATION,[1] SURFACE AND UNDERGROUND DRILLING, BY PROVINCE AND TERRITORY, BY COMMODITY SOUGHT, 1992

Province/Territory	Metals					Nonmetals	Coal	Total
	Base	Precious	Iron	Uranium	Other			
	(000 metres)							
Newfoundland	11	4	–	–	1	5	–	22
Nova Scotia	7	1	–	–	–	4	2	13
New Brunswick	48	17	–	–	–	–	–	65
Quebec	176	409	33	–	3	25	–	647
Ontario	220	197	–	–	–	11	–	428
Manitoba	191	10	–	–	2	1	–	204
Saskatchewan	20	27	–	84	–	1	–	133
Alberta	–	–	–	–	–	3	70	73
British Columbia	135	122	2	–	2	4	29	294
Northwest Territories	63	38	–	15	–	3	–	118
Yukon Territory	21	12	–	–	–	–	–	33
Total Canada	891	837	35	100	9	56	100	2 029

Source: Natural Resources Canada, from the Federal-Provincial Survey of Mining and Exploration Companies.
– Nil.
[1] Exploration activity includes only the search for new mines; it does not include exploration for extensions to deposits already being mined or committed to production.
Note: May not balance due to rounding.

TABLE 13. GENERAL EXPLORATION PLUS MINE-SITE EXPLORATION,[1] SURFACE AND UNDERGROUND DRILLING, BY TYPE OF COMPANY AND BY COMMODITY SOUGHT, 1992

Type of Company	Metals					Nonmetals	Coal	Total
	Base	Precious	Iron	Uranium	Other			
	(000 metres)							
1. Companies with a producing mine in Canada	545	520	33	50	4	25	101	1 277
2. Affiliates of group 1	201	47	–	6	–	–	–	255
3. Oil companies	2	11	–	17	–	–	–	30
4. Foreign companies (excluding group 3)	16	29	–	26	–	6	–	76
5. Junior companies and prospectors	113	212	2	–	4	25	–	357
6. Other companies	15	19	–	–	–	1	–	35

Source: Natural Resources Canada, from the Federal-Provincial Survey of Mining and Exploration Companies.
– Nil.
[1] Exploration activity includes only the search for new mines; it does not include exploration for extensions to deposits already being mined or committed to production.
Note: May not balance due to rounding.

TABLE 14a. GENERAL EXPLORATION PLUS MINE-SITE EXPLORATION[1] EXPENDITURES, NOT INCLUDING OVERHEAD,[2] BY PROVINCE AND TERRITORY, BY TYPE OF COMPANY, 1992

Province/Territory	(1) Companies With a Producing Mine in Canada	(2) Affiliates of (1)	(3) Oil Companies	(4) Foreign Companies Excluding (3)	(5) Junior Companies and Prospectors	(6) Other Companies	Total Field Expenditures
				($000)			
Newfoundland	2 192	3 768	–	456	1 879	88	8 384
Nova Scotia	1 463	137	–	–	729	44	2 373
New Brunswick	5 764	3 501	–	587	237	6	10 095
Quebec	37 774	20 059	190	1 246	18 710	6 230	84 209
Ontario	38 108	9 797	–	3 963	11 571	319	63 758
Manitoba	26 045	1 139	–	5	1 085	–	28 274
Saskatchewan	13 904	2 115	2 314	1 669	813	15	20 829
Alberta	3 070	–	–	920	8	–	3 997
British Columbia	20 264	5 343	15	2 476	27 127	583	55 808
Northwest Territories	10 028	8 968	2 066	13 374	3 275	110	37 821
Yukon Territory	3 254	1 134	727	729	2 063	–	7 908
Total Canada	161 867	55 961	5 311	25 424	67 497	7 396	323 456

Source: Natural Resources Canada, from the Federal-Provincial Survey of Mining and Exploration Companies.
– Nil.
[1] Exploration activity includes only the search for new mines; it does not include exploration for extensions to deposits already being mined or committed to production. [2] Overhead expenditures include land costs, field administration costs and exploration-related head office expenses.
Note: May not balance due to rounding.

TABLE 14b. GENERAL EXPLORATION PLUS MINE-SITE EXPLORATION[1] EXPENDITURES, INCLUDING OVERHEAD,[2] BY PROVINCE AND TERRITORY, BY TYPE OF COMPANY, 1992

Province/Territory	(1) Companies With a Producing Mine in Canada	(2) Affiliates of (1)	(3) Oil Companies	(4) Foreign Companies Excluding (3)	(5) Junior Companies and Prospectors	(6) Other Companies	Total, Including Overhead
				($000)			
Newfoundland	3 789	4 215	–	512	2 528	96	11 141
Nova Scotia	1 935	170	–	296	806	51	3 258
New Brunswick	6 357	4 419	–	1 052	370	8	12 207
Quebec	41 347	22 823	190	2 654	20 781	6 301	94 095
Ontario	44 437	13 572	6	6 052	13 028	349	77 445
Manitoba	28 779	1 800	–	22	1 228	130	31 959
Saskatchewan	17 873	2 361	2 701	1 969	956	15	25 875
Alberta	4 231	28	26	1 041	51	–	5 377
British Columbia	24 996	6 535	610	4 120	33 939	1 385	71 585
Northwest Territories	11 048	9 494	2 264	16 104	3 679	130	42 718
Yukon Territory	3 984	1 468	932	743	2 545	–	9 671
Total Canada	188 776	66 883	6 728	34 565	79 912	8 466	385 330

Source: Natural Resources Canada, from the Federal-Provincial Survey of Mining and Exploration Companies.
– Nil.
[1] Exploration activity includes only the search for new mines; it does not include exploration for extensions to deposits already being mined or committed to production. [2] Overhead expenditures include land costs, field administration costs and exploration-related head office expenses.
Note: May not balance due to rounding.

TABLE 15. GENERAL EXPLORATION PLUS MINE-SITE EXPLORATION[1] EXPENDITURES, INCLUDING OVERHEAD,[2] BY PROVINCE AND TERRITORY, 1990-92

Province/Territory	1990 ($ millions)	1990 (%)	1991 ($ millions)	1991 (%)	1992 ($ millions)	1992 (%)
Newfoundland	23.2	3.0	12.1	2.2	11.1	2.9
Nova Scotia	11.0	1.4	4.5	0.9	3.3	0.8
New Brunswick	16.5	2.1	15.8	3.0	12.2	3.2
Quebec	196.4	25.4	138.1	26.0	94.1	24.4
Ontario	152.6	19.7	109.7	20.6	77.4	20.1
Manitoba	41.2	5.3	29.7	5.6	32.0	8.3
Saskatchewan	42.2	5.4	31.5	5.9	25.9	6.7
Alberta	10.7	1.4	6.6	1.2	5.4	1.4
British Columbia	226.5	29.2	135.7	25.5	71.6	18.6
Northwest Territories	36.0	4.6	31.6	5.9	42.7	11.1
Yukon Territory	18.4	2.4	16.5	3.1	9.7	2.5
Total	774.7	100	531.8	100	385.3	100
General exploration	662.3	85.5	464.5	87.3	325.9	84.6
Mine-site exploration	112.4	14.5	67.3	12.7	59.4	15.4

Sources: Natural Resources Canada and Statistics Canada, from the Federal-Provincial Survey of Mining and Exploration Companies.
[1] Exploration activity includes only the search for new mines; it does not include exploration for extensions to deposits already being mined or committed to production. [2] Overhead expenditures include land costs, field administration costs and exploration-related head office expenses. Statistics Canada totals for mine-site exploration have been revised to take into account additional or revised data obtained by NRCan.
Note: May not balance due to rounding.

TABLE 16. DIA MET MINERALS LTD./BHP MINERALS CANADA LTD. LAC DE GRAS PROPERTY, BULK SAMPLE DIAMOND EVALUATIONS

Pipe	Sample Weight	Diamonds Recovered	Carats Per 100 Tonnes	% Gem Diamonds By Weight	Mean Values[1]	Mean Values[1]
	(tonnes)	(carats)			(US$/carat)	(US$/tonne)
Point Lake	161.0	101.00	63	25	. .	. .
Pipe 1	151.5	65.37	43	17	89	38
Pipe 2	21.2	7.99	38	6	. .	. .
Pipe 3[a]	179.7	61.28	34	33	81	28
Pipe 4[a]	49.8	62.11	124	31	112	139

Source: Company reports.
. . Not available.
[a] Pipes 3 and 4 contain multiple kimberlite phases that have not been segregated in reporting these results.
[1] Mean of six independent estimates. Value of entire diamond sample, not just the gem fraction.

Canadian Mine Openings, Re-Openings, Expansions, Closures and Suspensions

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Overview

For the first time since 1989, the number of mines that opened or re-opened in Canada in 1993 at least equalled the number that suspended operations or that closed permanently (Tables 1 and 2).

A total of 16 mines opened or re-opened in 1993 and another 16 either closed or suspended operations. However, because production and employment were greater at the mines that closed than at the new and re-opened operations, there were net declines in both production and employment.

Several mines that had originally been scheduled to close in 1993 actually closed in 1992. Therefore, the revised count of closings for 1992 is 32, up from the 28 reported last year. With only 8 mine openings in Canada in 1992, the year incurred the largest net losses in ore production capacity and employment in the recent history of Canadian mining.

In 1993, 4 new precious-metal mines opened: 3 gold mines located in Quebec, Manitoba and British Columbia, and 1 palladium-gold-platinum-nickel-copper mine in Ontario. Ten former gold mines re-opened in 1993. The addition of these 14 precious-metal mines compares favourably with only 5 precious-metal mine suspensions and closures in 1993. Base-metal mining was hit hard in 1993, with 7 production suspensions, 4 permanent mine closures and no new or re-opened mines. Two coal mines in British Columbia that had closed in 1992 were re-opened by new owners in 1993.

Most gold mines opened in the second half of the year, subsequent to a rise in the price of gold that commenced in April (Figure 1). Mine openings tend to increase as the price of gold rises, but they do not always open in the months where prices are higher because production decisions are made earlier. Base-metal prices, which were already low, declined to all-time lows (corrected for inflation) in the early fall of 1993. The depressed prices led to the early depletion of economic ore and the closure of four base-metal mines, and to the suspension of production at seven others, mostly in the second half of the year. More base-metal mines might have closed had price improvements not occurred late in the year.

Ore depletion was the cause of all 1993 mine closures; most production suspensions were caused by depressed metal prices.

Regional Perspective

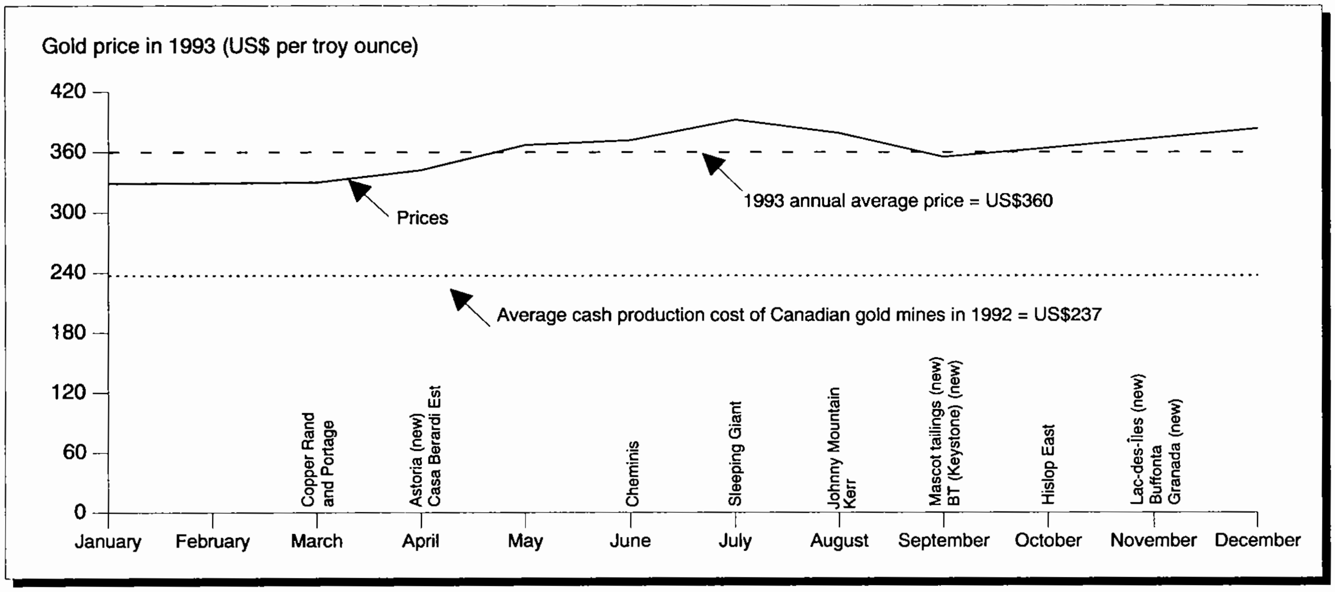
Mines opened or closed in six provinces and territories in 1993 (Tables 1 and 2). In the Bathurst district of New Brunswick, one base-metal mine closed permanently and production was suspended at another.

In northwestern Quebec, 6 gold mines opened and 5 mines (3 gold and 2 base-metal) closed, halting, at least temporarily, the trend of closings exceeding openings that had begun in 1990. In addition, the Camflo gold mill, which closed when the Camflo mine was depleted in 1992, re-opened in October 1993 under its new owner, Richmont Mines Inc., to process ore from the Francoeur mine. With a net loss in Quebec of nearly 800 t of daily ore production capacity and 80 jobs, the effects of mine closures in the province still outweighed those of mine openings. However, the negative impact has been reduced considerably compared to the three previous years.

In Ontario, 5 gold mines and 1 base-metal mine opened; a gold mine and a base-metal mine (Levack) suspended operations.

In Manitoba, the new BT mine, part of the Keystone gold project, opened near Lynn Lake. Plans are to increase production rapidly. The Chisel Lake and Stall Lake base-metal mines at Snow Lake, originally scheduled to close in 1993, continued to produce into 1994.

Figure 1
Average Monthly Gold Prices and Gold Mine Openings in Canada, 1993



Sources: Natural Resources Canada; London Gold Market PM fix.
Notes: Copper Rand and Portage mines are gold-copper mines with copper produced as a co-product. Lac-des-Îles is a palladium-gold-platinum-nickel-copper mine.

In British Columbia, for the first time in recent years, there was an overall net gain in mining employment. Four mines opened (2 gold and 2 coal); operations at 4 mines were suspended (1 gold and 3 base-metal). The result was that, although both production capacity and employment were down in metal mining, the decline in employment was more than offset by increased employment in coal mining.

Production was suspended at the Yukon Territory's two metal mining operations (the Faro and Vangorda mines). Placer gold production is currently the only mining activity in the Yukon.

Impact

In 1993, new and re-opened mines added 55 800 t to Canada's daily ore production capacity and some 1690 jobs. Mine closures and suspensions removed 97 600 t of daily capacity and about 2340 jobs, for a net loss in Canada of 41 800 t of daily capacity and 650 jobs. These represent the smallest net annual losses in capacity and jobs in Canada since 1989. The majority of mine closures in 1993 appear to represent temporary shut-downs that could be re-opened when prices improve. As a result, permanent capacity and employment losses in 1993 were smaller than the total net losses of 41 800 t and 650 jobs. Some 90% of the capacity and 55% of the employment losses represent production suspensions, mainly at base-metal mines. Only 11% of the capacity increase and 10% of the employment increase are due to new mines. The balance is due to mine re-openings.

The Canadian mines that accounted for the greatest capacity and employment gains in 1993 were the Copper Rand gold-copper mine in Quebec and two coal mines, Elkview (formerly Balmer) and Greenhills, both in southeastern British Columbia. The Similco and Gibraltar copper mines in British Columbia, and the Faro and Vangorda zinc-lead-silver mines in the Yukon Territory, were the most important mines to suspend production in 1993 (Table 2).

In 1993, the upsurge in gold mine openings helped reduce the production and employment shortfalls created by the large number of mine closings of the previous three years. However, as most of these gold mines are small- to medium-sized, they failed to compensate entirely for the closures and suspensions of medium- to large-sized base-metal mines over the previous three years. Moreover, because of persistently depressed metal prices, the trend of base-metal mine closings that began in 1991 continued through 1993.

MINE AND MILL EXPANSIONS

The most important mine and mill expansion programs announced in 1993 are in Ontario and British Columbia. These are: (1) the re-opening and expansion of Inco Limited's Garson nickel-copper mine at Sudbury, Ontario; (2) the expansion of Placer Dome Inc.'s Dome gold mine at Timmins, Ontario; and (3) possible capacity expansion at the copper mine of Gibraltar Mines Limited in British Columbia. Mine rehabilitation at the Garson mine began in 1993, with re-opening of the mine scheduled for 1994. Feasibility studies concerning proposed mine and mill expansions at both the Dome and Gibraltar mines were expected to be completed early in 1994. Although deteriorating copper prices led to the suspension of mining and milling operations at Gibraltar, some copper continues to be recovered by leaching of low-grade dumps.

The major expansion programs at Lac Minerals Ltd.'s Est-Malartic gold mill and Bousquet No. 2 gold mine near Malartic, Quebec, both of which started in 1989, were completed in June 1993. The expansion program at Inco's Birchtree nickel-copper mine at Thompson, Manitoba, continued through 1993. Following a six-month shut-down, production resumed in late August at Deak Resources Corporation's Kerr mine at Virginiatown, Ontario, but the earlier expansion program at the three-circuit Kerr mill was not resumed.

Production capacity at the Quinsam coal mine at Campbell River, British Columbia, where coal production had doubled to 500 000 t in 1992, was further increased to 550 000 t in 1993. The company plans to increase annual coal production to 750 000 t in 1994. Should market conditions for thermal coal improve, the long-term annual production target is 1.2 Mt.

OUTLOOK FOR 1994

Taking into account (1) current metal price forecasts, (2) the efforts that have been made by many base-metal producers to reduce metal inventories, (3) the agreement by the Commonwealth of Independent States to curtail metal exports, and (4) an expected rise in demand for both copper concentrates and gold on the part of China and other Southeast Asian countries, the outlook for 1994 mine openings in Canada is brighter.

With one exception, Canadian precious metal mine openings in 1993 were the result of the improved gold price. Barring a significant and persistent gold price decline, a number of gold mines are scheduled to open or re-open for production in Canada in 1994. These mines include: Donalda in Quebec, Komis in Saskatchewan, Dome Mountain and Table Mountain in British Columbia, and Colomac in the Northwest Territories. Still other gold mines are likely to open in Canada should the gold price remain in the vicinity of US$375 per troy ounce, or higher.

Several new Canadian base-metal mines are scheduled to come into production in 1994. These include: Louvicourt (copper-zinc-gold), Quebec; McCreedy East (nickel-copper), Ontario; and Thompson 1-D (nickel-copper), Manitoba. These mines will provide a significant boost to base-metal mining in Canada, and should also help to slow the rapid decline in employment that began in the early 1980s at Canadian metal mines. Also, the Garson (nickel-copper) mine in Ontario is being prepared for re-opening in 1994. However, production decisions for all these projects were made between 1991 and early 1993 when copper, nickel and zinc prices were considerably higher. Current lower prices for the three metals may place some of these production plans in jeopardy.

In October 1993, a joint federal-provincial Environmental Assessment Review Panel approved production from the Eagle Point uranium deposit in Saskatchewan. A 1994 production decision for this advanced mining project seems likely.

At least three Canadian gold mines and three base-metal mines are currently expected to close in 1994, all because of ore depletion. They are the Ferderber and Dumont gold mines in Quebec, originally scheduled to close in mid-1993, but now expected to close in early 1994. The Chisel Lake (zinc-copper-gold-silver) mine and the Stall Lake (copper-zinc) mine in Manitoba had both been expected to close by year-end 1993, but were rescheduled to close in early 1994. In British Columbia, the Equity Silver (silver-gold-copper) mine was depleted on January 23, 1994, and the Premier gold mine is scheduled to close in July 1994.

Note: Information in this review was current as of February 1, 1994.

TABLE 1. MINE OPENINGS AND CLOSINGS IN CANADA, 1993

Province/ Territory	New Mines			Mines Re-Opened			Mines Suspended			Mines Closed		
	Precious Metals	Base Metals	Other Minerals	Precious Metals	Base Metals	Other Minerals	Precious Metals	Base Metals	Other Minerals	Precious Metals	Base Metals	Other Minerals
New Brunswick	–	–	–	–	–	–	–	1	–	–	1	–
Quebec	1	–	–	5	–	–	–	–	–	3	2	–
Ontario	1	–	–	4	–	–	1	1	–	–	–	–
Manitoba	1	–	–	–	–	–	–	–	–	–	1	–
British Columbia	1	–	–	1	–	2	1	3	–	–	–	–
Yukon	–	–	–	–	–	–	–	2	–	–	–	–
Canada, total by commodity group	4	–	–	10	–	2	2	7	–	3	4	–
Total, Canada		4			12			9			7	

Source: Natural Resources Canada.
– Nil.

TABLE 2. CANADIAN MINE OPENINGS, RE-OPENINGS, EXPANSIONS, SUSPENSIONS, AND CLOSURES IN 1993

Mining Operation	Location	Province	Ore Capacity (tonnes/day)	Employment[1]	Date of Opening, Re-Opening, Expansion, Suspension or Closure	Mine or Plant Type	Main Commodities	Companies	Remarks
NEW OPERATIONS									
Precious Metals									
Astoria	Rouyn-Noranda	Que.	500	30	April 20	U/G	Gold	Yorbeau Resources Inc. and Deak Resources Corporation	Deak optioned Astoria from Yorbeau in 1992 to earn 100% interest. Ore reserves are estimated at 1.18 million st grading 0.20 troy oz of gold per short ton (st). Ore is milled at the nearby Kerr mill. Mine produced 35 000 oz of gold in 1993.
Mascot gold tailings	Hedley	B.C.	2 000	30	September	Surface	Gold	Candorado Mines Ltd.	The project will see the treatment of approximately 510 000 t of tailings over a two-year period.
BT (Keystone)	Lynn Lake	Man.	1 000	60	September 12	O/P	Gold	Black Hawk Mining Ltd. and Granduc Mining Ltd.	Ore is mined at the BT deposit and trucked about eight miles to the Lynn mill, near Lynn Lake. Annual production is projected at 40 000 oz of gold at a cash production cost of $US203 per oz. Open-pit reserves at the BT deposit are estimated at 1.4 million st grading 0.083 oz gold per st, giving a mine life of about 30 months. Further tonnages are available at the nearby Farley Lake deposit, which contains about 1.8 million st grading 0.11 oz gold per st. Granduc is in the process of acquiring the 55.2% controlling interest in the Farley Lake project owned by Manitoba Mineral Resources Inc.
Lac-des-Îles	Thunder Bay	Ont.	2 700	45	November 20	O/P	Palladium, gold, platinum	North American Palladium Ltd. and The Sheridan Platinum Group	The mine is North America's second primary palladium mine. Probable ore reserves stand at 7.4 million st grading 0.18 oz of platinum metals/st, chiefly palladium, 0.01 oz gold/st, 0.1% copper and 0.1% nickel. Current milling rate is at about 1900 t/d. Companies plan to produce annually 120 000 oz of palladium, 6000 oz of platinum, 12 000 oz of gold, 750 st of copper and 500 st of nickel.

TABLE 2 (cont'd)

Mining Operation	Location	Province	Ore Capacity (tonnes/day)	Employment[1]	Date of Opening, Re-Opening, Expansion, Suspension or Closure	Mine or Plant Type	Main Commodities	Companies	Remarks
RE-OPENINGS									
Precious Metals									
Copper Rand and Portage	Chibougamau	Que.	3 000	300	March	U/G	Gold, copper	MSV Resources Inc.	The mines will produce 45 000 oz of gold and 11 million lb of copper annually. Mine life is three years but could be increased because of recent discovery of new ore lenses. The mines were closed in November 1992 by the previous owner Westminer Canada Limited. MSV purchased the mines in February 1993.
Casa Berardi Est	La Sarre	Que.	1 500	170[e]	April 19	U/G	Gold	TVX Gold Inc. and Golden Knight Resources Inc.	The mine began production in September 1988 at 800 t/d. Operations were suspended in April 1992 due to ground problem. As of January 1, 1992, mineable ore reserves were 1 508 500 t grading 0.24 oz gold/st. Workforce could potentially be increased to 182.
Cheminis	Virginiatown	Ont.	350	20	June	U/G	Gold	Northfield Minerals Inc.	The mine was first opened in 1991, closed in 1992, re-opened in January 1993, closed again in March, then re-opened in June after the present owner purchased the mine from Deak Resources Corporation. Current reserves are estimated at 2 million st of ore averaging 0.16 oz gold/st.
Sleeping Giant	Amos	Que.	900	65	July 15	U/G	Gold	Cambior inc. and Aurizon Mines Ltd.	Mineable ore reserves stand at 458 300 st grading 0.22 oz gold/st. The annual milling rate is expected to be 170 000 st and average annual production will be about 35 000 oz of gold. Employment of 96 workers is expected during commercial production.
Johnny Mountain	Terrace	B.C.	270	80	August	U/G	Gold, copper	International Skyline Gold Corp. and Cheni Gold Mines Inc.	Production began in August 1988. Operation was suspended in August 1990 due to shortage of ore and low gold price. The mine is now producing gold by mining ore left in remnant pillars and old stopes on a seasonal basis. Milling resumed in September 1993. Mining stopped temporarily on November 14, 1993, for the winter.

Kerr	Virginiatown	Ont.	900	100	August	U/G	Gold	Deak Resources Corporation	Mining suspended in February 1993 due to refinancing problems. Company plans to increase mill capacity to 3000 t/d in 1993. Current ore reserves stand at 1.8 million st grading 0.12 oz gold/st.
Hislop East	Timmins	Ont.	550	25	October	O/P & U/G	Gold	St. Andrew Goldfields Ltd.	Mining started with the open-pit, which will provide a three-month supply of ore. Ore milled at the nearby Stock Township mill. The mine was closed in 1991 for economic reasons.
Buffonta	Virginiatown	Ont.	270	12	November	O/P	Gold	Deak Resources Corporation and Gwen Resources Ltd.	Mining suspended in March 1991 due to a lack of funds. The present owners are 50-50 joint venture partners. Ore is custom-milled at the nearby Kerr mill.
Granada	Rouyn-Noranda	Que.	900	15	November	O/P	Gold	KWG Resources Inc. and SEG Exploration Inc.	Ore is custom milled at Lac Minerals Ltd.'s Est-Malartic mill. Ore reserves are estimated at 3.7 million st grading 0.09 to 0.18 oz gold/st. Former production was from an underground operation from 1930 to 1935.
Others									
Greenhills	Sparwood	B.C.	11 000	319	March	O/P	Coal	Fording Coal Ltd.	Mine was closed in November 1992 because of financial difficulties. Employment will be increased gradually to 475 by 1995, when the mine reaches a full production rate of 3 Mt/y of clean coal.
Elkview (formerly Balmer)	Sparwood	B.C.	30 000	419	End of April	O/P	Coal	Teck Corporation	Mine was closed May 1, 1992, due to financial difficulties of the former owner, Westar Group Ltd. The mine produced 3 Mt of clean coal in 1993, all for export. Employment is expected to increase as production rises.
EXPANSIONS									
Precious Metals									
Est Malartic Mill	Malartic	Que.	2 500	43	June	Mill	Gold, silver, copper	Lac Minerals Ltd.	The overall mill capacity expansion program, which began in 1991, is now complete. The expansion was necessary to accommodate increased ore production at the Bousquet No. 2 mine.
Bousquet No. 2	Malartic	Que.	1 650	235	June	U/G	Gold	Lac Minerals Ltd.	Commercial production began in October 1990. Production increase at the mine was done in conjunction with expansion at the Est Malartic mill.
Kerr	Virginiatown	Ont.	2 000	50	1991-93	Mill	Gold	Deak Resources Corporation	Company's plan to increase capacity to 2700 t/d in 1993 was put on hold after the Kerr mine suspended operation in February 1993.

TABLE 2 (cont'd)

Mining Operation	Location	Province	Ore Capacity	Employment[1]	Date of Opening, Re-Opening, Expansion, Suspension or Closure	Mine or Plant Type	Main Commodities	Companies	Remarks
			(tonnes/day)						
Dome	Timmins	Ont.	4 000	353	1993-94	O/P & U/G	Gold	Placer Dome Inc.	Recent installation of a computer expert system has resulted in an increase in the mining and ore processing rate from 3000 t/d to 4000 t/d. A feasibility study on expanding the open-pit and mill is scheduled for completion in early 1994.
Keystone	Lynn Lake	Man.	1 000	60	1994	O/P	Gold	Black Hawk Mining Ltd. and Granduc Mining Ltd.	The companies plan to increase the mill capacity to 1450-1800 t/d in 1994. The expansion, which involves equipping the existing Lynn mill with grinding capacity, could be completed by April 1994. Employment may also increase slightly.
Base Metals									
Birchtree	Thompson	Man.	2 000[e]	85	1991-97	U/G	Nickel, copper	Inco Limited	Work continued in 1993 to double production to 34 million lb of nickel annually by 1997. Some 200-300 temporary construction jobs will be created. However, company-wide efforts to cut back on production at year-end 1993 has put mine expansion at Birchtree on hold. It is tentatively scheduled to recommence in 1997.
Other Minerals									
Quinsam	Campbell River	B.C.	1 650	136	1992-94	O/P & U/G	Coal	Hillsborough Resources Limited	Company increased coal production to 550 000 t in 1993 from 500 000 t in 1992 and plans to further increase it to 750 000 t in 1994. The mine produced 250 000 t of thermal coal in 1991. In late 1993, the company started expansion of its plant capacity towards the 3000-t/d target. But current market conditions make the completion date uncertain.
SUSPENSIONS									
Precious Metals									
Kerr	Virginiatown	Ont.	900	100	February	U/G	Gold	Deak Resources Corporation	Operations at the mine were suspended while the company seeked financing to carry out development work. Approximately 50 employees remained at the Kerr mill, which processes ore from the Francoeur gold mine in Quebec. The mine re-opened at the end of August 1993.

Dome Mountain	Smithers	B.C.	320	25	April	U/G	Gold	Timmins Nickel Inc. and Habsburg Resources Limited	Mining suspended because of disputes between the companies.
Base Metals									
Faro	Faro	YT	12 300	430 (Faro & Vangorda)	April 2	O/P	Zinc, lead, silver	Curragh Inc.	Mining operations suspended in early April 1993 because of low metal prices and company financial problems. Peat Marwick Thorne Inc. has been appointed as receiver for the Faro assets.
Vangorda	Faro	YT	8 000		April 2	O/P	Zinc, lead, silver	Curragh Inc.	Mining operations suspended in early April 1993 because of low metal prices and company financial problems. Peat Marwick Thorne Inc. is the receiver.
Silvana	New Denver	B.C.	130	15	April 2	U/G	Zinc, silver, lead, copper	Treminco Resources Ltd.	Mine closed due to low metal prices.
Heath Steele	Bathurst	N.B.	3 500	273	July 4	U/G	Zinc, copper, lead, silver	Brunswick Mining and Smelting Corporation Ltd. and Noranda Minerals Inc.	Operation suspended due to low metal prices.
Levack	Sudbury	Ont.	3 000•	300	July 5	U/G	Nickel, copper	Inco Limited	Mining suspended because of high costs and low metal prices. Affected workers were relocated to company's other mining operations in the area.
Similco	Princeton	B.C.	22 680	300	November 30	O/P	Copper	Princeton Mining Corporation	Mining suspended because of low copper prices.
Gibraltar	McLeese Lake	B.C.	36 280	196	December 1	O/P	Copper	Gibraltar Mines Ltd.	Mining suspended due to low copper prices. However, copper production through waste rock dump leaching and solvent extraction continues. 125 of the 196 workers were laid off.
CLOSURES									
Precious Metals									
Norlartic	Val-d'Or	Que.	1 650	52	January	U/G	Gold	Aur Resources Inc.	Mine closed due to depletion of ore reserves. Production began in July 1991.
Lucien C. Béliveau	Val-d'Or	Que.	1 635	72	End of October	U/G	Gold	Cambior inc.	Mine closed due to depletion of reserves. Production began in September 1989.
Pierre Beauchemin	Rouyn-Noranda	Que.	1 400	134	End of October	U/G	Gold	Cambior inc.	Mine closed due to depletion of reserves. Production began in January 1989.
Base Metals									
Ansil	Rouyn-Noranda	Que.	1 250	160	April 13	U/G	Copper, zinc, silver, gold	Minnova Inc.	Mine closed due to ore depletion. Mine was discovered in 1981; production began in July 1989.

TABLE 2 (cont'd)

Mining Operation	Location	Province	Ore Capacity	Employment[1]	Date of Opening, Re-Opening, Expansion, Suspension or Closure	Mine or Plant Type	Main Commodities	Companies	Remarks
			(tonnes/day)						
Stratmat	Bathurst	N.B.	1 000	280	July	U/G	Copper, lead, zinc, silver	Brunswick Mining and Smelting Corporation Limited and Heath Steele Mines Limited	Mine closed due to depletion of ore reserves. Production began on March 1, 1989; the open-pit operation ceased in 1992.
Namew Lake	Flin Flon	Man.	1 900	176	November 5	O/P	Nickel, copper	Hudson Bay Mining and Smelting Co., Ltd. and Outokumpu Mines Ltd.	Mine closed due to depletion of ore reserves. Production began in September 1989.
Selbaie underground	Joutel	Que.	1 650	250	End of 1993	U/G	Copper, zinc, gold, silver	Billiton Metals Canada Inc.	Underground operation ceased due to depletion of underground ore reserves. Open-pit operation continues. Cessation of the underground operation affected some 250 of the 550 workers at the Selbaie property. Company has budgeted $3 million to modify the concentrator to allow for future use of the circuit now serving the underground mine. Current open-pit has an ore production capacity of 6300 t/d. Open-pit resources are good for at least 10 years.

Source: Natural Resources Canada, based on company reports and communications with companies.
O/P Open-pit; U/G Underground.
• Estimated; oz Troy ounce; st Short ton; t tonne.
1 Employment refers to workers on the company's payroll and to contract workers at an operation, or at an operation prior to its closure.
Note: A mine that closed and re-opened in the same year is shown under both categories.

Aluminum

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For the third consecutive year, international aluminum markets were buffeted by increasing stocks and record low prices (in real terms). The effect of economic recession in some of aluminum's major markets resulted in Western World primary aluminum consumption growth remaining below 1% in 1993. Sluggish growth in demand coupled with increased exports from the former Soviet Union (FSU) of about 1.6 Mt, compared to 1 Mt in 1992, resulted in continued weak prices throughout 1993.

Prices on the London Metal Exchange (LME) averaged US52¢/lb in 1993 compared to US57¢/lb in 1992. The International Primary Aluminium Institute (IPAI) reported that Western World primary unwrought aluminum inventories increased to 1.970 Mt in December 1993 compared to 1.717 Mt in December 1992. The increase in producer stocks was coupled with a 1-Mt increase in LME stocks. LME stocks reached record levels by year-end to over 2.5 Mt from 1.5 Mt at the end of 1992.

Towards the end of the year, governments representing the six major aluminum-producing nations held informal multilateral meetings in Moscow and again in Washington, D.C., in an attempt to address the increased oversupply of aluminum on world markets. A third meeting was held in Brussels in late January 1994. Full details of a draft memorandum of understanding were not yet published by the end of January 1994. The participants agreed to schedule further meetings to take place at the end of February in Canada.

CANADIAN DEVELOPMENTS

Canadian production of primary aluminum in 1993 increased 14.6% to 2.308 Mt, compared to 1.972 Mt in 1992. Work was completed on the last of the new aluminum smelter projects at Deschambault and Sept-Îles, Quebec, raising Canada's aluminum smelting capacity to 2.283 Mt. Canadian exports of primary smelter products during the first nine months of 1993 rose to 1.38 Mt, compared with 1.17 Mt for the same period in 1992. Of this amount, exports to the United States totalled 928 337 t compared to 791 264 t in the same period last year.

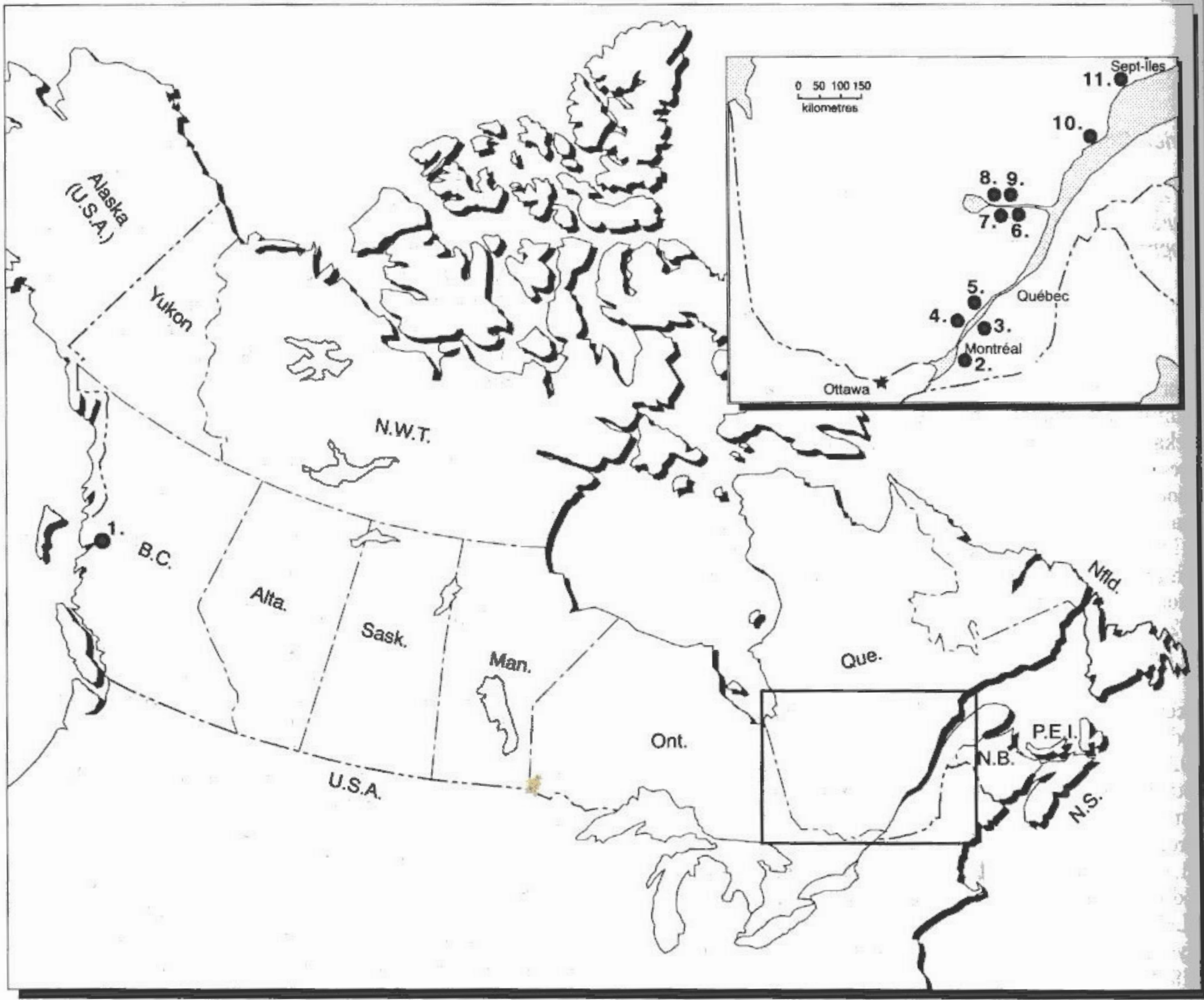
Alcan Aluminium Limited announced a loss for 1993 of US$104 million, despite achieving its target of cash neutrality and reducing total debt. Alcan cited increased aluminum exports from the FSU as the main cause of the weak prices, which contributed to Alcan's losses. In Canada, losses narrowed for the year, mainly due to lower smelter production costs and improved fabricated product volumes. In September 1993, Alcan announced the appointment of Jacques Bougie as the company's President and Chief Executive Officer (CEO), effective November 1, 1993.

In early January 1994, Alcan announced temporary production cuts of 156 000 t/y of primary aluminum production capacity from its worldwide operations. The closures announced were in addition to the 102 000 t/y closed in 1991 and 1992. Together the closures, totalling 258 000 t/y, will reduce Alcan's operating rate to 85% of its world capacity (93.5% in Canada). Alcan said it would cut 60 000 t/y in the United States, 18 000 t/y in the United Kingdom, and 8000 t/y in Brazil. Reductions in Canada include 30 000 t/y at the Kitimat smelter in British Columbia and 40 000 t/y at various locations in Alcan's Quebec smelter system. The production cuts will be made by a combination of potline closures, non-replacement of potlinings, and amperage reduction.

The suspension of work on Alcan's half-built Kemano Completion Project near Kitimat, British Columbia, continued pending the outcome of the B.C. Utilities Commission's review of the project, in which Alcan is a full participant. The $1.4 billion project is the second phase of Alcan's hydro-electric development of the Nechako River System and was scheduled to add 540 MW to Alcan's Kemano Generating Station by 1994. The

Figure 1

Aluminum Smelters, 1993



SMELTER	COMPANY	CAPACITY (t/y)
1. Kitimat, B.C.	Alcan	272 000
2. Beauharnois, Que.	Alcan	48 000
3. Bécancour, Que.	A.B.I.	360 000
4. Shawinigan, Que.	Alcan	84 000
5. Deschambault, Que.	Lauralco	215 000
6. Grande-Baie, Que.	Alcan	180 000
7. Laterrière, Que.	Alcan	204 000
8. Isle-Maligne, Que.	Alcan	73 000
9. Arvida, Que.	Alcan	232 000
10. Baie-Comeau, Que.	Reynolds	400 000
11. Sept-Îles, Que.	Alouette	215 000

Supreme Court of Canada ruled in February 1993 that further arguments on the applicability of the Federal Environmental Assessment Review Process Guidelines Order to Kemano would not be heard. Alcan has stated that it will not restart construction until all uncertainties surrounding the project have been resolved.

Aluminerie Lauralco Inc., a subsidiary of Alumax Inc. of the United States, completed the start-up phase of its new 215 000-t/y smelter at Deschambault, Quebec, in the first quarter of 1993. The smelter began operations in February 1992 using the energy-efficient Pechiney 300 KA technology. The smelter has 500 employees and contributes an estimated $50 million annually to the local economy.

In September, Otto Knaisch, of Vereinigte Aluminium-Werke AG (VAW), was chosen as the next President and CEO at Aluminerie Alouette's 215 000-t/y smelter in Sept-Îles. Aluminerie Alouette was officially inaugurated in September 1992. The smelter is jointly owned by an international consortium comprising VAW (20%), Austria Metall Aktiengesellschaft (AMAG) (20%), Hoogovens Groep B.V. (20%), Société générale de financement du Québec (Alunor) (20%), Kobe Steel Ltd. (13.3%), and Marubeni Corp. (6.7%).

Canadian Reynolds Metals Limited announced that shipments at its 400 000-t/y Baie Comeau smelter totalled some 405 200 t in 1993, compared to 399 900 t in 1992. The increase was achieved through exceptional output from the potlines and cast house. North American shipments accounted for 74% of the total. Shipments within Canada increased 12.5% to reach 50 600 t. Shipments to the United States comprised 237 400 t, or 59% of the total. In addition to the increased shipments, the Baie Comeau smelter achieved cost reductions of US$8.4 million in 1993. Canadian Reynolds invested another $18.8 million in the Baie Comeau smelter for potline reconstruction and a computer system.

Aluminerie de Bécancour Inc. (A.B.I.) operated its 360 000-t/y smelter at full capacity in 1993. A.B.I. commenced the start-up of its third potline in 1991. The new line increased capacity at the smelter from 240 000 t/y to 360 000 t/y. A.B.I. is jointly owned by a consortium of companies comprising Pechiney (25.05%), Reynolds Metals Company (25.05%), Alumax Inc. (24.95%), and the Société générale de financement du Québec (Albecour) (24.95%).

In September, the Québec Aluminum Industry Association (AIAQ) released a study outlining the economic benefits that the aluminum sector brings to the province of Quebec. According to the study, prepared by Groupe Secor, the Quebec aluminum industry directly created some 13 000 jobs and contributed, either directly or indirectly, an estimated $620 million in government revenues in 1993. The industry injects more than $2.4 billion into the purchase of goods and services annually; it ranked second only to newsprint in terms of the value of exports to the Quebec economy in 1991.

WORLD DEVELOPMENTS

Total world production of primary and secondary aluminum reached an estimated 25 Mt in 1993, 19.4 Mt of which was primary. Western World smelter capacity reached 16.2 Mt by the end of 1993. Increased smelter capacity that started production in 1993 was offset by cuts in production in Europe and the United States. Western World production, therefore, remained relatively unchanged from 1992 production at an estimated 15.0 Mt.

In October, the Russian government invited several world aluminum-producing countries to Moscow to prepare the framework for informal multilateral meetings to address the current crisis in world aluminum markets. Representatives from Australia, Canada, the European Community (EC), Norway, Russia and the United States met to discuss the current oversupply situation as a result of the downturn in the major Western economies and the introduction of the FSU as a major exporter of aluminum. The two-day meetings ended with a commitment by all participants to meet again in Washington, D.C., in December.

The second round of meetings held in Washington, D.C., in December brought together the same group of producing nations along with their industry representatives, who were invited to give presentations outlining their analysis of the current crisis in aluminum markets. Industry participation was limited to a general session on the first day of the meetings and included most of the presidents and CEOs of the world's major aluminum-producing companies as well as representation from the IPAI. Industry estimated that between 1.5 and 2 Mt of aluminum must be taken out of production in order to return the market to balance by 1996. While no solution was reached by the government representatives, a framework for future meetings in January 1994 in Brussels was outlined.

The Brussels meetings took place at the end of January 1994, and no results were made available before the end of the month. Press reports indicated that a memorandum of understanding had been drafted and governments were awaiting acceptance by all of the participating countries before the details would be made public. Another round of meetings to monitor developments in world aluminum markets was scheduled to take place at the end of February in Canada.

United States

Total primary aluminum production declined in the United States in 1993 for the first time since 1986. Production cuts totalling more than 600 000 t (15.5% of capacity) were made at a number of smelters across the country by several producers in response to power shortages in the Pacific Northwest and to weak aluminum prices. Total U.S. production for 1993 was reportedly down 8.6% to 3.69 Mt compared with 4.04 Mt in 1992.

In February, The Bonneville Power Administration (BPA) announced an extension of its restriction of the first 25% of electric power to its industrial customers, including the eight companies that operate ten Pacific Northwest aluminum smelters. The 25% restriction, which began at the end of 1992, was originally scheduled to end February 28, 1993, but was extended due to continuing water shortages on the river systems that supply the dams.

As a result of the power cuts, all but two of the eight companies that operate aluminum smelters in the region cut production for a combined total of close to 300 000 t/y. Vanalco Inc. and Northwest Aluminum Corp. were the only two companies that continued to operate their smelters at close to full capacity. The Pacific Northwest aluminum smelters account for more than one third of total U.S. aluminum production.

Alumax cut 25% of its primary aluminum production at its 272 000-t/y Ferndale, Washington, smelter. Columbia Aluminum Corp. also cut production by 45 000 t/y at its 168 000-t/y Goldendale, Washington, smelter. By May 1993, however, the company restarted 17 000 t/y of capacity but was forced to again cut production by 11 000 t/y at year-end.

Other cuts made as a result of the BPA restrictions included smelters owned by Kaiser Aluminum & Chemical Corporation and the Aluminum Company of America (Alcoa). Kaiser temporarily shut down a 50 000-t/y potline at its 200 000-t/y Mead, Washington, smelter and another 18 000-t/y potline at its 73 000-t/y Tacoma, Washington, smelter. Alcoa closed 42 000 t of capacity at its 220 000-t/y smelter in Wenatchee, Washington.

Elsewhere in the country, production cuts were made as world aluminum prices continued to trade below most smelters' operating costs. In February, Alumax cut production by 20% at its 181 500-t/y Mount Holly, South Carolina, smelter to an annual rate of 145 200 t/y. In June, Alcoa announced that it would temporarily cut production by 268 000 t/y at five of its smelters. Cuts were made at Alcoa's smelters at Badin, North Carolina (56 000 t); Rockdale, Texas (93 000 t); Alcoa, Tennessee (53 000 t); Warrick, Indiana (44 000 t); and again at Wenatchee, Washington (22 000 t).

Reynolds announced total temporary production cuts of 88 000 t/y starting in October 1993. The cutback comprised a 41 000-t/y reduction at Reynold's 125 000-t/y smelter at Massena, New York, and another 47 000-t/y cut at its 204 000-t/y Longview smelter in Washington.

Toyota Motor Corporation's St. Louis, Missouri-based aluminum parts subsidiary, Bodine Aluminum Inc., opened a new $60 million plant in Troy, Missouri. Bodine Aluminum produces cylinder heads and intake manifolds to supply Toyota Motor Manufacturing USA Inc. (TMM). The new plant increases TMM's local procurement ratio since it will allow Toyota to discontinue exports of two key engine parts from Japan. The plant began running double shifts in May, increasing output to 900 castings per day by July.

In August, Reynolds signed a deal to purchase the aluminum beverage can and end manufacturing operations of Miller Brewing Co. The purchase increases Reynold's U.S. can capacity by about 50% to an annual capacity of five billion aluminum beverage cans and ends. As part of the deal, Reynolds and Miller entered into a long-term agreement under which Reynolds will supply substantially all of Miller's aluminum beverage can requirements.

Jamaica

The Jamaica Bauxite Institute reported that the country's earnings for 1993 continued to fall, despite an increase in alumina output and the fact that total production remained similar to 1992. Jamaica produced 11.2 Mt of bauxite in 1993, compared to 11.3 Mt in 1992. Alumina production increased 2.8% to 2.98 Mt. Gross earnings for the sector declined 8% to US$529 million. Earnings have dropped annually since 1990 when the sector earned US$705 million. The bauxite institute cited the continued slump in prices on the LME and the continued devaluation of the Jamaican dollar as the main reason for the decline. In addition, the loss of the bauxite contract with the FSU cost the sector US$25 million in annual earnings.

In September, Jamaica's state-owned Clarendon Alumina Producers Ltd. announced losses for the third straight year. Financial results for the fiscal year ending March 31 indicated losses of US$5.3 million. The fall in prices resulted in negative cash flows, and Clarendon was forced to rely on reserves built up since the company was formed in 1985. The state-owned company owns half of the Jamalco alumina plant; Alcoa owns the other half. Jamalco produced 709 300 t of alumina in the 1992/93 fiscal year, down from 905 300 t the previous year. The drop in production is partly due to expansion efforts currently under way that will increase the plant's capacity to 1 000 000 t by 1994.

According to the Jamaica Bauxite Institute, plans to open a joint-venture, 80 000-t/y aluminum smelter in Trinidad and Tobago were put on hold because of weak market conditions. Earlier in 1993, Jamaica and Trinidad and Tobago completed a pre-feasibility study on the latest proposal, which would have involved the governments of Jamaica and Trinidad and Tobago, and a German-Nigerian consortium, to build a US$200 million smelter at an existing industrial estate.

South America

According to the Brazilian Aluminum Association, Brazil's 1993 primary aluminum production totalled 1.17 Mt, down 1.9% from 1.19 Mt in 1992. The decrease was attributed to falling aluminum prices in the international market and to the high cost of electricity in Brazil. Aluminum export revenues totalled US$899.6 million in 1993 despite an increase in aluminum shipments to 874 200 t, up from 816 200 t in 1992.

In October, Valesul Alumínio S.A. cut production by about 21% in reaction to a proposed 50% increase in power.

In November, Alcan Alumínio Do Brasil S.A., a subsidiary of Alcan, announced that it had renegotiated its contract on a quarter of the power that supplies energy to its 51 000-t/y Ouro Peurto smelter. Elsewhere at Alcan's Aratu smelter, one of the two potlines remained closed in 1993, reducing production capacity by 27 000 t.

The Venezuelan cabinet approved a plan to join Interalumina, the state alumina company, with the bauxite mining firm Bauxiven, which later will be joined with the state-controlled aluminum company Venalum. Corporacion Venezolana de Guayana (CVG) announced that Bauxiven and Interalumina will be formally joined in October, but Venalum will not become part of the aluminum holding until its Japanese investors approve the plan. CVG proposed the merger to reduce costs and to improve efficiency. Venezuela's aluminum sector estimated losses in 1993 at about US$200 billion.

Europe

Pechiney announced temporary production cuts at several of its European smelters. In France, Pechiney cut 20% capacity at its 120 000-t/y St-Jean smelter; it also cut 44 000 t/y at Auzat and 44 000 t/y at Lannemezan. In addition, the company cut 8% capacity at its Vlissingen smelter in the Netherlands where a 12% cut was already in place. Pechiney also announced plans to eventually close its 31 000-t/y Venthon smelter.

In April, Alusuisse-Lonza Holding Limited cut production at its 135 000-t/y smelter at Essen, Germany, to one third of its capacity. This followed a previous cut in production announced in March 1992. Alusuisse also announced that it was closing its 48 000-t/y Steg smelter in Switzerland by the fall of 1994.

In August, the European Commission announced the introduction of a 60 000-t limit on aluminum imports from the FSU effective until the end of November. The limit was subsequently extended to allow another 45 000 t through to the end of February 1994. The import quotas were imposed on all aluminum metal, whether it arrived directly from states of the FSU or through a third country. The imposition of the import quotas was seen as a temporary measure while negotiations for an agreed-upon level of imports continued.

The European Bank for Reconstruction and Development (EBRD) concluded a deal to invest a total of $125 million in a 105 000-t/y smelter at Ziar nad Hronom in Slovakia. The smelter will replace the existing 69 000-t/y smelter using Söderberg technology. The EBRD's investment in the project consists of a $110 million loan and a $15 million equity interest. Construction is expected to be completed sometime in the first quarter of 1994, with full production due by the end of the year.

The Ukraine's industry ministry announced its intention to build a new 200 000-t/y aluminum smelter on the site of the existing 93 000-t/y

Zaporozhye smelter. The ministry intends to finance the project through state credits and eventually turn the project over to private shareholders. If approved, the project is expected to take seven years to complete.

Etibank General Management announced it was postponing plans to expand and modernize its 60 000-t/y Seydisher smelter in Turkey. The company had originally planned to increase production capacity to 100 000 t/y and to upgrade the existing potlines from Söderberg to prebake technology. Low world aluminum prices hampered efforts to raise the necessary financing for the project.

Russian Federation

Russian exports of primary aluminum are estimated to reach about 1.6 Mt in 1993, up from the previous estimate of 900 000 t in 1992. While some reductions in production were reported at some smelters, internal consumption is estimated to have declined even faster to about 900 000 t. This fall in internal demand has made more aluminum available for export to the West. By year-end, operating costs at Russian aluminum smelters were reportedly up significantly. Power rate increases, together with increased transportation costs and the higher cost of importing raw materials as the rouble continues to devalue against the U.S. dollar, combined to raise the cost of production for many of Russia's aluminum smelters. Despite the increased costs, however, the total cost of production is still thought to be lower than most Western producers' costs.

Russia announced in December that it had made cash available in the budget to fund a modernization program for the 250 000-t/y Novokuznetsk aluminum smelter in Western Siberia. The modernization project reportedly includes plans to double the smelter's capacity. Novokuznetsk will fund its modernization by revenues generated from the export of aluminum during the period 1993-99.

Finland's Kumera Corporation and the Kandalaksha aluminum smelter signed a contract in December for modernization of the 62 000-t/y smelter located in Russia's Kola Peninsula. The project, designed to reduce pollution, includes plans for a fume treatment plant and fume control equipment together with other process improvements for the two potlines at the smelter. The project will be carried out cooperatively by Kumera, Reynolds International Inc., and various European and Russian suppliers. The project, which has yet to be approved by the Russian government, is expected to take 30 months to complete.

Kaiser Aluminum continued conversion work on the 800 000-t/y Krasnoyarsk aluminum smelter. Conversion of the smelter's electrolytic cells from wet to dry Söderberg anode paste was scheduled for completion by the end of the year. In addition to the current conversion project, officials at the smelter have proposed an extensive environmental modernization program to reduce pollution.

The new 43 000-t/y rolling mill at the Sayansk aluminum smelter was officially opened in August. The $240 million plant is expected to reach full capacity by the end of the year. Ownership of the plant is shared between Reynolds International (13.5%), Fata European Group of Italy (13.5%), San Paolo Bank of Italy (3%), and the remainder by a Russian consortium comprising five agencies.

Middle East

The Saudi Arabian Ministry of Petroleum and Mineral Resources reportedly announced the discovery of 94 Mt of bauxite near Zubeira, 460 km northwest of the capital city of Riyadh. Surveys continue in the area around Zubeira with the aim of further increasing the proven reserves of bauxite in the region. The two principal aluminum smelters in the region, ALBA in Bahrain and DUBAL at Dubai in the United Arab Emirates, have a combined capacity to produce 700 000 t/y of aluminum. They currently import the bulk of the alumina required from Australia.

The fifth and last production line at Iran's Arak aluminum company, IRALCO, came on stream in March, increasing total annual output by 25 000 t to 120 000 t/y. The addition will make it possible to meet domestic requirements and to raise exports to over 20 000 t/y.

A smelter expansion at Aluminium Bahrain B.S.C.(c) (ALBA) led to record output of 450 000 t in 1993. The 235 000-t/y smelter expansion performed above expectations in its first full year of production. Annual capacity was raised to 460 000 t. Conversion to modern technology of the 228 cells in Line 2 was completed ahead of schedule in November. Line 1's cells had already been modernized and Line 3 conversion is in the last phase.

Asia

The Pingguo Aluminium Company reportedly completed the first phase of a refinery and smelter project in the Guangxi Zhuang region of China. The first phase will produce 300 000 t/y of alumina and

100 000 t/y of aluminum. Plans call for the project to eventually reach a production capacity of 1 Mt/y of alumina and 300 000 t/y of aluminum.

In India, an agreement was signed between Kaiser Aluminum and the state-owned Bharat Aluminum Company to modernize the 100 000-t/y Korba smelter in Madhya Pradesh. Once completed in 1995, the modernization is expected to substantially reduce the smelter's power costs.

Indian companies plan to more than triple the country's alumina output by 1997 to exploit large bauxite reserves in the eastern state of Orissa. At least three large-scale export-oriented projects, all involving some form of foreign collaboration or joint venture, are being considered which, if completed, could increase India's alumina production from 1.3 Mt/y to close to 4.2 Mt/y. Larsen & Tubro (L&T), India's largest engineering company, held discussions with several foreign companies about possible collaboration. Possible projects include Alcoa, Pechiney and Alusuisse. L&T is planning a two-phase development to produce 500 000 t of alumina, rising to 1 Mt after four years.

Apart from L&T, both the National Aluminium Company Ltd. (Nalco) and Indian Aluminium (Indal) are planning major alumina projects in Orissa. Nalco, India's largest producer of aluminum, announced that it is planning a 900 000-t/y alumina refinery in collaboration with Hydro Aluminium of Norway. The state-run Nalco produced 672 000 t of alumina in the fiscal year to March 1992. The new $800 million refinery will use bauxite from Nalco's existing mines in the Koraput district of Orissa.

Elsewhere in India, the Indian Aluminium Company Limited (Indal) announced the closure of its 73 000-t/y smelter at Belgaum. The company cited increased power costs as the main reason for the closure. Montréal-based Alcan owns a 39.6% share in Indal, which operates two more smelters in India at Hirakud (24 000 t/y) and Alupuram (20 000 t/y). In December, Indal announced plans to join with Norsk Hydro of Norway and Tata Industries to set up an export-oriented company that will build a 1-Mt/y alumina plant to come on stream in 1998. Technology for the plant, which is to be built in the Indian state of Orissa, will be supplied by Alcan and Alusuisse.

The International Development Corp. (IDC) announced that financing difficulties would probably delay the planning and construction of the 220 000-t/y Bandar Abbas aluminum smelter project in Iran. The first phase of the project was tentatively scheduled to start production at the end of 1995 and produce 110 000 t/y.

Africa

South Africa's Alusaf (Pty) Limited announced that it plans to complete its aluminum smelter project ahead of schedule. The Hillside smelter is now expected to be completed in June 1995, five months ahead of schedule. The smelter is expected to reach full production one year later. At full capacity, the smelter will produce 466 000 t/y. By completing the smelter ahead of schedule, Alusaf expects to achieve significant cost savings due to inflation.

Australia

In April, Alcoa of Australia Limited announced plans to increase capacity by 200 000 t to 1.7 Mt/y at its Wagerup alumina refinery in Western Australia. Alcoa of Australia, owned 51% by the Aluminum Company of America and 48% by Western Mining Corporation Holdings Limited, plans to have the new capacity on stream by mid-1994. Alcoa's alumina production rose to about 6.0 Mt in 1993 from 5.5 Mt in 1992 as a result of the 1992 expansion of the Wagerup refinery in Western Australia from 900 000 t/y to 1.5 Mt/y.

In July, Comalco Limited announced it was purchasing AMAG's 20% equity interest in the 220 000-t/y Boyne aluminum smelter. The purchase increases Comalco's share in the smelter to 50%. Feasibility studies were completed during the year to examine the possibility of adding a third potline and increasing the smelter's capacity to 420 000 t/y.

In August, the Australian government announced that it would validate Comalco's title to the Weipa bauxite deposits in Northern Queensland to protect them from an aboriginal land claim. The decision provides security for Comalco's proposed A$1.75 billion aluminum smelter expansion in Queensland, which the company said the land claim had put in jeopardy.

New Zealand

Australia's Comalco signed a number of electricity agreements to secure power for its 260 000-t/y Tiwai Point smelter in southern New Zealand. The new long-term electricity supply contract was approved by the New Zealand government in December. The deal gives Comalco security of supply of electricity until 2012.

RECYCLING

Secondary aluminum production continues to increase worldwide. Western World production of secondary aluminum in 1992 was estimated at 6.0 Mt, compared to 5.7 Mt in 1991. Production in the first nine months of 1993 was about 4.4 Mt. The increase in secondary production can be attributed to continuing improvements in scrap collection systems and increased recycling.

Recycling aluminum requires less than 5% of the energy used to make the original metal. As a result, energy represents only 2% of a secondary aluminum smelter's operating cost, compared to about 26% for a primary smelter. The automotive industry is the largest consumer of secondary aluminum, consuming some 80% of secondary production either through direct sales or to casters supplying the automotive industry. As requirements for lighter vehicles increase, it is likely that the demand for secondary aluminum will increase significantly.

In 1992, the largest secondary producers were the United States at 2.2 Mt, Japan at 1.5 Mt, and Germany at 0.5 Mt. Canada produced about 120 000 t of secondary aluminum in 1992, and consumed about 127 800 t compared with 101 500 t in 1991 (excluding the direct use of scrap).

Secondary aluminum production in the Russian Federation in 1993 was reportedly about 142 000 t, compared with 191 000 t in 1992 and 340 000 t in 1991. The steady decline in production is reportedly due to a shortage of scrap.

The most important sources of aluminum scrap in the United States are from the packaging (principally used beverage containers) and transportation sectors. In 1992, 62.8 billion cans were recycled in the United States, representing a recycling rate of 68%. In Europe, 40 000 t, or about 25%, of used beverage cans were recycled in 1992. In Canada, about 1.5 billion cans are recovered and recycled annually for a recycling rate of about 80%.

Programs are currently in place in the United States and Canada to promote recycling of other types of household aluminum products in addition to beverage cans. Advertising campaigns to promote the recycling of aluminum foil and other aluminum products were started by Reynolds Metals, Alcoa and Alcan. Alcan's Arvida Research and Development Centre develops new technologies for recycling a variety of household aluminum products. Barriers to wider recycling of aluminum foil products include the lack of public awareness, municipal curb-side recycling programs that do not accept such products, and aluminum producers that do not handle foil or other household sources of aluminum.

Cash metal trading of the LME Aluminum Alloy Contract began on January 4, 1993. Special arrangements to control temperature and humidity were made to avoid problems that can lead to secondary aluminum oxidizing during long periods of storage. Ingots are warranted within eight weeks of production. The LME approved warehouse locations in the United Kingdom, the United States, Germany, Belgium, the Netherlands, France and Italy. The LME's deliverable brands account for 2 Mt of annual secondary production capacity.

Ford Motor Company of Canada expects to open a new aluminum casting plant in Windsor, Ontario, by February 1994. The plant will make semi-finished parts primarily from secondary aluminum. The parts to be produced include cylinder heads and engine blocks for Ford's new 2.5-L V-6 Ford Contour and Mercury Mystique models. Engine blocks will also be cast for Ford's 4.6-L V-8 Lincoln Continental, which is scheduled for production in 1995.

Indal announced plans to build a 40 000-t/y aluminum recycling plant near Bombay, India. The plant will be the first of its kind in India using the latest in modern technology. The cost of the new facility is expected to be around $10 million and is scheduled to start production in mid-1996.

CONSUMPTION AND USES

Total world consumption of primary aluminum is estimated at 19.2 Mt in 1993, compared to 19.3 Mt in 1992. Canada consumed an estimated 501 700 t of primary aluminum in 1992 compared to 465 300 t in 1991. Total Western World consumption of primary aluminum increased by less than 1% to 15.7 Mt in 1992. Total reported Canadian consumption of aluminum metal at the first processing stage in 1992, including secondary aluminum, was 629 500 t.

Aluminum is the most abundant metal in the earth's crust. Unlike most of the other major metals, aluminum does not occur in its native state but mainly as an oxide. When combined with water and other impurities, it produces the main ore of aluminum known as bauxite. Pure aluminum is a bluish silver-white, malleable, ductile metal with one third the density of steel. Aluminum's dull lustre results from a thin coating of oxygen that forms when it is exposed to air. It is this characteristic that accounts for aluminum's resistance to corrosion. Aluminum is an excellent conductor of electricity. Gram for gram, aluminum has twice the electrical conductance of copper. It is also an efficient conductor of heat and a good reflector of light and radiant heat.

Combining aluminum with other metals to produce alloys enhances its characteristics and increases its versatility. The most common metals used in combination with aluminum are copper, magnesium, manganese, silicon and zinc. Aluminum's tensile strength, hardness, corrosion resistance, and heat-treatment properties improve when alloyed with one or more of these metals. Some copper-aluminum alloys, for example, can exceed the tensile strength of mild steel by as much as 50%.

In both its pure and alloyed forms, aluminum is used to make a variety of products for the consumer and capital goods markets. The largest markets for aluminum are transportation (25%), building and construction (21%), packaging (21%), electrical (10%), consumer durables (7%), and machinery and equipment (9%). Geographically, North America is the largest consuming region, accounting for 36% of total Western World production, followed by Europe at 30% and Asia at 25%.

The transportation sector is the largest single consumer of primary and secondary aluminum. The enforcement of stricter fuel efficiency and emissions standards is encouraging many auto manufacturers to reduce their vehicles' weight. Increased consumer demand for cars with added luxury items is also driving manufacturers to find ways to reduce automobile curb-weight. New applications for aluminum sheet and extrusion go beyond the traditional casting applications used in auto parts. Currently, most aluminum applications centre on cylinder heads, intake manifolds, engine blocks, pistons, heat exchangers, air conditioners, transmission housings, wheels, and exterior trim and bumper systems.

In addition to the automotive industry, aluminum is used in several applications in other areas of the transportation sector. Aluminum's light weight and strength are used in all types of aircraft, trucks, trains, subway cars, and ships. Aluminum faces increasing competition in the aircraft industry from composites, polymers, ceramics and titanium. Weight-saving carbon-fibre composites now account for between 10% and 15% of the structural weight of most new airliners. Several aluminum producers are meeting the challenge by introducing aluminum-based composites.

Aluminum is also used in a variety of applications in the building and construction sector. Uses include siding, roofing, eaves-troughs, windows, doors, frames, screens, awnings and canopies. In recent years, aluminum has faced intense competition from vinyl in the residential siding market and from wood in framing applications.

The packaging sector is one of the fastest growing markets for the aluminum industry after the transportation sector. Within this sector, which includes foil, flexible packaging and food containers, the beverage can market is forecast to grow by 5%/y to eventually comprise 15% of total aluminum consumption by the year 2000. In the United States, aluminum beverage cans comprise 95% of the total beverage can market. Despite its higher costs compared to other materials, aluminum has gained wide consumer acceptance based on its light weight, convenience, and recycling potential.

Some of the most promising new applications for aluminum are based on a family of new metal matrices. Alcan has invested more than $100 million in its "Duralcan" metal-matrix composite. Duralcan comprises aluminum reinforced with silicone carbide ceramic particles. While outperforming traditional aluminum alloys, it is fabricated using the same techniques. In addition, Duralcan has greater specific strength, is lighter than steel, and is less expensive than titanium. Initial markets for this material are expected in sporting goods, cast products, and small engine components. Potential applications are also expected in the automotive and aerospace industries. Alcan is currently working with Ford, Chrysler, Allied Signal, and Toyota to develop brake rotors, and with Ford, General Motors, and Dana Corporation to develop drive shafts.

Another promising new use for aluminum is in the new aluminum air-cell battery developed by Alcan. The main advantages of the battery are long shelf life, low weight before activation, and constant power output. One of the many potential uses for the battery is in electric vehicles. When used in combination with a conventional lead-acid battery, the range of an electric vehicle increases from approximately 75 km to over 300 km.

HEALTH, SAFETY AND THE ENVIRONMENT

Reynolds Metals obtained final approval from the U.S. Environmental Protection Agency (EPA) for the full operation of its new 120 000-t/y spent potlining treatment plant in Gum Springs, Arkansas. The new facility comes on stream in time to meet new regulations that will no longer allow untreated spent potlining to be sent to landfill sites in the United States. In addition to treating potliners from Reynolds' operations, the company expects to treat material from other companies as well. Reynolds has reportedly signed a letter of intent with JTM Industries to market the residue by-product, which can be used for a number of applications including abrasives and refractory bricks.

Canadian-based AISCO Systems reportedly received a licence from Comalco to commercialize its "COMTOR" technology for the treatment of spent potlining. The Comalco process uses a special calciner to remove hazardous cyanides. A scale prototype is currently operating at Comalco's Boyne Island smelter.

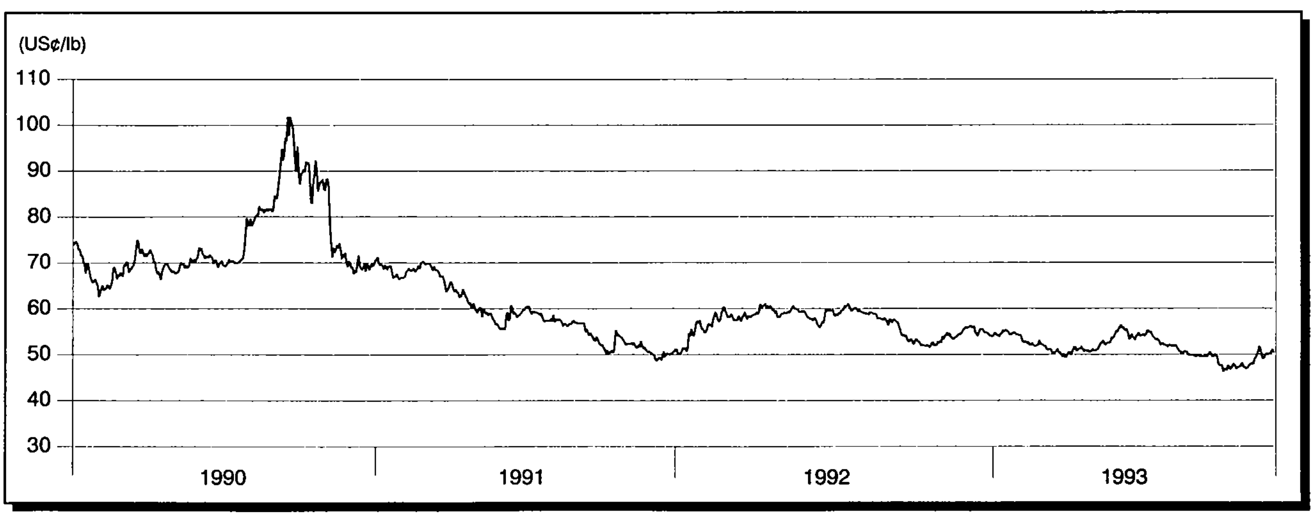
PRICES AND STOCKS

Prices on the London Metal Exchange (LME) for primary aluminum averaged US52¢/lb in 1993 compared to US57¢/lb in 1992. The International Primary Aluminium Institute reported that Western World primary aluminum inventories increased to 1.970 Mt at the end of December 1993 compared to 1.717 Mt in December 1992. The increase in producer stocks was coupled with a 1-Mt increase in LME stocks. LME stocks reached record levels by year-end to over 2.5 Mt from 1.5 Mt at the end of the 1992.

By year-end, prices on the LME for aluminum alloy were at their lowest level since the start of trading in January. Aluminum alloy started the year trading at about US50¢/lb and ended the year at just under 44¢/lb for a yearly average of 47¢/lb. The weak prices reflected both the difficulties in automotive markets in Europe and Japan, and with the LME's attempt to establish the new contract. LME stocks of aluminum alloy ended the year at about 49 000 t.

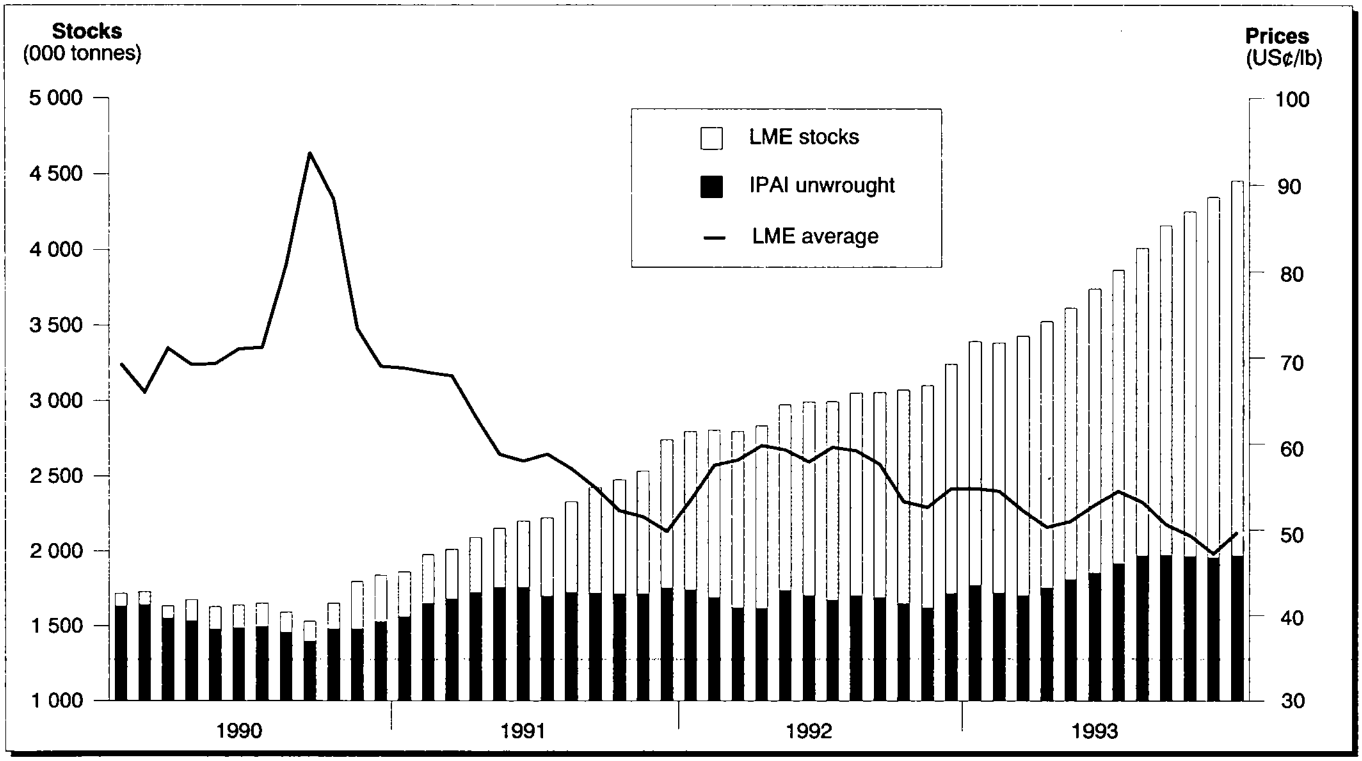
Spot alumina prices were reported at between US$130 and $140/t by the end of 1993, down about $10/t from the third quarter of 1993. Prices for spot alumina ranged between US$155 and $200/t in 1991, and are forecast to remain flat to slightly lower in 1994. The decrease in spot prices toward the end of 1993 was mainly the result of increased alumina production, particularly in Australia, India and Europe, coupled with the flat demand, most notably from China and the FSU. Further cuts in aluminum production next year could produce even lower spot alumina prices in 1994.

Figure 2
London Metal Exchange Aluminum Prices, 1990-93



Source: Natural Resources Canada.

Figure 3
Aluminum Prices[1] and Stocks,[2] 1990-93



Source: Natural Resources Canada.
[1] Average monthly London Metal Exchange (LME) prices.
[2] International Primary Aluminium Institute (IPAI) unwrought primary stocks and LME stocks.

OUTLOOK

Canadian aluminum production capacity increased substantially in the latter half of the 1980s and early 1990s to about 2.3 Mt in 1993. Canadian aluminum production capacity is forecast to remain relatively steady to the year 2000. The two new smelters commissioned last year, with a total installed capacity of 215 000 t/y each, represent the final phase of a major program of Canadian aluminum smelter capacity expansions that was started in the latter half of the 1980s. The proposed expansion of the Alouette smelter that would double capacity to 430 000 t/y has been postponed as a result of the weak market conditions. Plans by Alcan to build a new smelter at Alma, Quebec, to replace older Söderberg smelters are also on hold until economic conditions improve.

As cuts that were announced in 1993 begin to be implemented, Western World primary aluminum production in 1994 is expected to decrease slightly from 15.0 Mt to about 14.5 Mt. To date, apart from the forecast increased capacity in South Africa, few new major projects are expected to come on stream before the end of the decade. Additional cuts of between 1.5 and 2.0 Mt are required, however, if the market is to return to more normal stock levels of 50 days' consumption.

Western World aluminum consumption is expected to increase about 2.5% in 1994 to 16.1 Mt. The weak economic conditions that persisted throughout 1992 in Europe and Japan are expected to improve toward the latter half of 1994. Aluminum consumption in the United States is expected to increase by about 3% in 1994. Strong growth in demand for primary aluminum of between 3% and 4% is forecast for the remainder of the 1990s. The transportation and packaging (in particular beverage can) markets are expected to lead the increase in demand for aluminum to the year 2000.

Prices are expected to remain in the US55¢/lb range for most of 1994, barring any significant production cuts worldwide. As the recovery in the

North American economy continues to strengthen and the economies in Europe and Japan recover, inventories are expected to decline and prices should increase to about US60¢/lb by year-end. Exports to the West by the FSU are expected to remain at 1 Mt. As the demand for aluminum increases, prices in the medium term are forecast to average between US70¢ and 80¢/lb in constant 1993 dollars.

Note: Information in this review was current as of February 1, 1994.

TARIFFS

Item No.	Description	Canada			United States
		MFN	GPT	USA	Canada
7601.10	Unwrought aluminum, not alloyed				
7601.10.10	Billets, blocks, ingots, notched bars, pigs, slabs and wire bars	Free	Free	Free	Free
7601.10.91	Granules, cut from ingots, for use in the manufacture of cleaning compounds	1.98¢/kg	Free	Free	Free
7601.10.99	Other	10.3%	6.5%	Free	Free
7601.20	Unwrought aluminum alloys				
7601.20.10	Billets, blocks, ingots, notched bars, pigs, slabs and wire bars	Free	Free	Free	Free
7601.20.91	Granules, cut from ingots, for use in the manufacture of cleaning compounds	1.98¢/kg	Free	Free	Free
7601.20.99	Other	10.3%	6.5%	Free	Free
7602.00	Aluminum waste and scrap	Free	Free	Free	Free
76.03	Aluminum powders and flakes	9.2%-10.3%	Free-6.5%	Free	Free
76.04	Aluminum bars, rods and profiles	2.1%-10.3%	Free-6.5%	Free	Free
76.05	Aluminum wire	2.1%-10.3%	Free-6.5%	Free	Free
76.06	Aluminum plates, sheets and strip, of a thickness exceeding 0.2 mm	Free-10.3%	Free-6.5%	Free-4%	Free-2.6%
76.07	Aluminum foil not exceeding 0.2 mm	Free-12.2%	Free-8%	Free-4.8%	1.2%-2.3%
76.08	Aluminum tubes and pipes	Free-8.1%	Free	Free	Free
7609.00	Aluminum tube or pipe fittings	10.3%	6.5%	Free	Free
76.10	Aluminum structures (excluding prefabricated buildings of heading no. 94.06) and parts of structures, aluminum plates, rods, profiles, tubes and the like, prepared for use in structures	10.3%	6.5%	4%	2.2%
7611.00	Aluminum reservoirs, tanks, vats and similar containers, for any material	Free-10.3%	Free-6.5%	Free-4%	1%
76.12	Aluminum casks, drums, cans, boxes and similar containers, for any material	10.3%	6.5%	4%	0.9%-2.2%
7613.00	Aluminum containers for compressed or liquefied gas	10.3%	6.5%	4%	2%
76.14	Stranded wire, cables, plaited bands and the like, of aluminum, not electrically insulated	10.2%	6.5%	4%	1.9%-2.2%
76.15	Table, kitchen or other household articles and parts thereof, of aluminum	10.2%-11.4%	Free-6.5%	4%-4.5%	1.5%-2.2%
76.16	Other articles of aluminum	Free-10.3%	Free-6.5%	Free-4%	Free-2.5%

Sources: Customs Tariff, effective January 1994, Revenue Canada, Customs and Excise; Harmonized Tariff Schedule of the United States, 1994.

TABLE 1. CANADA, ALUMINUM PRODUCTION AND TRADE, 1992 AND 1993

Item No.		1992		1993p	
		(tonnes)	($000)	(tonnes)	($000)
PRODUCTION		1 971 843	. .	2 308 868	. .
IMPORTS				(Jan.-Sept.)	
2606.00.00	Aluminum ores and concentrates				
	Brazil	1 707 189	52 288	1 203 432	38 596
	Ghana	30 058	826	268 972	8 585
	United States	66 724	7 537	65 187	7 121
	Guinea	197 053	9 902	134 219	6 459
	Australia	245 798	9 628	149 085	6 276
	Guyana	29 544	1 821	107 799	4 834
	Bermuda	260 754	8 666	–	–
	Other countries	262 294	10 887	124 304	5 777
	Total	2 799 414	101 555	2 052 998	77 648
2620.40.00	Ash and residues containing mainly aluminum	3 379	1 536	1 791	738
2818.20.00	Aluminum oxide (excluding artificial corundum)				
	Australia	1 123 330	230 936	1 346 674	288 195
	United States	756 659	182 226	624 058	154 176
	Jamaica	649 350	137 148	529 061	118 458
	Germany	662	1 858	354	1 378
	France	648	926	940	995
	Austria	299	220	251	411
	United Kingdom	182	172	270	237
	Other countries	18 944	4 642	375	344
	Total	2 550 074	558 128	2 501 983	564 194
2818.30.00	Aluminum hydroxide	8 895	5 745	7 882	6 117
7601.10	Unwrought aluminum, not alloyed				
7601.10.10	Billets, blocks, ingots, notched bars, pigs, slabs and wire bars				
	United States	20 706	36 161	14 159	25 326
	Russia	. .	. .	13 177	23 394
	Tajikstan	. .	. .	615	755
	Brazil	–	–	204	379
	France	1 104	3 159	100	130
	Other countries	131	308	12	44
	Total	21 941	39 628	28 267	50 030
7601.10.91	Aluminum granules, unwrought, not alloyed, cut from ingots, for use in the manufacture of cleaning compounds	10	51	20	44
7601.10.99	Other	770	2 010	333	850
7601.20	Unwrought aluminum, alloyed				
7601.20.10	Billets, blocks, ingots, notched bars, pigs, slabs and wire bars				
	United States	50 605	86 096	38 526	66 015
	Russia	. .	. .	7 665	11 200
	United Kingdom	1 472	3 340	1 127	2 682
	Germany	–	–	1 198	1 851
	France	530	1 152	270	678
	Other countries	964	2 090	349	505
	Total	53 571	92 678	49 135	82 931
7601.20.91	Granules, cut from ingots, for use in the manufacture of cleaning compounds	4	14	67	86
7601.20.99	Other	9 186	15 068	6 820	11 057
7602.00.00	Aluminum waste and scrap	52 674	62 396	39 233	47 551
76.03	Aluminum powders and flakes	1 576	5 171	1 032	3 635
76.04	Aluminum bars, rods and profiles				
7604.10	Of aluminum, not alloyed				
	United States	3 124	15 332	2 627	10 119
	Other countries	219	862	45	293
	Total	3 343	16 194	2 672	10 412

TABLE 1 (cont'd)

Item No.		1992		Jan.-Sept. 1993p	
		(tonnes)	($000)	(tonnes)	($000)
IMPORTS (cont'd)					
7604.21 to	Of aluminum alloys				
7604.29	United States	11 334	44 209	10 294	38 517
	Other countries	445	1 848	343	1 402
	Total	11 779	46 057	10 637	39 919
76.05	Aluminum wire	2 393	10 172	1 990	8 478
76.06	Aluminum plates, sheets and strip, of a thickness exceeding 0.2 mm	288 585	739 678	234 030	596 496
76.07	Aluminum foil not exceeding 0.2 mm	23 257	95 003	17 339	69 582
76.08	Aluminum tubes and pipes	5 640	23 821	5 419	23 663
76.09	Aluminum tube or pipe fittings	..	8 035	..	7 004
		(number 000)		**(number 000)**	
76.10	Aluminum structures (excluding prefabricated buildings of heading no. 94.06) and parts of structures, aluminum plates, rods, profiles, tubes and the like, prepared for use in structures	..	46 650	..	35 242
76.11	Aluminum reservoirs, tanks, vats and similar containers	...	38	...	1 281
76.12	Aluminum casks, drums, cans, boxes and similar containers	332 773	47 716	357 998	43 270
76.13	Aluminum containers for compressed or liquefied gas	231	6 587	70	5 034
		(tonnes)		**(tonnes)**	
76.14	Stranded wire, cables, plaited bands and the like, of aluminum, not electrically insulated	148	495	83	320
76.15	Table, kitchen or other household articles and parts thereof, of aluminum	..	56 593	..	43 819
76.16	Other articles of aluminum	..	95 404	..	78 651
EXPORTS					
2606.00	Aluminum ores and concentrates				
	United States	377	31	4 407	372
	Total	377	31	4 407	372
2620.40	Ash and residues containing mainly aluminum	7 103	1 515	3 127	848
2818.20	Aluminum oxide (excluding artificial corundum)				
	United States	67 885	40 535	52 127	32 696
	Germany	1 705	1 478	1 555	1 603
	Brazil	751	1 073	442	620
	Other countries	2 559	2 338	1 161	1 144
	Total	72 900	45 424	55 285	36 063
7601.10	Unwrought aluminum, not alloyed				
	United States	576 933	890 170	525 210	804 309
	Netherlands	156 758	244 439	173 423	281 669
	United Kingdom	21 715	35 624	58 057	94 882
	Japan	37 586	50 842	38 613	54 677
	South Korea	25 901	39 258	16 948	26 079
	Germany	10 498	17 340	11 225	17 937
	Other countries	26 706	43 639	13 127	21 972
	Total	856 097	1 321 312	836 603	1 301 525

TABLE 1 (cont'd)

Item No.		1992		Jan.-Sept. 1993p	
		(tonnes)	($000)	(tonnes)	($000)
EXPORTS (cont'd)					
7601.20	Unwrought aluminum alloys				
	United States	481 501	807 860	403 127	674 741
	Japan	108 473	164 849	76 319	118 820
	South Korea	29 114	49 589	15 033	25 673
	United Kingdom	38 265	65 501	11 437	19 995
	Turkey	16 762	29 350	7 613	13 767
	Netherlands	10 261	16 358	5 534	9 256
	Italy	9 945	16 959	5 420	9 232
	Taiwan	13 631	23 344	5 006	8 680
	Israel	8 689	15 265	4 616	8 345
	Other countries	32 336	56 857	12 672	22 599
	Total	748 977	1 245 932	546 777	911 108
7602.00	Aluminum waste and scrap				
	United States	167 722	223 487	133 677	166 062
	Japan	21 742	31 820	13 519	19 215
	Hong Kong	125	166	892	771
	Taiwan	2 523	2 294	553	480
	Other countries	5 281	5 900	820	1 109
	Total	197 393	263 667	149 461	187 637
76.03	Aluminum powders and flakes	607	909	360	707
76.04	Aluminum bars, rods and profiles	6 443	19 128	29 239	63 815
76.05	Aluminum wire	20 104	41 576	12 355	24 138
76.06	Aluminum plates, sheets and strip, of a thickness exceeding 0.2 mm	206 883	483 346	158 731	370 154
76.07	Aluminum foil not exceeding 0.2 mm	8 782	45 014	10 731	48 377
76.08	Aluminum tubes and pipes	871	6 423	1 017	5 164
7609.00	Aluminum tube or pipe fittings	. .	2 486	. .	1 491
76.10	Aluminum structures (excluding prefabricated buildings of heading No. 94.06) and parts of structures, aluminum plates, rods, profiles, tubes and the like, prepared for use in structures	. .	50 061	. .	32 127
		(number 000)		**(number 000)**	
7611.00	Aluminum reservoirs, tanks, vats and similar containers	3	1 119	2	375
76.12	Aluminum casks, drums, cans, boxes and similar containers	245 048	40 785	250 976	39 433
7613.00	Aluminum containers for compressed or liquefied gas	20	77	127	315
		(tonnes)		**(tonnes)**	
76.14	Stranded wire, cables, plaited bands and the like, of aluminum, not electrically insulated	749	1 304	2 198	4 934
76.15	Table, kitchen or other household articles and parts thereof, of aluminum	. .	7 324	. .	8 688
76.16	Other articles of aluminum	. .	54 740	. .	43 182

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available or not applicable; . . . Amount too small to be expressed; p Preliminary.
Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, ALUMINUM SMELTER CAPACITY

Company	As of December 31, 1993
	(tonnes/year)
Alcan Aluminium Limited	
Quebec	
Grande-Baie	180 000
Arvida	232 000
Isle-Maligne	73 000
Shawinigan	84 000
Beauharnois	48 000
Laterrière	204 000
British Columbia	
Kitimat	272 000
Total Alcan capacity	1 093 000
Canadian Reynolds Metals Company, Limited	
Quebec	
Baie-Comeau	400 000
Aluminerie de Bécancour Inc.	
Quebec	
Bécancour	360 000
Aluminerie Alouette Inc.	
Quebec	
Sept-Îles	215 000
Aluminerie Lauralco Inc.	
Quebec	
Deschambault	215 000
Total Canadian capacity	2 283 000

Source: Natural Resources Canada.

TABLE 3. CANADA, CONSUMPTION[1] OF ALUMINUM METAL[4] AT FIRST PROCESSING STAGE, 1990-92

	1990[a]	1991[a]	1992[p]
		(tonnes)	
CASTINGS			
Sand	2 534	2 974	2 430
Permanent mould	73 633	69 178	78 733
Die and other	58 125	57 901[r]	70 207
Total	134 292	130 054[r]	151 370
WROUGHT PRODUCTS			
Extrusions, including tubing	101 182	86 280	92 527
Sheet, plate, coil and foil	131 475	141 703	142 619
Other wrought products (including rods, forgings and slugs)	72 149	76 984	80 740
Total	304 806	304 967	315 887
OTHER USES			
Destructive uses (deoxidizer), non-aluminum base alloys, powder and paste and other uses	26 046[r]	30 282	34 423
Total consumed	465 144[r]	465 302[r]	501 680
Secondary aluminum[2]	115 112[r]	101 503[r]	127 818

	Metal Entering Plant			On Hand December 31		
	1990	1991	1992	1990	1991	1992
Primary aluminum ingot and alloys	381 705[r]	384 857	400 796	12 965[r]	13 670	13 782
Secondary aluminum	82 456[r]	74 068[r]	88 638	4 121[r]	4 670[r]	4 803
Scrap originating outside plant	131 131[r]	117 759[r]	161 361	5 905[r]	6 583[r]	5 929
Total	595 292[r]	576 684[r]	650 795	22 990[r]	24 924[r]	24 514
Aluminum shipments[3]				23 267[r]	8 133[r]	21 706

[p] Preliminary; [r] Revised.
[a] Increase in number of companies being surveyed. Therefore, closing inventory of previous year does not equal opening inventory of current year.
[1] Available data as reported by consumers. [2] Aluminum metal used in the production of secondary aluminum is not included in consumption totals. [3] Aluminum metal shipped without change. Does not refer to shipments of goods of own manufacture. [4] Aluminum metal refers to primary aluminum ingot and alloys, purchased secondary aluminum ingot and outside aluminum scrap.
Note: Numbers may not add to totals due to rounding.

TABLE 4. AVERAGE ALUMINUM PRICES

Year	Month	LME Cash[1]	M.W. U.S. Markets[1]
		(US¢/lb)	
ANNUAL AVERAGES			
1983		65.3	68.3
1984		56.5	61.1
1985		47.9	48.8
1986		52.2	55.9
1987		70.8	72.3
1988		117.3	110.1
1989		88.5	87.8
1990		74.4	75.0
1991		59.1	59.5
1992		56.9	57.5
1993		52.7	53.3
MONTHLY AVERAGES			
1992	January	53.4	53.7
	February	57.5	58.2
	March	58.1	59.3
	April	59.8	61.0
	May	59.3	60.0
	June	57.9	58.4
	July	59.6	59.8
	August	59.2	59.6
	September	57.6	58.2
	October	53.3	53.7
	November	52.6	52.8
	December	54.8	55.5
1993	January	57.7	56.1
	February	57.5	58.2
	March	52.2	53.3
	April	50.3	51.8
	May	52.8	52.3
	June	52.9	53.8
	July	57.5	56.1
	August	53.1	55.0
	September	50.6	52.5
	October	49.3	51.1
	November	47.2	49.9
	December	49.7	52.2

Source: "Metals Week."
[1] Highest grade sold.

TABLE 5. WORLD MINE PRODUCTION OF BAUXITE

	1989	1990	1991	1992p
	(000 tonnes)			
Albania	35.0	26.0	8.0	–
Australia	38 583.0	41 391.0	40 510.0	39 476.0
Brazil	7 893.8	9 875.6	10 364.2	9 365.6
Chinae	3 800.0	3 655.0	5 926.0	6 000.0
Dominican Republic	164.5	85.2	6.5	–
France	719.8	489.8	183.3	104.0
Ghana	347.7	381.3	333.8	338.2
Greece	2 602.0	2 495.9	2 133.5	2 042.1
Guinea	17 547.0	16 150.0	17 065.0	15 997.0
Guyana	1 340.0	1 424.0	2 205.6	2 264.8
Hungary	2 643.0	2 559.0	2 037.0	1 721.1
India	4 334.9	5 277.0	4 738.0	4 986.6
Indonesia	862.3	1 205.7	1 406.1	803.5
Iran	60.0	54.0	80.0	92.0
Italy	11.7	0.3	8.7	97.5
Jamaica	9 395.0	10 936.7	11 608.6	11 359.5
Kazakhstan	n.a.	n.a.	n.a.	3 040.0
Malaysia	355.0	398.2	376.4	330.6
Mozambique	5.5	6.6	7.7	8.8
Pakistan	2.0	2.6	4.2	3.5
Romania	345.0	247.0	200.0	173.4
Russia	n.a.	n.a.	n.a.	4 580.0
Sierra Leone	1 548.0	1 455.0	1 288.3	1 262.2
Surinam	3 457.0	3 267.0	3 136.0	3 159.5
Turkey	534.3	772.7	530.0	526.2
U.S.S.R.e	8 990.0	9 250.0	7 870.0	n.a.
United States	670.0	495.0	50.0	45.0
Venezuela	702.0	771.4	1 992.3	1 052.1
Ex-Yugoslavia	3 252.0	2 951.0	258.1	798.9
Total world	110 200.5	115 613.0	114 327.3	109 628.1

Source: Natural Resources Canada.
– Nil; e Estimated; n.a. Not applicable; p Preliminary.

TABLE 6. WORLD PRODUCTION OF ALUMINA (HYDRATE)

	1989	1990	1991	1992p
	(000 tonnes)			
Australia	10 823.0	11 231.0	11 713.0	11 783.0
Azerbaijane	n.a.	n.a.	n.a.	240.0
Brazil	1 624.4	1 654.8	1 742.5	1 833.0
Canada	1 048.4	1 087.0	1 131.0	1 104.0
Chinae	1 400.0	1 464.0	1 522.2	1 580.0
Czechoslovakiae	205.0	209.0	187.0	100.0
France	624.0	606.0	538.0	508.0
Germany	1 174.0	1 172.8	1 148.3	1 128.0
Germany, Democratic Republic of	63.0	27.0	n.a.	n.a.
Greece	533.3	585.0	641.2	626.8
Guinea	626.8	642.1	650.9	603.2
Hungary	891.0	848.0	661.0	555.9
India	1 418.5	1 334.0	1 435.0	1 484.0
Ireland	891.0	926.5	981.0	1 007.0
Italy	722.2	752.0	804.5	762.1
Jamaica	2 248.1	2 868.8	3 014.6	2 917.2
Japan	863.4	890.0	864.3	714.1
Kazakhstan	n.a.	n.a.	n.a.	1 050.0
Romaniae	611.0	440.0	310.0	279.7
Russiae	n.a.	n.a.	n.a.	2 500.0
Spain	949.1	1 001.6	1 004.0	959.1
Surinam	1 567.1	1 531.0	1 510.0	1 591.0
Turkey	200.6	177.1	159.1	156.5
Ukraine	n.a.	n.a.	n.a.	1 230.0
United Kingdom	116.2	131.4	120.0	120.0
U.S.S.R.e	5 980.0	5 640.0	5 277.0	n.a.
United States	5 180.0	5 430.0	5 230.0	5 185.0
Venezuela	1 290.2	1 404.8	1 481.0	1 282.8
Ex-Yugoslavia	1 240.0	1 086.0	780.0	340.0
Total world	42 290.3	43 139.9	42 905.6	41 640.4

Sources: Natural Resources Canada; World Bureau of Metal Statistics.
e Estimated; n.a. Not applicable; p Preliminary.

TABLE 7. WORLD PRODUCTION OF ALUMINUM

	1990	1991	1992p	1993e
	(000 tonnes)			
Argentina	165.6	168.3	155.6	146.0
Australia	1 232.7	1 228.6	1 236.1	1 350.0
Austria	89.4	80.4	32.9	10.0
Azerbaijan	n.a.	n.a.	24.0	7.0
Bahrain	212.5	213.7	292.5	440.0
Brazil	930.6	1 139.6	1 193.3	1 176.0
Canada	1 567.4	1 821.6	1 971.8	2 309.0
Cameroon	87.5	85.6	82.5	85.0
China e	854.1	963.0	1 080.0	1 100.0
Czechoslovakia	69.8	66.3	40.0	40.0
Dubai	174.3	239.0	244.6	245.0
Egypt	179.6	177.7	177.8	180.0
France	325.9	286.1	417.7	385.0
Germany	720.3	690.3	602.8	550.0
Germany, Democratic Republic of	21.0	n.a.	n.a.	n.a.
Ghana	174.2	175.4	179.9	180.0
Greece	149.7	152.4	152.8	150.0
Hungary e	75.1	63.3	26.8	25.0
Iceland	87.8	89.2	89.9	90.0
India	433.2	511.8	496.3	480.0
Indonesia	192.1	174.8	188.8	190.0
Iran	65.0	67.4	79.3	80.0
Italy	231.9	217.7	160.7	159.0
Japan	34.2	32.4	18.9	20.0
Mexico	67.5	50.8	24.8	–
Netherlands	277.1	263.9	235.1	220.0
New Zealand	259.7	260.4	242.9	250.0
Norway	871.1	885.9	866.5	896.0
North Korea	11.0	9.5	10.0	10.0
Poland e	46.0	45.8	43.6	45.0
Romania e	167.0	158.4	112.0	110.0
Russia	n.a.	n.a.	2 725.0	2 715.0
South Africa	159.8	171.1	174.0	174.0
South Korea	2.0	–	–	–
Spain	355.3	355.2	359.0	355.0
Surinam	31.3	31.0	32.4	30.0
Sweden	96.3	96.9	77.2	75.0
Switzerland	71.8	65.9	52.4	35.0
Tadjikistan	n.a.	n.a.	345.0	250.0
Turkey	60.9	55.8	58.6	60.0
Ukraine	n.a.	n.a.	105.0	100.0
United Kingdom	289.8	293.5	244.2	240.0
U.S.S.R. e	3 513.0	3 251.0	n.a.	n.a.
United States	4 048.3	4 121.2	4 042.1	3 695.0
Venezuela	594.0	609.7	567.4	610.0
Ex-Yugoslavia	366.0	314.0	170.0	80.0
Total world	19 361.8	19 684.6	19 432.2	19 347.0

Sources: Natural Resources Canada; World Bureau of Metal Statistics.
– Nil; e Estimated; n.a. Not applicable; p Preliminary.

TABLE 8. WORLD CONSUMPTION OF ALUMINUM

	1990	1991	1992p	1993e
	(000 tonnes)			
Albania[e]	2.5	1.0	1.0	1.0
Algeria	8.5	5.3	3.4	3.0
Argentina	67.9	102.8	108.3	115.0
Australia	287.8	298.0	309.2	340.0
Austria	171.0	168.0	165.0	160.0
Bahrain	103.8	105.8	124.7	125.0
Bangladesh[e]	15.0	15.0	10.0	10.0
Belgium/Luxembourg	317.8	323.0	291.8	275.0
Brazil	341.2	354.2	377.1	395.0
Bulgaria	35.2	–	4.5	5.0
Canada	387.2	408.2	420.3	435.0
Cameroon	20.3	20.1	15.5	16.0
Chile	6.4	5.6	6.0	6.0
China[e]	860.7	938.1	1 253.8	1 500.0
Colombia	15.6	23.8	28.8	30.0
Cuba	2.5	1.0	1.0	1.0
Czechoslovakia	150.7	83.0	61.8	60.0
Denmark	24.1	26.4	24.0	20.0
Egypt	75.7	86.9	65.0	70.0
Finland	23.6	17.4	15.0	12.0
France	720.9	734.2	716.0	675.0
Germany	1 295.4	1 360.9	1 457.1	1 350.0
Germany, Democratic Republic of	83.1	n.a.	n.a.	n.a.
Ghana	10.2	9.8	32.4	30.0
Greece	99.8	99.4	120.1	115.0
Hong Kong	28.8	36.7	45.9	50.0
Hungary	161.4	96.4	112.3	115.0
India	433.3	430.2	414.3	420.0
Indonesia[e]	67.0	45.0	90.0	100.0
Iran[e]	120.0	120.0	120.0	120.0
Iraq[e]	5.0	1.0	1.0	1.0
Ireland	6.4	6.9	6.0	5.0
Israel	19.6	24.2	21.4	22.0
Italy	652.0	670.2	660.0	625.0
Japan	2 415.2	2 431.6	2 414.0	2 360.0
Lebanon[e]	6.0	10.0	10.0	10.0
Malaysia	58.8	66.6	75.0	85.0
Mexico	91.9	94.4	83.4	87.0
Netherlands	106.6	119.8	123.3	117.0
New Zealand	29.4	19.8	22.3	25.0
Nigeria	12.0	12.0	5.0	5.0
North Korea[e]	50.0	40.0	30.0	25.0
Norway	138.0	157.2	170.0	160.0
Pakistan	10.0	11.1	8.5	10.0
Peru	5.0	5.0	5.0	5.0
Philipines	14.4	17.6	24.9	28.0
Poland	63.4	31.9	54.8	60.0
Portugal	48.9	46.2	58.1	50.0
Romania	42.0	94.0	20.6	25.0
Russia	n.a.	n.a.	1 430.0	1 115.0
Saudi Arabia	21.9	23.9	25.0	27.0
Singapore	23.2	13.5	27.5	30.0
South Africa	91.4	86.2	85.6	90.0
South Korea	345.4	383.3	397.0	415.0
Spain	288.0	297.0	309.0	291.0

TABLE 8 (cont'd)

	1990	1991	1992p	1993e
		(000 tonnes)		
Sweden	80.1	73.3	73.0	70.0
Switzerland	164.1	156.7	145.2	140.0
Taiwan	197.7	262.9	265.8	280.0
Thailand	128.1	146.5	147.4	150.0
Turkey	152.0	114.0	128.6	130.0
U.S.S.R.e	2 700.0	2 250.0	n.a.	n.a.
United Arab Emirates	8.9	10.4	12.4	15.0
United Kingdom	453.7	412.4	483.3	495.0
United States	4 330.4	4 200.7	4 552.4	4 850.0
Venezuela	133.9	148.4	150.0	155.0
Vietname	8.0	4.0	7.0	10.0
Ex-Yugoslavia	170.0	140.0	75.0	60.0
Other	80.0	76.7	804.2	640.0
Total world	19 088.8	18 575.6	19 306.0	19 222.0

Sources: Natural Resources Canada; World Bureau of Metal Statistics.
– Nil; e Estimated; n.a. Not applicable; p Preliminary.

Asbestos

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In 1993, Canadian asbestos production decreased 12.7% from 1992 levels. Canadian mines, which are located in Quebec, operated at an average of 90% of current capacity. A tailings reprocessing operation in Newfoundland operated at about 78% of capacity, despite another forced closure over the winter that was related to frozen tailings (the Newfoundland operation increased its production by about 10% compared to 1992). Average prices increased by about 3.5%-4.0%. Total shipments for 1993 were estimated to be 509 341 t valued at $213.1 million, compared to revised shipment figures for 1992 totalling 586 994 t valued at $231.0 million. The 13.3% decrease in shipments is explained by the general softening of markets as a consequence of the world recession. Demand for short fibres continued to be soft. The U.S. Bureau of Mines estimates 1993 Canadian asbestos imports into the United States at about 33 000 t compared with 30 683 t in 1992. This represented a 7.5% increase, suggesting a recovery of the U.S. asbestos industry in the wake of the remanding by an appeal court of the attempted ban rule of the U.S. Environmental Protection Agency (EPA).

Canadian exports of asbestos for 1993 were an estimated 477 000 t. This represented a 20.5% decrease in volume from the previous year. The value of these exports decreased by an estimated 21.0%. Exports in the January-September 1993 period totalled 357 991 t valued at $210.1 million, compared with 434 908 t valued at $253.8 million for the same period in 1992.

In 1993, world production of asbestos is believed to have decreased by about 15.7% to reach a level of 3.1 Mt. Although the decrease in Canadian production contributed to this trend, most of it was due to continued problems in Russia and Kazakhstan where production has decreased steadily, mainly due to a lack of funds since the demise of the former U.S.S.R.

For the first time in a few years, employment in the Canadian asbestos industry remained fairly stable.

ASBESTOS, WORLD PRODUCTION BY COUNTRY, 1993

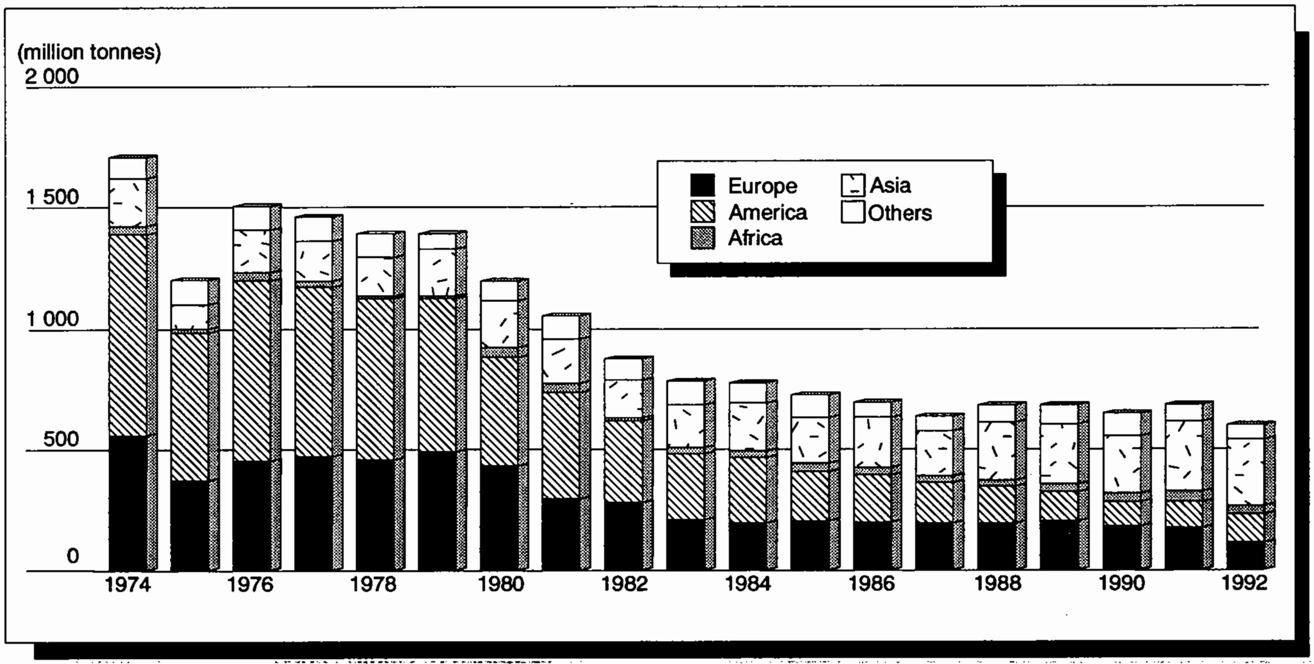
Country	Tonnes[e]
Commonwealth of Independent States	1 700 000
Canada	510 000
Brazil	250 000
Zimbabwe	150 000
China	250 000
Republic of South Africa	130 000
United States	15 000
Greece	45 000
India	25 000
Swaziland	30 000
Colombia	5 000
Yugoslavia	1 000
Romania	3 000
Total	3 114 000

Sources: Natural Resources Canada; U.S. Bureau of Mines.
[e] Estimated.

ASBESTOS AND ITS USES

Asbestos is a generic name that covers several naturally occurring fibrous hydrated silicates. These are separated into two basic groups: serpentine and amphiboles. Chrysotile is the only member of the serpentine group, while the amphibole group consists of crocidolite, amosite anthophyllite, actinolite and tremolite. Of all these minerals, chrysotile is the least dangerous to human health and is the only one extracted in Canada. Chrysotile, which is sensitive to acid, tends to dissolve in the lungs, unless the lungs are overburdened, rather than remain as an irritant like the other types of fibres do. In the past, most of the problems associated with asbestos in

Figure 1
Canadian Asbestos Exports, 1974-92



Sources: Natural Resources Canada; Statistics Canada.

general, and chrysotile in particular, have been due to poor working practices that existed in the first half of this century. With the marked improvement in today's work practices and the increased protection of workers, the risks associated with asbestos have been tremendously reduced.

Because of their chemical and physical properties, asbestos fibres are an extremely useful material that has been, and still is, widely used throughout the world. In Canada, chrysotile asbestos fibres are classified into seven groups, each one with its own sub-categories with the longest fibres pertaining to group 1 and the shortest to group 7. In decreasing length, asbestos has been used in textiles, clothing, packings, woven brake linings, clutch facings, electrical insulation materials, high-pressure and marine insulation, asbestos-cement pipe, asbestos-cement products (sheets, mouldings, etc.), gaskets, paper products, vinyl sheet backings and millboards. The shortest fibres (group 7) are used in moulded brake linings and clutches, and as a filler in vinyl and asphalt floor tiles, cement, plastics, roof coatings and caulking compounds. Today, however, 85% of asbestos is used in asbestos-cement products. Low-density and friable products such as paper products are no longer marketed.

Canadian Developments

In 1993, J.M. Asbestos Inc. continued to concentrate more efforts on its development phase, which proceeded as planned. When completed, the development phase should provide the company with enough reserves to stay in operation until 2005 and should allow for a return to its original production capacity of 300 000 t. In early January 1993, mine workers announced the formation of the J.M. Asbestos mine workers' cooperative and the purchase of a 25% ownership stake for the amount of $2 million. This action was the final step in the 1991 purchase of the company by its employees in a joint partnership with management. The partnership was also a requirement for the government of Quebec to guarantee a $25 million loan needed by the company to proceed with its development.

In 1993, LAB Chrysotile, Inc. had production levels similar to those of 1992. However, a lock-out was imposed by the employer at the Bell underground mine in light of a potential strike by hourly workers who had given their union a strike mandate. Their previous contract had expired on February 28, 1993. The workers returned to work in October after a six-week lock-out. The contract for workers at the British Canadian mine expired on May 14, 1993; however, they adopted a new contract in November without going on strike. The contract for workers at the Black Lake operation is up for renewal on February 28, 1994.

Régis Labeaume, President of Mazarin Mining Exploration Inc. (Mazarin), resigned from his position and Michel Cyr became the new president of the company. Mazarin purchased the asbestos assets of the Quebec government at the end of 1992 and, as a result, has a 40% interest in LAB Chrysotile Inc. On September 30, 1993, according to the company, the balance owed to the government of Quebec was $18.7 million, down from the original $32.3 million.

In its continued bid to dispose of its asbestos assets, the Quebec government, on July 16, 1993, authorized la Société nationale de l'amiante to sell its research centre known as CERAM-SNA to a private corporation, the Groupe R&D Amiante et Minéraux Industriels Inc. This new company is formed by the employees and management of CERAM-SNA, entrepreneurs from the region, J.M. Asbestos Inc., and a manufacturer of high-temperature industrial products, Pyroteck Inc. of Drummondville. The total sale price was $2.6 million. This new corporation is not only going to continue research on asbestos, but it is also to enter the field of industrial minerals.

The Quebec government also announced that it had reached and signed a new agreement with the Asbestos Institute which would guarantee the financing of the latter until March 31, 1998. Over the five-year period, the Institute is to receive $2.45 million from Quebec and $4 million from the asbestos industry.

Minority shareholders in Asbestos Corporation Limited still hope to be compensated for not having been included in the 1981 deal between the Quebec government and General Dynamics Corp. that was completed in 1986, by which Quebec paid $80 per share. In May 1993, the Supreme Court of Canada refused to hear Quebec's appeal of the judgement of the Ontario Court of Appeals. The latter ruled that the Ontario Securities Commission (OSC) had jurisdiction to look into the actions taken by the Quebec crown corporation, la Société nationale de l'amiante, when it took over control of Asbestos Corporation Limited, thus clearing the way for the OSC to hear the complaint of minority shareholders. In late 1993, the Quebec government decided to appeal an earlier judgement by a Quebec Court ordering the Quebec Securities Commission to probe the treatment of minority shareholders. In 1988, the Quebec Securities Commission ruled that it had no mandate to conduct a hearing into the takeover because the Crown was above the law. The case is expected to be heard in early 1994.

As in previous years, Teranov Mining Corp. returned to production in the spring after a closure for the winter months. (Problems continue to prevent the company from operating continuously.) Despite these difficulties, the company was able to increase its production by about 10% in comparison to 1992. The operation was again shut down in late November and is expected to resume in March 1994. Towards the end of the year, Black Hill Minerals Ltd., an Australian company, exercised its option to purchase 50% of Princeton Mining Corporation's interest in Teranov Mining Corp. Under the terms of the agreement, Black Hill Minerals Ltd. would advance up to $1 million to Teranov Mining Corp. and will bring to the joint venture its engineering expertise in the screening of fine particles and in fibre enhancement. Black Hill Minerals Ltd. will manage the operation while Princeton Mining Corporation will manage the newly formed marketing company, Chrysotile Marketing Inc. Black Hill Minerals Ltd. also has until December 1, 1994, to purchase Princeton's remaining 50% interest. It is believed that the reprocessing of the tailings alone could extend asbestos operations at the site by up to 20 years.

The government of Newfoundland and Labrador is currently studying a proposal by Cliff Resources Corporation to backfill the old asbestos open pit at Baie Verte with asbestos-containing waste imported mainly from Europe and the United States. An environmental preview report was presented to the Newfoundland Minister for the Environment who requested some clarification. A final decision on the project can be expected in the coming year.

In British Columbia, an agreement was reached between the receiver for Cassiar Mining Corporation and a joint venture group comprised of Minpro Pty Ltd., Cliff Resources Corporation, and Black Hill Minerals Ltd. Under this agreement the joint venture group has a six-month period to buy the remaining assets of Cassiar Mining Corporation. The plan is to build a wet milling facility which would utilize the existing tailings and, in the process, rehabilitate the site. Cliff Resources was involved in developing the wet milling operation at Baie Verte, Newfoundland.

In a relatively surprising move not warranted by the latest scientific information, the government of

British Columbia lowered its occupational exposure limit to chrysotile asbestos from the value of 2 fibres per cubic centimetre (f/cm^3) to 0.1 f/cm^3. However, the occupational exposure limit for miners and millers in that province remains at 2 f/cm^3.

INTERNATIONAL AND REGULATORY DEVELOPMENTS

United States

After two years, on November 5, 1993, the U.S. EPA finally published in the Federal Register its long-awaited clarification notice regarding the status of several asbestos products in the United States. This clarification notice was in response to the right to ban certain asbestos products granted to the EPA by the U.S. Fifth Circuit Court of Appeals at the time of the remanding of the 1989 EPA ban rule. (Only asbestos products that were not being manufactured, processed nor imported on July 12, 1989, the time of issuance of the ban rule, could be banned.) This clarification notice states that asbestos-cement sheets (corrugated or flat), asbestos-cement shingles, asbestos clothing, roofing felt, millboard, pipeline wrap, and vinyl asbestos tile are authorized for use in the United States. However, the use of corrugated paper, commercial paper, flooring felt, rollboard and specialty paper is prohibited. In addition, all new uses of asbestos are also prohibited. To that effect, the EPA defines "new uses of asbestos" as commercial uses that were not manufactured, processed or imported on July 12, 1989. The table below is a summary of asbestos products authorized or prohibited in the United States at the time of writing.

In 1993, the EPA continued to reject the Appeals Court judgement. Consistent with this approach, the EPA sought the agreement of 44 manufacturers of vehicles using friction materials (cars, trucks, buses and motorcycles) to sign a "voluntary phase-out agreement" by which signees would commit themselves to phase out asbestos-containing products by October 1, 1994, in all new vehicles and to not reintroduce them in the future. In its proposal, the EPA indicated that substitutes for asbestos were readily available, even after the big three U.S. automakers made clear in their response to an earlier request by the EPA that substitutes did not yet exist for all applications and that roughly 20% of their fleet was still using asbestos and would continue to use asbestos until such time that an appropriate substitute that ensured the same level of safety to the user was developed. It is worth noting that, in its judgement remanding the EPA ban rule, the U.S. Fifth Circuit Appeals Court stated that the agency failed in its effort to ban asbestos-containing friction products because it "failed to evaluate the toxicity of likely substitutes . . ." and that "while it is apparent that non-asbestos brakes either are available or soon will be available on new vehicles, there is no evidence indicating that forcing consumers to replace asbestos brakes with new non-asbestos brakes will decrease fatalities . . ." In fact, some of the fibres used in non-asbestos brakes (i.e., refractory ceramic fibres and fibreglass) are a concern to both the EPA and the U.S. Department of Health and Human Services because of their probable toxicity. The EPA set October 1, 1993, as

STATUS OF ASBESTOS PRODUCTS IN THE UNITED STATES

Asbestos Products Banned in the U.S.	Asbestos Products Authorized in the U.S.	
Corrugated paper	Corrugated asbestos-cement sheet	Millboard
Commercial paper	Flat asbestos-cement sheet	Pipeline wrap
Flooring felt	Asbestos-cement pipes	Vinyl asbestos pipe
Rollboard	Asbestos-cement shingles	Acetylene cylinders
Specialty paper	Friction materials	Asbestos diaphragms
New uses of asbestos	Drum brake lining	High-grade electrical paper
	Clutch facing	Packings
	Disc brake pads	Sealant tape
	Asbestos clothing	Specialty industrial gaskets
	Automatic transmission components	Arc chutes
	Roofing felt	Battery separators
	Roof coating	Reinforced plastic
	Non-roof coating	Textiles

a deadline for companies to provide their response. As it became clear that companies would not respond, the EPA changed its tactics and informed the companies that it would set up a meeting in the future to discuss the matter.

On October 5, 1993, the EPA published a clarification notice in the Federal Register regarding the removal of asbestos-containing materials (ACM). The purpose of this notice was to clarify possible misunderstandings in the regulated community regarding the removal of ACM that were not covered in the EPA's revision of the National Emission Standard for Hazardous Air Pollutants for asbestos as published on November 20, 1990. In the notice, the EPA emphasized that removal of asbestos is "not always a building owner's best course of action to reduce asbestos exposure." It also recommended "proper in-place management of ACM rather than removal of ACM."

The American Conference of Governmental Industrial Hygienists (ACGIH) introduced in its booklet on Threshold Limit Values a notice of intended changes for asbestos that, if adopted, would lower the occupational exposure limit for chrysotile asbestos from the current 2 f/cm^3 to a value of 0.2 f/cm^3 and would further eliminate the discrimination between the various fibres, therefore attributing the same risk to each of them. This approach is not supported by the internationally recognized scientific evidence, which instead reinforces the notion of different levels of risk associated with different fibres, with chrysotile asbestos carrying the lowest risk. The action also contradicts the 1989 World Health Organization's recommendation to lower exposure to chrysotile asbestos to a level of 2 f/cm^3 as a first step, and then, when possible, to a level of 1 f/cm^3. A number of representations have been made to the ACGIH, including several from Canada; the body is to revisit the issue in 1994.

In another development, sometime in 1994, the Occupational Safety and Health Administration is expected to adopt a new limit of 0.1 f/cm^3, down from the current 0.2 f/cm^3, with no differentiation of the fibre type.

Although the asbestos market in the United States appears to have stabilized, it is worth noting that the last of the U.S. producers of asbestos-cement pipe, CAPCO, ceased production in early September 1993, leaving the roof coating and friction material industries as the major asbestos users in the United States. A Mexican company is now exporting asbestos-cement pipes to the United States to satisfy American demand for the product.

John Myers retired as long-time president of the Californian asbestos producer KCAC in King City, but will remain chairman of the Board of Directors of the Asbestos Information Association/North America.

The Asbestos Cement Pipe Producers Association published a special report on asbestos-cement pipe providing a comprehensive and current review of the product, with special focus on its cost-effectiveness and safety. The report is addressed to the wide variety of users and potential users of asbestos-cement pipes.

On September 23, 1993, following concerns regarding asbestos in New York City public schools, 17 world-renowned scientists from the United States and Great Britain issued a news release stating that "children are not at increased risk from the long-term effects of exposure to minute levels of asbestos found in schoolroom air," while "improperly conducted asbestos removal is a concern since it can release substantial amounts of asbestos fibres into the air." The cost to New York City has reached $65 million and, by some reports, may eventually exceed $1 billion. It is worth noting that the EPA has decided to terminate funding for its asbestos abatement program.

Brazil

Brazil is an important producer of asbestos and a competitor, especially in the increasingly important Latin American market. Sociedade Anonima Mineraçao de Amianto (SAMA) produced about 200 000 t in 1993. Also in 1993, there was an attempt by several politicians, under pressure by environmentalist groups, to introduce an asbestos ban in the country.

South Africa

The Republic of South Africa ceased all production of amosite asbestos in 1993. The closure of the country's only amosite-producing mine (the Penge mine) was prompted by growing health concerns over amphibole asbestos and by Japan's decision to eliminate amphibole asbestos from its manufacture of extruded asbestos-cement products. At the time of closure, the Penge mine was only operating at about 50% of its rated capacity of 40 000 t. This development is another recognition that amphibole asbestos involves greater health risks than chrysotile asbestos.

Europe

In March 1993, the Greek Zidani asbestos mine, previously controlled by Asbestos Mines of

Northern Greece (MABE), returned to production under a five-year lease (with an option for a further five years) to Hellenic Mineral Mining Co. Ltd. (HMMC). Under this agreement, HMMC will operate the mine and the plant. Production in 1993 was estimated to be around 45 000 t. The mine had stopped production in 1991.

The German government implemented its ban of asbestos with exception on October 1, 1993. The said ban forms part of a German federal guideline on the classification of dangerous goods. The production and use of asbestos will be prohibited in Germany, and German companies will be banned from any involvement in the trade of asbestos. Certain exemptions will be allowed such as the repair of existing machinery and vehicles, and special industrial uses. German authorities hope that this law will reduce consumption of asbestos in that country by about 20%. The Germans hope to achieve total elimination of asbestos by an as yet unspecified date and are asking other European Community (EC) member states to implement similar legislation. Denmark, Italy and the Netherlands have already implemented similar bans; however, no other EC member is expected to follow the German lead. Despite numerous attempts to introduce a ban by several of its members, the official position of the EC remains that of controlled use.

The Eighth Biennial Conference of the Asbestos International Association (AIA) took place in Paris May 11-12, 1993. More than 200 people from 35 countries representing labour, industry, science and government were in attendance. Participants listened to 19 presentations organized in three sessions covering all issues associated with asbestos: medical, media, regulation, workplace, and national and international cooperation. At the conference, the Governing Council of the AIA elected Bernard Giboin as its new chairman, replacing Freidrich Bachmayer who was elected at the Seventh Biennial Conference in Brussels. At the end of the meeting, the new chairman reiterated that the AIA would continue to defend the principle of controlled use and announced a number of new initiatives including, most notably, a new structure of the AIA to ensure a maximum efficiency of all actions taken.

Commonwealth of Independent States

Asbestos production in Russia and Kazakhstan continued to decline due to internal problems and a lack of funds. At the AIA conference in Paris, Russian representatives reported production of 1.5 Mt in 1992. It is believed that about 300 000 t of the asbestos produced in Russia and Kazakhstan is exported, mainly to Asian countries.

SCIENTIFIC DEVELOPMENTS

On May 10, 1993, the International Centre for a Scientific Ecology organized a one-day scientific seminar entitled "Is the concept of linear relationship between dose and effect still a valid model for assessing risk related to low doses of carcinogens?" This question is as relevant to asbestos as it can be to other carcinogens. The seminar drew about 200 people from 26 countries, half of which were scientists of international reputation. One key presentation was that of Dr. Corbett McDonald, Professor Emeritus of the United Kingdom Heart and Lung Institute. In his presentation "Linear extrapolation for risk estimation at low-level exposure: the asbestos example," Dr. McDonald underlined the varying degrees of risks of mesothelioma (a form of lung cancer) associated with different fibres. In fact, most of the mesothelioma is attributable to amphibole exposure rather than to chrysotile. He further indicated that it is probably beyond the power of science to determine whether or not there is a threshold below which risk is zero. In a concluding statement to the seminar, the scientific panelists stated that "low levels of carcinogenic agents of natural origin are omnipresent in man's environment, in the air we breathe and the food we eat . . . Zero risk cannot be achieved." They concluded by saying that "risks compete with risks: society must distinguish between significant risks and trivial hypothetical risks."

On November 13-17, 1993, the International Commission of Occupational Health and the International Program on Chemical Safety (a World Health Organization program) co-sponsored an international workshop on health risks associated with chrysotile exposure which took place on the Isle of Jersey (United Kingdom). Thirty-six scientists of international reputation representing various opinions and twelve countries were invited along with eleven observers, mainly from governments. The results of this important workshop are to be published in the April 1994 issue of the *Annals of Occupational Hygiene*. It will consist of the original papers submitted to peer review and the summaries of the rapporteurs. It is expected that this report will be used extensively by the various organizations and countries which are currently reviewing their asbestos regulations.

In December 1993, J.C. McDonald, F.D.K. Liddell, A. Dufresne and A.D. McDonald published in the *British Journal of Industrial Medicine* a paper entitled "The 1891-1920 Birth Cohort of Quebec Chrysotile Miners and Millers: Mortality 1976-1988," as a follow-up to previous studies of the same cohort. The main conclusions of this study were that there was little or no excess of observed-over-expected death (all causes) below exposures at about 15 f/cm^3 for 20 years and only two small excesses, statistically non-significant, for exposures up to 45 f/cm^3. However, there was considerable excess for exposures greater than 45 f/cm^3. The authors also noted that "there was no evidence of a gradient over the seven classes of exposure up to 45 f/cm^3, although above that value the risk increased greatly." The authors also stated that "mortality generally was related systematically to cigarette-smoking habit," but they noted that the interaction between smoking and asbestos was less than multiplicative. This study confirms earlier results that the higher the exposure, the higher the risk.

ASBESTOS SUBSTITUTES

Non-asbestos fibrous materials, many of which are used as asbestos substitutes, are coming under increasing scrutiny in the workplace. The 1991 HEI-AR (U.S. Health Effects Institute – Asbestos Research) report expressed concern about the substitutes for asbestos and stated that "in view of the growing numbers of different types of man-made fibres that are entering commerce to substitute for asbestos, as a result of the phase-out of asbestos itself, detailed material characterization and biological testing of such fibres should precede their widespread dissemination into the human environment."

Under pressure from industry, the U.S. Department of Health and Human Services has decided to review the research that led the National Toxicology Program (NTP) to propose, in 1989, the listing of fibreglass insulation "used in 90% of homes in the U.S." as a possible carcinogen to humans. (At the time, scientists believed that only workers in the insulation manufacturing sector were at risk, not homeowners or construction workers.) The North American Insulation Association, which represents the four largest U.S. fibreglass manufacturers, has stated that there are not enough scientific data to prove that inhaled fibreglass fibres could cause cancer. The Association also contested the NTP testing methods. Dr. James Fouts, senior science adviser to the Director of the National Institutes of Environmental Health Sciences, said that some limited human tests in the United States and Europe seem to confirm the results observed in rodents. A decision on whether or not to include fibreglass in the list of potential human carcinogens is expected in early 1994.

In September 1993, the German federal departments of Health and the Environment and the federal Office for Occupational Safety issued a joint preliminary report on "maximal concentration of hazardous substances in the workplace" in which it was concluded that some of the mineral synthetic fibres used in the insulation industry seem to be as dangerous as asbestos. According to this report, refractory ceramic fibres (RCFs) are more dangerous than asbestos and have been classified as a "demonstrated carcinogen to humans." Mineral wool and fibreglass could carry a risk similar to that of asbestos and were definitely less carcinogenic than RCFs; consequently, they remain in the category of "possible carcinogen to humans." However, German authorities were quick to say that there was no need to remove these materials and that the risk was limited to workers associated with the manufacturing and processing of these materials. A need for further research was also identified.

In the United States, the EPA and three major manufacturers of RCFs have signed an agreement that requires these manufacturers to conduct worker exposure studies for all workplace activities. This agreement results from industry-sponsored toxicity tests which showed that RCFs may pose a cancer threat. In 1991, based on animal data, the EPA concluded that RCFs may present an unreasonable risk of cancer to humans. In mid-1993, the EPA classified RCFs as a "probable human carcinogen."

In Canada, the Fédération des travailleurs et travailleuses du Québec, with the support of the Canadian Labour Congress, has drafted a Code of Practice for the use of synthetic mineral fibres. This exercise was prompted by the recent data from both animals and humans indicating that these materials were dangerous to health. The proposed code would include a description of each synthetic mineral fibre with its known health effects, as well as recommendations for proper monitoring, safe work practices, and exposure limits. This proposed Code of Practice is intended to eliminate interprovincial inconsistencies in the protection of workers across Canada.

OUTLOOK

The publication of the clarification notice by the EPA is expected to have a positive impact on Canadian markets in developing countries which are usually influenced by U.S. developments. The stabilization of the U.S. market is also a very positive sign. The benefits and safety of asbestos-cement products continue to be recognized despite increasing competition from substitute fibres and steel. Asian countries are still the main markets for Canadian fibres, accounting for about 56% of Canadian exports in 1993. However, Japan's share has decreased due to the current state of the Japanese economy, which is expected to remain weak in comparison to other Asian countries in 1994. A very marginal gain was observed in South America in light of a potential Pan-American free trade agreement. The South American market is still a good candidate for future growth, although the Brazilian producer is in a good position to take advantage of increases in demand. The European market continues to decrease and is expected to do so, at least until the economies of the Eastern European countries show some signs of improvement. Canadian production is expected to remain stable in 1994 and may, in fact, increase slightly.

Note: Information in this review was current as of December 31, 1993.

TARIFFS

Item No.	Description	Canada			United States
		MFN	GPT	USA	Canada
2524.00.10	Crude asbestos	Free	Free	Free	Free
2524.00.90	Other asbestos	8%	5%	Free	Free
6811.10	Corrugated sheets of asbestos-cement, of cellulose fibre-cement or the like	8%	5%	Free	Free
6811.20	Sheets n.e.s., panels/tiles etc. of asbestos-cement, cellulose fibre-cement, etc.	8%	5%	Free	Free
6811.30	Tubes, pipes and tube or pipe fittings of asbestos-cement, of cellulose fibre-cement, etc.	8%	5%	Free	Free
6811.90	Articles n.e.s. of asbestos-cement, of cellulose fibre-cement, or the like	8%	5%	Free	Free
6812.10	Fabricated asbestos fibres; mixtures with a basis of asbestos or with a basis of asbestos and magnesium carbonate	8%	5%	Free	Free
6812.20	Asbestos yarn and thread	12.5%	12.5%	Free	Free
6812.30	Asbestos cords and string, whether or not plaited	12.5%	12.5%	Free	Free
6812.40	Asbestos woven or knitted fabric	8%	5%	Free	Free
6812.50	Asbestos clothing, clothing accessories, footwear and headgear	25%	25%	Free	Free
6812.60	Asbestos paper, millboard and felt	8%	5%	Free	Free
6812.70	Compressed asbestos fibre jointing, in sheets or rolls	8%	5%	Free	Free
6812.90.10	Asbestos belting	17.5%	7.5%	Free	Free
6812.90.90	Other asbestos fabricated products n.e.s.	8%	5%	Free	Free
6813.10.10	Asbestos brake linings and pads for motor vehicles of heading Nos. 87.02, 87.03, 87.04 or 87.05	11.3%	Free	4.4%	Free
6813.10.90	Other asbestos brake linings and pads	8%	5%	3.2%	Free
6813.90.10	Asbestos clutch facings for motor vehicles of heading Nos. 87.02, 87.03, 87.04 or 87.05	11.3%	7.5%	4.4%	Free
6813.90.90	Other asbestos friction material and articles n.e.s.	9.2%	2.5%	3.6%	Free

Sources: Customs Tariff, effective January 1994, Revenue Canada, Customs and Excise; Harmonized Tariff Schedule of the United States, 1994.
n.e.s. Not elsewhere specified.

TABLE 1. CANADA, ASBESTOS PRODUCTION AND TRADE, 1992 AND 1993

Item No.		1992		1993p	
		(tonnes)	($000)	(tonnes)	($000)
PRODUCTION (Shipments)[1]					
	By type				
	Crude, groups 1, 2 and other milled	–	–	. .	. .
	Group 3, spinning	9 647	7 767	. .	. .
	Group 4, shingle	125 087	80 191	. .	. .
	Group 5, paper	125 085	57 352	. .	. .
	Group 6, stucco	206 786	62 520	. .	. .
	Group 7, refuse	120 389	23 189	. .	. .
	Total	586 994	231 020	509 341	215 076
	By province				
	Quebec	567 001	224 549	494 000	209 860
	British Columbia	5 984	2 939	–	–
	Newfoundland	14 009	3 531	15 341	5 216
	Total	586 994	231 020	509 341	215 076
EXPORTS				**(Jan.-Sept.)**	
2524.00.10	Crude asbestos				
	Japan	1 381	478	1 162	412
	Malaysia	67	25	–	–
	United States	41	23	34	38
	Other countries	–	–	62	23
	Total	1 489	527	1 258	473
2524.00.21	Asbestos milled fibres, group 3 grades				
	EC countries (12)[1]				
	United Kingdom	568	738	483	629
	Spain	877	1 138	352	456
	Portugal	455	301	100	137
	Germany	99	143	55	72
	Belgium	–	–	–	–
	France	582	591	–	–
	Italy	243	313	–	–
	EC countries, subtotal	2 824	3 224	990	1 294
	Israel	595	772	350	454
	South Korea	869	1 154	347	451
	Hungary	333	437	317	410
	Brazil	390	537	284	389
	Colombia	1 001	1 302	250	325
	Egypt	–	–	250	325
	Mexico	958	1 232	222	291
	United States	486	222	704	271
	Peru	176	239	196	263
	Turkey	723	939	200	260
	India	588	771	146	196
	Other countries	2 170	2 817	352	470
	Total	11 113	13 646	4 608	5 399
2524.00.22	Asbestos milled fibres, groups 4 and 5 grades				
	EC countries (12)[1]				
	France	17 470	14 727	13 229	11 032
	Spain	11 822	10 572	6 789	6 484
	Italy	16 896	14 277	6 641	5 852
	United Kingdom	5 371	4 408	3 088	2 532
	Portugal	3 563	3 319	2 007	1 894
	Belgium	5 008	4 767	2 207	1 816
	Netherlands	1 306	1 386	193	196
	Germany	1 014	886	160	147
	Ireland	1 839	1 757	159	110
	Denmark	49	34	25	17
	Greece	300	359	–	–
	EC countries, subtotal	64 638	56 492	34 498	30 080

TABLE 1 (cont'd)

Item No.		1992		Jan.-Sept. 1993p	
		(tonnes)	($000)	(tonnes)	($000)
EXPORTS (cont'd)					
	Thailand	34 472	27 249	21 540	16 764
	Japan	22 881	18 584	14 194	11 942
	India	14 448	11 693	14 677	11 626
	Mexico	9 056	7 506	9 366	8 007
	Colombia	14 127	11 333	8 371	6 829
	Nigeria	7 184	6 145	5 794	4 965
	Brazil	11 628	9 975	5 712	4 656
	Indonesia	8 052	5 188	7 248	4 650
	Malaysia	12 681	9 737	4 792	3 568
	Chile	5 596	4 467	3 590	2 771
	Pakistan	2 629	2 172	2 881	2 336
	Iran	1 250	1 500	1 818	2 219
	Sri Lanka	6 011	5 896	2 312	2 083
	Tunisia	1 960	2 003	1 785	1 808
	Algeria	12 830	9 676	2 000	1 673
	Morocco	5 052	4 729	1 696	1 471
	Peru	1 574	1 264	1 402	1 153
	Egypt	3 869	3 683	1 089	1 141
	United Arab Emirates	2 375	2 041	1 150	1 072
	Turkey	2 258	1 905	1 328	1 054
	South Korea	975	853	870	685
	Australia	1 019	854	686	594
	Argentina	892	777	526	455
	Other countries	13 443	11 512	4 114	3 637
	Total	260 900	217 234	153 439	127 239
2524.00.29	Asbestos shorts, groups 6, 7, 8 and 9 grades				
	EC countries (12)[1]				
	France	5 133	1 518	3 933	1 119
	Italy	5 815	2 021	2 949	980
	Belgium	4 433	1 668	2 277	927
	United Kingdom	2 953	1 084	2 112	791
	Portugal	3 419	1 276	1 931	625
	Spain	6 547	2 732	1 277	561
	Ireland	1 295	540	420	178
	Denmark	547	254	294	135
	Germany	1 283	413	278	97
	Netherlands	30	7	36	7
	Greece	844	421	18	3
	EC countries, subtotal	32 299	11 934	15 525	5 423
	Japan	70 442	27 280	44 074	18 289
	South Korea	56 701	21 642	29 577	11 466
	Thailand	37 773	16 617	22 715	9 836
	United States	30 117	8 121	23 078	7 024
	India	19 302	7 893	15 793	6 336
	Indonesia	8 967	3 276	7 419	3 013
	Colombia	8 349	3 792	5 600	2 740
	Mexico	11 724	3 915	6 162	2 005
	Malaysia	6 890	2 652	4 555	1 721
	Brazil	8 141	2 893	4 355	1 706
	Turkey	2 009	718	2 068	897
	Taiwan	5 549	1 998	2 387	893
	Nigeria	2 184	878	1 679	723
	Chile	3 281	1 091	1 808	668
	Sri Lanka	1 409	704	860	441
	Other countries	21 938	7 510	11 031	3 849
	Total	327 075	122 914	198 686	77 030
Grand total, crude, milled fibres and shorts		600 577	354 321	357 991	210 141
6811.10	Corrugated sheets of asbestos-cement, of cellulose fibre-cement, or the like				
	United States	..	1 337	..	851
	Total	..	1 337	..	851

TABLE 1 (cont'd)

Item No.		1992		Jan.-Sept. 1993p	
		(tonnes)	($000)	(tonnes)	($000)
EXPORTS (cont'd)					
6811.20	Sheets n.e.s., panels/tiles, etc., of asbestos-cement, cellulose fibre-cement, etc.				
	United States	. .	865	. .	1 135
	Australia	–	–	. .	4
	St. Pierre and Miquelon	. .	8	–	–
	Germany	–	–	–	–
	Total	. .	874	. .	1 140
6811.30	Tubes, pipes and tube or pipe fittings of asbestos-cement, of cellulose fibre-cement, etc.				
	Total	–	–	–	–
6811.90	Articles n.e.s. of asbestos-cement, of cellulose fibre-cement, or the like				
	United States	. .	77	. .	18
	Japan	–	–	. .	13
	United Kingdom	–	–	. .	2
	Total	. .	77	. .	34
6812.10	Fabricated asbestos fibres; mixtures with a basis of asbestos or with a basis of asbestos and magnesium carbonate				
	Thailand	–	–	. .	133
	Indonesia	–	–	. .	60
	Malaysia	–	–	. .	59
	United States	. .	28	. .	23
	Other countries	. .	207	. .	29
	Total	. .	235	. .	304
6812.20	Asbestos yarn and thread				
	Chile	92	392	90	362
	Colombia	34	137	43	183
	United States	17	129	15	130
	Brazil	1	2	25	117
	Other countries	105	416	54	249
	Total	249	1 076	227	1 041
6812.30	Asbestos cords and string, whether or not plaited				
	United States	–	–	. .	2
	Mexico	. .	. . .	–	–
	Total	. .	. . .	. .	2
6812.40	Asbestos woven or knitted fabric				
	United States	52	581	35	425
	United Kingdom	22	153	42	321
	Other countries	9	36	10	68
	Total	83	770	87	814
6812.50	Asbestos clothing, clothing accessories, footwear and headgear				
	C.I.S.	. .	21	–	–
	Germany	. .	1	–	–
	Guyana	. .	1	–	–
	United States	. .	1	–	–
	Total	. .	25	–	–

TABLE 1 (cont'd)

Item No.		1992		Jan.-Sept. 1993p	
		(tonnes)	($000)	(tonnes)	($000)
EXPORTS (cont'd)					
6812.60	Asbestos paper, millboard and felt				
	United Kingdom	–	–	. .	3
	United States	–	–	. .	2
	Pakistan	. .	36	–	–
	Total	. .	36	. .	5
6812.70	Compressed asbestos fibre jointing, in sheets or rolls				
	United States	. .	1 062	. .	763
	Other countries	. .	9	. .	90
	Total	. .	1 071	. .	853
6812.90.10	Asbestos building materials				
	Thailand	. .	732	. .	141
	Egypt	. .	37	. .	66
	Singapore	. .	75	. .	55
	St. Pierre and Miquelon	. .	3	. .	1
	Other countries	. .	692	–	–
	Total	. .	1 539	. .	265
6812.90.90	Other asbestos fabricated products n.e.s.				
	United States	. .	48	. .	96
	Poland	–	–	. .	23
	Israel	–	–	. .	17
	Chile	–	–	. .	12
	Other countries	. .	99	. .	26
	Total	. .	147	. .	174
6813.10	Asbestos brake linings and pads				
	United States	. .	47 614	. .	35 325
	Other countries	. .	282	. .	261
	Total	. .	47 896	. .	35 586
6813.90	Asbestos friction material and articles n.e.s.				
	United States	. .	100	. .	100
	Other countries	. .	4	–	–
	Total	. .	104	. .	100
Total exports, asbestos manufactured		. .	55 187	. .	41 169
IMPORTS					
2524.00.10	Crude asbestos	303	255	220	152
2524.00.90	Other asbestos	948	224	560	169
6811.10	Corrugated sheets of asbestos-cement, of cellulose fibre-cement, or the like	. .	343	. .	359
6811.20	Sheets n.e.s., panels/tiles, etc., of asbestos-cement, cellulose-fibre cement, etc.	. .	1 070	. .	1 412
6811.30	Tubes, pipes and tube or pipe fittings of asbestos-cement, cellulose fibre-cement, etc.	. .	229	. .	746
6811.90	Articles n.e.s., of asbestos-cement, cellulose fibre-cement or the like	. .	319	. .	232
6812.10	Fabricated asbestos fibres; mixtures with a basis of asbestos or with a basis of asbestos and magnesium carbonate	. .	395	. .	230

TABLE 1 (cont'd)

Item No.		1992		Jan.-Sept. 1993p	
		(tonnes)	($000)	(tonnes)	($000)
IMPORTS (cont'd)					
6812.20	Asbestos yarn and thread	1	3	3	15
6812.30	Asbestos cords and string, whether or not plaited	. .	73	. .	73
6812.40	Asbestos woven or knitted fabric	38	443	22	379
6812.50	Asbestos clothing, clothing accessories, footwear and headgear	. .	519	. .	265
6812.60	Asbestos paper, millboard and felt	5	117	37	220
6812.70	Compressed asbestos fibre jointing, in sheets or rolls	184	1 782	110	934
6812.90.10	Asbestos belting	. .	11	. .	. . .
6812.90.90	Other asbestos fabricated products n.e.s.	. .	2 489	. .	1 679
6813.10	Asbestos brake linings and pads	. .	38 135	. .	34 760
6813.90	Asbestos friction material and articles n.e.s.	. .	5 087	. .	4 274

Sources: Natural Resources Canada; Statistics Canada.
C.I.S.: Commonwealth of Independent States.
– Nil; . . Not available or not applicable; . . . Amount too small to be expressed; n.e.s. Not elsewhere specified; p Preliminary.
[1] EC includes Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain and the United Kingdom.
Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADIAN ASBESTOS PRODUCERS, 1993

Producers	Mine Location	Normal Mill Capacity Ore/Day	Normal Mill Capacity Fibre/Year	Remarks
		(tonnes)		
Teranov Mining Corp.	Baie Verte, Nfld.	6 000	20 000	Wet-processing of tailings started in July 1991. Black Hill Minerals Ltd. acquired 50% of Princeton Mining Corporation's interest. It also has an option to purchase the remaining 50% before December 1, 1994.
LAB Chrysotile, Inc.[1]				Partnership owned 55% by LAQ and 45% by Mazarin Mining Exploration Inc.
- Lac d'Amiante du Québec, Ltée (LAQ)	Black Lake, Que.	9 000	160 000	Open-pit. Since September 1989, LAQ has been owned by Jean Dupéré (President of LAB) and Connell Bros. Company, Ltd. of the United States.
- Asbestos Corporation Limited British Canadian mine	Black Lake, Que.	7 000	70 000	Sold to Mazarin Mining Exploration Inc. on September 2, 1992. Open-pit.
- Bell Asbestos Mines, Ltd.	Thetford Mines, Que.	2 700	70 000	Sold to Mazarin Mining Exploration Inc. on September 2, 1992. Underground. Mine was re-opened January 1989.
J.M. Asbestos Inc. Jeffrey mine	Asbestos, Que.	15 000	250 000	Open-pit (effective capacity reduced by one half since 1982).
Total of four producers at year-end			570 000	

[1] A partnership involving three operating companies.

TABLE 3. CANADA, ASBESTOS PRODUCTION AND EXPORTS, 1985-93

	Crude	Milled	Shorts	Total
		(tonnes)		
PRODUCTION[1]				
1985	–	397 729	352 461	750 190
1986	–	332 092	330 289	662 381
1987	–	365 144	299 402	664 546
1988	14	399 550	310 793	710 357
1989	–	410 588	303 448	714 036
1990	–	379 047	306 580	685 627
1991	–	335 506	350 502	686 008
1992	–	259 819	327 175	586 994
1993[p]	. .	. .	. .	509 341
EXPORTS				
1985	44	395 158	326 311	721 513
1986	127	375 948	341 609	717 684
1987	1 696	353 321	293 808	648 825
1988	11 288	381 561	292 236	685 085
1989	17 198	379 601	312 915	709 714
1990	1 469	378 074	269 942	649 485
1991	2 302	353 391	330 360	686 053
1992	1 489	272 013	327 075	600 577
1993[a]	1 258	158 047	198 686	357 991

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available; [p] Preliminary.
[a] January-September.
[1] Producers' shipments.

Cement

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Shipments of cement in 1993 were estimated to be 9.8 Mt valued at $764.6 million, an increase of 12% in volume compared to 1992, based on preliminary figures. This increase resulted mainly from a moderate increase in demand in western Canada, along with higher exports to the United States. Construction activity remained weak, particularly in Ontario and Quebec; overall housing starts in Canada were about 7.5% lower than in 1992. Cost-cutting measures led to temporary reductions in active kiln capacity; reported kiln capacity in 1992 was about 14.8 Mt/y, with approximately 13.4 Mt/y active.

THE CANADIAN INDUSTRY

The Canadian cement industry is diversified and mainly integrated with the primary construction materials and products sectors. Many cement manufacturers also supply ready-mix concrete, crushed stone aggregates, and concrete products such as slabs, bricks, and pre-stressed concrete units. Restructuring during recent years has tended to result in decentralization of operations and in greater foreign control, now estimated to account for about 80% of the industry's capacity. Major international companies include: Holnam Inc. (part of Holderbank Financière Glaris Ltd., headquartered in Zurich), which indirectly controls St. Lawrence Cement Inc.; Lafarge Corporation (part of the Lafarge Coppée Group, headquartered in Paris), which indirectly controls Lafarge Canada Inc.; S.A. Cimenteries CBR of Belgium (CBR), which owns Inland Cement Limited; and Société des Ciments Français (SCF) of France, which owns both Lake Ontario Cement Limited (LOC) and Miron Inc. SCF now uses the name "ESSROC" to identify all of its holdings in Canada and the United States. (Accordingly, LOC uses the name of ESSROC Canada Inc.)

In 1992, Italcementi S.p.A. acquired a controlling interest in SCF and, in 1993, "ESSROC" (now owned by Ciments Francais/Italcimenti) merged its Quebec operations with those of Ciment Québec Inc. (CQI). Effectively, the combined operations, under the CQI name, are now owned 50:50 by "ESSROC" and CQI. Also in 1993, Heidelberger Zement A.G. acquired a controlling interest in CBR.

In 1993, Lafarge reorganized its North American operations. As a result, its cement operations now include only three regions: Western, based in Calgary; Eastern, based in Montréal; and the United States, based in Southfield, Michigan. Similarly, its concrete products operations have been organized into three regions.

Clinker-producing and finish-grinding capacities of cement plants, on a company-by-company basis, are listed in Table 2. In 1992, active clinker capacity in Canada was reduced by about 1900 t and is currently about 13.4 Mt/y. Clinker production is more indicative of ultimate cement production capacity because clinker can be stockpiled for later use or sale. The average kiln capacity over the last 10 years (1982-92) increased from about 330 000 t/y to 450 000 t/y; the average kiln age is reported to be about 24 years.

In **Atlantic Canada**, two cement plants obtain raw materials on site or nearby. These account for about 4% of total Canadian clinker-producing capacity. Nova Scotia and Newfoundland are now the only producers of cement in the region since Lafarge Canada Inc. retired its Havelock, New Brunswick plant in 1988.

In **Quebec**, four clinker-producing plants and one grinding operation accounted for about 20% of national output. St. Lawrence Cement Inc. (SCL) is the dominant manufacturer of cement and a leading producer of concrete and aggregates in eastern Canada. Its major markets, in competition with Lafarge Canada Inc. and Ciment Quebec Inc., are in Quebec, the Maritime provinces and the northeastern United States. Considering the northeastern region of North America as a whole, there are generally four to six distribution terminals for every cement clinker plant. Plans by

St. Lawrence Cement to build a $200 million cement plant at Hudson, New York, remained on hold. Expansions of stone aggregate operations and raw material reserves remain major company objectives.

In **Ontario**, clinker-producing plants account for about 45% of the nation's capacity. Lafarge Canada Inc., with operations across Canada, is the largest producer in terms of both clinker and finish grinding capacity. Lafarge's raw materials handling is extensive; for example, limestone for its plant at Bath is quarried on site and silica is supplied from Potsdam sandstone near Pittsburgh, New York, about 65 km east of Bath. Iron oxide and gypsum are purchased from Hamilton and Nova Scotia, respectively. Lafarge's Woodstock plant obtains limestone on site, silica from Falconbridge Limited, iron oxide from Stelco Inc., and gypsum from sources in southern Ontario. At Picton, ESSROC Canada Inc. operates one of the largest cement plants in North America. In addition to the company's usual markets, the plant supplies cement and clinker to an associated company, ESSROC Materials Inc., in New York State and Michigan. Reflecting the growing importance of recycling, SLC has an alliance with Philip Environmental Services, a major supplier of used and recycled waste industrial products. With extensive operations in Ontario and metropolitan Montréal, the fully integrated waste management company may be in a position to provide a range of inputs from supplemental fuels to low-cost substitutes for some cement raw materials. SLC continued its Resource Recovery/Refuse Derived Fuel (RDF) project. Following acceptable assessment of environmental factors, the company plans to replace up to 20% of its coal requirements with RDF produced from local non-hazardous municipal wastes.

In **western Canada**, two companies, CBR and Lafarge Canada Inc., normally operate four clinker-producing plants in the Prairie provinces and three in British Columbia. Western Canada accounts for about 26% of clinker-producing capacity, roughly in proportion to its share of total Canadian consumption. CBR affiliate Inland Cement Limited ceased production of clinker at its Regina and Winnipeg plants in 1992; cement is now shipped from the larger Edmonton operation for wide distribution. (Previously, a limestone quarry at Mafeking, Manitoba, near the Manitoba-Saskatchewan border, supplied limestone to Inland's Regina plant, while the company's Winnipeg plant was supplied from Steep Rock, Manitoba.) Lafarge continued to benefit from new markets in the northern-tier states following a major upgrade of the rail facilities at its plant in Exshaw, Alberta. Most raw materials for the Exshaw plant are from on-site sources. However, gypsum is provided by Westroc Industries Limited, while iron oxide is from IPSCO Inc. in Regina and the Oregon Steel Co. at Portland, Oregon. Lafarge's Vancouver plant at Richmond and Tilbury Cement Limited's plant at Delta utilize limestone from Texada Island. Lafarge's Kamloops plant is supplied from reserves nearby.

WORLD DEVELOPMENTS

Multinational companies with widespread production and distribution networks have now become much more dominant in world markets. An outstanding recent example of this is the partial consolidation of markets in the United States, Canada and Mexico, with companies competing on a regional basis. An estimated 70% of the U.S. industry is now controlled by European and Pacific Rim cement producers.

World cement production in 1992 was 1255 Mt, according to the U.S. Bureau of Mines. China ranked number one, leading all countries with 304 Mt, followed by the former Soviet Union with 127 Mt and Japan with 91 Mt.

The U.S. Department of Commerce made several determinations relative to dumping margins on exports of cement by Cementos Mexicanos (Cemex) to the United States. Margins were increased 10.28% for the period April 1, 1990 to July 31, 1991, and a final determination for a margin of 42.74% was made for August 1, 1991 to July 31, 1992. A third review concerning a period extending into mid-1993 was being considered.

The United States International Trade Commission determined in June 1993 that the U.S. cement industry was materially injured or threatened with injury by imports of grey Portland cement and cement clinker from Japan into the United States. (The action was in response to a remand order from the Court of International Trade; the original determination relative to this case had been made in 1991.)

CONSUMPTION AND TRADE

Portland cement is produced by burning, usually in a rotary kiln, an accurately proportioned, finely ground mixture of limestone, silica, alumina and iron oxide. The three most commonly used types of cement produced by most Canadian cement producers are: Normal Portland (Type I), Moderate Sulphate-Resistance Portland (Type II), and High-Early-Strength Portland (Type III).

Portland cement used in Canada should conform to the specifications of CAN/CSA-A5-M93 published by the Canadian Standards Association (CSA). This standard covers the five main types of Portland cement. Masonry cement produced in Canada should conform to CAN/CSA-A8-M93. Blended hydraulic cements are covered by CAN/CSA-A362-M93. Types of cement manufactured in Canada, but not covered by the CSA standards, generally meet the appropriate specifications of the American Society for Testing and Materials (ASTM).

Canada exports cement and clinker mainly to bordering states, particularly to New York, Vermont, Michigan, Minnesota and Washington. The quantities and proportions vary considerably from year to year depending on demand. Canadian cement production efficiencies and a lower-valued Canadian dollar continue to make Canadian cement and clinker competitive in U.S. markets. Low-cost marine transportation has influenced world trade considerably. Total U.S. imports of cement for consumption were about 7.3 Mt, or 9% of apparent consumption.

TECHNOLOGY

Energy conservation programs by the Canadian cement industry have reduced energy consumption per unit of production by about 22% since 1974. Although the number of kilns has decreased, their individual capacities have increased and the more efficient dry-process plants now account for more than 80% of total cement production. Work continues toward using cheaper fuels, improving methods for defining optimal particle sizes based on grinding, and using waste materials in kilns. The fuel mix has changed considerably away from natural gas and petroleum products toward coal/coke. In 1992, of 18 clinker-producing plants, 14 reported using coal and/or coke as their primary fuel. Eight plants in 1992 reported using waste as a primary, alternate or supplemental fuel, according to the Canadian Portland Cement Association (CPCA). In 1992, the Canadian cement industry consumed, on average, 4868 megajoules per tonne of production, of which 4104 megajoules (84.3%) were derived from fossil fuels (Table 2).

Suitable waste materials are an attractive alternative fuel because pyro-processing accounts for more than 80% of total energy needs, or about 30% of total production costs. Although there has been a growing acceptance that both the production process and the Portland cement product itself offer practical solutions to the management of certain types of waste, regulations governing incineration in kilns and other industrial furnaces have not been finalized. In the United States and Europe in particular, the use of waste-derived fuels and spent organic solvents has grown. Monitoring of kiln emissions has generally confirmed that this is acceptable as a result of long residence times and the very high flame temperatures (1950°-2300°C) prevailing within. The waste materials generally established as being very satisfactory include paints and coatings, surplus oils and greases, solvents, inks and cosmetics. In the context of sustainable development, it seems apparent that improved waste management involving combustion technology could lead to greater conservation of some non-renewable fossil fuels.

The Canada Centre for Mineral and Energy Technology (CANMET), through its Industrial Targeted Program (ITP) under the new *National Energy Efficiency Act*, is developing long-term energy efficiency R&D strategies for major industrial sectors. The cement and concrete sector study was completed in 1993; it is expected that there will be cooperative investments in energy efficiency research leading to field trials and technical transfer.

CANMET has established cooperative arrangements for investigating the properties of concrete made with a high proportion of fly ash. The work, based on CANMET's technology allowing up to 60% of Portland cement replacement by fly ash, is being funded by the Electric Power Research Institute of Palo Alto, California. Past cooperative research into supplementary cementing materials led to the production of a ground granulated blast furnace slag for use as a cementitious material in concrete. Koch Minerals of Canada Limited (formerly Reiss Lime Company of Canada, Limited) now produces this type of material, often called "slag cement," at Spragge, Ontario. Granulated slag is from The Algoma Steel Corporation, Limited's plant at Sault Ste. Marie. The capacity of the Spragge plant is about 150 000 t/y, with the product being used for complete or partial replacement of Portland cement.

In 1994, CANMET, along with the American Concrete Institute, will sponsor the "Third CANMET/ACI International Conference on Durability of Concrete." This conference will be held May 22-28 in Nice, France.

Along with co-sponsors, including the American Concrete Institute, the Electric Power Research Institute, and Canada's National Research Council, CANMET is planning the "Fifth Canmet/ACI International Conference on Flyash, Silica Fume, Slag and Natural Pozzolans in Concrete." The conference will be held in Milwaukee, Wisconsin, in June 1995. The purpose is to present new developments and to continue the transfer of related technology as widely as possible.

Major cement-related research is carried out by the Portland Cement Association (PCA) based in Illinois. This is a non-profit research group conducting technical and market research on behalf of members and affiliates, including the CPCA. Lafarge Corporation, acting independently in technical research, operates its own research and technical centre in Montréal.

Moderate Sulphate-Resistance Cement (Type II) and Low-Heat-of-Hydration Cement (Type IV), designed for concrete poured in large masses, as in dam construction, are manufactured by several companies in Canada. Masonry cement (a generic name) includes such proprietary product names as Mortar Cement, Mortar Mix (unsanded), Mason's Cement, Brick Cement, and Masonry Cement. The latter product, produced by Portland cement manufacturers, is a mixture of Portland cement, finely ground, high-calcium limestone (35%-65% by weight), and a plasticizer. The generic products do not necessarily consist of Portland cement and limestone, but may include mixtures of Portland, hydrated lime, and/or other plasticizers.

OUTLOOK

Shipments of cement in 1994 are expected to increase about 6% to about 10.4 Mt, based on an increase in demand in Canada and continuing strength in exports to the United States. This projection, if realized, will represent a moderate recovery and the highest level of shipments since 1990 when the recession began.

The economy in 1993 expanded about 2.5% (preliminary) in terms of real Gross Domestic Product; the outlook is for an expansion of about 3.1% in 1994. Five-year conventional mortgage rates declined to less than 8% in late 1993; however, housing starts were only 155 000, according to the Canada Mortgage and Housing Corporation. Housing starts were 156 000 in 1991, 168 000 in 1992 and, with some recovery in 1994, are expected to be about 165 000. Considering the forecasts for stronger economic growth in both Canada and the United States, the outlook in the office and industrial building sectors is expected to improve.

Engineering-related construction will benefit from a new two-year, $6 billion cost-shared program for infrastructure renewal. The federal government, which plans to contribute $2 billion over two years, began signing agreements with the provinces (including some municipal governments) in early 1994.

Energy management will continue to concentrate on gains in efficiency based on timely switching among the available choices of common fuels. However, most longer-term cost savings are expected to result from the partial substitution of fossil fuels by waste-derived fuels. For example, in the case of Refuse Derived Fuel (RDF), about 70% (by volume) of municipal solid waste from post-recycled curbside garbage could be used by the cement industry. This would reduce by about two thirds the volume of material for disposal as landfill. Under certain circumstances using RDF, reductions in requirements for traditional fuels, such as coal, have been predicted to be as high as 20%-25%.

The use of supplementary cements incorporating pozzolans or slags, and classified accordingly as various types of blended cements, is expected to become more important in modern concrete practice.

Note: Information in this review was current as of February 1, 1994.

TARIFFS

Item No.	Description	Canada MFN	Canada GPT	Canada USA	United States Canada
25.23	Portland cement, aluminous cement, slag cement, supersulphate cement and similar hydraulic cements, whether or not coloured or in the form of clinker				
2523.10	Cement clinker	Free	Free	Free	Free
	Portland cement:				
2523.21	White cement, whether or not artificially coloured	81.59¢/t	54.25¢/t	Free	Free
2523.29	Other	Free	Free	Free	Free
2523.30	Aluminous cement	Free	Free	Free	Free
2523.90	Other hydraulic cements	Free	Free	Free	Free
68.10	Articles of cement, of concrete or of artificial stone, whether or not reinforced				
	Tiles, flagstones, bricks and similar articles:				
6810.11	Building blocks and bricks	5%	Free	Free	Free
6810.19	Other	8%	Free	Free	Free
6810.20	Pipes	9.8%	6.5%	Free	Free
6810.91	Prefabricated structural components for building or civil engineering	6.8%-8%	Free-4.5%	Free	Free
6810.99	Other	8%	Free	Free	Free

Sources: Customs Tariff, effective January 1994, Revenue Canada, Customs and Excise; Harmonized Tariff Schedule of the United States, 1994.

TABLE 1. CANADA, CEMENT PRODUCTION AND TRADE, 1991-93

Item No.		1991 (tonnes)	1991 ($000)	1992 (tonnes)	1992 ($000)	1993p (tonnes)	1993p ($000)
PRODUCTION[1] (all forms)							
	Ontario	3 760 989	348 646	3 789 125	269 861	4 141 809	301 764
	Quebec	2 267 240	135 840	1 909 264	129 662	2 530 000	146 482
	Alberta	x	x	x	x	x	x
	British Columbia	x	x	1 336 304	119 313	1 460 684	133 418
	Manitoba	x	x	x	x	x	x
	Nova Scotia	x	x	x	x	x	x
	Saskatchewan	x	x	x	x	x	x
	Newfoundland	x	x	x	x	x	x
	Total	9 372 219	810 769	8 598 231	682 422	9 841 562	764 589
IMPORTS						(Jan.-Sept.)	
2523.10	Cement clinker						
	United States	21 236	1 255	2 458	177	3 369	422
	Colombia	76 408	2 400	9 953	321	–	–
	Total	97 644	3 656	12 411	499	3 369	422
2523.21	Portland cement, white, whether or not artificially coloured						
	United States	8 908	1 344	9 875	1 543	7 768	1 268
	Japan	736	108	306	53	367	70
	Belgium	–	–	130	24	–	–
	Total	9 644	1 453	10 311	1 620	8 135	1 338
2523.29	Portland cement, n.e.s.						
	United States	453 745	25 128	500 267	29 313	366 480	23 663
	Japan	–	–	5 689	442	205	24
	France	–	–	–	–	145	17
	Germany	349	40	340	40	–	–
	Other countries	2 751	196	–	–	–	–
	Total	456 845	25 364	506 296	29 796	366 830	23 705

TABLE 1 (cont'd)

Item No.		1991		1992		Jan.-Sept. 1993p	
		(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
IMPORTS (cont'd)							
2523.30	Aluminous cement						
	United States	9 623	4 134	9 714	4 279	8 239	3 658
	France	–	–	–	–	20	3
	South Africa	95	45	37	20	–	–
	Total	9 718	4 179	9 751	4 299	8 259	3 662
2523.90	Hydraulic cement, n.e.s.						
	United States	51 191	5 286	31 376	3 871	22 104	3 054
	United Kingdom	1 704	271	720	143	1 189	95
	France	109	28	142	36	228	58
	Belgium	13	3	136	14	300	29
	Other countries	8	4	44	8	236	11
	Total	53 025	5 592	32 418	4 072	24 057	3 247
6810.11	Building blocks and bricks of cement, concrete or artificial stone						
	United States	. .	3 930	. .	4 110	. .	2 900
	Total	. .	3 930	. .	4 110	. .	2 900
6810.19	Tiles, flagstones and similar articles of cement/concrete or artificial stone						
	United States	. .	5 880	. .	7 390	. .	6 921
	Italy	. .	2 672	. .	1 182	. .	847
	Mexico	–	–	. .	185	. .	295
	Spain	. .	2	. .	82	. .	181
	United Kingdom	. .	104	. .	18	. .	43
	Portugal	. .	135	. .	162	. .	31
	Germany	–	–	. .	10	–	–
	Israel	. .	32	–	–	–	–
	Other countries	. .	100	. .	26	. .	3
	Total	. .	8 925	. .	9 055	. .	8 321
6810.20	Pipes of cement or concrete						
	United States	. .	122	. .	16	. .	18
	Total	. .	122	. .	16	. .	18
6810.91	Prefabricated structural components of buildings, etc., of cement/concrete, etc.						
	United States	. .	3 282	. .	4 853	. .	2 125
	United Kingdom	–	–	. .	112	. .	67
	France	–	–	–	–	. .	7
	Italy	–	–	–	–	. .	3
	Netherlands	. .	4	. .	4	–	–
	Total	. .	3 287	. .	4 969	. .	2 203
6810.99	Articles of cement, of concrete or of artificial stone, n.e.s.						
	United States	. .	5 266	. .	8 205	. .	7 429
	Mexico	. .	197	. .	340	. .	255
	Italy	. .	154	. .	91	. .	123
	United Kingdom	. .	46	. .	92	. .	89
	Belgium	. .	200	. .	94	. .	24
	Spain	. .	10	–	–	. .	21
	People's Republic of China	–	–	. .	29	. .	13
	Other countries	. .	41	. .	11	. .	18
	Total	. .	5 914	. .	8 862	. .	7 972
EXPORTS							
2523.10	Cement clinker						
	United States	544 870	17 487	988 348	34 256	553 437	21 442
	Total	544 870	17 487	988 348	34 256	553 437	21 442
2523.21	Portland cement, white, whether or not artificially coloured						
	United States	112 458	12 815	107 399	13 970	96 074	14 016
	France	–	–	33	3	932	26
	St. Pierre and Miquelon	–	–	38	4	77	9
	Total	112 458	12 815	107 470	13 977	97 083	14 052

TABLE 1 (cont'd)

Item No.		1991		1992		Jan.-Sept. 1993p	
		(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
EXPORTS (cont'd)							
2523.29	Portland cement, n.e.s.						
	United States	2 133 960	109 464	1 845 842	103 119	1 749 139	96 677
	Mexico	–	–	–	–	79 399	2 300
	St. Pierre and Miquelon	88	11	46	4	256	32
	France	990	91	1 566	133	227	26
	Greenland	200	26	300	39	–	–
	Other countries	1 601	188	22	17	10	4
	Total	2 136 839	109 780	1 847 776	103 312	1 829 031	99 039
2523.30	Aluminous cement						
	United States	30	2	10	3	90	3
	Total	30	2	10	3	90	3
2523.90	Hydraulic cement, n.e.s.						
	United States	10 059	1 723	17 890	2 032	6 110	994
	South Korea	49	26	1	. . .	88	39
	Bulgaria	–	–	–	–	22	12
	Belgium	20	4	–	–	20	4
	Other countries	578	122	46	18	18	8
	Total	10 706	1 875	17 937	2 050	6 258	1 057
6810.11	Building blocks and bricks of cement, concrete or artificial stone						
	United States	. .	2 189	. .	3 489	. .	5 235
	Argentina	–	–	–	–	. .	38
	Japan	. .	159	. .	85	–	–
	Other countries	. .	24	. .	6	–	–
	Total	. .	2 372	. .	3 580	. .	5 273
6810.19	Tiles, flagstones and similar articles of cement/concrete or artificial stone						
	United States	. .	3 836	. .	3 227	. .	3 985
	Former Yugoslavia	–	–	–	–	. .	30
	Hong Kong	–	–	. .	19	. .	6
	Total	. .	3 836	. .	3 246	. .	4 021
6810.20	Pipes of cement or concrete						
	United States	. .	110	. .	110	. .	117
	Uganda	. .	130	–	–	–	–
	St. Pierre and Miquelon	. .	17	–	–	–	–
	Total	. .	258	. .	110	. .	117
6810.91	Prefabricated structural components of buildings, etc., of cement/concrete, etc.						
	United States	. .	37 287	. .	21 915	. .	24 584
	Hungary	–	–	–	–	. .	154
	Japan	–	–	. .	4	. .	107
	People's Republic of China	–	–	–	–	. .	52
	Taiwan	–	–	. .	59	. .	38
	United Kingdom	. .	8 061	. .	1 082	. .	36
	Other countries	. .	199	. .	775	. .	21
	Total	. .	45 547	. .	23 835	. .	24 992
6810.99	Articles of cement, of concrete or of artificial stone, n.e.s.						
	United States	. .	9 451	. .	8 775	. .	9 569
	Taiwan	–	19	–	–	. .	37
	Japan	–	–	–	–	. .	1
	Germany	. .	16	–	–	–	–
	Netherlands	. .	4	–	–	–	–
	Sweden	. .	3	–	–	–	–
	Other countries	–	–	. .	16	–	–
	Total	. .	9 494	. .	8 791	. .	9 608

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available; . . . Amount too small to be expressed; n.e.s. Not elsewhere specified; p Preliminary; r Revised; x Confidential.
1 Producers' shipments plus quantities used by producers.
Note: Numbers may not add to totals due to rounding.

TABLE 2. CEMENT PLANTS, APPROXIMATE ANNUAL GRINDING CAPACITY, END OF 1992

Company	Plant	Wet (W) Dry (D) Preheater (x) Precalciner (c)	Fuel (Coal, Oil, Gas, Waste)	No. of Kilns	Grinding Capacity	Clinker Capacity
					(000 t/y)	
ATLANTIC REGION						
Lafarge Canada Inc.	Brookfield, N.S.	D	C,Wa	2	600	515[a]
North Star Cement Limited	Corner Brook, Nfld.	Dx	O,Wa	1	245	152
Subtotal, Atlantic region				3	845	667
QUEBEC						
Lafarge Canada Inc.	Montréal East		–		328	–
Lafarge Canada Inc.	St. Constant	D	C,O,G,Wa	2	1 000	991
Ciment Québec Inc.	St. Basile	W,Dc	O,G,C	3	940	1 074[b]
St. Lawrence Cement Inc.	Beauport	W	C, Wa	2	700	611
(Independent Cement Inc.)	Joliette	D	C,O	4	1 200	1 038[a]
Subtotal, Quebec region				11	4 168	3 714
ONTARIO						
Lafarge Canada Inc.	Woodstock	W	C,G	2	570	563
	Bath	Dx	C,G	1	1 000	1 045
Federal White Cement Ltd.	Woodstock	D	C,O,G	1	150	151
Lake Ontario Cement Limited	Picton	D,Dx	C,G	2	927	1 124
St. Lawrence Cement Inc.	Mississauga	W,Dc	C,Wa	3	1 600	1 876[b]
St. Marys Cement Company	Bowmanville	Dc	C	1	1 300	1 550
	St. Marys	Dx	C,G	1	735	645
Subtotal, Ontario region				11	6 282	6 954
PRAIRIES REGION						
Lafarge Canada Inc.	Fort Whyte, Man.		–	–	474	–
	Exshaw, Alta.	D,Dc	G	2	900	1 029
Inland Cement Limited	Winnipeg, Man.	W	G	1	430	inactive
(S.A. Cimenteries CBR)	Regina, Sask.	D	G,O	1	400	inactive
	Edmonton, Alta.	Dc	G	1	1 500	726
Subtotal, Prairies region				5	3 704	1 755
BRITISH COLUMBIA						
Lafarge Canada Inc.	Kamloops	D	C,G	1	300	194
	Richmond	W	C,G	2	515	474
Tilbury Cement Limited (S.A. Cimenteries CBR)	Delta	Dx	C,G	1	980	1 052
Subtotal, B.C. region				4	1 795	1 720
Total Canada (9 companies)				34	16 794	14 810

Source: Market and Economic Research Department, Portland Cement Association.
– Nil.
[a] One kiln inactive. [b] Two kilns inactive.
Note: Total active kiln capacity is approximately 13.4 Mt/y.

TABLE 3. CANADA, CEMENT PLANTS, KILNS AND CAPACITY UTILIZATION, 1979-93

	Clinker-Producing Plants	Kilns	Approximate Cement Grinding Capacity[1]	Portland and Masonry Cement Production[2]	Clinker Exports	Approximate Total Production[3]	Capacity Utilization
			(t/y)	(t)	(t)	(t)	(%)
1979	24	51	15 985 000	11 765 248	1 530 537	13 295 785	83
1980	23	47	16 363 000	10 274 000	726 087	11 000 087	67
1981	23	48	16 771 000	10 145 000	524 006	10 669 006	64
1982	23	48	16 771 000	8 418 000	290 329	8 708 329	50
1983	23	49	17 900 000	7 870 878	404 793	8 275 671	46
1984	23	49	17 900 000	9 387 466	440 297	9 827 763	55
1985	23	49	17 900 000	10 192 442	676 596	10 869 038	61
1986	23	49	17 900 000	10 611 223	324 000	10 935 223	61
1987	20	40	16 600 000	12 603 164	767 338	13 370 502	81
1988	20	40	15 506 000	12 349 873	331 796	12 681 669	82
1989	20	38	15 546 000	12 590 637	178 491	12 769 128	82
1990	20	38	16 439 000	11 745 152	460 075	12 205 227	74
1991	20	34	16 262 000	9 372 219	544 870	9 917 089	61
1992	18	34[a]	16 800 000	8 598 231	988 348	9 586 579	57
1993[p]	18	34[a]	16 800 000	9 841 562	882 935	10 724 497	64

Sources: Statistics Canada; U.S. Bureau of Mines; Portland Cement Association (PCA).
[p] Preliminary.
[a] Includes eight kilns that are inactive.
[1] Includes plants that grind only. [2] Producers' shipments and amounts used by producers. [3] Cement shipments plus clinker exports.

TABLE 4. CANADA, HOUSE CONSTRUCTION, BY PROVINCE, 1992 AND 1993

	Starts			Completions			Under Construction		
	1992	1993	% Diff.	1992	1993	% Diff.	1992	1993	% Diff.
Newfoundland	2 271	2 405		2 556	2 457		2 464	2 378	
Prince Edward Island	644	645		595	674		326	296	
Nova Scotia	4 673	4 282		5 485	4 545		2 751	2 298	
New Brunswick	3 310	3 693		3 051	3 631		1 599	1 676	
Subtotal, Atlantic provinces	10 898	11 025	+1	11 687	11 307	–3	7 140	6 648	–7
Quebec	38 228	34 015	–11	42 323	34 859	–18	11 033	9 811	–11
Ontario	55 772	45 140	–19	63 134	51 130	–19	31 653	25 047	–21
Manitoba	2 310	2 425		2 190	2 572		1 136	1 002	
Saskatchewan	1 869	1 880		1 554	2 020		871	710	
Alberta	18 573	18 151		16 307	17 859		7 536	7 595	
Subtotal, Prairie provinces	22 752	22 456	–1	20 051	22 451	+12	9 543	9 307	–2
British Columbia	40 621	42 807	+5	36 050	42 047	+16	28 149	28 998	+3
Total Canada	168 271	155 443	–8	173 245	161 794	–7	87 518	79 761	–9

Source: Canada Mortgage and Housing Corporation.

TABLE 5. CANADA, VALUE OF CONSTRUCTION BY PROVINCE,[1] 1991-93

	1991			1992			1993		
	Building Construction[2]	Engineering Construction[2]	Total	Building Construction[2]	Engineering Construction[2]	Total	Building Construction[2]	Engineering Construction[2]	Total
					($ millions)				
Newfoundland	906	871	1 777	824	1 048	1 873	836	1 438	2 275
Nova Scotia	1 544	955	2 499	1 460	696	2 157	1 526	602	2 129
New Brunswick	1 150	837	1 987	1 160	1 057	2 217	1 120	712	1 832
Prince Edward Island	257	99	356	242	106	348	227	98	326
Quebec	14 032	6 369	20 401	13 106	7 027	20 133	13 261	7 323	20 584
Ontario	24 980	8 978	33 958	23 132	8 941	32 074	23 473	9 502	32 974
Manitoba	1 500	1 226	2 725	1 517	1 200	2 717	1 578	1 135	2 713
Saskatchewan	1 269	2 254	3 523	1 306	1 754	3 060	1 286	1 449	2 735
Alberta	5 577	7 170	12 747	6 204	5 995	12 199	6 030	6 348	12 378
British Columbia, Yukon and Northwest Territories	9 684	4 497	14 182	10 995	4 088	15 083	11 978	4 488	16 465
Total Canada	60 901	33 254	94 155	59 948	31 913	91 861	61 315	33 096	94 411

Sources: Natural Resources Canada; Statistics Canada.
[1] Actual expenditures 1991, preliminary 1992, intentions 1993. [2] Includes total value of new and repair work purchased.
Note: Numbers may not add to totals due to rounding.

TABLE 6. CANADA, VALUE OF CONSTRUCTION BY TYPE,[1] 1991-93

	1991	1992	1993
		($ millions)	
BUILDING CONSTRUCTION[2]			
Residential	34 768	37 315	38 432
Industrial	3 642	2 777	2 594
Commercial	13 436	11 185	11 146
Institutional	5 845	5 964	6 205
Other building	3 210	2 707	2 937
Subtotal	60 901	59 948	61 315
ENGINEERING CONSTRUCTION[2]			
Marine	553	556	576
Highways, airport runways	6 334	6 374	6 800
Waterworks, sewage systems	2 660	2 701	3 026
Dams, irrigation	399	306	334
Electric power	6 859	7 867	7 645
Railway, telephones	3 135	3 053	3 070
Gas and oil facilities	9 629	7 790	8 081
Other engineering	3 686	3 267	3 565
Subtotal	33 254	31 913	33 096
Total construction	94 154	91 861	94 411

Sources: Natural Resources; Statistics Canada.
[1] Actual expenditures 1991, preliminary 1992, intentions 1993. [2] Includes total value of new and repair work purchased.
Note: Numbers may not add to totals due to rounding.

TABLE 7. WORLD PRODUCTION OF CEMENT, 1992 AND 1993

	1992	1993[e]
	(000 tonnes)	
People's Republic of China	304 000	304 000
Former Soviet Union	127 005	130 000
Japan	90 700	91 000
United States	72 620	73 500
India	50 000	54 000
Italy	41 347	42 000
Korea, Republic of	42 637	45 000
Germany	37 503	38 000
Brazil	28 100	28 000
France	21 600	19 000
Canada	8 598	9 800
Other	431 003	432 900
Total world	1 255 113	1 267 200

Sources: Natural Resources Canada; U.S. Bureau of Mines' Mineral Commodity Summaries, January 1994.
[e] Estimated.

Chromium

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SUMMARY

In 1993, the world chromium industry was further rationalized through retrenchments and closures of production capacity in both its ore and alloy segments. World production of chromium ore fell by more than 24% to about 8.53 Mt, while ferrochromium production, excluding Russia, is estimated at 3.06 Mt, down 9.6% from 1992. Production in South Africa, the world's largest producer of chromium ore and alloys, was down to roughly 50% of capacity, while exports of chromium ore and alloys from Kazakhstan and Russia continued, mostly unabated.

Despite a vigorous performance by the world stainless steel industry, which accounts for 80% of ferrochromium usage, demand for chromium-based products was soft during the year. This is due in part to an increase in 1992 and early 1993 in the replacement of primary chromium as feed in the stainless steel industry by chromium units contained in stainless steel scrap.

In general, prices in 1993 remained fairly stable and appeared to have reached the bottom of the trough, if variations caused by supply disturbances on the spot market are discounted. Chromium ore contract prices on the North American market remained the same throughout the year; however, there were some price movements on the European market. Ferrochromium contract list prices, after falling by US1¢/lb compared to 1992, stayed at US47¢/lb all year; however, net prices to large customers were discounted by up to US5¢/lb. Spot market prices bottomed out and then inched up, narrowing the spread between Russian and South African-origin material from US10¢/lb to 5¢/lb.

The fundamentals are in place for strong sustained growth in stainless steel demand into the late 1990s with the newly industrialized countries carrying most of this growth. Supplies of chromium products in the short and medium term are expected to remain in a delicate balance with demand; however, developments in C.I.S. countries will probably dictate the levels of operation in the rest of the world. Major price improvements are unlikely to happen until mid-1995 when the European and Japanese economies have fully emerged from the recession and a significant increase in demand materializes.

USES

While many minerals contain chromium, chromite is the only commercial ore mineral. The theoretical formula for chromite is $FeCr_2O_4$, although it usually contains several other elements and is represented by the general formula (FeMn)O $(CrAlFe)_2O_3$. Traditionally, chromium ores have been classified as metallurgical, chemical and refractory grades, according to the expected industrial end uses. However, recent technological advances have allowed some degree of interchange in the usage of these three product categories so that the classification has become less meaningful. Current nomenclature is based upon chromite composition in addition to end use. High-chromium ores, defined by high chromium-to-iron ratios, are used for making ferrochromium for metallurgical applications. High-iron chromites, previously limited almost entirely to the production of chromium-based chemicals, are now finding growing usage in the production of low-quality ferrochromium, refractories and foundry sands. High-aluminum chromites with relatively low iron and silica have application mainly for refractory purposes, primarily in the manufacture of magnesite-chromite and chromite-magnesite bricks.

The principal use of chromium ferroalloys is in the production of stainless and specialty steels, such as heat-resistant and tool steels. Most applications of stainless and heat-resistant steels or refractory metals are in corrosive environments, such as petrochemical processing; in high-temperature environments, such as turbines and furnace parts; and in consumer goods, such as concluded the feasibility study of the project, includes the construction of the plant, the training of personnel, and the operation of the plant until full capacity is achieved in exchange for a lump sum of $32 million.

In September 1993, Coleraine received a letter of intent from MG Ores and Alloys Corp. (MG) of New York, a subsidiary of Metallgesellshaft AG of Germany, stipulating MG's interest to develop the ferrochromium project. Upon completion of a due diligence process, the finalized agreement would include the financing of the project, the construction and operation of the plant, and exclusive marketing of the products. However, before MG could complete the technical revision of the project, the company ran into serious financial problems following investments it made on the oil futures market. Near the end of December 1993, MG Ores and Alloys announced it was pulling out of the project. Shortly after the MG decision was released, Coleraine announced it was reactivating the contacts made before the MG agreement and giving itself two to three months to restructure financing for the project.

Canchrome Mines Inc. has, in recent years, been studying the Reed-Bélanger and Sterret deposits but was not active on the properties in 1993. In 1992, the company carried out additional diamond drilling on the Reed-Bélanger property, located near the town of Black Lake, to boost and better delineate reserves. It also proceeded with metallurgical tests to rate the quality of the deposit material.

As a result of this work, reserves in all categories at Reed-Bélanger are now estimated at 6.2 Mt grading 7.16% Cr_2O_3, which include proven and probable reserves of 5.0 Mt grading 7.35% Cr_2O_3. Results from the metallurgical tests confirmed that the ore has the qualities needed for applications in the metallurgical industry; the chromium-to-iron ratio of the chromite was defined as 3:1. As for the Sterret property, located 145 km east of Montréal near the town of Asbestos, reported reserves are still 150 000 t grading 25%-30% Cr_2O_3.

Quebec junior mining company Pro-Or Inc. reported exploration results from a recent diamond drilling program carried out on a chromite showing located on its James Bay area property. Using drill intervals of 50 m, the company outlined geological reserves of 2.7 Mt grading 8.2% Cr_2O_3 up to a depth of 150 m.

Joint-venture partners Canchrome Mines Inc. and International Corona Corp. mentioned that no additional work to assess its heavy minerals sand deposit at Port au Port Bay near Stephenville, Newfoundland, would be considered until market prices appreciate substantially.

In other developments, following a key provision of the *Canadian Environmental Protection Act* (CEPA), the Canadian government pursued its assessment of chromium as a potentially toxic substance. Under the CEPA, a substance is considered toxic if it has the ability to cause adverse effects to different organisms and if it is, or may be, present in the Canadian environment in concentrations sufficient to pose a risk to the environment or to human health.

On February 5, 1994, the federal departments of the Environment and Health announced that chromium was deemed toxic under the CEPA. Specifically, their conclusions were that hexavalent chromium (Chromium VI) compounds were deemed toxic while information was insufficient to conclude that trivalent forms of chromium (Chromium III) are toxic under the CEPA.

As a result of these findings, chromium may be placed on Schedule I of the act and considered for possible development of regulations, guidelines, or codes of practice to control any aspect of its life cycle, from chromite mining activities to the manufacturing of secondary products, and the use, storage, transport and ultimate disposal of all materials containing chromium.

WORLD DEVELOPMENTS

Based on six-month figures published by the International Chromium Development Association (ICDA), the world's production of chromium ore is expected to reach 8.53 Mt in 1993, down 24.2% compared to 1992 and 37.8% from 1991. The fall in production results from the retrenchment and temporary, or in some cases permanent, closure of mining operations around the world brought about by a reduction in consumption by ferrochromium producers.

Production of ferrochromium in 1993, from the ICDA's six-month figures, which do not include production from Russia, is forecast at 3.06 Mt, a reduction of 9.6% compared to 1992. As a sign of recent changes, the world production of ferrochromium (Russia not included) peaked in 1989 at 3.7 Mt. As with chromium ore, the reduction in ferrochromium production in recent years resulted from declining demand from the steel producers brought on by the contraction of world economies and the replacement of ferrochromium by stainless steel scrap from the C.I.S. for chromium units.

Finally, the production of chromium metal in 1993 is expected to be slightly less than in 1992 because of the temporary shut-down of a plant in China.

South Africa

South Africa's chromium industry is dominated by two major companies, Samancor Ltd. (Samancor), owned principally by the Gencor Group and Anglo American of South Africa, and Consolidated Metallurgical Industries (CMI), controlled by the Johannesburg Consolidated Investment Co. Ltd. (JCI) in which Anglo American has an interest.

Following the purchase in 1991 of Middleburg Steel and Alloys, owners of the number two ore producer in South Africa (Rand Mines Ltd.), Samancor increased its chromium ore production capacity to about 4.3 Mt/y, which equates to 72% of the country's capacity. Samancor is also the country's largest ferrochromium producer with a capacity to manufacture over 1 Mt/y. In 1993, Samancor's mining operations located in the Western Transvaal and in the Steelpoort Valley of the Eastern Transvaal produced at about 50% of capacity. Likewise for ferrochromium, Samancor decided to scale its production down to about 500 000 t and only operate six of its twenty furnaces. These retrenchments forced the company to curtail its personnel by 16% to bring its workforce down to 11 000 employees.

CMI, the second largest producer of ferrochromium in South Africa and a significant producer of chromium ore, reported in June 1993 that its ferrochromium operations were running at less than 50% of capacity and that the retrenchment had forced a 20% cut in staff. Its output of ferrochromium is expected to be 30% lower than in 1992. Chromecorp Technology, the third largest ferrochromium producer, also reported similar production cutbacks, while Ferralloys Ltd., the country's fourth largest producer, has been idle since late 1992.

On a more positive note, South Africa's Columbus Joint Venture (CJV), the stainless steel expansion project equally owned by Samancor, Highveld Steel & Vanadium, and the state-owned Industrial Development Corp., was inaugurated on January 1, 1993. This project entails the four-fold capacity expansion of the Southern Cross Stainless plant, located in the Middleburg district in Eastern Transvaal, to a production capacity of 500 000 t/y of stainless steel. This will catapult South Africa as the world's sixth largest producer of stainless steel, and the plant as the world's largest single-site producer. The construction, scheduled for completion in 1995, will bring 450 000 t of stainless steel onto the international market as 90% of the plant's production is slated for export.

In other developments, aside from the Nippon Denko-Samancor ferrochromium deal and the Tosoh-Samancor chromium metal project discussed later in the section on Japan, other South African projects were being looked at in 1993. These included the Goudini ferrochromium project near Marico, the Swiss Chrome project near Brits, which envisages the construction of a 130 000-t capacity ferrochromium plant, CMI's ore production project at Thorncliffe, and Pilanesburg Chrome's development of ore deposits in the Pilanesburg area.

Kazakhstan

Kazakhstan, the former U.S.S.R.'s main producer of chromium ore, operates three open-pit mines and one underground mine. In 1993, Donskoy Chrome Ore Mine & Dressing Combine, which controls the country's production of chromium ore, is reported to have produced 2.79 Mt of ore, based on production figures published by the Interfax News Agency, a drop of about 22.3% compared to 1992. Exports of ore outside the C.I.S. are forecast at under 500 000 t, 38% less than in 1992.

The country's 1993 ferrochromium production, manufactured at the Yermak and Aktyubinsk ferroalloy plants, is estimated at 320 000 t, down 15% compared to 1992. Exports of ferrochromium are expected to reach 60% of output, up from about 50% in 1992.

The lower production of chromium ore and ferrochromium in 1993 is due to lower demand in the C.I.S. and in the export market, but it is also due to difficulties in maintaining the level of production and political problems at Donskoy. Higher energy prices and shortages of metallurgical coal, which is imported from Russia, are affecting the industry. By the end of 1993, the main producer, Aktyubinsk, was reportedly running only one of its three plants and producing only high-carbon ferrochromium.

In 1994, Donskoy aims to raise exports of chromium ore to 1.2 Mt out of a production of 3.8 Mt. New production is planned from the Tsentralnaya mine, now being built, which will increase the output of chromium ore to 4.0 Mt by the year 2000. Concerning the production of ferrochromium, four projects will impact on the country's output in the short-to-medium term. First, in part because of anti-dumping duties put on exports of ferrosilicium from the C.I.S., the Yermak ferroalloy plant started converting six of its ferrosilicium furnaces to produce ferrochromium. Over a three- to four-year period, production will increase from its current 230 000 t/y to 700 000 t/y. This will affect Donskoy's exports of ore in the medium term since supplies to Yermak have priority over ore exports to favour higher added-value exports. Second, the Aktyubinsk Ferroalloy Works and the Donskoy Combine will build a 125-MW power plant in Aktyubinsk to supply their needs in electricity to end their present dependence on power imported from Russia at increasing prices. The power plant will be fuelled by domestic natural gas and will reduce the cost of power by half.

The third and fourth projects developed by the Kazamchrome joint venture consist of a briquetting plant and a pelletizing plant. Joint-venture partners, Donskoy and U.S. trader AIOC Corp., who bought the Swedish trader Axel Johnson in 1993, are involved in the construction of a 200 000-t/y briquetting plant for chromium ore fines, expected to come on stream in June 1994. Vargon, a Swedish ferrochromium producer and future main customer of the new plant, is the technical advisor for the project. The pellet plant, also set up to increase the quality and range of products, will have a 700 000-t/y capacity and come on stream in 1995.

Russia

For reasons similar to Kazakhstan, Russia's chromium ore and ferrochromium production decreased in 1993 compared to 1992. Preliminary figures published by the Interfax News Agency puts the 1993 Russian chromium ore production at 118 300 t, down 2.55% from 1992, while the ferrochromium output can be forecast (using various sources) at 420 000 t or 70% of capacity, down 14% compared to 1992.

Developments in 1993 include the start of privatization in June of Russia's sole chromium ore producer, the Saranovskaya mine. With respect to the ferrochromium industry, increased Russian exports to Europe and Asia prompted Germany's Elektrowerk Weisweiler, the European Community's sole low-carbon ferrochromium producer, to ask that anti-dumping duties be put on imports of that material from the C.I.S. The decision to apply provisional duties from April 1993 resulted in Chelyabinsk Electrometallurgical Works, Russia's main producer of ferrochromium, to invest to switch its production from low- to high-carbon ferrochromium.

Also, the Serov ferrochromium plant is planning on building a 300 000-t/y briquetting plant which could briquette fines for use in the production of high-carbon ferrochromium. Presently, Serov has 18 furnaces for a total capacity of 400 000 t.

Zimbabwe

The Zimbabwe government, which has monopolized mineral marketing for the past decade, has now granted a local company, Midlands Distributors, based in Kwekwe, permission to export chromium ore. Previously known as Rhodesia, Zimbabwe was a major supplier of high-grade chromium ore to Japan until sanctions against the country were introduced in 1968. In recent years, Zimbabwe has been exporting small quantities of ore to China and Czechoslovakia and most of the ferrochromium it produces, about 5% of world production. Now plans are to export about 100 000 t/y of high-grade ore through the port of Maputo in Mozambique.

In other developments, Zimbabwe's ferrochromium industry has been hit by the combined effect of undisciplined sales from the C.I.S., a reduced world demand for ferrochromium, and a 112% hike in domestic power tariffs. Anglo-American Corp.-owned Zimbabwe Alloys, the country's sole producer of low-carbon ferrochromium, closed a furnace and retrenched over 300 employees in July 1993. The company is looking for new technology to ensure its medium- and long-term survival. Zimbabwe's other producer, Union Carbide Corp.-owned Zimasco, which has a production capacity of 180 000 t of high-carbon ferrochromium, was forced to shut its operations between December 1992 and February 1993 and leave 1250 workers idle. It then re-opened, but at 50% of capacity.

India

In India, the Tata Iron and Steel Co. Ltd. (Tisco) recently commissioned a lump chromium ore-processing plant at its Sukinda Chromite mines located in the district of Orissa, India. The facility has a production capacity of 200 000 t/y of low-grade hard lumpy chromium ore. The fines reject from this new unit will be used as extra feed material for the existing beneficiation plant, which produces chromium concentrates. A second project, that of Orissa Mining Corp. (OMC), set to start operating in 1993, has been delayed by power shortages. Located at Kaliapani in the Cuttack district, the plant will beneficiate low-grade ore containing 33% Cr_2O_3 to a 51%-52% Cr_2O_3 content for sand concentrates and to 55% Cr_2O_3 for fines. The additional output from both projects is slated mostly for the export market. Tisco is also exploring the possibility of sending its chromium ore to the Gulf where steel majors in Saudi Arabia and the United Arab Emirates would convert it to ferrochromium. China, a significant and growing importer, is also a country where India is well positioned to sell.

In the ferroalloy industry, however, India's plans to export 200 000 t of charge and ferrochromium have floundered and may only reach 110 000 t because of falling prices on the world market. The continuing recession in the steel industry and increasing electricity rates are forcing companies to cut back output or face shut-downs to help clear accumulated stocks.

Finally, an Indian ferroalloy and metal trading company, Mobar India (Mobar), was set up during the summer of 1993 to "properly represent Indian business interests overseas and present the world to India." Mobar owners, which include ROE, a German group, Indian industrialist B.J. Bajoria, and former executives of Tisco, plan to recreate with C.I.S. republics the business that was lost with the break-up of the former Soviet Union.

Turkey

Turkey, one of the world's four major chromium ore producers, has curtailed its production significantly because of increased export from C.I.S. republics. Turkey's exports, which recently were in the 500 000-800 000-t/y range, are not expected to exceed 100 000 t in 1993. To stave off the crisis, the government decided to support the chromium producers by offering them low interest credit with extended payback periods. Meanwhile, the country's sole ferrochromium producer, state-owned Etibank, closed a low-carbon ferrochromium plant for repairs in October only to re-open it in the first quarter of 1994.

Albania

Working its way towards a market economy, Albania is planning on tripling its production of ferrochromium by privatizing its state-owned chromium industry and involving foreign investors. The aim behind this is to expand the more value-added ferrochromium production to earn more income from the country's resources.

Albchrome, the state body that controls the country's producing and exporting industry, operates nine mines which are expected to produce some 200 000 t of chromite ore grading 30%-42% Cr_2O_3 and 90 000 t of chromite concentrate in 1993. It also operates two ferrochromium plants, the Burel and Elbasan, each equipped with three 9-MW furnaces for a total capacity of 75 000 t. However, only 30 000 t of ferrochromium is forecast to be produced in 1993 due to the closure of three of the plants because of a lack of spare parts.

Because of the difficult political and economic situation in Albania, and the depressed state of the world's ferrochromium industry, progress on the privatization is expected to be slow. However, the European Bank for Reconstruction and Development (EBRD), which is advising Albania, has already indicated that it could finance more than 35% of any investment project.

Japan

In 1993, as a result of the appreciation of the yen on international markets, high domestic energy costs and the fall in prices for ferrochromium, Japan's chromium industry suffered a number of retrenchments signalling the start of a downsizing of its production capacity of chromium metal and ferrochromium.

Tosoh Corp. announced in 1993 that it will close its 3600-t/y electrolytic chromium metal plant located in Yamataga, Japan, in early 1995 to make way for the city's urban development program. A project to build a new production facility in South Africa, through a joint venture between Tosoh and Samancor Ltd., was cancelled when the feasibility study outlined it would not be economically viable under present market conditions. This development could have a severe impact on the market since the world's production of chromium metal is only about 15 000 t. Increased exports from Russia's Tula electrolytic chromium metal plant may help replace part of the lost production.

In the ferrochromium sector, Japan's 1993 production is not expected to exceed 205 000 t, a reduction of 25% from 1992, with producers reducing their output through temporary shut-downs. NKK closed its Toyama plant for about one month in July to reduce its 54 000-t production by about 10%. Japan Chemicals & Metals also reduced its 80 000-t production by about 20% by closing its Kyushu plant for two months between July 20 and September 20, while Nippon Denko temporarily idled the 62 000-t Hokuriku plant to reduce its output by 15%-30%. However, a joint-venture agreement approved in October between Nippon Denko and Samancor Ltd. whereby a new company, NST Ferrochrome, owned 50-50 by the partners, will buy the 60 000-t capacity No. 5 furnace at Samancor's Tubatse plant in South Africa, should result in keeping the Hokuriku plant permanently closed. Finally, Japan's Pacific Metals Co.'s 30 000-t capacity Hachinohe plant was shut down in May 1993 for an extended period. A news item at the end of August still reported it closed.

Because of increased demand in China, Japan's stainless steel industry has not been as affected as its ferrochromium industry since production in 1993 is about level with 1992 at around 2.63 Mt. As a result of the important hike in the production costs of domestic producers of ferrochromium, Japanese stainless steel producers in 1993 were sourcing more of their ferrochromium supplies on the spot market, seeking ways to cut costs by buying Russian or Chinese material.

China

The People's Republic of China, considered the world's largest consumer of high-grade chromium ore, depends entirely on imports for its requirements. In the first nine months of 1993 it imported 460 000 t of ore, mostly from India, the C.I.S. and Iran, down 23% from the same period last year. China's consumption of chromium ore is estimated at 500 000 t/y; however, it is mostly used for toll smelting of chromium alloys with 80% (about 240 000 t) earmarked for exports to Japan and other Asian countries. The other 20% is used to produce approximately one third of China's need for stainless steel, about 200 000 t; the rest is imported.

Production of chromium metal in China was affected in 1993 by power shortages. The Jing Zhou plant, northern China's biggest producer at 1000 t/y plus, was initially shut for repairs and refurbishment in March, but news in May still reported its operations stopped.

Finally, the easing of restrictions on the participation of foreign investors in China, especially in the metals industry, permitted the set-up of a new Far East trading company named Asia Minerals Ltd. This company, an 80-20 joint venture between Hirotaka Suzuki of Itochu of Hong Kong and China's Emei Ferroalloy Works located in Sichuan Sheng, will supply imported ore to the plant and sell part of the plant's alloy production slated for the export market.

Philippines

Because of electric power restrictions throughout 1993, the ferrochromium production of the Philippines' Mindanao Island-based industry was only a fraction of its 80 000-t capacity. Reduced rainfall since 1991 forced the government in recent years to increase the use of higher-cost fuel-powered generators to make up for the loss in hydro-electricity. The resulting increase in the cost of power announced in July, coupled with the fierce competition on the international market, has made survival very difficult for the Philippines' ferroalloy industry. By the end of the summer, most of the plants were either shut down or operating at a reduced level. However, after good rains in September, most companies were planning to resume their operations before the end of 1993 or early in 1994, but only to meet minimum sales.

A joint-venture agreement between the Philippines and China was approved for the exploration of chromite deposits located in the Surigao del Norte Province on southern Mindanao Island. The Mauban Mining & Development Corp., owned 60% by the Philippines and 40% by China, plans on opening a mine with a capacity of about 43 000 t/y of chromite ore and 18 000 t/y of chromite concentrate.

United States

The sole ferrochromium producer in the United States, Macalloy Corp., still has one year remaining on its 10-year contract with the Defense Logistics Agency (DLA) to upgrade chromite ore to generate over 527 500 t of high-carbon ferrochromium for the U.S. stockpile. In 1994, it will produce 3200 t of ferrochromium in addition to completing the 1993 agreement to produce 63 000 t. After completion of the contract, Macalloy intends to stay in production by sourcing ore internationally and competing in the market. Macalloy's Charleston, South Carolina plant is equipped with two 45-KVA furnaces for a capacity of 90 000 t/y.

In fiscal year 1993 (i.e., from October 1, 1992 to September 31, 1993), the DLA sold 9000 t of metallurgical-grade chromite ore and just under 57 000 t of high-carbon ferrochromium to Macalloy as payment in kind. In fiscal year 1994, the DLA has authority to dispose of 45 000 t of chemical-grade, 90 000 t of refractory-grade, and 220 000 t of metallurgical-grade chromite ore. However, by the end of September 1993, only 8000 t of metallurgical-grade was left for sale, the rest having already been sold to Macalloy and Metal Refining Co. In a last development, the U.S. House of Representatives approved a bill in October 1993 that will result in the upgrade of chromium ore to generate at least 720 t of electrolytic chromium metal, to be added to the stockpile in each of fiscal years 1994, 1995 and 1996.

Brazil

Companhia de Ferro Ligas de Bahia (Ferbasa), Brazil's only ferrochromium producer, based in the northeastern state of Salvador, is expected to produce at the same level as in 1992, i.e., about 85 000 t of high-carbon ferrochromium and 6750 t of low-carbon ferrochromium. The imposition of anti-dumping duties (in February 1993, 13.6% on high-carbon ferrochromium from South Africa, and in September, 18.97% on low-carbon ferrochromium from C.I.S. republics) is surely a factor that helped Ferbasa in 1993. About 80% of Ferbasa's production of high-carbon ferrochromium and all of its low-carbon ferrochromium is destined for the domestic market.

Slovakia

Oravia Ferroalloys Works (Oravia), the sole producer of bulk ferroalloy in the Slovakian Republic, signed a marketing deal with Sumitomo Corporation, a Japanese trading house, for the sale of ferrochromium in Japan and the United States. The deal follows an earlier announcement by the Slovak company that it was increasing its ratio of exports to Western market to more than 40% to offset shrinking domestic demand. Oravia, a former state-owned enterprise privatized in 1992, has two plants, only one of which produces ferrochromium. Located near the border with Poland, the Istebne plant produces an average total of over 40 000 t/y of low- and high-carbon ferrochromium.

MARKETS

In 1993, the chromium market was somewhat unstable in response to supply disturbances. Since 1992, adding to the already oversupplied market, exports from Kazakhstan and Russia entering the spot market at distress prices have triggered the further downfall of the market. However, on the consumption side, despite the recession affecting European and Japanese economies and slow recoveries in Canada and the United States, the global stainless steel industry's production reached a record level of 11.66 Mt, posting a growth of 5% compared to 1992, which helped balance the chromium industry.

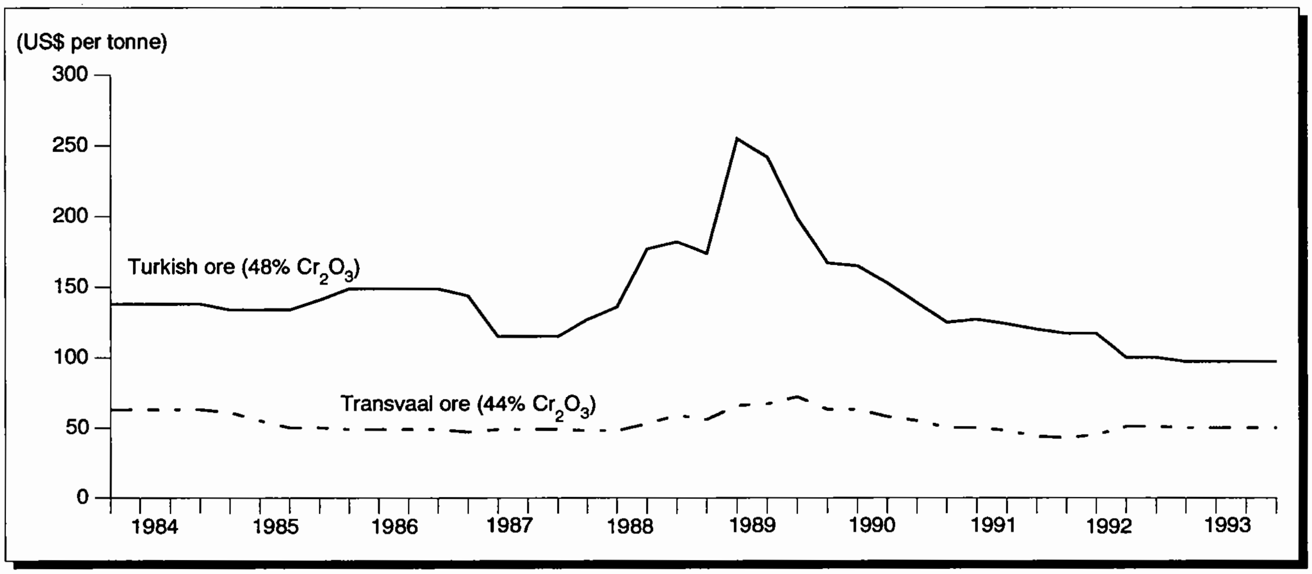
Despite sales of material originating from Kazakhstan, which mostly affected the European Community (EC) and parts of Asia, prices for chromium ore of Transvaal or Turkish origin, which had fallen in the past three years, remained stable throughout the year on the North American market at price levels reached in mid-1992. However, there was some price movement on the European market when, in the second quarter, Transvaal ore increased from US$55-65/t to US$63-67/t, while Turkish material, starting the year in the US$160-180/t range, decreased to US$100-105/t because of greater availability of material. This stability was achieved through major retrenchments from traditional export-oriented producers (see price table and Figure 1).

Concerning ferrochromium prices on the North American market, spot charge chromium 60%-65% "imported," started the year just off its historic price low of US33.5-34.5¢/lb reached in December 1992, increased on good demand throughout the year to US38.0-38.5¢/lb, but started to collapse in early December, for no basic reason, to close the year at US35.0-36.0¢/lb. On the European market, prices firmed up in the first half of the year, then bottomed out in November at US34.0-36.0¢/lb only to regain ground and finish the year at US37.0-39.0¢/lb. Finally, charge chromium prices on the Japanese spot market decreased all year with both China and the C.I.S. competing for the market. From a high of around US38.0-39.0¢/lb in the first and second quarters, prices closed at a low of US35.5-36.0¢/lb in December but were firming in early January 1994. Contract list prices, on the other hand, remained stable throughout the year after a US1¢/lb drop from 1992, with Samancor at US47¢/lb c.i.f. However, the net price (the price offered to major customers) was said to be around US42¢/lb and decreasing at the end of the year (see price table and Figures 2 and 3).

As for low-carbon ferrochromium prices, except for a firming during the spring possibly as a result of anti-dumping duties put on C.I.S. imports into the EC, they gradually decreased throughout the year, starting at US71.5-74.0¢/lb in January, to bottom out in November at an historic low of US62.0-66.0¢/lb. However, before the end of the year, possibly because of the decision of Turkish producer Etibank to exit the market temporarily, prices were on the rise again, closing at US71.0-73.0¢/lb.

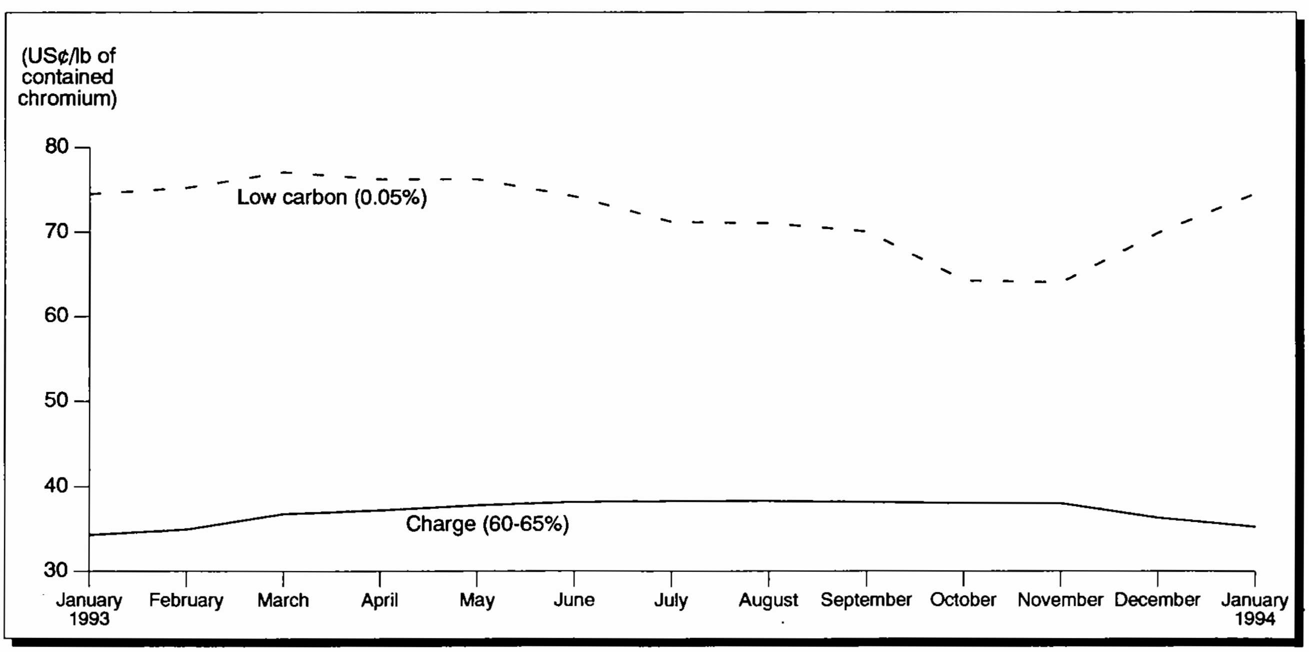
Prices for electrolytic chromium metal were stable in the first quarter in the range of US$2.60-3.00/lb but then started increasing to peak in October at US$3.10-3.30/lb, probably on news of the closure in 1995 of the Tosoh plant in Japan, which will only leave Elkem-USA and a Russian producer to supply the market for that grade. Prices closed the year in the range of US$3.00-3.40/lb (see price table and Figure 4).

Figure 1
Chromite Ore, Average Quarterly Price, 1984-93
F.o.b., in Constant 1990 US$



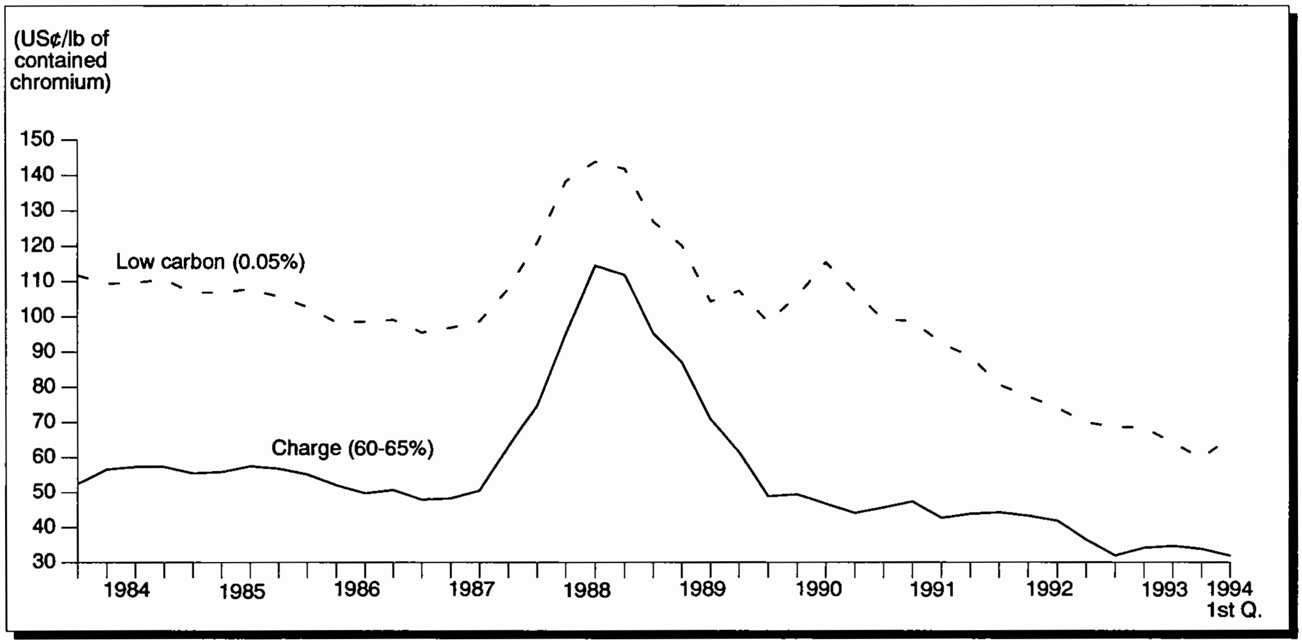
Source: Metals Week.
f.o.b. Free on board.

Figure 2
Imported Ferrochromium, 1993 Average Monthly Prices (f.o.b.)



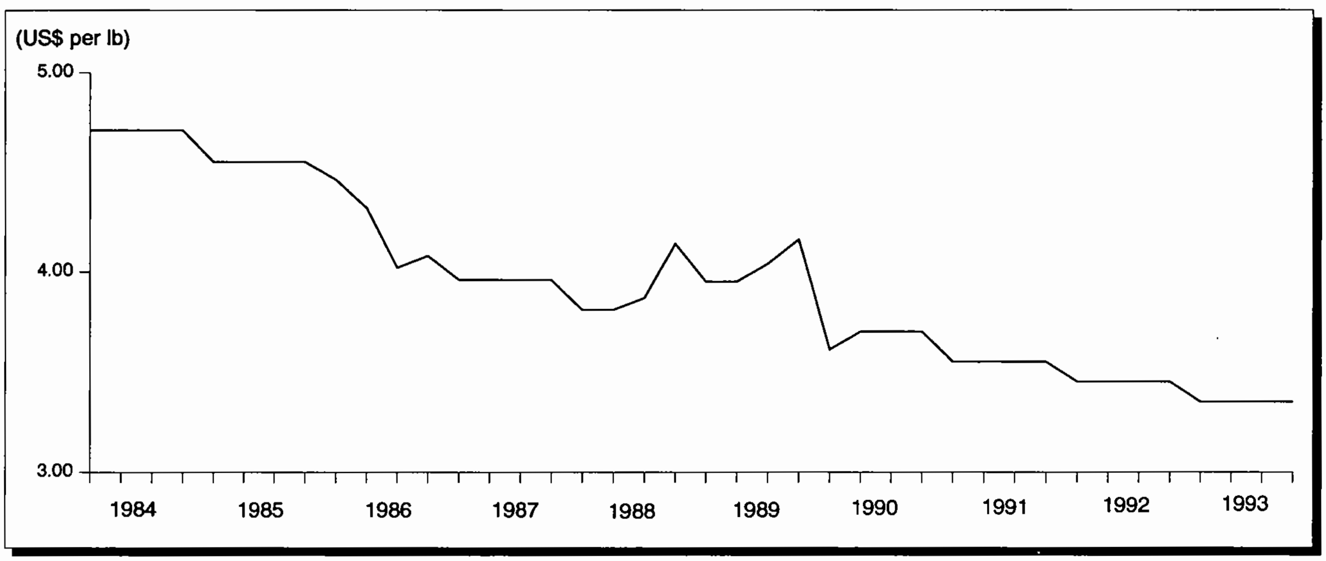
Source: Metals Week.

Figure 3
Imported Ferrochromium, Average Quarterly Prices, 1984-93
F.o.b., in Constant 1990 US$



Source: Metals Week.

Figure 4
U.S. Electrolytic Chromium Metal, Average Quarterly Price, 1984-93
F.o.b. in Constant 1990 US$



Source: Metals Week.

OUTLOOK

In 1993, despite a 5% increase in production of ferrochromium's major consuming sector, stainless steel, the demand for chromium ore and ferrochromium fell significantly compared to 1992. The reason for this fall in consumption stems in part from the replacement, as feed in the stainless steel industry, of ferrochromium by stainless steel scrap exported at record levels from the C.I.S. Also affecting demand in 1993 was the 9.8% fall in the world production of specialty steels, while the world steel industry is only expected to have grown by 0.4% compared to 1992, according to the International Iron and Steel Institute.

In the short term, consumption in the chromium industry is forecast to increase at a slow rate following the growth of the stainless steel industry, assuming demand in China remains stable and chromium prices do not increase, which would see steel producers revert to a greater use of scrap stainless steel. Since mid-1993, usage of primary materials by the stainless steel industry has been increasing relative to scrap because of lower commodity prices erasing the price advantage of scrap. From an all-time high in 1992 of 37.2% usage of scrap as a source of input, the rate decreased to 33% in 1993.

In the medium-to-long term, consumption of chromium products is expected to increase at a rate similar to the growth of the stainless steel industry; hence, between 2.5% and 5.0% annually.

Global demand for chromium ore and ferrochromium is depressed, but the crisis is mainly a supply-side one caused by massive Russian and Kazakhstan oversupply and an overall excess in capacity of production. In the short and medium term, supplies of chromium products should be in delicate balance with demand; however, all depends on how successful the C.I.S. countries are at keeping production at current levels, and on how long it takes for these countries to reform their economies and start consuming again. Another factor to keep in mind that could affect the balance is the South African producers' willingness to wait the market out instead of trying to buy back market share.

In the short term, because of possible increases in exports of ore and alloys, mostly from the C.I.S. or South Africa, a major price improvement in either sector is unlikely. This is not forecast to happen until mid-1995 when the European and Japanese economies have fully emerged from recession and a significant increase in demand materializes, and when supplies fall as some high-cost producers are forced out of the market.

However, chromium ore and ferrochromium prices could be volatile while the markets undergo final restructuring. A significant fall in ore consumption in China, expected in 1994 because of policy changes to slow the growth of the economy, could cause a price drop for chromium ore. On the other hand, increasing costs in China for the production of ferrochromium should put upward pressure on ferrochromium prices on the Japanese market. Similarly, higher power costs and freight rates in Kazakhstan and Russia, signs that price alignment to reflect free market fundamentals are in progress, could cause price hikes for ore and alloys.

In Canada, low energy costs in Manitoba, Quebec and British Columbia may eventually make the upgrading of chromium ores to intermediate or processed chromium products an economically interesting venture. However, in the present situation of low prices and excess supply, and with the trend which is seeing ferrochromium production moving towards integrated producers with dedicated chromium ore deposits, Canadian chromium projects will be developed very slowly.

Note: Information in this review was current as of February 5, 1994.

PRICES

	December 23, 1991	December 25, 1992	December 24, 1993
		(US$)	
Chrome ore, dry basis, f.o.b. shipping point			
Transvaal 44% Cr_2O_3, no ratio (per tonne)	42.00-50.00	50.00-60.00	50.00-60.00
Turkish 48% Cr_2O_3, 3:1 ratio (per tonne)	120.00-130.00	105.00-110.00	105.00-110.00
Chromium metal			
Electrolytic 99.1% Cr, f.o.b. shipping point (per kg)	8.15	8.15	8.15
		(US¢)	
Ferrochromium, f.o.b. shipping point (per kg Cr content)			
Imported 50%-55% charge chrome	105.73-106.89	79.34-85.96	78.24-83.75
Imported 60%-65% charge chrome	103.04-103.59	73.83-76.04	77.14-79.34
MW, imported, low carbon, 0.05% C	198.36-200.01	157.59-163.00	156.48-160.89

Source: Metals Week.
f.o.b. Free on board.

TARIFFS

Item No.	Description	Canada MFN	Canada GPT	Canada USA	United States Canada	EC MFN	Japan[1] MFN
2610.00	Chromium ores and concentrates						
2610.00.00.10	Refractory grade	Free	Free	Free	Free	Free	Free
2610.00.00.90	Other (chrome content)	Free	Free	Free	Free	Free	Free
28.19	Chromium oxides and hydroxides						
2819.10	Chromium trioxide	12.5%	8%	Free	Free	13.4%	4.9%
2819.90	Other	12.5%	8%	Free	Free	13.4%	4.9%
2833.23	Sulphates; alums; peroxosulphates (persulphates) of chromium						
2833.23.10	Chromium sulphate, basic	Free	Free	Free	Free	9%	4.9%
2833.23.90	Other chromium sulphates	9.2%	6%	Free	Free	9%	4.9%
2841.30	Sodium dichromate	Free	Free	Free	Free	12.4%	6%
	Ferrochromium						
7202.41	Containing by weight more than 4% of carbon	10.2%	6.5%	Free	Free	8%	8%
7202.49	Other	10.2%	6.5%	Free	Free	8%[a]	8%
7202.50	Ferro-silico-chromium	10.2%	6.5%	Free	Free	4.9%	3.7%
8112.20	Chromium						
8112.20.10	Unwrought chromium, not alloyed; powders, not alloyed	4%	Free	Free	Free	Free-7%	5.1%-6.5%
8112.20.20	Unwrought chromium, alloyed; waste and scrap; powders, alloyed; articles of chromium	10.2%	6.5%	Free	Free	Free-7%	5.1%-6.5%

Sources: Customs Tariff, effective January 1994, Revenue Canada, Customs and Excise; Harmonized Tariff Schedule of the United States, 1994; The International Customs Journal, European Economic Community, 1992-1993, Number 14, "Conventional" column; Customs Tariff Schedules of Japan, 1993.
[a] Exemptions may apply circumstantially.
[1] GATT rate is shown; lower tariff rates may apply circumstantially.

TABLE 1. CANADA, CHROMIUM TRADE, 1991-93

Item No.		1991		1992		Jan.-Sept. 1993p	
		(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
IMPORTS							
2610.00	Chromium ores and concentrates						
	United States	7 200	1 360	5 031	970	3 543	862
	South Africa	3 339	391	2 839	326	6 077	747
	Cuba	3 060	364	–	–	4 290	643
	Philippines	7 358	1 078	5 905	861	3 139	569
	Total	20 957	3 195	13 775	2 158	17 049	2 823
2819.10	Chromium trioxide						
	United States	1 591	3 425	1 432	3 103	1 107	2 368
	Germany	361	819	440	1 023	417	1 115
	Italy	18	35	59	120	79	183
	Other countries	20	79	–	–	35	138
	Total	1 990	4 359	1 931	4 247	1 638	3 806
2819.90	Chromium oxides n.e.s.; chromium hydroxides						
	United States	404	1 241	523	1 888	515	1 701
	People's Republic of China	–	–	–	–	51	194
	Other countries	137	507	34	129	6	28
	Total	541	1 748	557	2 017	572	1 923
2833.23	Chromium sulphates						
	Germany	393	347	276	221	476	375
	United States	2	2	3	4	4	4
	Mexico	7	5	–	–	–	–
	Total	402	354	279	226	480	380
2841.30	Sodium dichromate						
	United Kingdom	4 480	3 078	5 521	3 716	2 157	1 559
	Turkey	290	275	542	550	374	411
	United States	520	559	527	611	334	406
	Other countries	157	184	51	61	48	53
	Total	5 447	4 097	6 641	4 939	2 913	2 429
7202.41	Ferrochromium containing by weight more than 4% carbon						
	South Africa	23 139	12 933	21 996	12 610	16 321	9 298
	United States	3 699	3 635	3 710	3 657	5 174	4 511
	Finland	1 041	1 161	–	–	6 239	3 913
	Former Yugoslavia	412	360	1 659	1 415	1 408	1 158
	Other countries	12 470	7 941	2 665	2 181	366	343
	Total	40 761	26 030	30 030	19 863	29 508	19 223
7202.49	Ferrochromium n.e.s.						
	South Africa	3 280	3 347	3 132	2 492	1 876	1 859
	United States	1 152	2 204	532	1 172	1 100	1 536
	Germany	959	2 070	546	1 185	577	1 258
	Russia	. .	. .	. .	. .	21	21
	Other countries	140	265	117	225	2	2
	Total	5 531	7 888	4 327	5 074	3 576	4 678
7202.50	Ferro-silico-chromium						
	United States	709	971	546	731	611	680
	Zimbabwe	186	239	–	–	–	–
	Total	895	1 211	546	731	611	680
8112.20.10	Unwrought chromium, not alloyed; powders, not alloyed						
	United States	38	455	61	550	78	700
	Japan	116	952	85	717	57	499
	United Kingdom	18	156	16	133	35	324
	Other countries	15	125	2	60	2	50
	Total	187	1 690	164	1 462	172	1 572

TABLE 1 (cont'd)

Item No.		1991		1992		Jan.-Sept. 1993p	
		(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
IMPORTS (cont'd)							
8112.20.20.10	Unwrought chromium, alloyed; powders, alloyed; articles of chromium, n.e.s.						
	United States	71	658	15	340	96	830
	United Kingdom	–	–	1	9	13	101
	Japan	9	67	9	75	5	60
	Other countries	2	31	2	42	1	23
	Total	82	759	28	470	114	1 015
8112.20.20.20	Chromium waste and scrap						
	United States	4	29	2	15	–	–
	Total	4	29	2	15	–	–
EXPORTS							
2610.00	Chromium ores and concentrates						
	United States	3 255	740	–	–	–	–
	Total	3 255	740	–	–	–	–
2819.10	Chromium trioxide						
	United States	2	4	2	7	–	–
	Other countries	1	6	–	–	–	–
	Total	3	11	2	7	–	–
2819.90	Chromium oxides n.e.s.; chromium hydroxides						
	United States	71	856	69	706	89	670
	Other countries	–	–	–	–	21	55
	Total	71	856	69	706	110	725
2833.23	Chromium sulphates						
	United States	–	–	1	1	–	–
	Taiwan	26	25	–	–	–	–
	Total	26	25	1	1	–	–
2841.30	Sodium dichromate						
	United States	10	30	18	26	200	219
	Total	10	30	18	26	200	219
7202.41	Ferrochromium containing by weight more than 4% of carbon						
	Philippines	–	–	5	16	–	–
	United States	28	30	–	–	–	–
	Total	28	30	5	16	–	–
7202.49	Ferrochromium, n.e.s.						
	Philippines	22	72	14	42	–	–
	Total	22	72	14	42	–	–
8112.20	Chromium and articles thereof, including waste, scrap and powders						
	United States	2	40	. . .	13	18	94
	Germany	–	–	–	–	. . .	17
	Total	2	40	. . .	13	18	112

Source: Statistics Canada.
– Nil; . . . Amount too small to be expressed; n.e.s. Not elsewhere specified; p Preliminary; r Revised.
Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, CHROMIUM TRADE, 1975, 1980 AND 1985-93

	Imports		
	Chromite[1]	Ferrochromium	Chromium Metal[2]
	(tonnes)		
1975	29 663	41 109	. .
1980	28 373	41 369	. .
1985	11 324	28 271	. .
1986	15 974	39 045	. .
1987	13 545	44 121	. .
1988	28 975	50 181	265
1989	33 843	48 551	149
1990	21 309	43 245	214
1991	20 957	46 292	273
1992	13 775	34 357	194
1993[a]	17 049	33 084	286

Source: Statistics Canada.
. . Not available.
[a] Data are for first nine months of 1993.
[1] As of 1988, data are collected under the Harmonized System; data include refractory grade chromite and the chrome content of other chromite. [2] Data include H.S. codes 8112.20.10, 8112.20.20.10 and 8112.20.20.20.

TABLE 3. CANADA, CHROMIUM CONSUMPTION, 1975 AND 1980-92

	Consumption[1]	
	Chromite	Ferrochromium[2]
	(tonnes)	
1975	36 790	18 417
1980	27 900	30 175
1981	24 771	29 547
1982	15 330	18 393
1983	15 682	23 741
1984	21 059	28 524
1985	17 555	21 856
1986	20 935	33 185
1987	18 569	37 227
1988	18 546	40 464
1989	21 066	35 721
1990	19 921	36 114
1991	14 722[r]	39 705
1992[p]	10 752	36 834

Source: Natural Resources Canada.
[p] Preliminary; [r] Revised.
[1] Available data as reported by consumers.
[2] Gross weight.

Coal

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Coal is an organically derived material. It is formed from the remains of decayed plant material compacted into a solid through millions of years of pressure and heat. Coal is the world's most abundant and widely distributed fossil fuel. About 5 billion t are mined annually in over 40 countries.

Coal is used primarily for the generation of electricity and the production of steel. Nearly 50% of the world's electricity is generated from coal and about 75% of the world's steel is produced with coal. Coal can also be used as an energy source in industrial processes (such as cement manufacture and pulp and paper) and can be used to produce a wide range of by-products (such as tars and chemicals). In some developing countries, coal is still used as a residential heating fuel.

Canada's coal production and exports increased steadily during the 1970s and 1980s. By 1991, Canada was the world's fourth largest coal exporter and twelfth largest producer.

Following uncharacteristic declines in 1992 in Canada's coal production and exports, 1993 saw significant improvements, although neither production nor exports have yet climbed back to the record levels of 1991.

While world steam coal trade has been growing for many years, coking coal trade has recently declined. Problems in several steel industries, as well as low energy growth rates in some regions using steam coal, will likely reduce world coal trade to under 400 Mt in 1993. This compares with a record 404 Mt in 1992, which included 236 Mt of steam coal and 168 Mt of coking coal.

CANADIAN DEVELOPMENTS

The volume and value of Canadian coal production for 1993 are expected to increase. Production of 68.6 Mt with a value of $1.8 billion should be achieved, representing increases of 4.6% and 6.8%, respectively.

Canadian consumption is estimated to be approximately 49 Mt, about 2 Mt lower than in 1992. The decrease is attributable to Ontario Hydro, which increased its electrical generation from nuclear facilities and experienced an overall drop in electricity demand. Coal consumption by the steel industry and the industrial sector in 1993 is expected to be similar to the previous year, at approximately 4.8 Mt and 1.5 Mt, respectively.

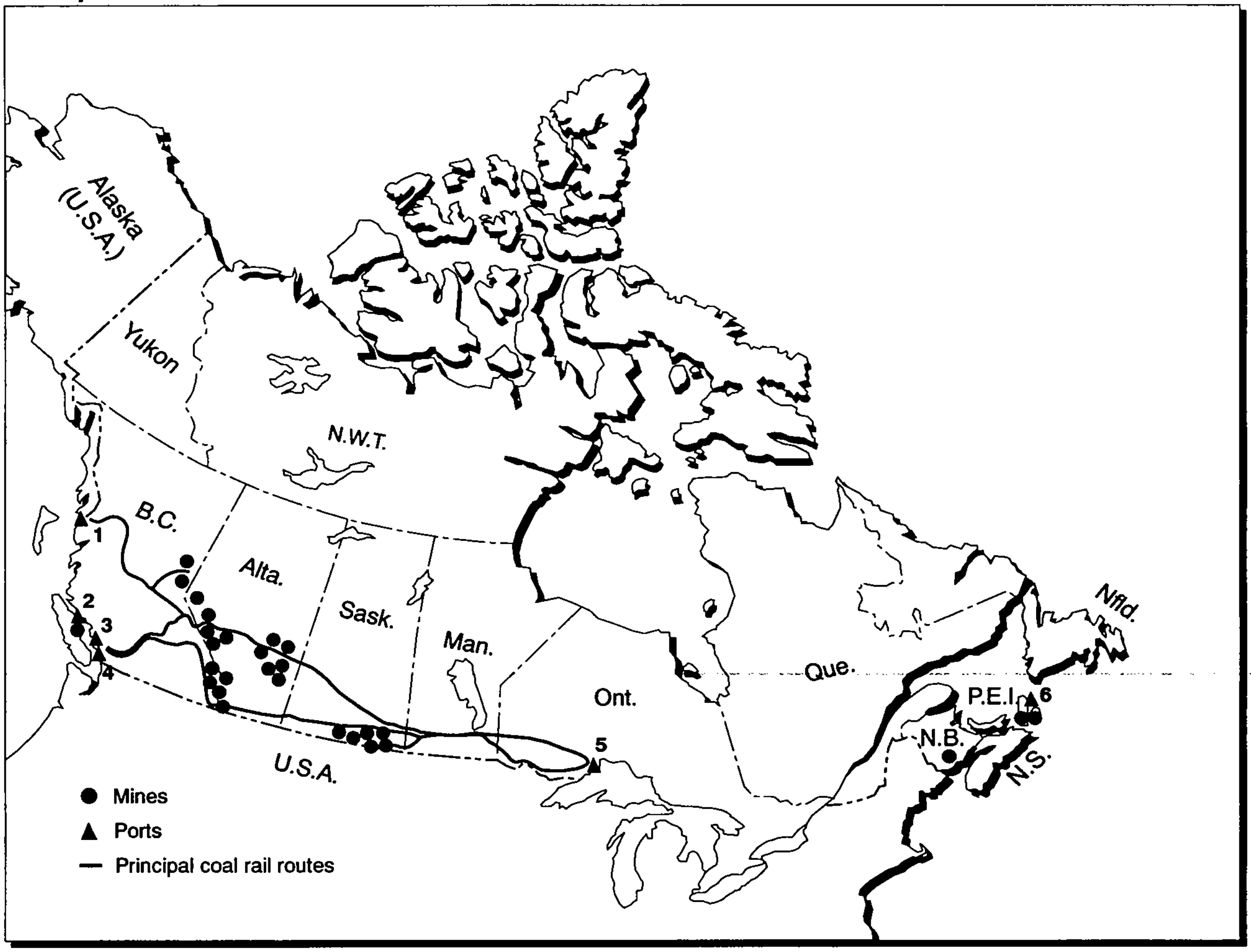
In Nova Scotia, production was down about 1 Mt, to 3.5 Mt, primarily because of the shut-down of Cape Breton Development Corporation's (CBDC) Lingan mine in late 1992. Despite the drop in production, coal consumption in Nova Scotia was similar to the 1992 level at approximately 2.4 Mt.

Coal exports from Nova Scotia are estimated to be down in 1993 by some 1 Mt. A portion of CBDC production which would normally have been exported was sold to Nova Scotia Power Inc. to fuel the Trenton generating station. This unexpected requirement was necessary following the 1992 shut-down of the Westray mine.

In New Brunswick, coal production was about 0.4 Mt in 1993, a level similar to 1992. Consumption by the New Brunswick Power Corporation was up somewhat to about 0.7 Mt due to the commissioning in November 1993 of the 440-MW Belledune station. Provincial production is expected to remain fairly constant for the next several years, while consumption will increase somewhat in 1994 with the Belledune station operational for the entire year.

While neither Quebec, Ontario nor Manitoba produce coal, all three provinces consume coal for electricity generation, steel-making and/or general

Figure 1
Principal Canadian Coal Mines and Ports



PORTS

British Columbia
1. Ridley Island
2. Texada Island Facility
3. Neptune
4. Roberts Bank

Ontario
5. Thunder Bay

Nova Scotia
6. International Pier

industry uses. Coal consumption is expected to be similar to the previous year in Quebec and Manitoba, at about 0.5 Mt and 0.4 Mt, respectively. The majority of the coal consumed in Quebec is imported from the United States. In Manitoba, small amounts of coal are used to generate electricity and for industrial purposes. Most of this coal comes from Saskatchewan.

Ontario remains Canada's second largest coal consumer, using coal for electricity generation, steelmaking and industrial uses. Nevertheless, Ontario's coal consumption dropped by approximately 2.5 Mt in 1993 to under 13 Mt. This was primarily because of the drop in the use of coal for electricity generation from 9.9 Mt in 1992 to about 7.4 Mt in 1993. The lower coal use resulted from lower electricity demand, combined with increased electrical generation from the utility's nuclear plants in 1993. About 35% of the coal consumed by the utility was from western Canada; the rest was from the United States.

Coal utilization by the steel industry in Ontario in 1993 was about the same as the previous year, at close to 5 Mt. All of this coal is imported from the United States. Coal use by the industrial sector was similar to the previous year, at about 0.4 Mt.

In Saskatchewan, production was very close to the previous year, at 10 Mt. Consumption in the province was comparable to the previous year, at some 8 Mt. The province continues to supply Manitoba and some Ontario coal requirements.

Alberta remained Canada's largest coal-producing and consuming province. Production is forecast to be a record 34 Mt, consisting of 23 Mt of sub-bituminous coal and nearly 11 Mt of bituminous coal. Approximately 23 Mt was consumed in the province to generate electricity; this consisted mostly of sub-bituminous coal. About 10 Mt of bituminous coal was sent overseas and to Ontario markets, approximately 9 Mt and 1 Mt, respectively.

Coal production in British Columbia increased by 3.4 Mt to 20.6 Mt. This reflected the resolution of labour and financial problems at three B.C. coal mines at the end of 1992. Since these mines did not resume full production until several months into 1993, the production volume is expected to increase again in 1994.

British Columbia remains Canada's largest coal-exporting province, shipping coal to Asia, Europe, Latin America and the United States. B.C. exports in 1993 are estimated to be close to 20 Mt, up from 17 Mt in 1992.

Canada's coal imports were down in 1993, from 12.8 Mt in 1992 to a predicted 9 Mt in 1993, the lowest level in many years. The drop is accounted for by Ontario Hydro. While the utility burned some 4 Mt of imported coal, about 2 Mt of this amount came from stockpiles. As a result, Ontario Hydro actually imported only about 2 Mt of coal, compared to some 6 Mt in 1992.

THE ENVIRONMENT

Environmental concerns exist with both the mining and utilization of coal. At the mining stage, environmental assessments are an integral part of the provincial mine permitting process. Activities associated with coal mining, such as the removal of vegetation, relocation of overburden, construction of roads, blasting, and reclamation of mined-out areas, are carried out to minimize any negative effect on the environment. Several Canadian coal mining companies have been recognized for their successful environmental mine management programs.

At the coal utilization stage, most of the environmental concerns surround air emissions. In 1993, following extensive consultations with industry, Environment Canada updated its national guidelines for emissions of sulphur dioxide (SO_2) and nitrogen oxides (NO_x) from new thermal generating stations. It also published a report outlining specifications for the design, installation and operation of automated continuous emission monitoring systems used to measure gaseous releases of SO_2 and NO_x from thermal generating facilities.

The seven easternmost provinces in Canada have signed agreements with the federal government to control SO_2 emissions. As a result, some provinces have imposed sulphur dioxide emissions limits on their electric utilities.

Nova Scotia Power Inc. has agreed to limit SO_2 emissions to 145 000 t annually by 1994. As part of its program to limit emissions, Nova Scotia Power Inc. completed construction in 1993 of Canada's first commercial circulating fluidized bed combustor at Point Aconi. This 165-MW unit is designed to achieve 90% SO_2 removal and to reduce NO_x emissions to about 30% of those in a conventional pulverized coal-fired boiler.

New Brunswick Power Corporation has an annual SO_2 ceiling of 123 000 t. To stay within this limit, the utility began operation in late 1993 of a new 440-MW coal-fired plant at Belledune. This plant is equipped with a wet limestone scrubber that will capture about 90% of the SO_2. In addition, the plant controls emissions of NO_x via staged combustion. High-sulphur domestic coal previously consumed in a generating unit with no sulphur controls will supply about one third of the coal requirements for this station; the remainder is imported lower-sulphur coal. As well, the Dalhousie plant is being converted from coal and oil to a water bitumen mixture and is being retrofitted with a wet limestone flue gas scrubber.

Ontario Hydro operates with an emission limit of 175 000 t of SO_2. At the end of 1993, the utility was adding flue gas desulphurization scrubbers to two units at its Lambton generating station to capture 90% of the SO_2 in the form of a saleable gypsum product. These units will then operate with a coal containing about 2.5% sulphur. Previously, Ontario Hydro installed flue gas conditioning equipment at all operating units of the Lambton, Nanticoke and Lakeview coal-burning plants to allow them to use coals containing less than 1% sulphur without impeding the performance of the existing particulate control systems.

WORLD DEVELOPMENTS

Coal trade worldwide continued to reflect economic and political developments. Recession and slow economic growth in many regions of the world, in combination with large coal stockpiles, constrained coal trade in 1993. Coal production and demand in several European countries were stagnant or declined; on the other hand, demand grew in some markets, such as South Korea and Taiwan. On the supply side, a major strike curtailed production and exports in the United States, while Australian, Canadian and Polish exports increased.

Canada has maintained its position as the world's fourth largest coal exporter despite two years of difficulties. Exports peaked in 1991 at 34 Mt and then declined to 27 Mt in 1992. This decline reflected the labour and financial difficulties at three B.C. mines. Total Canadian exports are expected to rebound to approximately 29 Mt in 1993 and to exceed 30 Mt in 1994.

Shipments from three other main coal-exporting countries will be up in 1993. The world's number one coal exporter, Australia, will maintain its position in 1993, despite a short interruption in 1993 exports caused by a strike. Australia's 1993 exports will exceed 130 Mt, above the 1992 record of 126 Mt. South Africa's coal exports should approach 55 Mt, up from 52 Mt in 1992. Poland should see a 30% increase in its exports from 19 Mt in 1992 to 25 Mt in 1993.

However, the United States, the world's second largest coal exporter, is expected to experience a drop from 92 Mt in 1992 to 75 Mt in 1993. This is due to a lengthy strike by 17 000 miners in seven states. The strike forced several utilities to turn to offshore suppliers for 6 Mt of steam coal in 1993, double the amount of 1992 imports. Russia, which used to be a significant coal exporter, also experienced lower exports in 1993, due in part to problems with its rail system.

Traditionally, more than 80% of Canada's exports are coking coal, sold mostly to the Japanese steel industry, which is the world's largest purchaser of coal. While Japanese steel production grew modestly in 1993, the industry lost US$3 billion and forecasts suggest 1994 production will be down. The industry used this, plus an oversupplied coking coal market, to put downward pressure on coking coal prices.

World benchmark prices for traded coking coal for the 1993 contract year were US$49.30/t f.o.b. the port of export. In January 1994, initial agreements with Canadian and Australian producers for 1994 contracts were settled at US$45.45/t, down US$3.85/t. This is the fifth year of price cuts for exporters.

Steam coal contract prices, which usually track coking coal prices, averaged about US$36/t in 1993. Most observers expect contract steam coal prices to drop by about US$2/t for the 1994 contract year.

Steel production in other Asian countries importing Canadian coking coal, such as South Korea and Taiwan, remained strong. Canadian exports to these markets are expected to increase in 1993. Canadian coking coal exports to Brazil and the United States, which have traditionally been the third and fourth largest markets for Canadian coal, may also be up in 1993 over 1992.

Approximately 70% of Canadian steam coal exports normally go to Japan and South Korea. Exports in 1993 are predicted to conform to this pattern. Sales to the South Korean market may increase marginally because of the strong performance of the Korean economy and its increasing demand for energy.

The countries of the European Community (EC), which used to figure prominently in world coal production, are reducing their output. EC hard coal production is expected to be down in 1993 by 13%. For the first time in many years, hard coal imports also dropped, by about 9%. EC figures suggest that Canada and other traditional exporters decreased exports to the EC in 1993.

The lower demand for coal in the EC is attributed to the contraction in the Community's 1993 total energy demand and a serious decline in its steel market. Stockpiles at collieries and power stations have also grown substantially.

The EC itself does not subsidize coal production, but it does allow its member countries to subsidize. However, the EC has been encouraging reductions in coal subsidies. In December 1993, the EC announced new rules for state aid for coal for the period 1994-2002. Member states can continue to subsidize mines with average production costs below world prices. Companies wanting aid must present a restructuring plan to 2002 showing how costs will be reduced. Greater transparency will be required from member states in reporting subsidies. Germany and Spain will have three years to phase in the new regulations.

Other developments in the steam coal market, with potential long-term implications, were China's decision to eliminate coal production subsidies and its signing of a memorandum of understanding to import 500 000 t of steam coal for a planned new power station.

China is likely to become a major importer because of a lack of infrastructure to move sufficient volumes of coal from its northern producing areas to the rapidly expanding economic regions in the south. In addition, China's low calorific, high-ash coals benefit from blending with higher-quality imports.

Some projections show China's demand for imported coal growing to between 30 and 50 Mt/y by the turn of the century. At the same time, China remains a significant exporter with 1993 shipments approaching 20 Mt. China exports coal primarily to obtain foreign currency.

OUTLOOK

Predictions for the remainder of this decade and into the twenty-first century suggest that Canadian and world coal production, utilization and trade will increase. Domestically, steam coal demand will grow in Nova Scotia, New Brunswick, Ontario, Saskatchewan and Alberta. Most of this coal will come from indigenous sources, although some will also come from the United States.

On the world scene, steam coal trade and use will increase in Asia and Europe. Most of this coal will come from the established steam coal exporters such as Australia, the United States, South Africa, Indonesia, Colombia, China and Canada.

Coking coal demand is forecast to stabilize or decline during the next few years. However, this segment of the market will still be active as changes in purchasing patterns and steel-making technology will alter some coking coal trading patterns.

Note: Information in this review was current as of February 1, 1994.

TABLE 1. COAL SUPPLY AND DEMAND, 1982-93

	Production	Imports	Total Supply	Exports	Domestic Consumption	Total Demand	Stock Changes and Adjustment
				(000 tonnes)			
1982	42 811	15 775	58 586	16 004	41 353	57 357	1 229
1983	44 780	14 667	59 447	17 011	43 649	60 660	(1 213)
1984	57 402	18 359	75 761	25 138	48 699	73 837	1 923
1985	60 854	14 620	75 474	27 378	48 666	76 044	(570)
1986	57 811	13 125	70 936	25 943	44 558	70 501	435
1987	61 209	14 719	75 928	26 740	50 144	76 884	(956)
1988	70 644	17 248	87 892	31 732	54 390	86 122	1 770
1989	70 513	14 660	85 173	32 744	53 881	86 625	(1 452)
1990	68 356	14 204	82 560	31 009	49 040	80 049	2 511
1991	71 134	12 424	83 558	34 113	50 282	84 395	(837)
1992	65 610	12 833	78 444	28 097	51 683	79 780	(1 336)
1993p	69 015	8 451	77 466	28 313	48 979	77 292	174

Sources: Natural Resources Canada; Statistics Canada.
p Preliminary.

TABLE 2a. COAL DISPOSITION FROM MINES, 1993p

	Nova Scotia	New Brunswick	Saskatchewan	Alberta	British Columbia	Canada
			(000 tonnes)			
DELIVERIES TO:						
Newfoundland	–	–	–	–	–	–
Prince Edward Island	–	–	–	–	–	–
Nova Scotia	2 660	–	–	–	–	2 660
New Brunswick	9	389	–	–	–	398
Quebec	–	–	–	–	–	–
Ontario	–	–	833	1 088	662	2 583
Manitoba	–	–	212	–	24	236
Saskatchewan	–	–	8 960	1	22	8 983
Alberta	–	–	–	24 231	–	24 231
British Columbia	–	–	–	27	291	318
Total Canada	2 669	389	10 005	25 347	999	39 409
Shipments for export	978	–	40	8 972	19 617	29 607
Total	3 647	389	10 045	34 319	20 616	69 016

Sources: Natural Resources Canada; Statistics Canada.
– Nil; p Preliminary figures or estimates.

TABLE 2b. COAL DISPOSITION FROM MINES, 1992

	Nova Scotia	New Brunswick	Saskatchewan	Alberta	British Columbia	Canada
			(000 tonnes)			
DELIVERIES TO:						
Newfoundland	27	–	–	–	–	27
Prince Edward Island	–	–	–	–	–	–
Nova Scotia	2 367	–	–	–	–	2 367
New Brunswick	10	399	–	–	–	409
Quebec	20	–	–	–	–	20
Ontario	–	–	1 091	1 618	586	3 295
Manitoba	–	–	330	–	20	352
Saskatchewan	–	–	8 598	–	37	8 635
Alberta	–	–	–	23 499	–	23 499
British Columbia	–	–	–	33	229	262
Total Canada	2 424	399	10 019	25 150	874	38 866
Shipments for export	2 062	–	9	8 378	16 295	26 744
Total	4 486	399	10 028	33 528	17 169	65 610

Sources: Natural Resources Canada; Statistics Canada.
– Nil.

TABLE 3. COAL SUPPLY BY RANK, 1980-93

Year	Production				Imports			Total Supply
	Bituminous	Sub-Bituminous	Lignite	Total	Anthracite	Bituminous	Total	
	(million tonnes)							
1980	20.2	10.5	6.0	36.7	0.3	15.5	15.8	52.5
1981	21.7	11.6	6.8	40.1	0.4	14.4	14.8	54.9
1982	22.3	13.0	9.5	42.8	0.3	15.5	15.8	58.6
1983	22.5	14.5	7.8	44.8	0.3	14.4	14.7	59.5
1984	32.1	15.4	9.9	57.4	0.2	18.1	18.3	75.7
1985	34.2	16.8	9.7	60.7	0.3	14.6	14.9	75.6
1986	32.2	17.3	8.3	57.8	0.4	12.7	13.1	70.9
1987	32.7	18.5	10.0	61.2	0.4	14.3	14.7	75.9
1988	38.6	18.9	12.1	70.6	0.4	16.8	17.2	87.8
1989	38.8	20.9	10.8	70.5	0.4	14.3	14.7	85.2
1990	37.7	21.3	9.4	68.4	0.4	13.8	14.2	82.6
1991	39.9	22.2	9.0	71.1	0.2	12.2	12.4	83.5
1992	32.6	23.0	10.0	65.6	0.2	12.6	12.8	78.4
1993p	35.3	23.7	10.0	69.0	0.2	8.2	8.4	77.4

Sources: Natural Resources Canada; Statistics Canada.
p Preliminary.

TABLE 4. COAL SUPPLY BY RANK AND VALUES, 1989-93

	1989		1990		1991		1992		1993p	
	(000 t)	($000)	(000 t)	($000)	(000 t)	($000)	(000 t)	($000)	(000 t)	($000)
DOMESTIC[1]										
Bituminous										
Nova Scotia	3 512	199 000	3 415	191 000	4 134	242 000	4 486	273 000	3 646	232 000
New Brunswick	520	34 000	548	37 000	498	34 000	399	32 000	387	34 000
Alberta	9 907	309 000	9 153	296 000	10 312	355 000	10 508	352 000	10 659	348 000
British Columbia	24 840	948 000	24 581	1 002 000	24 962	986 000	17 169	689 000	20 615	849 000
Subtotal	38 779	1 490 000	37 697	1 526 000	39 906	1 617 000	32 563	1 346 000	35 307	1 463 000
Sub-Bituminous										
Alberta	20 918	156 000	21 252	165 000	22 242	178 000	23 020	187 000	23 662	197 000
Lignite										
Saskatchewan	10 816	100 000	9 407	99 000	8 981	94 000	10 027	100 000	10 046	95 000
Total domestic	70 513	1 746 000	68 356	1 790 000	71 129	1 889 000	65 610	1 633 000	69 015	1 755 000
IMPORTED[2]										
Bituminous and anthracite briquettes	14 660	808 000	14 204	616 000	12 424	532 000	12 834	577 000	8 451	416 000
Total supply	85 173	2 554 000	82 560	2 406 000	83 553	2 421 000	78 444	2 210 000	77 466	2 171 000

Sources: Natural Resources Canada; Statistics Canada.
p Preliminary figures or estimates.
[1] F.o.b. mines. [2] Value at U.S. port of exit.

TABLE 5. COAL EXPORTS BY TYPE, 1993

Country	Metallurgical	Thermal	Total
		(000 tonnes)	
Japan	14 043	2 207	16 250
South Korea	4 582	1 431	6 013
United States	860	65	925
Brazil	733	123	856
United Kingdom	582	105	687
China	501	–	501
Mexico	415	39	454
Spain	446	–	446
Taiwan	397	–	397
Italy	317	–	317
Chile	285	–	285
Denmark	–	284	284
Belgium	239	–	239
Portugal	101	108	209
Sweden	118	–	118
Algeria	98	–	98
Egypt	90	–	90
France	57	–	57
Netherlands	56	–	56
Germany	30	–	30
Total	23 950	4 363	28 312

Source: Natural Resources Canada/Statistics Canada joint survey, Coal.
– Nil.

TABLE 6. COAL CONSUMED BY THERMAL POWER STATIONS, 1972-93

	Nova Scotia	New Brunswick	Ontario	Manitoba	Saskat-chewan	Alberta	Total Canada
				(000 tonnes)			
1972	663	281	7 599	410	2 145	4 113	15 211
1973	585	193	6 615	386	2 806	4 474	15 059
1974	606	292	6 721	132	2 902	4 771	15 424
1975	571	248	6 834	323	3 251	5 345	16 572
1976	730	207	7 612	979	3 521	5 996	19 045
1977	572	198	8 795	1 113	4 304	7 461	22 443
1978	771	151	9 097	341	4 585	8 029	22 914
1979	644	198	9 901	73	4 956	9 181	24 956
1980	1 052	315	10 779	240	4 972	10 424	27 782
1981	1 126	515	11 460	332	4 935	11 445	29 813
1982	1 300	548	12 484	184	5 897	13 242	33 656
1983	1 400	564	13 025	109	6 625	14 492	36 216
1984	2 974	610	13 413	163	7 925	16 123	40 208
1985	2 235	521	10 985	253	8 290	18 112	40 396
1986	2 137	469	9 172	111	6 786	17 719	36 394
1987	2 077	526	12 016	457	7 672	19 077	41 825
1988	2 266	678	13 079	780	8 637	20 538	45 978
1989	2 141	705	12 809	327	8 534	21 410	45 926
1990	2 184	496	10 362	298	7 462	21 340	42 142
1991	2 290	426	10 850	232	7 548	22 480	43 826
1992	2 344	471	10 022	233	8 419	23 752	45 241
1993p	2 416	506	7 004	178	8 428	24 194	42 726

Sources: Natural Resources Canada; Statistics Canada.
p Preliminary.

TABLE 7. COAL DEMAND, 1986-93

	1986	1987	1988	1989	1990	1991	1992	1993p
				(000 tonnes)				
THERMAL ELECTRIC								
Canadian	30 033	33 932	37 614	37 447	35 858	36 413	38 612	38 470
Imported	6 359	7 892	8 441	8 392	6 284	7 413	6 629	4 256
Total	36 392	41 824	46 055	45 839	42 142	43 826	45 241	42 726
METALLURGICAL								
Canadian	243	290	19	–	–	–	–	–
Imported	5 891	6 019	6 242	5 918	4 996	4 906	4 886	4 665
Total	6 134	6 309	6 261	5 918	4 996	4 906	4 886	4 665
GENERAL INDUSTRY								
Canadian	642	591	673	608	465	461	602	664
Imported	1 364	1 416	1 477	1 430	1 433	980	954	924
Total	2 006	2 007	2 150	2 038	1 898	1 441	1 556	1 588
EXPORTS								
Canadian	25 904	26 741	31 725	32 827	31 009	34 113	28 097	28 313
TOTAL								
Canadian	56 822	61 554	70 031	70 882	67 332	70 987	67 311	67 447
Imported	13 614	15 327	16 160	15 740	12 713	13 299	12 469	9 845
Total demand	70 436	76 881	86 191	86 622	80 045	84 286	79 780	77 292

Sources: Natural Resources Canada; Statistics Canada.
– Nil; p Preliminary.

Cobalt

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Summary

In 1993, the cobalt content of metal concentrates produced in Canada was 2370 t, an increase of 6.6% from 1992. However, the value of 1993 production, about $89.8 million, was 31.6% less than in 1992. These lower earnings are due to a major price slump for cobalt which began in the middle of 1992 and lasted throughout 1993, where the free market price for cobalt spot cathode hovered around US$13.79/lb. The price slump was a result of slack demand caused by the worldwide recession and relative abundance of supplies on the market. However, a price hike at the close of the year, which saw the high-grade cobalt price climb to US$17/lb and more, seemed to signal a change in 1994 when a greater tightness in supply is expected to develop.

World production estimates from the Cobalt Development Institute's six-month production figure put the 1993 production of refined cobalt at 18 500 t, a decrease of about 14% from 1992. The drop in output is mostly attributed to production disruptions in Zaire, Zambia and Russia.

The outlook for 1994 calls for further decreases in production in Zaire, Zambia and Russia, while increases in demand are expected as world economies improve and as the result of low consumer inventories following de-stocking in 1993. A supply shortage, especially for higher-grade material, is likely to happen with a corresponding general pressure on prices and a widening of the premium for good-quality Western-origin cobalt. Increased sales from the U.S. stockpile and from Russia's strategic stockpile, coupled with a shift in production by Western producers to optimize their cobalt output may, at the end, help balance the equation.

Uses

One of the major uses for cobalt is in superalloys where it improves the strength, wear and corrosion-resistance characteristics of alloys at elevated temperatures. The major uses of cobalt-based superalloys are in turbine blades for aircraft jet engines and in gas turbines for pipeline compressors. Cobalt-based superalloys normally contain 45% or more cobalt, while nickel- and iron-based superalloys contain 8%-20% cobalt.

The demand for cobalt in the production of magnets has been declining in recent years. The substitution of neodymium-iron-boron magnets for cobalt-rare earth magnets has been a major factor. However, the use of cobalt-rare earth permanent magnets will continue where the specific advantages of reliability and good performance are required. In addition, Alnico magnets are staging a comeback, especially in automobile anti-lock braking systems.

Cobalt-based alloys are also used in specialized applications, such as in machining very hard materials or where high abrasion-resistant qualities are required. In such applications, the most important group of cobalt-based alloys is the stellite group, which contains cobalt, tungsten, chromium and molybdenum as principal constituents. The hard-facing or coating of tools with cobalt alloys provides greater resistance to wear, heat, impact and corrosion.

Cobalt metal powder has an important application as a binder in the production of cemented tungsten carbides for heavy-duty and high-speed cutting tools. In chemical applications, cobalt oxide is an important additive in paint, glass and ceramics. Cobalt is also used to promote the adherence of enamel to steel for applications such as appliances, and steel to rubber for the construction of steel-belted tires. A cobalt-molybdenum-alumina compound is used as a catalyst in hydrogenation and for petroleum desulphurization.

CANADIAN DEVELOPMENTS

Canada's mineral production of cobalt in 1993 was 2370 t, up 6.6% from 1992, whereas the output of refined cobalt totalled 2355 t, an increase of 29% from 1992.

In Canada, Inco Limited and Falconbridge Limited produce cobalt as a by-product of their nickel-copper operations and from purchased concentrates. Inco refines its concentrates in Canada to produce cobalt metal and oxide, while Falconbridge sends nickel-cobalt matte to its refinery in Norway. Sherritt Inc. produces refined cobalt at its Alberta refinery from concentrates purchased domestically and abroad.

Inco's 1993 mineral production of cobalt was 1544 t, up 8% from last year, while its production of refined cobalt was 1163 t, up 2% from 1992.

Inco's cobalt production comes from several underground mines located in the Sudbury area of Ontario and in Manitoba's Thompson Nickel Belt. The nickel-cobalt ores from these operations are processed at the Clarabelle and Copper Cliff mills near Sudbury and at the mill and concentrator complex in Thompson. The Sudbury concentrate is then sent to the nearby Copper Cliff smelter for further processing to produce a variety of nickel and copper products, including nickel matte. Some of this matte is sent by rail to Inco's refinery complex at Port Colborne, Ontario, where cobalt metal is produced as a by-product. An electrolytic cobalt refinery further upgrades the material to 99.9%-pure cobalt rounds.

In Thompson, a local plant smelts and refines the concentrate to produce electrolytic nickel and by-product cobalt oxide. The cobalt oxide is sent by ship to Inco's Clydach refinery in Wales for re-processing.

In 1993, for the double purpose of helping reduce stocks accumulating on international metal markets and to simplify the organization of vacation periods, all Inco mining and milling operations in Canada shut down for a three-week Christmas vacation period in December 1992 and January 1993, and for a four-week summer vacation period between June 28 and July 26, 1993 in Sudbury, and between July 12 and August 9, 1993 in Thompson. The Port Colborne nickel-cobalt refinery also closed for the same periods while the Clydach refinery in Wales closed for shorter periods and operated at a reduced rate. Inco announced in October 1993 that its Ontario and Manitoba divisions would shut down for extended periods for the 1993/94 Christmas and 1994 summer vacations.

Contract negotiations with workers at Inco's Thompson, Manitoba operations went well. An agreement on a three-year contract, reached on September 15, 1993, included a new profit-sharing plan with the workers that will replace the nickel price bonus, and several added or amended contract clauses, but no wage or vacation increases.

The Lower Coleman mine in Ontario came into production in early 1993 and should be working at full capacity in 1994. Inco also re-opened the rich Garson mine in Sudbury in 1993, although it is only scheduled to begin production in the late spring of 1994. This will lower Inco's overall production costs but should not increase production of the Sudbury division. The opening mines will replace existing operations at the Little Stobie and Frood mines which will soon close down, and the Levack mine, Inco's highest-cost producing mine, which was shut down indefinitely during the summer. In Manitoba, development of the Thompson 1-D mine moved ahead toward initial production in 1994 while full production is anticipated by 1997.

In 1993, Falconbridge's Canadian mineral production of cobalt was 826 t, up 4% from 1992.

Falconbridge operates six mines in the Sudbury, Ontario area, namely the Lockerby, Onaping, Craig, Fraser, Strathcona and Thayer Lindsley mines, although this last one is still classified under exploration. The nickel-cobalt ore is concentrated at the Strathcona mill and further processed at the Falconbridge smelter to produce cobalt-bearing nickel matte. This matte is sent by ship to the company's refinery at Kristiansand, Norway, to produce cobalt metal and nickel products.

Falconbridge shut its Sudbury division for a six-week Christmas vacation period from December 20, 1992 to January 31, 1993. The ten-week summer shut-down announced earlier in the year to help rebalance the market by helping reduce high worldwide nickel inventories was reduced to two weeks in July. Finally, it also closed for the last week of December 1993 to accommodate the Christmas period.

Also in 1993, Falconbridge cut its 2240-strong workforce by about 10%. Thirty-three percent of the cut was achieved through voluntary redundancies or early retirements while the rest came from layoffs at all levels. The company mentioned that a further 10% cut at its Sudbury operations was being considered for 1995 through attrition or layoffs.

A feasibility study was completed in 1993 on the Raglan project located on the Ungava Peninsula in northern Quebec. The study was the final step of an extensive development program which included a 2000-m decline, several exploration drifts, and 40 000 m of underground definition drilling done in 1991/92. Reserve estimates standing at 18.1 Mt grading 3.13% nickel, 0.88% copper, 0.05% cobalt and precious metal credits would permit the production of 20 000 t of nickel annually (or about 315 t/y of cobalt). However, no financing or production decision will be made until the nickel market firms up and permitting is reasonably assured. It would take about three years and $405 million to develop the mine. In 1994, Falconbridge has a $3.7 million budget to pursue surface exploration, including drilling work, on the Raglan properties.

As of June 1993, Sherritt Gordon Limited underwent a name change. The company adopted the name Sherritt Inc. (Sherritt).

In 1993, Sherritt's production of refined cobalt was about 1192 t, 74% more than the 686 t produced in 1992 (the preliminary 1992 estimate of 803 t published in last year's review having been overestimated). The large production increase results from the operational start of the redesigned processing system, modernized at a cost of $60 million, which includes a new cobalt refinery employing Sherritt's proprietary ammonia partial leach reduction process. The completion of the construction of the cobalt refinery (phase II of the upgrading plan) in early 1993 increased the cobalt production capacity of the refinery to 1361 t (3 million lb). Phase III of the upgrading plan to gradually increase the cobalt production capacity of the refinery to the 2042-2722-t (4.5-6.0 million lb) range was being completed at the end of the year. The full production capacity reached will depend on the nature of the feed.

Sherritt produces cobalt from feedstock purchased mostly on a contract basis, both domestic and foreign. It does not operate any Canadian base-metal mines. In 1993, its feed included ore from North America, Australia, South Africa and, since 1991, from Cuba. In fact, for a few years of the contract, up to 60% of Sherritt's feed could be supplied through the 15-year feed agreement signed with Cubaniquel and the Union del Niquel.

In another development, Sherritt has entered into a five-year $1200 million investment program in Cubaniquel to upgrade Cuba's nickel-cobalt industry and realize expansion plans.

Sherritt's nickel-cobalt refinery located at Fort Saskatchewan, northeast of Edmonton, Alberta, produces cobalt metal in the form of briquettes pressed from the powder form and is the Western World's only producer of Standard (S) grade cobalt powder. Since 1992, Sherritt also produces ultrafine cobalt powder used as a bonding agent in the manufacture of tungsten carbide cutting tools and parts, as well as in the manufacture of diamond saw segments. As a result of importing feed from Cuba, however, Sherritt lost the U.S. powder market because of the U.S. embargo which bans imports of materials originating in Cuba.

On June 22, 1993, the governement of British Columbia ruled against the development of the Windy Craggy deposit located in the Tatshenshini wilderness area that environmentalists wanted to protect. Faced with two choices to resolve the issue, either to allow resource development in part of the region and have the land declared as having two vocations, or to prohibit resource development altogether, the government decided on the latter choice. The area will be permanently protected as a class "A" provincial park, the Tatshenshini-Alsek Provincial Park, which will be nominated as a world heritage site.

The provincial government mentioned it would negotiate financial compensation with Geddes Resources Ltd., the owner of the deposit, and 19 other mining companies holding claims in the area. The deposit, which hosts 297 Mt of reserves grading 1.38% copper and 0.06% cobalt with gold and silver credits, was valued at between $110 million and $620 million in January 1993 by the Commission on Resources and the Environment (CORE), a provincial government agency.

Before the end of the year, British Columbia's ombudsman promised to review the process that led to the provincial government decision for the creation of a park. This was to respond to concerns that the government abandoned the legal review process to statute on the project and that it was a purely political decision that ignored the concerns of industry and native groups.

Ego Resources, a junior mining company listed on the Toronto Stock Exchange, has agreed to purchase Cobatec, a private company that has developed a low-cost process to recover cobalt from high-grade feedstock. Using standard hydrometallurgical processes, Cobatec is planning on treating ore feed sourced in Northern Ontario. The treatment plant is expected to be operational in 1994.

Canada's most important cobalt export in 1993 was in the form of matte and "other intermediate products." This trade, directed mostly to Norway and the United States, generated nine-month revenues of $103.8 million, down 10.5% from 1992. By extension, the most important cobalt import on the basis of value was "unwrought cobalt." The greater portion of these products was imported from Zaire for transformation and made up 39% of total imports. As a general comment on trade, Canada's imports and exports of cobalt products were significantly reduced both in quantity and value in 1993 compared to 1992. Also, as a result of bilateral trade agreements, all cobalt products exported to the United States from Canada are now duty-free.

Canada's cobalt trade is significantly greater than indicated in the statistics because much of the cobalt imported or exported in ore, concentrates and matte is counted as nickel and copper imports/exports (therefore, it is not included in the cobalt statistics). For example, in the first nine months of 1993, Canada imported 16 841 t of Cuban nickel-cobalt matte valued at $89 million, while it exported to Norway 15 541 t of nickel-cobalt matte worth $252 million.

WORLD DEVELOPMENTS

Estimating from the Cobalt Development Institute's six-month production figure, the 1993 world production of refined cobalt will be about 18 500 t, or 14% less than in 1992. This figure includes 15 000 t supplied by member countries of the Institute, and 3500 t estimated to be the combined production of Russia, China, South Africa and Brazil. The decrease in production seen in 1993 continues the downward trend experienced in the past six years and may signal the start of a deficit period where consumption exceeds production.

Zaire

The economical and political situation in Zaire, until recently the world's largest cobalt-producing country, continued to deteriorate in 1993. Because of political wrangling, social unrest, and a lack of investment damaging the metal industry's infrastructure, Zaire's cobalt output is expected to be down to about 3500 t in 1993 compared to 6625 t in 1992 and 8790 t in 1991. The industry is said to be operating at 20% of capacity.

Outside aid from the United States or Europe to help resolve the situation is not expected until steps are taken to allow the transitional government, set up in December 1991, to govern Zaire. This should allow it to prepare the country for an election and to improve the economy. Western investments directly to Générale des Carrières et des Mines (Gécamines), the state-owned mining company, will not be made until it is privatized – something Zaire's President Mobutu does not favour. Experts agree that even after banks put the necessary financial packages back in place, Gécamines will need three to five years before it can produce at "normal" levels.

Near the end of 1993, the Shaba Province, which hosts most of Zaire's copper-cobalt resources, unilaterally proclaimed its autonomy and will revert to its former name, Katanga. Contrary to what happened in 1978 when the province tried the same and was rebuffed, it now appears that President Mobutu Sese Seko had already approved the move. The province is to impose taxes on all goods entering or leaving the region.

Zambia

Production from neighbouring Zambia, now the world's largest cobalt-producing country, was also reduced in 1993. Production in the first six months of the year was reported at 2236 t; however, improvements, minor changes and maintenance work carried out on the cobalt refineries in the second half of the year was expected to reduce production to a yearly total of about 4000 t. Zambia's production has been decreasing since its 1990 high of 4844 t because of a lack of capital to operate the plants properly.

Near the end of the year, Zambia's deputy minister for mines outlined the extent of the problem when he said that state-run Zambia Consolidated Copper Mines (ZCCM), which operates the country's copper-cobalt mines, could risk closure since the company was unable to secure funds for continued operations because of its debt position and its inability to service its loans. To that effect, ZCCM cut its workforce by some 850 senior workers.

Although earlier plans to privatize ZCCM would go a long way towards solving the company's problem by providing a much-needed impetus to investment, the benefits of foreign intervention are not clear to Zambians who worry that a careless privatization plan could deprive them of valuable resources.

Russia

Contraband or unregulated sales of cobalt from Russia continued to decline during 1993 following the trend started at the end of 1992. Therefore, there was less Russian cobalt for sale on the market. The dramatic change resulted from the application of tougher licences and border controls towards exports, while domestic consumers, who are forbidden to re-export material, are checked so supplies are carefully matched to their end production. In a further effort to control exports, the Foreign Trade Ministry of Russia ruled that, as of September 1993, the export of nonferrous metals was restricted to five companies, down from 132 previously licensed companies. This was aimed at stemming the losses to the Russian state from dumping, tax evasion and the illegal concealment of hard currency.

Russian production of cobalt, in step with nickel production, was reported as decreasing due to the breakdown of the production apparatus illustrated by mechanical problems and the lack of spare parts, and shortages of coking coal or feed at smelters and refineries. As usual, exact production figures were not released during the year but observers estimate the 1993 production in Russia to be anywhere between 2600 and 4000 t of cobalt, although production capacity was said during the year to be about 8500 t.

In another development, the Norilsk Nickel Concern, which accounts for about 70% of Russian cobalt, has realized the first stage of a partial privatization program by becoming a joint stock company through the sale of 5% of its shares. The ownership is expected to be split as follows: 38% to the state, 25% to be issued free of charge to the Concern's 250 000-strong workforce, 10% sold to employees at a preferential rate of 90% of par value, 10% reserved for future employees, 5% sold to the management of the Concern and, finally, 12% sold on the free market.

United States

Following the approval by the U.S. House of Representatives in May 1992 to dispose of 2722 t of cobalt from the National Defense Stockpile in fiscal year 1993, the Defense Logistics Agency (DLA) started offering for sale each month 113 t (250 000 lb) of cobalt granules and 45 t (100 000 lb) of cobalt rondelles. Cobalt rondelles grading 98.87% cobalt can be used in the chemical industry while cobalt granules grading 99.23% cobalt are suitable for the magnet and tool steel industries.

DLA sales were fairly popular during 1993, mostly with domestic chemical industry consumers interested in cobalt rondelles rather than in granules. About 350 t (771 400 lb) of cobalt was sold between March 24 and the end of December 1993. On average, stockpiled material sold at a discount of about US$2/lb compared to Russian material grading 99.3% cobalt. During fiscal year 1993, i.e., up to September 30, 1993, sales were worth US$7 million, equating an average price of US$11.51/lb.

Contrary to fears expressed earlier that DLA sales would depress market prices, industry observers were later of the opinion that the responsible approach taken by the DLA in consulting industry on details of the timing and quantity of sales, and by not accepting low bids, stabilized the North American domestic cobalt market. The size of the DLA supply was also seen as having a stabilizing effect on the market, balancing fears of a supply shortage from African suppliers.

Black Hawk Mining Inc. of Toronto is at the permitting stage for its Knox deposit located near Warren, Maine, in the United States. However, the company is keeping the project on a care and maintenance basis until metal prices appreciate. When that happens, the company will proceed with the permitting stage, which should take two years to complete, and then make a production decision. Reserves at the Knox deposit, estimated at close to 4.0 Mt grading 1.40% nickel, 0.64% copper and 0.12% cobalt, are, in part, amenable to open-pit mining. The company expects to produce 340 t of cobalt in concentrates annually. These concentrates would be sent to a smelter in Canada or abroad for processing.

A group of investors known as Blackbird Metals Inc. of New York is still considering plans to build a 5000-t/y cobalt refinery in Idaho in the United States and continued to seek financing for the project. The plant, located close to the Blackbird cobalt deposit and mined briefly in the early 1980s, would treat imported materials and scrap. Because of problems over environmental issues, there are no current plans to re-open the Blackbird cobalt mine. The last reserve figures published for this deposit were 4 Mt grading 1.2% copper and 0.65% cobalt. The refined cobalt produced at the plant would be 99.9% pure and suitable for use in the superalloy industry.

Tanzania

BHP Minerals International Exploration Inc. has agreed to finance all exploration costs up to the completion of a positive feasibility study in exchange for a 52.2% interest in the nickel-copper-cobalt-rich Kabanga deposit and a 60% interest in the Kagera deposit, both located in northwestern

Tanzania. Sutton Resources Ltd., a British Columbia-based junior mining company, will retain a 37.8% interest in the Kabanga deposit and 30% in Kagera, while the government of Tanzania holds the remaining 10% in each deposit.

The Kabanga and neighbouring Kagera deposits are located in an extensive nickel belt similar in geology to the ones in Canada and Australia. Drill estimated resources at the Kabanga deposit amount to 25.5 Mt grading 1.19% nickel, 0.20% copper and 0.10% cobalt amenable to production by open-pit. Additional exploration is being done to extend reserves at Kabanga, to investigate other showings to the north near Kagera, and to explore the belt's extension in nearby Burundi.

As reported by the *Metal Bulletin*, the cost of building a smelter complex at Kabanga, with a production capacity of 24 000 t/y of nickel, 3000 t/y of copper and 1400 t/y of cobalt, is estimated at US$210 million because of the project's remoteness from power sources and shipping points. Calculations of cash costs indicate that the project may be viable at current base-metal prices. However, the project could not be brought into production before at least five years.

Uganda

A feasibility study for the Kasese cobalt project recently recommended the construction of a combined biological oxidation, solvent extraction and electrowinning plant to extract 1000 t/y of cobalt cathode from cobaltiferous pyrite concentrates recovered from waste dumps at the old Kilembe copper mine in western Uganda. These dumps are said to contain around 1.1 Mt of pyrite concentrate grading an average of 1.4% cobalt.

The Kasese Cobalt Company Ltd. (KCCL), set up by joint venture partners the Bureau de Recherches Géologiques et Minières (BRGM), a French government agency (27.5%), Barclays Metals Ltd. (27.5%), and the Ugandan government (45.0%) (through state-owned Kilembe Mines), was active in 1993 conducting tests at the pilot plant stage. A 65-m^3 bioleach tank was constructed and was operational in the last few months of 1993. The pilot plant proved the efficiency of the extraction process and will be used to assist with engineering design for the commercial plant.

By the end of 1993 financing for the project was being finalized through the Multilateral Investment Guarantee Agency (MIGA), part of the World Bank, and commercial banks. However, as a last hurdle before construction begins on the commercial cobalt plant, KCCL is now waiting on results of a separate study on the feasibility of constructing hydro-generating facilities for the project in the Mobuku area. If results are positive, the full-scale cobalt plant could be in operation by 1996 at a rate of 500 t/y and be at full capacity by 1998.

Cuba

Union del Niquel (UNI), Cuba's state-owned nickel producer, is working on starting production of metallic cobalt within five years. To this effect, a nickel-cobalt separation plant is planned for construction at the newly built Las Camariocas plant, a fourth smelter operation in Cuba where nickel-cobalt sulphide concentrates are produced.

The United Nations Development Programme (UNDP), for several years now, has been helping Cuba develop a new technique for processing nickel and cobalt ores that is less damaging to the environment. Work is under way at the Commandante Pedro Sotto Alba plant at Moa to improve the pressure-leaching processing method, which uses sulphuric acid. Also at Moa, UNI has been working on solvent extraction technologies for the production of cobalt and nickel salts. The cobalt salts are being tested for the feedstock market.

Mexico

International Curator Resources Ltd. (International Curator), a Vancouver-listed junior mining company, is studying the possibility of re-opening the Boleo copper-cobalt mine located 3 km inland from the port city of Santa Rosalia, Mexico, on the Gulf of California. The Boleo deposit, in operation between 1886 and 1947, is hosted in dark-coloured tuff beds and is metallurgically complex. The mineralization occurs in flat-lying seams, averaging 1.2 m in thickness, which contain both sulphide and oxide ore.

International Curator, with Coeur d'Alene Mines, who is spending US$6 million or more to complete a feasibility study in order to gain a half interest in the project, has just completed a 22-hole, 1508-m diamond drill program to confirm the reserves while metallurgically testing to determine whether solvent extraction-electrowinning can be applied to the Boleo material. The companies are planning to begin test mining in 1994 to determine the suitability of various mining methods to mine the thin flat-lying zones. A preliminary pre-feasibility study is expected to be completed by May 1994. Mining reserves are estimated at 15.7 Mt grading 2.67% copper and 0.08% cobalt, when a dilution factor of 30% and cutoff grades of 0.5% copper and 0.015% cobalt are taken.

Japan

Japan has decided to boost its rare metals stockpile levels. The Ministry of International Trade and Industry (MITI) has appropriated US$32 million to purchase stockpile material for fiscal year 1993. Its target for cobalt is to increase the stockpile to equal 60 days of consumption by the end of fiscal year 1995. Stocks now amount to about 46 days of consumption. If Japan's 1990 cobalt consumption level is taken as a reference, 150 t of cobalt will have to be bought by the end of 1995 to reach the fixed goal.

PRICES

In 1993, the cobalt market was somewhat unstable in response to supply disturbances. Because of the flat world demand resulting from recessions in Japan and Europe, and because of the ready availability of the metal on the market, prices pursued the downward trend started in early 1992. However, responding to reports of additional riots in Zaire, which might affect production further, and to a tightening in the supply of Russian cobalt on the market, prices increased for a short period of time in February and March (see Figures 1 and 2 on next page).

The price for Russian material bottomed out during the summer at around US$9.25/lb while the higher-grade, Western-origin cobalt reached its year low of US$11.60/lb in November, also after dipping during the summer. Finally, in December a rapid hike brought the price of high-grade cobalt in the range of US$15-$17/lb, and that of Russian-grade cobalt to US$14.00-$14.50/lb.

Although a price increase had been expected for a while because of a developing tightness in supply, the rapid movement was felt to result from the activity of merchants, who were rumoured earlier in the year to be stockpiling while on the lookout for rising prices. Prices, however, were still on the rise in early January 1994 with Western-grade cobalt trading in the US$22.50-$24.50/lb range, and Russian-grade in the US$17.50-$18.50/lb range. Producers were quick to point out that the price hike was too rapid and would result in big consumers looking at other materials to replace cobalt.

Although the African producer price, fixed at US$18/lb in November 1992, was kept at that level for all of 1993, it did not have the anticipated stabilizing effect on the market. In fact, it was reported that no attempt was made by Zairians and Zambians to stick to the producer price. They were selling as they saw fit, offering discounts on larger quantities to more important users in order to stay competitive after consumers stopped being reluctant to use cheaper, lower-grade material for most applications other than alloying. As a result of this, the price premium between lower-grade Russian cobalt and Western high-grade material narrowed from US$4/lb in January to no more than US$0.50-$1.00/lb in September.

By the end of the year, African producers had still not announced the new producer price for 1994 which is usually settled in November. Some market observers were quick to speculate that Zaire and Zambia were about to move away from the established fixed price contracts toward free market pricing. Given their reduced control of the market and their apparent disinterest in meeting to decide on a price level, the story may have some truth.

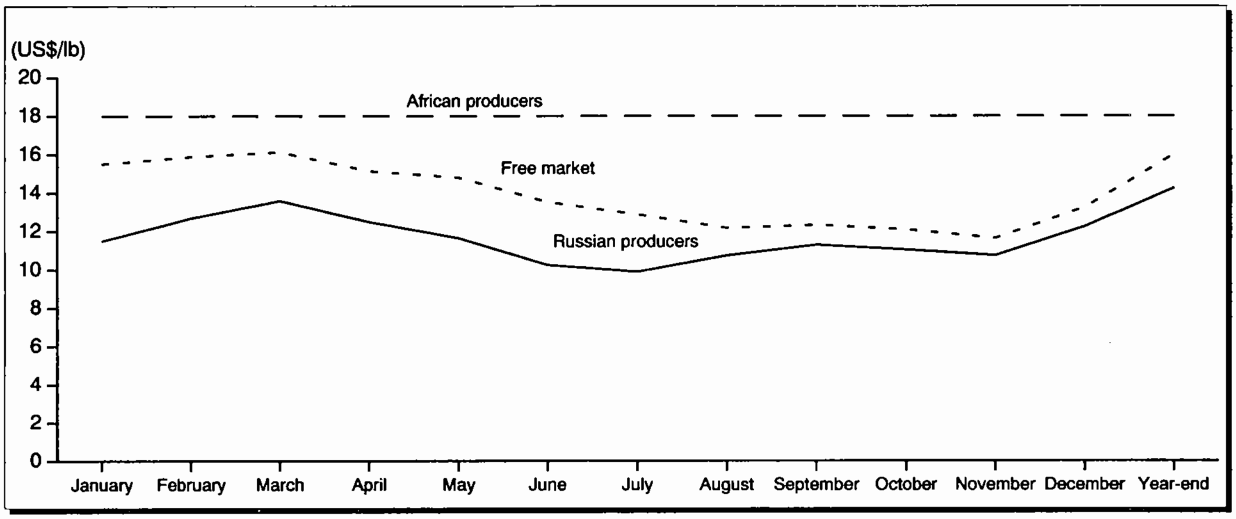
As a result of the volatility and downward trend in prices, consumers in 1993 continued their habits of 1992 by buying their immediate needs on the spot market instead of taking longer-term contracts, and by running down their stocks. With market availability tightening, this may cause a supply shortage in the short term and push prices up.

OUTLOOK

In Canada, the 1994 production of refined cobalt is expected to increase by 19% to 2800 t. Inco Limited is forecasting production at 1000 t of refined cobalt, 225 t less than was expected, due to extended shut-downs of its operations during the year. The company has already announced that the Sudbury operations will be shut for eight weeks from January 3 to February 27, 1994, and for a one-month period during the summer. Its Thompson, Manitoba division will also close, but for a four-week period from December 27, 1993 to January 24, 1994, and then resume operating on a four-day-a-week basis until a four-week vacation shut-down in July 1994. Production at Falconbridge Limited is expected to increase by about 8% compared to 1993, bringing its world cobalt output to 2600 t. Finally, the production of Sherritt Inc. is planned to reach 1800 t following the recent expansion of its refinery.

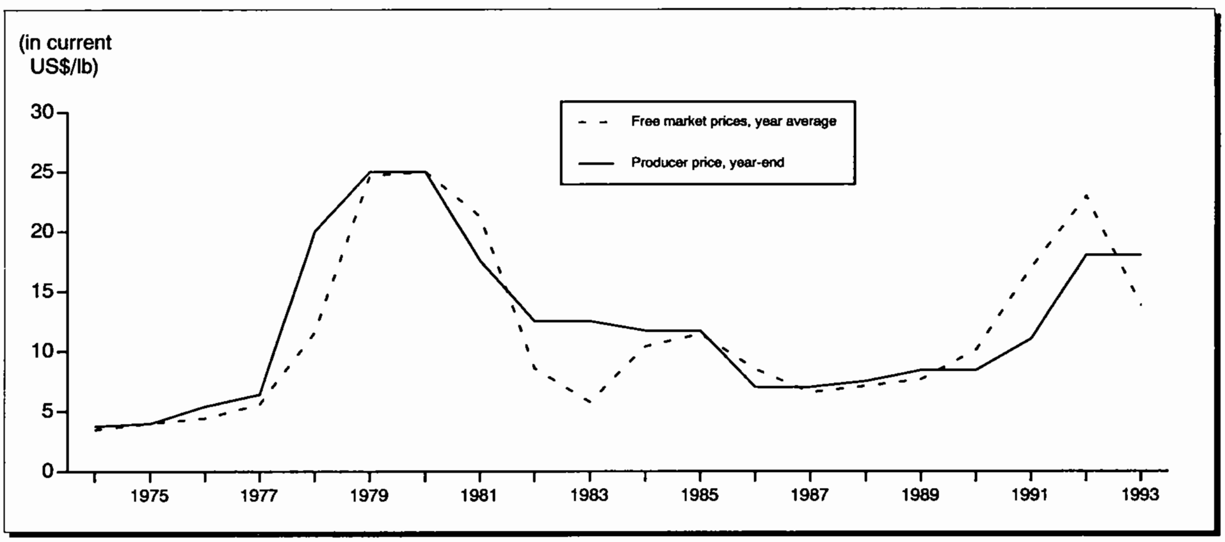
In 1994, because of production disruptions in Zaire, Zambia and Russia, and production cutbacks in the nickel industry which will also affect the production of cobalt, but in a lesser way, the

Figure 1
Cobalt Price Variations, 1993



Sources: Metals Week; Mining Journal; Reuters.
Note: Quotes are for spot cathode.

Figure 2
Cobalt Price Variations, 1974-93



Source: Metals Week.
Note: Quotes are for spot cathode.

world production of refined cobalt is projected to reach 16 200 t, a decrease of about 18% compared to 1993. Additional sales from the strategic stockpile in Russia or from the U.S. DLA, which has the authority to sell up to 2000 t of cobalt in 1994, or additional output of cobalt from Western producers shifting their production or hiking imports of higher-grade feed, however, could come into play to offset the production loss.

In contrast to declining production, the world's consumption of cobalt is expected to increase, albeit slowly. The superalloy sector, which typically used 40% of cobalt production, is not expected to significantly increase its consumption until the commercial segment of the aircraft industry recovers, which is slated for the end of 1994 or early 1995 as major airlines replace their ageing fleets of 747s. Meanwhile, the strong demand for alloys for industrial gas turbines used in power generation and marine transport should replace some of the aircraft industry's business. Consumption in the chemical sector, the second most important segment of the market, has already improved significantly, mostly in the recording tape industry in Japan, while consumption in the magnet segment is decreasing because of substitution in uses. Finally, consumption in the cemented carbides and hard facing-tool steel segments of the cobalt market should increase as the world economy improves.

In the longer term, the use of cobalt in the chemical industry should expand as new applications are found in the tire and medical industries. Continued tight supply in the market and the lack of price stability, however, hampers the growth of the cobalt industry and favours the switch to substitutes.

In 1994, the decline in production, coupled with an increase in consumption, is expected to cause a supply deficit. The lack of inventory on the part of both traders and consumers following the destocking and hand-to-mouth buying that prevailed during 1993 should result in stronger demand in the short term. This will send prices up until the market slowly re-balances.

Note: Information in this review was current as of January 14, 1994.

TARIFFS

Item No.	Description	Canada MFN	Canada GPT	Canada USA	United States Canada
2605.00	Cobalt ores and concentrates	Free	Free	Free	Free
2822.00.10	Cobalt hydroxides	Free	Free	Free	Free
2822.00.90	Cobalt oxides, commercial cobalt oxides	9.8%	Free	Free	Free
2827.34	Cobalt chloride	12.5%	8%	Free	Free
2833.29.00.40	Cobalt sulphate	9.2%	6%	Free	Free
2836.99.00.20	Cobalt carbonates	12.5%	8%	Free	Free
2915.23	Cobalt acetates	12.5%	8%	Free	Free
8105.10.10	Cobalt mattes and other intermediate products; unwrought cobalt, alloyed; waste and scrap; powders, alloyed	10.2%	6.5%	Free	Free
8105.10.20	Unwrought cobalt, not alloyed; powders, not alloyed	Free	Free	Free	Free
8105.90.10	Cobalt bars and rods, not alloyed	6.8%	Free	Free	Free
8105.90.90	Cobalt and articles thereof, n.e.s.	10.2%	6.5%	Free	Free

Sources: Customs Tariff, effective January 1994, Revenue Canada, Customs and Excise; Harmonized Tariff Schedule of the United States, 1994.
n.e.s. Not elsewhere specified.

TABLE 1. CANADA, COBALT PRODUCTION AND TRADE, 1992 AND 1993, AND CONSUMPTION, 1990-92

Item No.		1992		1993p	
		(kilograms)	($000)	(kilograms)	($000)
PRODUCTION[1]	(All Forms)				
	Ontario	1 705 767	100 797	1 994 454	75 600
	Manitoba	517 095	30 556	375 121	14 219
	Total	2 222 862	131 353	2 369 575	89 819
EXPORTS				**(Jan.-Sept.)**	
2605.00	Cobalt ores and concentrates	–	–	–	–
2822.00	Cobalt oxides and hydroxides; commercial cobalt oxides				
	United Kingdom	480 779	22 856	258 291	10 094
	United States	1 613	105	3 225	186
	Australia	6 573	322	2 344	82
	Total	488 965	23 284	263 860	10 363
2915.23	Cobalt acetates	–	–	–	–
8105.10	Cobalt, unwrought, matte and other intermediate products, waste, scrap and powders				
	Norway	1 373 500	66 874	608 559	51 056
	United States	887 953	47 687	513 094	20 468
	Japan	109 289	7 227	233 597	9 926
	Netherlands	70 100	4 033	205 720	8 912
	United Kingdom	223 974	13 620	183 506	7 304
	Other countries	251 965	15 209	141 558	6 100
	Total	2 916 781	154 650	1 886 034	103 766
8105.90	Cobalt and articles thereof, n.e.s.				
	United States	6 042	631	6 355	905
	Germany	7 594	648	4 284	361
	Japan	79	17	5 001	162
	Other countries	32 609	1 323	524	103
	Total	46 324	2 619	16 164	1 531
IMPORTS					
2605.00	Cobalt ores and concentrates				
	United States	5 689	135	3 762	77
	People's Republic of China	3 810	62	–	–
	Total	9 499	197	3 762	77
2822.00.10	Cobalt hydroxides				
	United States	31 832	1 517	19 573	644
	Belgium	12 000	565	9 000	325
	Japan	9 561	540	7 000	309
	United Kingdom	3 000	75	–	–
	Total	56 393	2 698	35 573	1 278
2822.00.90.10	Cobalt oxides				
	United States	4 541	162	4 914	137
	Greece	1 960	84	–	–
	Belgium	888	22	–	–
	Total	7 389	269	4 914	137
2822.00.90.20	Commercial cobalt oxides				
	United States	30	. . .	508	12
	United Kingdom	54	1	74	1
	Total	84	2	582	14
2827.34	Cobalt chlorides				
	United States	383 865	2 259	272 261	1 550
	Other countries	686	9	1 062	13
	Total	384 551	2 269	273 323	1 563
2833.29.00.40	Cobalt sulphate				
	United States	22 652	312	27 341	247
	People's Republic of China	20 000	270	17 000	240
	Brazil	–	–	5 000	102
	Other countries	586	8	–	. . .
	Total	43 238	591	49 341	591

TABLE 1 (cont'd)

Item No.		1992 (kilograms)	1992 ($000)	Jan.-Sept. 1993p (kilograms)	Jan.-Sept. 1993p ($000)
IMPORTS (cont'd)					
2836.99.00.20	Cobalt carbonates				
	United States	20 002	533	24 828	730
	Australia	–	–	21 360	470
	Other countries	36 076	660	2 297	58
	Total	56 078	1 193	48 485	1 258
2915.23	Cobalt acetates				
	United States	11 848	205	3 160	36
	United Kingdom	104	1	–	–
	Total	11 952	207	3 160	36
8105.10.10.10	Unwrought cobalt; powders; mattes and other intermediate products, alloyed				
	United States	18 144	1 009	16 544	596
	Other countries	151	9	934	52
	Total	18 295	1 018	17 478	648
8105.10.10.20	Cobalt waste and scrap				
	United States	160 337	793	81 616	260
	Italy	–	–	19 377	115
	Zaire	398 204	23 541	–	–
	Other countries	57 122	1 324	133	7
	Total	615 663	25 658	101 126	382
8105.10.20.10	Unwrought cobalt, not alloyed				
	Zaire	380 296	24 987	164 850	7 118
	Russia	. .	. .	8 455	301
	United States	12 691	568	6 991	144
	Other countries	55 908	2 396	1 636	63
	Total	448 895	27 951	181 932	7 626
8105.10.20.20	Cobalt powders, not alloyed				
	United States	41 812	3 476	21 170	1 192
	United Kingdom	38 825	2 770	19 598	954
	Other countries	2 183	193	14 453	708
	Total	82 820	6 439	55 221	2 854
8105.90.10	Cobalt bars and rods, not alloyed				
	United States	1 094	65	1 491	111
	Other countries	676	57	376	27
	Total	1 770	122	1 867	138
8105.90.90	Cobalt and articles thereof, n.e.s.				
	United States	29 372	3 112	29 857	2 961
	Germany	842	83	712	73
	Other countries	2 353	144	1 197	53
	Total	32 567	3 339	31 766	3 088

	1990	1991	1992p
		(kilograms)	
CONSUMPTION[2]			
Cobalt contained in:			
Cobalt metal and metallic compounds	76 068	72 554	67 381
Cobalt pigments, feed and ground coat frit	13 068	9 039	5 801
Cobalt salts and driers and other uses[3]	105 069	84 315	131 542
Total	194 205	165 908	204 724

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available; . . . Amount too small to be expressed; n.e.s. Not elsewhere specified; p Preliminary.
[1] Production (cobalt content) from domestic ores. [2] Available data reported by consumers. [3] Other uses include glass and chemicals.
Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, COBALT PRODUCTION, TRADE AND CONSUMPTION, 1975 AND 1980-93

	Production[1]	Exports			Imports	Consumption[4]
		Cobalt Metal	Cobalt Oxides and Hydroxides	Cobalt Ores[2]	Cobalt Oxides and Hydroxides[3]	
	(tonnes)					
1975	1 354	431	561	. .	. .	123
1980	2 118	325	1 091	2	26	105
1981	2 080	677	601	24	20	101
1982	1 274	585	212	2	30	81
1983	1 410	885	192	45	30	101
1984	2 123	1 487	373	14	27	113
1985	2 067	1 551	268	36	192	101
1986	2 297	1 805	374	20	31	96
1987	2 490	1 875	440	45	38	120
1988	2 398	3 062	953	98	37	159
1989	2 344	3 236	371	22	33	147
1990	2 184	3 039	391	–	73	194
1991	2 171	3 456	459	–	42	166
1992	2 223	2 963	489	–	64	205
1993p	2 370	1 902a	264a	–a	41a	. .

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available; p Preliminary.
a First nine months only.
1 Production from domestic ores and cobalt content of intermediate products exported, including cobalt content of Inco Limited and Falconbridge Limited shipments to overseas refineries. 2 Cobalt content. 3 Gross weight.
4 Reported consumption of cobalt in metal, oxides and salts.

TABLE 3. WESTERN WORLD COBALT PRODUCTION, 1991-93

	1991	1992	1993
		(tonnes)	
Falconbridge	1 983	2 300	2 414
Gécamines	8 790	6 625	2 200
Inco	1 385	1 465	1 410
Outokumpu Oy	1 503	2 100	2 200
Sherritt	823	686	1 218
Sumitomo	185	105	190
Z.C.C.M.	4 817	4 610	4 211
Total	19 486	17 891	13 843

Source: Cobalt Development Institute.

Copper

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Copper prices declined significantly in 1993 due to the combined effects of relatively lacklustre demand and continuing high mine output levels. While there was significant growth in demand in the important U.S. market, this was offset by weakness in Europe and Japan. With the build-up of inventory levels through 1993 and the prospect of slow overall economic growth in the major industrialized nations during 1994, it is unlikely that there will be any major sustained increase in copper prices in the short term.

During 1993, Western World production of refined copper increased to about 9.0 Mt from 8.9 Mt in 1992. Western World copper consumption in 1993 increased to about 9.3 Mt from 9.1 Mt in 1992. Copper prices averaged US$0.87/lb in 1993 compared to $1.04/lb the previous year.

CANADIAN DEVELOPMENTS

Copper shipments (recoverable copper) from Canadian mines in 1993 declined to about 699 000 t ($1.76 billion) from 762 000 t ($2.14 billion) in 1992. During 1993, refined copper production increased to 553 000 t from 539 000 t in 1992.

The reduction in copper shipments was due to a number of temporary mine closures which resulted largely from the weakness of metal prices. In addition, there were several permanent mine closures in 1992 and 1993 due to the exhaustion of ore reserves.

British Columbia

In June 1993, British Columbia announced the creation of the Tatshenshini-Alsek Wilderness Park in the northwestern part of the province and stated that it would seek to have the park designated as a World Heritage Site. Within the park boundaries, no resource exploitation will be permitted. For the mining industry, the creation of the park will prevent the development of the large Windy Craggy copper deposit of Geddes Resources Ltd. as well as a number of other potentially attractive deposits in this area. Negotiations between the government of British Columbia and the mining companies whose mineral claims have been expropriated are expected to begin in 1994.

While the mineral industry voiced considerable opposition to the banning of mining activity in the Tatshenshini-Alsek region, it was particularly critical of the process followed by the provincial government. It has been reported that British Columbia's ombudsman will review this matter.

In northwestern British Columbia, Redfern Resources Ltd. continued work on its Tulsequah Chief and Big Bull properties. Mineable reserves at Tulsequah Chief are estimated at about 7 Mt grading 1.4% copper, 1.1% lead and 6.4% zinc, plus silver and gold.

New Canamin Resources Ltd. plans to continue exploration work in 1994 at its Huckleberry deposit near Kemano. The East zone deposit contains a geologic resource of about 69 Mt grading 0.57% copper, while the Main zone contains 31 Mt grading 0.52% copper.

At the South Kemess property, located in the Toodoggone area, El Condor Resources Ltd. completed a pre-feasibility study which indicated that the proposed development would be profitable. Mineable reserves for the property total 200 Mt grading 0.22% copper and 0.6 g/t gold. Based on a mine life of 15 years, annual copper production would total about 26 000 t of contained copper and 6600 kg of gold. Development costs for the project are estimated at $374 million. In January 1994, it was reported that Pegasus Gold Inc. had agreed to acquire El Condor Resources by issuing $108 million in Pegasus common shares.

At the Gibraltar copper mine in central British Columbia, low copper prices forced Gibraltar Mines Ltd. to schedule a 24-day summer shutdown followed in September by a 50% scale-back of its mining and milling operations in order to reduce operating costs. However, with further deterioration of copper prices in the fall, the company suspended all mining activities on December 1, 1993. The closure, which forced the company to lay off 125 of the 196 full-time employees, did not affect the operation of the solvent extraction/electrowinning facility at the Gibraltar site. At the time of the shut-down, it was reported that unit operating costs at the mine were about US$0.90/lb of copper. In 1992, Gibraltar produced about 32 000 t of copper in concentrate.

At the end of 1993, Placer Dome was awarded a mine development certificate for its Mt. Milligan copper-gold property located northwest of Prince George. However, it is unlikely that the $440 million project will proceed until there is a significant increase in metal prices.

Princeton Mining Corporation implemented a temporary closure at its Similco copper mine near Princeton on November 30. The closure, which forced the layoff of about 270 workers, was blamed on depressed copper prices and high operating costs. The mine produced about 26 000 t of copper in concentrates during 1992. At the time of the closure, it was reported that unit operating costs were estimated at between US$0.90 and $1.00/lb of copper.

Equity Silver Mines Ltd. ceased mining operations at its mine near Houston in January 1994 due to the depletion of ore reserves. The mine produced about 3800 t of copper in concentrate in 1992.

In April, production at the Myra Falls copper-zinc mine of Westmin Resources Ltd. was suspended when the company locked out workers during a labour dispute. For the remainder of 1993, the company used its non-union workforce to undertake maintenance and development work as well as some limited production. In 1992, Westmin produced about 35 000 t of zinc and 18 000 t of copper in concentrate.

Early in 1994, Highland Valley Copper declared force majeure on its shipments of copper concentrates due to a strike of longshoremen in British Columbia. However, several days after the announcement, the federal government legislated an end to the strike. Highland Valley Copper, which is the largest copper producer in Canada, is owned by Cominco Limited, Rio Algom Limited and Teck Corporation.

Ontario

As a result of the continuation of depressed nickel markets, Inco Ltd. announced plans for production cutbacks in 1994. It is expected that these cutbacks will reduce Inco's Canadian copper output in 1994 by about 10%, or roughly 10 000 t.

In October, Falconbridge Ltd. announced that underground exploration had indicated major extensions at its Kidd Creek orebody in Timmins. The company said the results demonstrated that the main orebody extends below the 5600-foot level, which is the bottom of existing proven and probable reserves, to at least the 7400-foot level. While exploration work will continue, the results indicate at least 10 Mt of additional reserves, which will provide several additional years of mine operation.

Quebec

Development continued in 1993 on the Louvicourt deposit near Val-d'Or. The operation, which is expected to begin commercial production in October 1994, will cost approximately $350 million. During its planned 12-year operating life, Louvicourt is expected to produce an average of about 50 000 t/y of contained copper and 20 000 t/y of zinc, as well as significant amounts of gold and silver. It is expected that the orebody will be developed in a manner that will provide a higher copper output during the first several years of operation. Geological reserves of the deposit total 15.7 Mt grading 3.4% copper, 2.2% zinc, 31 g/t silver and 0.9 g/t gold. The Louvicourt deposit is owned by Aur Resources Inc. (30%), Novicourt Inc. (45%) and Teck Corporation (25%).

In February, MSV Resources Inc. acquired the Copper Rand and Portage mines in the Chibougamau area from Westminer Canada Limited. The company subsequently re-opened the two copper-gold operations that had been closed since November 1992. Proven and probable reserves at the two mines total 1.9 Mt grading 1.6% copper and 4.1 g/t gold.

New Brunswick

Brunswick Mining and Smelting Corporation Limited closed the Heath Steele mine in July due to depressed market prices for lead and zinc. The company has stated that the re-opening of the mine will depend on market conditions. In 1992, the operation produced about 4000 t of contained copper.

Yukon

Thermal Exploration Co. and Western Copper Holdings continued work on their Carmacks

Copper deposit (formerly Williams Creek), which is located approximately 230 km north of Whitehorse. Diluted open-pit reserves at the site total 11.3 Mt grading 1.15% copper plus 0.5 g/t gold. Development plans for this property envisage a solvent extraction/electrowinning (SX/EW) operation that would produce up to 14 000 t/y of copper cathode. As part of a feasibility study for the proposed operation, which would be the world's most northerly mine to employ the SX/EW process, the company has undertaken extensive metallurgical test work at the site. Development costs for the project are estimated at about $40 million.

Pacific Sentinel Gold undertook significant exploration work in 1993 at its Casino copper-gold-molybdenum property in the southern Yukon. Geologic reserves are estimated at about 530 Mt grading 0.26% copper, 0.025% molybdenum and 0.3 g/t gold. Within this total there exists a supergene-enriched zone containing an estimated 86 Mt grading 0.43% copper, 0.031% molybdenum and 0.4 g/t gold.

Northwest Territories

Metall Mining Corp. began work on a feasibility study for its Izok Lake deposit, located approximately 360 km northeast of Yellowknife. Mineable ore reserves are now estimated at 16.6 Mt grading 2.2% copper and 11.5% zinc, plus lead, silver and gold. With a production rate of about 3000 t/d of ore, the mine would produce about 100 000 t/y of copper concentrates. This would be shipped to markets via a new port facility on the Coronation Gulf. In February 1994, Metall announced it was deferring the project due to high infrastructure costs and depressed zinc prices.

In the Coronation Gulf area, exploration work was undertaken at the High Lake copper-zinc deposit of Kennecott Canada Inc. and Aber Resources Limited. Previous work at the site had identified reserves of 5 Mt grading 3.5% copper, 2.5% zinc and 0.8 g/t gold.

World Developments

Western World mine production of copper in 1993 decreased slightly to an estimated 7.5 Mt from 7.6 Mt in 1992. The production of Western World refined copper, which includes metal derived from both primary and secondary material, increased in 1993 to an estimated 9.0 Mt from 8.9 Mt one year earlier.

Argentina

In early 1994, Musto Exploration of Argentina, a subsidiary of Canadian-based International Musto Explorations Ltd., signed a joint-venture agreement with MIM Holdings Ltd. for the development of Musto's Bajo de la Alumbrera copper-gold property in northwestern Argentina. The mine, which could begin production in late 1996 or early 1997, will produce about 115 000 t/y of copper in concentrate and over 11 000 kg/y of gold. Development costs for the project are estimated at US$600 million. The deposit contains reserves of 494 Mt grading 0.53% copper and 0.68 g/t gold.

Chile

Chilean copper production increased 6% to about 2.04 Mt in 1993. It is expected that production in 1994 will increase to about 2.15 Mt.

State-owned Corporacion Nacional del Cobre (Codelco) produced 1.14 Mt of copper in 1993, the same level as in 1992. Output at the company's Chuquicamata mine was expected to decline to 615 000 t in 1993 from 628 000 t in 1992 while, at the El Teniente mine, production was expected to fall to 301 000 t in 1993 from 314 000 t in 1992.

As a result of declining ore grades at several of its existing mines, Codelco's production will begin to decline in the next several years. In 1994, the company expects that its total mine output will fall to about 1.13 Mt. In order to reverse this downward trend, Codelco plans to develop several new orebodies. One of the largest of these projects is the Radomiro Tomic development, located 6 km north of the Chuquicamata mine, which will produce 150 000 t/y of copper cathode. Costs for developing this mine are estimated at US$450 million. While Radomiro Tomic is scheduled for completion in 1997, financing arrangements for the project have yet to be finalized. Reserves at the Radomiro Tomic deposit total 691 Mt grading 0.73% copper.

In January 1994, it was reported that Codelco had incurred losses of US$200 million on futures contracts on copper, gold and silver. The losses sparked a number of resignations by Codelco executives and an official inquiry by the Chilean government.

The La Escondida complex, which is owned by The Broken Hill Proprietary Company Limited (BHP) (57.5%), RTZ Corporation PLC (30%), a Japanese consortium (10%) and International Finance Corp.

(2.5%), produced approximately 389 000 t of contained copper in concentrate during 1993 compared to 337 000 t in 1992. During 1993, Escondida reported that construction on its new ammonia leach facility was ahead of schedule with project completion expected in the second half of 1994.

Escondida announced in January 1994 that it was considering an additional US$500 million expansion of the mine to over 100 000 t/d by the end of 1995. At this mining rate, Escondida would produce about 700 000 t/y of copper in concentrate.

In October, it was reported that Minera Lince Ltda. (name subsequently changed to Minera Michilla SA) would increase the capacity of its El Lince mine to 50 000 t/y from 25 000 t/y of electrowon copper.

Empresa Minera de Mantos Blancos announced at the beginning of 1994 that its Mantos Blancos development project was proceeding on schedule. While copper output will increase by only 6000 t/y to 80 000 t/y, the principal objective of the project will be to boost reserves and thereby extend the mine's life. It was also reported that the company would proceed with the construction of a 30 000-t/y SX/EW plant to replace existing ingot and cement operations.

The company also plans to bring its Manteverde copper oxide deposit in northern Chile into production in mid-1995. It is expected that Manteverde will produce about 42 000 t/y of copper cathode.

With the completion of a US$440 million expansion project, Minera Disputada de Las Condes S.A., a subsidiary of Exxon Minerals Chile, Inc., reported that copper production at its Los Bronces mine increased to 118 000 t in 1993 compared to 61 000 t in 1992. In November, Minera Disputada announced that it had temporarily closed its Chagres smelter in order to ensure that sulphur dioxide emissions did not exceed ambient air-quality standards. The company expected that the closure would remain in effect for the remainder of the year. With the completion of a US$200 expansion and modernization of the smelter in 1994, capacity will increase to 120 000 t/y from 74 000 t/y, while sulphur dioxide emissions will be significantly reduced.

Phelps Dodge Corporation and Sumitomo Metal Mining Co. Ltd. continued work on the development of their La Candelaria project. The mine, which will begin production in 1995, will produce 108 000 t/y of copper and about 2500 kg/y of gold. Development costs for the project are estimated at US$538 million.

Codelco announced in October that Cyprus Lac Minerals Company, a 50/50 partnership between Lac Minerals Ltd. and Cyprus Minerals Company (name subsequently changed to Cyprus Amax Minerals Company), had been the successful bidder for a 51% interest in the large El Abra copper deposit in northern Chile. Details of the bid included the payment by Cyprus Lac of US$404 million to Codelco on closing and the contribution to the venture equity of up to $151 million on Codelco's behalf. The initial El Abra development will be an SX/EW operation that will eventually produce 225 000 t/y of copper cathode. Oxide ore reserves, which total about 500 Mt grading 1% copper, are sufficient to sustain the operation for about 20 years. The deposit also contains large sulphide reserves that could be developed in the future.

Early in 1994 it was reported that the finalization of the agreement between Codelco and Cyprus Lac had been delayed to resolve variances between assays.

At the beginning of 1994, Teck Corporation announced that work on the 75 000-t/y Quebrada Blanca SX/EW project was on schedule but was slightly over budget. Production is expected to begin in mid-1994. Capital costs for the project are estimated at about US$360 million. The Quebrada Blanca property is owned 42.5% by Cominco, 29.25% by Teck Corporation, 10% by Empresa Nacional de Mineria (ENAMI), 10% by Cominco Resources International Ltd., and 5% by Sociedad Minera Pudahuel (SMP). Copper oxide reserves at Quebrada Blanca, which total 85 Mt grading 1.35% copper, are sufficient to sustain the operation for at least 14 years.

Placer Dome Inc. and Outokumpu Copper Resources B.V. announced that they would proceed with their Zaldivar SX/EW project in northern Chile. The mine, which will produce about 125 000 t/y of copper cathode, is expected to be completed in the second half of 1995. On the basis of a feasibility study completed by Placer in 1993, mineable ore reserves were calculated at 246 Mt grading 1.02% copper plus an additional dump leach reserve of 70 Mt grading 0.41% copper. Development costs for the project are estimated at about US$600 million. Copper production costs at Zaldivar are expected to be about US52¢/lb.

Rio Algom Ltd. plans to begin production at its Cerro Colorado SX/EW mine project in early 1994 and reach the planned output of 40 000 t/y of copper cathode in 1995. The Cerro Colorado deposit contains reserves of 79 Mt grading 1.39% copper.

At the Collahuasi deposit of Falconbridge Limited, Shell Chile SA and Minera Mantos Minorco Limitada (a joint venture between Minorco SA and Empresa Minera de Mantos Blancos), a feasibility study is expected to be completed in 1994. The project, which would produce up to 300 000 t/y of copper in concentrate and 50 000 t/y of copper cathode, is expected to cost US$1 billion. Reserve estimates for the property, which includes three separate orebodies, are 1.7 billion t grading 1% copper. The project would likely come on stream in 1998.

At the Ivan copper property near Antofagasta, Minera Rayrock Inc. expects to begin production in the third quarter of 1994. The operation, which will employ both sulphuric acid and bio leaching technologies, is expected to produce about 10 000 t/y of copper cathode. Capital costs for the project are estimated at US$31.6 million.

In October, it was reported that Inco Limited had signed a joint-venture contract with Codelco to conduct an exploration program on the Mamina copper project in northern Chile. Elsewhere in Chile, Princeton Mining Corporation will undertake an exploration program at its Elenita copper property. The deposit, which would be amenable to the SX/EW recovery process, contains an estimated reserve of about 27 Mt grading 1.5% copper.

Canada Tungsten Inc. acquired an option in 1993 to gain a 70% interest in the Andacollo copper property from state-owned Empresa Nacional de Mineria (ENAMI). In 1992, Placer Dome withdrew from the Andacollo project when it concluded that the economics of the potential development were insufficient to warrant further investment.

During 1993, Refinadora de Metales SA (Refimet) commissioned its new 95 000-t/y copper smelter near Antofagasta. The cost of the smelter was US$57 million. The company was reported to be considering a further expansion to 160 000 t/y by 1998.

ENAMI announced at the beginning of 1994 that the modernization project at its Las Ventanas smelter would be completed in 1996. The principal objective of this modernization will be to reduce sulphur dioxide and particulate emissions. While the company had originally anticipated that this modernization would result in the slight reduction of smelting capacity to 370 000 t/y of concentrate, it subsequently announced that the project had been modified in order to keep smelting capacity at about 420 000 t/y.

Peru

Peru's copper production in 1993 increased to 375 000 t from 369 000 t in 1992.

Cyprus Minerals Co. acquired the Cerro Verde copper mine from state-owned Minero Peru S.A. in November for US$37 million and a commitment to invest up to $485 million for the purpose of increasing annual production to 100 000 t of contained copper.

In 1994, it is expected that the Peruvian government will proceed with the sale of other copper assets including Minero Peru's Ilo refinery, the Tintaya copper mine of Empresa Minera Especial Tintaya S.A., and the assets of Centromin Peru S.A. which include mining and processing facilities.

Southern Peru Copper Corporation reported that it is proceeding with the construction of a 41 000-t/y SX/EW plant at its Toquepala mine as well as a 150 000-t/y sulphuric acid plant at its Ilo smelter.

Mexico

At the beginning of 1994, Cominco Resources International Ltd. announced that it had signed an agreement to sell its Mariquita copper deposit in Sonora to Minera Maria. Minera Maria itself is owned 49% by Cominco International. Preliminary plans for the deposit are for an SX/EW operation that would produce about 15 000 t/y of copper cathode. Production will likely commence in 1997. The Mariquita deposit contains estimated ore reserves of 43 Mt grading 0.46% copper.

Cuba

According to press reports, Matlock Mining of Australia and Geominera SA of Cuba have undertaken a feasibility study for the proposed Hierro Mantua mine development project in the province of Pinar del Rio. The deposit contains reserves of 5.3 Mt grading 3.3% copper. The proposed development, which will use the SX/EW process, is expected to produce about 15 000 t/y of copper cathode.

United States

Despite the heavy rains which disrupted mine output in Arizona at the beginning of the year, copper mine production in the United States was expected to total 1.775 Mt in 1993 compared to 1.760 Mt in 1992.

Kennecott Corporation is proceeding with construction plans to replace its existing 150 000-t/y Garfield smelter with a new 280 000-t/y plant. The new smelter, which will cost an estimated US$700 million, is expected to reach full capacity in March 1996. The company also announced that it will spend US$500 million over the next five years to expand and upgrade its tailings impoundment area at its Bingham Canyon mine.

Cyprus Amax Minerals Company plans to spend about US$300 million on a number of projects that will bring the company's cash production costs for copper to under US60¢/lb. This includes $83 million for its copper refinery at the Miami operation in Arizona, a $20 million expansion at the Bagdad mine in Arizona, as well as $75 million for a fleet expansion and $13 million for an SX/EW expansion at the Sierrita mine. The company also announced that it was considering a $60 million investment for an SX/EW operation at Casa Grande, Arizona. This mine would produce approximately 36 000 t/y of copper cathode.

Magma Copper Co. expects to obtain all necessary permits for its Robinson mining project near Ely, Nevada, by August 1994. This would allow the project to be completed at the end of 1995 or early 1996. The mine is expected to produce about 60 000 t/y of contained copper and 3100 kg of gold. The Robinson orebody contains proven and probable ore reserves of 182 Mt grading 0.61% copper and 0.4 g/t gold. Magma also plans to bring its Kalamazoo mine project in Arizona into production in 1997. The Kalamazoo mine, which will cost US$140 million to develop, is expected to produce about 90 000 t/y of contained copper. Ore reserves at Kalamazoo total 160 Mt grading 0.7% copper.

In early 1993, Azco Mining Inc. reported that it had received the necessary environmental approvals for its Sanchez copper project in southeast Arizona. This SX/EW operation, which is expected to produce about 25 000 t/y of copper cathode, is scheduled to be fully on stream in 1995. At the end of the year it was reported that Magma Copper would not proceed with the acquisition of a 15% interest in the project.

In the fourth quarter of 1993, Arimetco International Inc. reported that copper cathode production at its Yerington mine in Nevada had been increased to a level of about 6600 t/y as a result of the completion of new leach pads. At the end of the year, Arimetco announced that it had obtained the final permits for its MacArthur mining project. The company, which plans to process MacArthur ore at Yerington, is expanding the Yerington SX/EW plant to produce over 13 000 t/y of copper cathode. The expansion is scheduled for completion in mid-1994.

Metall Mining Corporation announced in 1993 that it was considering the expansion and modernization of its Copper Range smelter in White Pine, Michigan. This $200 million project, which would increase smelting capacity from 60 000 t/y to 135 000 t/y, would significantly lower operating costs and also help control gaseous emissions.

Cambior Inc. completed a feasibility study on its Carlota copper deposit in the Miami-Globe region of Arizona, which confirmed the viability of a proposed mine development. The mine, which would have a capacity of over 25 000 t/y of copper, could be completed in 1995.

In August, Mitsubishi Materials Corp. announced that it was temporarily closing its Cox Creek copper refinery in Maryland. The company reported that its decision was based on a global oversupply of copper and poor demand prospects. At the time of the closure, the refinery was operating at only a fraction of its total capacity of about 250 000 t/y.

Australia

In November it was reported that a consortium comprised of North Broken Hill Peko Ltd., Sumitomo Metal Mining Co. Ltd. and Sumitomo Corporation had discovered a new copper-gold deposit in the Northparkes mining area of New South Wales. The new E-48 deposit is estimated to contain reserves of 19 Mt grading 1.2% copper and 0.7 g/t gold. The existing E-26 deposit contains about 68 Mt of ore grading 1.26% copper and 0.65 g/t gold. The consortium, which plans to have the Northparkes mine project fully on stream in 1996, expects to produce about 65 000 t/y of copper concentrates as well as 2200 kg/y of gold.

Western Mining Corporation announced in 1993 that it would increase copper production at its wholly owned Olympic Dam mine in South Australia to 84 000 t/y by mid-1995.

MIM Holdings Limited commenced work on a feasibility study on the Ernest Henry copper deposit in North Queensland. The deposit is estimated to contain about 70 Mt grading 1.6% copper and 0.8 g/t gold. Preliminary development plans for Ernest Henry envisage an open-pit mine that would produce about 100 000 t/y of copper in concentrate and 4000 kg/y gold.

Papua New Guinea

The government of Papua New Guinea announced in late 1993 that it would work to re-open the Bougainville copper mine once the island of Bougainville was brought under government control. The mine was closed in 1989 due to an armed uprising by local land-owners.

In early November, Ok Tedi Mining Ltd. declared force majeure on shipments of copper concentrate due to continuing low water levels on the Fly River. The company was able to lift the force majeure on December 17, 1993. The Ok Tedi mine, which is operated by The Broken Hill Pty. Co. Ltd. (BHP), produces about 200 000 t/y of copper in concentrate. On October 1, BHP increased its ownership interest in the mine to 50% while, on January 1, 1994, the government of Papua New Guinea and Metall Mining Corporation increased their ownership interests to 30% and 15%, respectively.

Philippines

Atlas Consolidated Mining and Development Corp. was forced to scale back its copper mining operations in 1993 due to lower metal prices. At the end of the year, Atlas suspended work at its copper mine in Cebu province because of damage sustained by typhoon Nell. While the company had expected that necessary repairs would take between three to four weeks to complete, the re-opening was subsequently delayed when the mine was affected by mud flows.

Indonesia

Freeport-McMoRan Copper & Gold Inc. announced that it would increase production at its Grasberg copper-gold orebody in Indonesia to 115 000 t/d in 1996. At the time of the announcement, the company was in the process of increasing capacity to 90 000 t/d, also by 1996. At the proposed new output rate, it is expected that the Grasberg mine will produce approximately 500 000 t/y of copper in concentrate plus 46 650 kg of gold. At the end of 1993, proven and probable reserves at both the Grasberg and Big Gossan deposits were increased to 1074 Mt grading 1.31% copper, 1.47 g/t gold and 4.04 g/t silver.

At the beginning of 1994, Metallgesellschaft AG announced that the Gresik copper smelter project would be delayed due to the company's financial difficulties. The smelter is expected to cost an estimated US$600 million. Other partners in the 150 000-t/y facility include PT Freeport Indonesia Co. and Nippon Mining Company Ltd.

Malaysia

Mamut Copper Mining Sdn Bhd reported that it would cease mining operations at its Malaysian copper mine in 1997 due to weak prices and low ore grades. Mamut produces about 25 000 t/y of copper in concentrate.

Japan

As a result of low copper prices, declining treatment and refining charges (TC/RCs) and a strong yen, a number of Japanese companies were reportedly considering smelter cutbacks in 1994. These include a possible 10% cut at Nippon Mining & Metals Co. Ltd.'s Saganoseki and Hitachi smelters and an unspecified cut at Mitsubishi Materials Corporation Naoshima smelter. Also in Japan, it was reported that Hibi Kyodo Smelting, a joint venture of Mitsui Mining & Smelting Co. Ltd., Nittetsu Mining Co. Ltd., and Furukawa Co. Ltd., would expand its Tamano smelter and refinery by 2500 t/m to 18 800 t/m of blister and 16 000 t/m of copper cathode. The expansion is expected to be completed by September 1994.

In November it was reported that Dowa Mining would suspend mining operations at its three Japanese mines in March 1994. These operations account for a small quantity of by-product copper production.

People's Republic of China

In October, China National Nonferrous Metals Import & Export Corp. (CNIEC) estimated 1993 copper demand in China at between 900 000 and 950 000 t. The CNIEC also estimated copper cathode imports for the year at about 300 000 t while the copper content of imported copper concentrate was forecast at about 80 000 t. In addition to the imported cathode and concentrate, China imports significant quantities of copper scrap and blister copper. In 1993, Chinese copper mine production was estimated at about 325 000 t. China reported that its refined copper output in 1993 was 690 000 t.

In October, Noranda Inc. announced that it had reached an agreement to sell its continuous copper smelting technology to the CNIEC for the Shenyang smelter project in northern China. The start-up of the Shenyang smelter is expected in early 1996. The plant will have an annual treatment capacity of 350 000 t of concentrate. In April 1992, Noranda signed an agreement to supply its continuous smelting process technology to the Chinese corporation's Da Ye smelter operations.

During 1993, China entered into several joint-venture agreements with foreign mining companies for the evaluation and potential development of promising mineral deposits in China. One of these is the Ashele copper-zinc prospect in northwest China where Asia Minerals Corp. of Canada will undertake a pre-feasibility study for a 3000-t/d underground mine. The Ashele deposit contains geologic reserves of 24 Mt grading 3.1% copper and 1.5% zinc.

Thailand

Padaeng Industry Co. Ltd. reported that it had discovered a large copper deposit in northeast Loei province that would be amenable to development with the SX/EW process technology. The deposit contains a reserve of 185 Mt grading 0.4% copper.

At year-end there were reports that the feasibility study for the proposed 150 000-t/y copper smelter/refinery project for Thailand was under re-examination. The same report stated that the start-up date for this facility had now been pushed forward to 1998.

India

Hindustan Copper Ltd. announced that it would expand the capacity of its Khetri copper smelter from 31 000 t/y to 100 000 t/y.

In September, it was reported that Metdist Ltd. had received provisional approval from the Indian government for the construction of a 150 000-t/y copper smelter. However, at the time of writing, a location for the plant had not yet been determined. During 1993, it was reported that another copper smelter project was under consideration by SWIL Ltd. in the western state of Maharashtra. This smelter would have an initial capacity of 50 000 t/y.

Sterlite Industries (India) Limited was reported to have completed 90% of the work on a 40 000-t/y copper smelter and refinery at Ratnagiri in the state of Maharashtra. However, completion of the project, which was scheduled for the third quarter of 1995, was in some doubt due to the considerable opposition to the smelter that was being mounted by environmental groups.

Pakistan

Despite continuing financial problems, work on the Saindak gold-copper development, a joint venture between Pakistan's Resources Development Corporation and Metallurgical Construction Corporation of China, is scheduled for completion in June 1994. The project, which includes both mining and processing operations, is expected to produce about 16 000 t/y of copper and 1500 kg/y of gold.

Iran

In December it was reported that China National Non-ferrous Metals Industry Corporation had signed a contract to build an 80 000-t/y copper smelter in the southeast province of Kerman. The plant, which will use flash furnace technology, will take about four years to complete. Earlier in the year, it was reported that National Iranian Industries Company had awarded a contract for the construction of a new SX/EW plant at its Sar Cheshmeh mining complex in southeastern Iran. The facility will have a capacity of about 15 000 t/y of refined copper.

Saudi Arabia

A consortium of Japanese companies and Alujain Corp. of Saudi Arabia were reported to be considering the construction of a 150 000-t/y greenfield smelter project at Yanbu. A feasibility study for the project is expected to be completed in 1994.

Kazakhstan

In October it was reported that Irtysh, the Kazakhstan copper producer, had signed a contract with two Turkish companies for the construction of a 40 000-t/y anode plant and a 40 000-t/y tank house. The new plant will presumably be built at Irtysh's 40 000-t/y smelter at Glubokoye.

Turkey

Metall Mining Company, Etibank, and Gama Endustrie Tesisleri Imlat VE Montaj A.S. plan to bring their Cayeli mine project on stream at the end of 1994. It is expected that Cayeli will produce about 23 000 t/y of copper and 35 000 t/y of zinc in concentrate.

Russia

At the time of writing, the future of the large Udokan copper deposit in Siberia was unclear due to the alleged failure of the Western partner, Chita Minerals Ltd., to meet its financial obligations to the project. The deposit contains estimated reserves of about 1.2 billion t grading 2% copper. Udokan, for which development costs are estimated at about US$1.5 billion, will take seven or eight years to complete. Preliminary plans are for an annual output of up to 400 000 t/y of copper in concentrate.

According to press releases by the Russian government, refined copper production in that country in 1993 was only 80% of the total for 1992. On the basis of statistics for the first 10 months of 1993, copper exports fell to 78 300 t from 119 000 t during the same period in 1992.

While large volumes of offshore concentrates were toll smelted in Russia, Kazakhstan and Uzbekistan during 1992, the scale of these activities diminished significantly in 1993. The alleviation of the worldwide shortage of smelting capacity and the significant decline of smelting and refining charges were the most likely reasons for this change.

Poland

Copper production increased in Poland during 1993 to 404 000 t from 387 000 t in 1992. KGHM Polska Miedz SA, the state-owned copper producer, reported that its production costs in 1993 were between US71¢ and 72¢/lb. KGHM also reported that it was embarking on a modernization of its facilities in order to further reduce its costs. In this regard, the company was reported to be considering the installation of Isasmelt technology at its 140 000-t/y Glogow I smelter.

Spain

In the first half of 1993, Freeport McMoRan Copper & Gold Inc. acquired a 65% interest in Rio Tinto Minera, S.A., the operator of a 150 000-t/y copper smelter at Huelva, for about US$50 million. Freeport, which announced in September that it would expand the capacity of the plant to 180 000 t/y by 1995, subsequently acquired the remainder of Rio Tinto Minera for US$33 million.

Freeport, which was reported to have supplied the smelter with about 100 000 t of concentrate in 1993, expects to eventually supply about half of the smelter's feed requirements.

Zambia

Copper output in Zambia was expected to total about 415 000 t in 1993 compared to 433 000 t in 1992. Zambia has predicted that its copper output in 1994 will increase to about 450 000 t.

There were continuing reports in 1993 that Zambia Consolidated Copper Mines Ltd. (ZCCM) was facing severe financial problems. In November the company reported that it had suspended all non-productive capital expenditures and that it would review all of its capital projects. One of the major projects planned to be undertaken in the next several years is the Konkola Deep Mining Project. This project is essential to the company's plans to maintain copper production levels once the Nchanga open pit is exhausted. The Konkola project, which will provide access to a resource of 340 Mt grading 3.8% copper, is expected to cost US$545 million. The annual output from the Konkola project will be about 180 000 t of copper and 600 t of cobalt.

Zaire

The copper industry in Zaire suffered further setbacks in 1993 due to political upheaval and a continuing lack of investment to maintain existing mining infrastructure and develop new capacity. Copper output in 1993 was expected to decline to 80 000 t from 144 000 t in 1992. By comparison, Zaire produced 465 000 t of copper in 1988. With the declaration of independence in December by the country's copper-rich Shaba province, it is unlikely that there will be early recovery of copper production in Zaire.

International Copper Study Group

In 1993, the International Copper Study Group (ICSG) held two meetings in Lisbon. The first Regular General Session of the organization was held June 23-29, 1993, and meetings of the Standing, Statistical and Finance Committees of the ICSG were held on November 9 and 10, 1993. No new members joined the ICSG in 1993, but several nations indicated to the Study Group that they intended to join in the near future.

At the June meeting, the Group agreed to focus its activities on statistical matters and deferred implementation of an economic committee.

At the same meeting, the Statistical Committee concluded that the most important gaps in the existing statistical coverage for copper related to the former Soviet Union, end-use consumption, scrap, stocks and definitions.

At the November meeting of the Standing Committee, the Secretary General of the ICSG reported that the group had entered into a contract with the World Bureau of Metal Statistics (WBMS) for the provision of statistical services.

At the Statistical Committee meeting, a consensus was reached that the initial work program of the ICSG be focused on a limited number of activities, which include the preparation of a monthly statistical bulletin covering mine, smelter and refined production, as well as copper consumption. Member nations agreed to undertake the preparation of semi-annual short-term forecasts of production and consumption.

Member nations agreed that one of the major priorities of the ICSG will be to collect end-use statistics for copper consumption. In order to further this objective, the Statistical Committee established a working group to study this matter and to report its findings to the Committee in May 1994. The collection of statistics on copper scrap, the preparation of directories of both existing mines/processing plants and new mines/plants, as well the establishment of common definitions for the copper industry, were also deemed to be of high importance.

The next general session of the ICSG will be held in May 1994 in Lisbon.

CONSUMPTION AND USES

Canadian refined copper consumption in 1993 was estimated to have increased to approximately 205 000 t from 176 000 t in 1992. Western World consumption of refined copper in 1993 was estimated to have increased to 9.3 Mt from 9.08 Mt in 1992 (this includes refined copper from both primary and secondary material). In 1992, about 2.92 Mt of copper scrap was used directly by consumers. Altogether, 4.27 Mt of copper scrap was recovered in 1992.

Copper's high electrical and thermal conductivity, combined with its good tensile strength and mechanical properties, elevated melting point (1083°C), non-magnetic properties, and resistance to corrosion, make it and its alloys very attractive for electrical transmission, water tubing, castings and heat exchangers. Copper is the most efficient conductor of electrical power, signals and heat of all the industrial metals (aluminum's electrical and thermal conductivity is only 72% and 76%, respectively, of copper's).

Table 8 presents preliminary end-use data for 1991 and 1992 for the United States collected by the Copper Development Association Inc. (detailed copper consumption statistics are not officially collected in Canada). Building construction represented the largest market for copper with 42% of the total in 1992. Electrical and electronic products accounted for about 24% of U.S. copper usage, followed by industrial machinery and equipment (13%), transportation equipment (11%) and consumer and other products (9%).

The Canadian Copper and Brass Development Association (CCBDA), an association of Canadian producers and fabricators, provides support services to assist consumers with the traditional applications in the electrical field, plumbing and heating, the automotive sector, engineering components such as bearings and bushings, roofing and architectural metalwork, as well as a multitude of other end uses.

NEW MARKETS

In Canada, copper tube and fittings are now being used in houses and other buildings to carry natural gas. The growth of this market has been dramatic, with copper quickly becoming the preferred material, replacing steel pipe. In the fire sprinkler industry, the growth of copper usage has not been as dramatic, but good progress is being made in competition with steel pipe and certain plastics. Both markets are being heavily promoted by the CCBDA, with the financial support of the International Copper Association, Ltd.

The CCBDA is also actively involved in the promotion of electrical wire and cable. Three sectors have been targeted: high-voltage underground transmission cables, medium-voltage power cables, and wire and cable for systems in buildings, including telecommunications. Other areas receiving attention include brass forgings for engineered components and a study on the potential market for copper-based materials in applications to control zebra mussels. The CCBDA and the Copper Development Association of the United States have also jointly undertaken major North American initiatives on the promotion of architectural applications as well as plumbing tube and fittings.

According to the Copper Development Association Inc., the use of copper and copper alloys in North American vehicles has increased from approximately 16 kg in 1980 to 23 kg in 1991. This increase is largely due to the growth of copper wire usage, larger wiring harnesses and more numerous electrical motors and connectors. With the expectation that additional electronics will be added to future generations of automobiles such as an anti-skid gyroscope, there could be significant future growth in copper wire applications.

However, considerable research is being undertaken on the use of multiplexing technology in automobiles. This technology, which would incorporate fibre-optic cables or a combination of fibre optics and fewer copper wires in automobiles, offers design engineers the flexibility to add more electrical circuits without sacrificing payload capacity or ease of assembly.

While copper use in original-equipment automobile radiators has declined due to the market penetration of aluminum radiators, copper and brass radiators have an important share of the replacement market. However, with the development of new solders and new processing methods for coating and core baking, as well as a new brazed structure, it is possible that copper can regain a large share of the original-equipment market in view of its superior heat exchange efficiency. During 1993, Chrysler Corporation announced that it will use a copper-brass radiator on its new "Neon" line of economy cars.

Despite a number of technological advances in the communications and telecommunications sectors in recent years that promised to reduce copper consumption, including fibre optics, multiplexing and gauge reduction, the decline of copper usage in this sector has slowed. In this regard, the higher costs associated with these alternate technologies provide copper with a competitive advantage in certain applications, particularly for distribution. Recent technological breakthroughs for copper enable more information to be transmitted than previously possible. It is expected that this technology will enable copper to maintain an important share of this expanding market.

Meanwhile, copper also continues to be the preferred metal for electrical wiring applications in building construction. As houses increase in size and incorporate more labour-saving electrical devices, the use of copper in household wiring applications could increase by up to 40%. At present, the average new home in the United States contains about 420 lb of copper, up from 230 lb in the early 1980s.

TRADE

In 1992, exports of copper concentrates by Western World countries totalled 2.16 Mt. Chile was the largest exporter (631 000 t) followed by Canada (327 000 t) and the United States (266 000 t). Blister and anode copper exports by Western nations totalled 534 000 t, while refined copper exports were about 3.42 Mt. In 1992, the countries of the former Eastern Bloc enjoyed a trade surplus of about 170 000 t of refined copper. In 1991, the trade surplus was over 300 000 t.

While the United States, the European Community, Canada and Australia had sought the elimination of copper tariffs at the Uruguay Round of Multilateral Trade Negotiations, it is likely that there will be agreement to reduce tariffs to the lower of 3% or a one-third reduction. It is expected that the reductions will be phased in over five years beginning in July 1995.

HEALTH AND THE ENVIRONMENT

Proper human and animal health depends on an adequate dietary intake of copper. Copper combines with proteins to form many enzymes critical for life. One such important enzyme is superoxide dismutase, which removes the superoxide radicals in the human body. Superoxide radicals are the "residues" of metabolic processes which otherwise could build up to toxic levels. Copper is also required to transport iron from absorption sites to the bone marrow where red blood cells are produced.

Many regulatory agencies have chosen 1 part per million (ppm) as the maximum desirable concentration of copper in drinking water. It signifies more of an aesthetic limit than a health limit; water containing more than 1 ppm can stain laundry, and persons with a keen sense of taste may perceive a metallic flavour in the water.

Copper tube used for the distribution of potable water supplies inhibits bacterial growth. In addition to the suppression of bacteria such as *Legionnella pneumonillia* in a water system, copper also discourages biofilm formation under which bacteria can survive.

With concerns about the health effects associated with the use of leaded brasses in potable water systems, there has been extensive research into the development of lead-free plumbing brass alloys. One of the promising new materials is a brass that contains about 1% bismuth and less than 0.1% lead.

STOCKS

Combined copper stocks on the London Metal Exchange (LME) and the Commodities Exchange, Inc. (COMEX), which had increased to about 440 000 t at the end of 1992, declined to 410 000 t at the beginning of 1993. However, from that point onwards, stock levels climbed steadily to reach over 700 000 t at the end of October. For the remainder of the year, stock levels eased slightly. At year-end, combined copper stocks totalled 666 000 t. At the end of January 1994, stock levels stood at 653 000 t. Figure 1 shows both LME copper stocks and prices for the period 1990-93.

The American Bureau of Metal Statistics reported that total refined copper stocks held by U.S. refineries at the end of December were 26 300 t. The Bureau also reported that copper stocks at other Western World refineries totalled 443 000 t in November 1993.

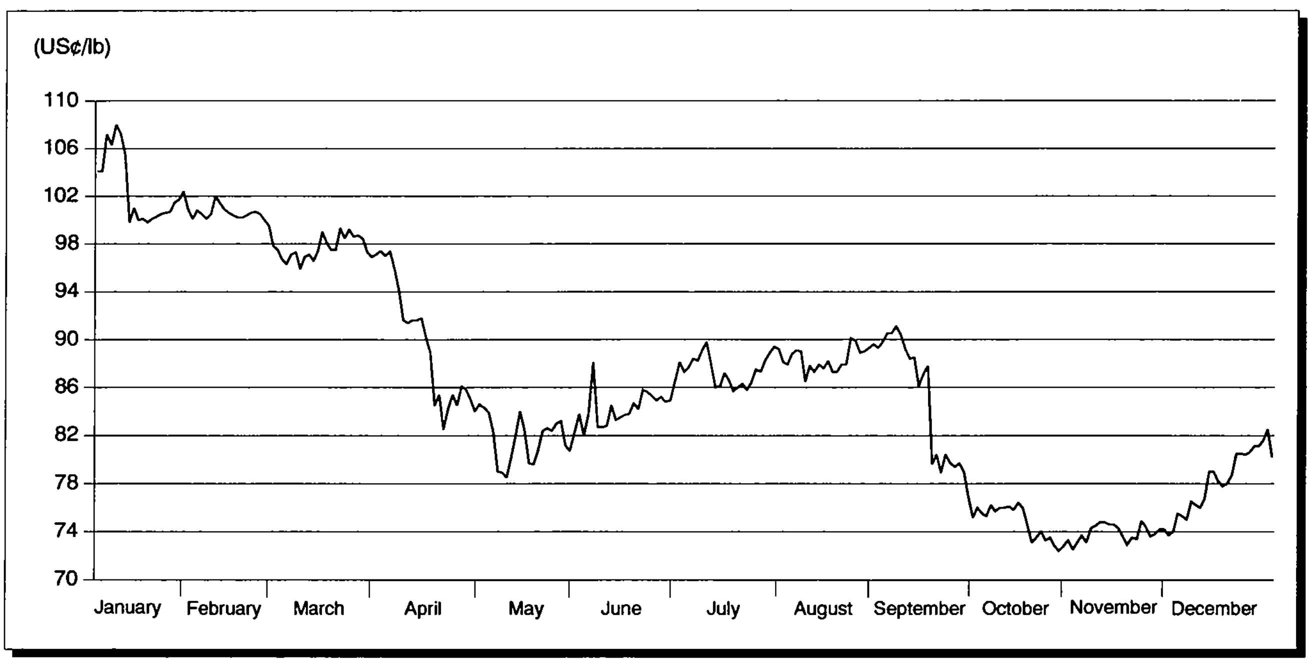
METAL PRICES

Copper prices experienced a significant decline in 1993. While the metal's weakening fundamentals were largely ignored in 1992, the market finally reacted in 1993 to the significant build-up of copper stocks and poor demand prospects in the short term. The average LME Grade A settlement price in 1993 was US87¢/lb compared to US$1.04/lb in 1992.

At the beginning of January 1993, prices rose to the yearly high of US$1.08/lb on the strength of reports of significant buying activity by China combined with a temporary dip of LME stock levels. However, with subsequent increases in LME stocks and poor demand prospects, prices softened to about US$1.00/lb in mid-month and remained at around that level for the remainder of January and most of February.

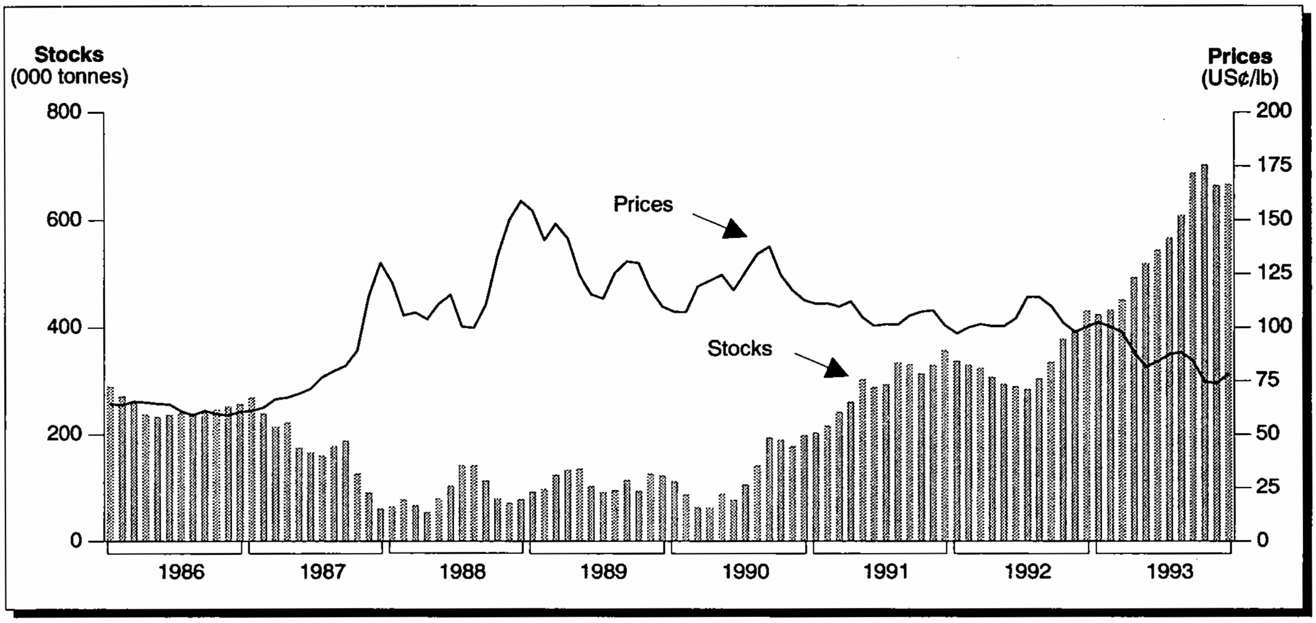
Prices, which averaged 98¢/lb in March, fell dramatically through April and May due to reports of major selling activity by China, further increases of metal stocks, as well as growing concern about the slow pace of recovery in the major consuming economies.

Figure 1
Daily London Metal Exchange Copper Prices, 1993
Grade A



Source: Reuters.

Figure 2
Copper Prices[1] and Exchange[2] Stocks, 1986-93



Source: Natural Resources Canada.

[1] Average monthly LME cash prices.

[2] Combined LME and COMEX stocks at beginning of the month.

From a low of about 81¢/lb in mid-May, prices staged a modest rally in June to over 85¢/lb due to what was described as a concerted squeeze in the market. Despite copper's poor market fundamentals, prices continued to strengthen through July, August and into September due to technical factors associated with option trading.

In order to correct the prolonged squeeze situation and, most importantly, to maintain an orderly copper market, the LME imposed a backwardation limit on September 8 of US$5/t of copper per market day. During the weeks preceding this action, the backwardation between cash and three-month prices had increased to over US$70/t.

Following the imposition of the backwardation limit, the liquidation of long positions caused prices to fall sharply. From a high of US91¢/lb on September 7, prices weakened for the remainder of September and throughout October. The LME cash price on October 27 was 72¢/lb.

Prices remained low in November despite reports that market sentiment for copper was improving. However, copper prices strengthened significantly through December due to the combined effects of strong demand in the United States and Chinese buying activity. Copper prices at the end of December were about US80¢/lb.

In January 1994, prices continued to strengthen on the basis of a perceived improvement in copper's market fundamentals. The average LME price in January was US82¢/lb.

The LME and COMEX predominate in establishing copper prices worldwide. Both trade in spot or "cash" metal, as well as in futures contracts. Figure 2 shows daily LME cash prices from 1990 to 1993 in US$/lb. In 1993, Canadian producers sold refined copper in the United States at COMEX plus a premium of between US2.5¢ and 3.0¢/lb, in Canada at the Canadian dollar equivalent of COMEX plus between 3.0¢ and 3.5¢/lb, and in Europe at LME plus £80/t (payment terms may differ between regions). In 1994, producers changed their European prices to LME plus US$12/t.

TREATMENT AND REFINING CHARGES

Treatment and refining charges (TC/RCs) for copper concentrates declined further in 1993 due to a tightening of copper concentrate supplies. From a level of almost US40¢/lb combined at the beginning of 1992, spot rates were reported to have fallen to below 17¢/lb combined at the end of 1993. While no benchmark price for 1994 TC/RCs had emerged at the time of writing, a number of significant 1994 contracts had been negotiated in the range of between US19¢ and 21¢/lb. The Japan Smelter Pool benchmark rate for TC/RCs in 1993 was reported to have been about US27¢/lb.

OUTLOOK

In the absence of a major increase in copper imports by China or large cutbacks at copper mines and/or smelters, prices in 1994 can be expected to trade within a range of between US$0.75 and $0.85/lb.

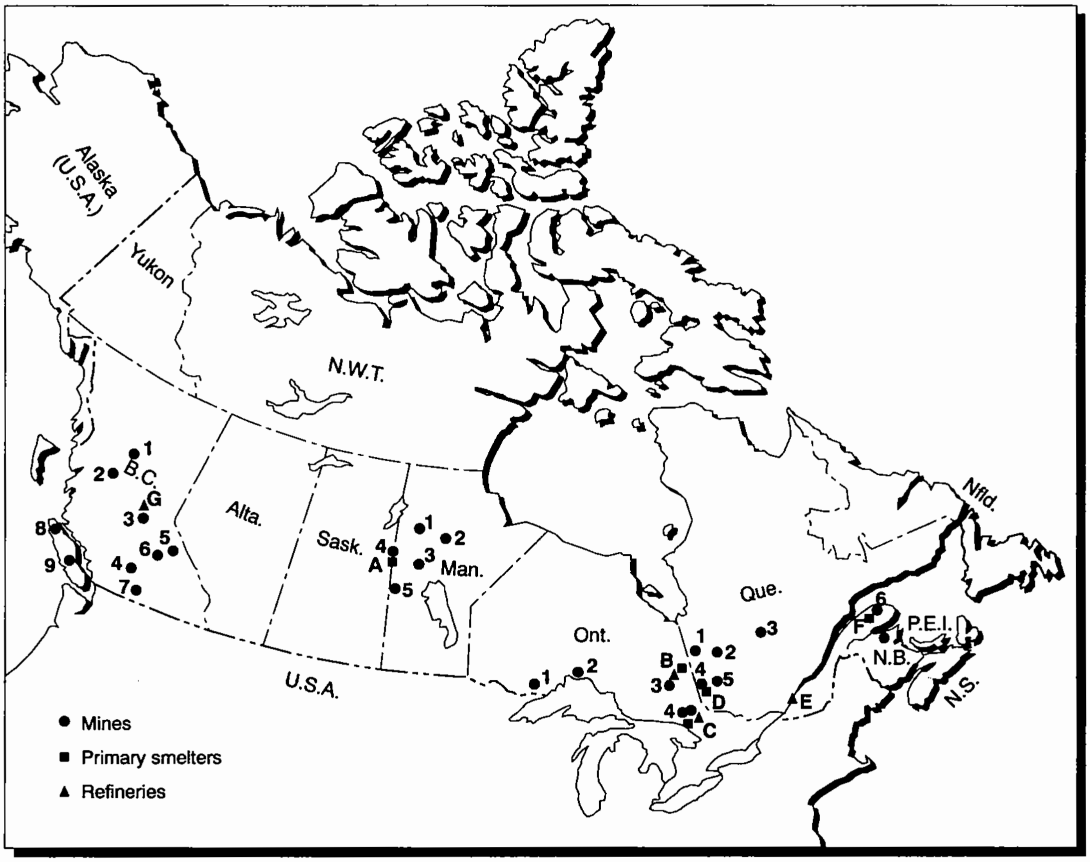
While copper consumption will begin to experience strong growth in 1995, it is likely that the expected growth of supply in the next several years, particularly from Chile, will moderate any price increase in the medium term. However, in the latter part of the decade, prices are expected to rise significantly due to a forecast slowdown in the growth of world copper supply, accompanied by very strong growth in demand. In the longer term, it is expected that copper prices will average between US$0.95 and $1.15/lb in constant 1993 dollars.

For the remainder of the 1990s, copper consumption is expected to grow at an annual average rate of over 2.5%. It is expected that the largest increases in copper consumption will occur in the construction and transportation industries. It is also expected that a large share of the forecast growth in demand will occur in the Asian markets.

While the start-up of the new Louvicourt deposit in Quebec should temporarily reverse the downward trend of Canadian copper mine production, it is expected that Canadian output will continue to decline in the medium term as new capacity will be unable to match anticipated mine closures or the decline of capacity at existing operations. Although there have been encouraging exploration results in Canada in recent years, it is unlikely these will result in a recovery of output by the end of the decade.

Note: Information in this review was current as of February 21, 1994.

Figure 3
Copper Producers in Canada, 1993



Mines

British Columbia

1. Noranda Inc. (Bell mine)
2. Equity Silver Mines Limited
3. Gibraltar Mines Limited
4. Highland Valley Copper[1]
5. Bethlehem Resources Corporation
   Goldnev Resources Inc. (Goldstream mine)
6. Minnova Inc. (Samatosum)
7. Princeton Mining Corporation (Similco)
8. BHP-Utah Mines Ltd.
9. Westmin Resources Limited

Saskatchewan

Hudson Bay Mining and Smelting Co., Limited (Flin Flon)

Manitoba

1. Hudson Bay Mining and Smelting Co., Limited (Ruttan mine)
2. Inco Limited (Thompson mine)
3. Hudson Bay Mining and Smelting Co., Limited, Snow Lake area mines
4. Hudson Bay Mining and Smelting Co., Limited, Flin Flon area mines
5. Hudson Bay Mining and Smelting Co. Limited/Outokumpu Mines Ltd. joint venture (Namew Lake mine)

Ontario

1. Noranda Inc., Geco Division
2. Minnova Inc. (Winston Lake mine)
3. Falconbridge Limited (Timmins)
4. Falconbridge Limited (Sudbury area)
   Inco Limited (Sudbury area)

Quebec

1. Les Mines Selbaie
2. Noranda Inc., Matagami Lake Division
3. Westminer Canada Limited
   Campbell Resources Inc.
4. Minnova Inc. (Lac Dufault Division – Ansil mine)
5. Agnico-Eagle Mines Limited (La Ronde mine)
   LAC Minerals Ltd. (Bousquet mine)
6. Noranda Inc., Division Mines Gaspé

New Brunswick

Brunswick Mining and Smelting Corporation Limited
Noranda Inc. (Heath Steele mine)

Smelters

A. Hudson Bay Mining and Smelting Co., Limited (Flin Flon)
B. Falconbridge Limited (Timmins)
C. Inco Limited (Sudbury area)
   Falconbridge Limited (Sudbury area)
D. Noranda Inc. (Noranda)
F. Noranda Inc. (Division Mines Gaspé)

Refineries

B. Falconbridge Limited (Timmins)
C. Inco Limited (Sudbury area)
E. Noranda Inc. (Division CCR)
G. Gibraltar Mines Limited (SX-EW)

1 Highland Valley Copper is a partnership of Cominco Ltd., Teck Corporation and Rio Algom Limited.
Note: For detailed production and ore grade information, refer to the nonferrous mine production table following the last commodity chapter.

TARIFFS

Item No.	Description	Canada MFN	Canada GPT	Canada USA	United States Canada	EC MFN	Japan[1] MFN
2603.00	Copper ores and concentrates						
2603.00.00.10	Copper content	Free	Free	Free	Free	Free	Free
2825.50	Copper oxides and hydroxides	Free	Free	Free	Free	3.2%	7.2%
28.33	Sulphates; alums; peroxosulphates						
	Sodium sulphates:						
2833.25	Of copper						
2833.25.10	Cupric sulphate	6.8%	Free	Free	Free	3.2%	5.8%
2833.25.90	Other copper sulphates	9.2%	6%	Free	Free	3.2%	5.8%
74.01	Copper mattes; cement copper (precipitated copper)						
7401.10	Copper mattes	Free	Free	Free	Free	Free	Free
7401.20	Cement copper (precipitated copper)	Free	Free	Free	Free	Free	Free
7402.00	Unrefined copper; copper anodes for electrolytic refining	Free	Free	Free	Free	Free	7.3%
74.03	Refined copper and copper alloys, unwrought						
	Refined copper:						
7403.11	Cathodes and sections of cathodes	Free	Free	Free	Free	Free	21 yen/kg
7403.12	Wire-bars	4%	Free	Free	Free	Free	21 yen/kg
7403.13	Billets	Free	Free	Free	Free	Free	21 yen/kg
7403.19	Other:						
7403.19.10	Ingots, ingot-bars and slabs	Free	Free	Free	Free	Free	21 yen/kg
7403.19.90	Other	10.3%	6.5%	Free	Free	Free	21 yen/kg
	Copper alloys:						
7403.21	Copper-zinc base alloys (brass)						
7403.21.10	Ingots, ingot-bars, slabs and billets	4%	Free	Free	Free	Free	21 yen/kg
7403.21.90	Other	10.3%	6.5%	Free	Free	Free	21 yen/kg
7403.22	Copper-tin base alloys (bronze)	10.3%	6.5%	Free	Free	Free	21 yen/kg
7403.23	Copper-nickel base alloys (cupro-nickel) or copper-nickel-zinc base alloys (nickel silver)						
7403.23.10	Ingots, ingot-bars, slabs and billets	Free	Free	Free	Free	Free	21 yen/kg
7403.23.90	Other	10.3%	6.5%	Free	Free	Free	21 yen/kg
7403.29	Other copper alloys (other than master alloys of heading no. 74.05)						
7403.29.10	Copper beryllium or copper phosphor alloys	4%	Free	Free	Free	Free	21 yen/kg
7403.29.90	Other	10.2%	6.5%	Free	Free	Free	21 yen/kg
7404.00	Copper waste and scrap						
	Not alloyed:						
7404.00.11	Spent anodes; waste and scrap with a copper content of less than 94% by weight	Free	Free	Free	Free	Free	Free
7404.00.19	Other	Free	Free	Free	Free	Free	Free
	Copper-zinc base alloys (brass):						
7404.00.21	With a copper content of less than 94% by weight	4%	Free	Free	Free	Free	Free
7404.00.29	Other	4%	Free	Free	Free	Free	Free
	Other:						
7404.00.91	With a copper content of less than 94% by weight	10.2%	6.5%	Free	Free	Free	Free
7404.00.99	Other	10.2%	6.5%	Free	Free	Free	Free
7405.00	Master alloys of copper	10.3%	6.5%	Free	Free	Free	6.0%
74.06	Copper powders and flakes	4%-10.6%	Free-7%	1.6%-4.2%	1.2-2.1%	1.4%-6.2%	7.2%
74.07	Copper bars, rods and profiles	4%-10.3%	Free-6.5%	Free-4%	Free-2.5%	6%	5.8%-7.2%
74.08	Copper wire	4%-10.3%	Free-6.5%	Free-4%	Free-1.7%	6%	5.8%-7.2%
74.09	Copper plates, sheets and strip, of a thickness exceeding 0.15 mm	4%-10.3%	Free-6.5%	Free-4%	Free-2.6%	6%	5.8%-6.5%
74.10	Copper foil (whether or not printed or backed with paper, paperboard, plastics or similar backing materials) of a thickness (excluding any backing) not exceeding 0.15 mm	4%-10.3%	Free-6.5%	Free-4%	Free-0.4%	6.5%	6%-6.5%
74.11	Copper tubes and pipes	Free-10.3%	Free-6.5%	Free-4%	Free-2%	6%	6.5%-8.2%

TARIFFS (cont'd)

Item No.	Description	Canada MFN	Canada GPT	Canada USA	United States Canada	EC MFN	Japan[1] MFN
74.12	Copper tube or pipe fittings (for example, couplings, elbows, sleeves)	10.3%	6.5%	4%	1.2%-4%	6.5%	5.8%
7413.00	Stranded wire, cables, plaited bands and the like, of copper, not electrically insulated	10.3%	6.5%	4%	1.6%-2.2%	Free-6.5%	7.2%
74.14	Cloth (including endless bands), grill and netting, of copper wire; expanded metal of copper	10.2%	6.5%	4%	1.9%-4%	6.5%	4.9%-5.8%
74.15	Nails, tacks, drawing pins, staples (other than those of heading no. 83.05) and similar articles, of copper or of iron or steel with heads of copper; screws, bolts, nuts, screw hooks, rivets, cotters, cotter-pins, washers (including spring washers) and similar articles, of copper	10.2%-10.3%	6.5%	4%	0.5%-2.5%	4.9%-6.5%	5.8%
7416.00	Copper springs	10.3%	6.5%	Free	Free	6.5%	5.8%
7417.00	Cooking or heating apparatus of a kind used for domestic purposes, non-electric and parts thereof, of copper	12.5%	8%	4.9%	1.6%	6.5%	5.8%
74.18	Table, kitchen or other household articles and parts thereof, of copper, pot scourers and scouring or polishing pads, gloves and the like, of copper; sanitary ware and parts thereof, of copper	10.3%	6.5%	4%	1.4%-1.9%	4.9%	5.1%
74.19	Other articles of copper	Free-10.3%	Free-10%	Free-6%	1.9%-3.4%	4.9%	5.8%-10%

Sources: Customs Tariff, effective January 1994, Revenue Canada, Customs and Excise; Harmonized Tariff Schedule of the United States 1994; The International Customs Journal, European Economic Community, 1992-93, No. 14, "Conventional" column; Customs Tariff Schedules of Japan, 1993.
[1] GATT rate is shown; lower tariff rates may apply circumstantially.

TABLE 1. CANADA, COPPER PRODUCTION AND TRADE, 1992 AND 1993p

Item No.		1992		1993p	
		(tonnes)	($000)	(tonnes)	($000)
SHIPMENTS[1]					
	Newfoundland	–	–	350	881
	Nova Scotia	–	–	–	–
	New Brunswick	13 697	38 428	10 517	26 484
	Quebec	91 950	257 979	77 963	196 322
	Ontario	272 242	763 814	268 944	677 239
	Manitoba	60 024	168 405	61 618	155 163
	Saskatchewan	–	–	–	–
	British Columbia	323 781	908 412	279 407	703 585
	Yukon	–	–	–	–
	Northwest Territories	–	–	–	–
	Total	761 694	2 137 039	698 799	1 759 675
	Refinery output	539 302	. .	552 795	. .
EXPORTS				**(Jan.-Sept.)**	
2603.00.10	Copper ores and concentrates				
	Copper content				
	Japan	234 022	471 395	148 623	276 166
	People's Republic of China	2 421	4 071	17 293	36 057
	Spain	22 421	49 331	15 447	29 680
	Philippines	19 443	41 634	15 526	27 903
	Mexico	6 577	11 771	8 975	19 071
	Other countries	32 182	57 158	16 127	27 319
	Total	317 066	635 365	221 992	416 201
2604.00.10, 2607.00.10, 2608.00.10	Other ores and concentrates				
	Copper content				
	United States	7 112	15 148	–	–
	Japan	2 605	2 999	–	–
	Total	9 717	18 147	–	–
2833.25	Copper sulphates				
	United States	1 463	1 451	683	700
	Cuba	–	–	. . .	. . .
	Ecuador	1	1	–	–
	Total	1 464	1 453	683	700
7401.10	Copper mattes				
	Norway	19 186	46 458	7 732	41 993
	United Kingdom	874	1 975	686	1 594
	Total	20 060	48 434	8 418	43 587
7403.11 to 7403.19	Refined copper				
	United States	222 890	615 337	178 512	465 046
	United Kingdom	52 256	145 849	42 196	110 235
	Italy	32 658	89 223	19 951	52 468
	Taiwan	6 948	18 871	10 008	26 108
	Sweden	10 821	29 884	9 417	24 492
	Other countries	60 187	166 498	44 537	121 770
	Total	385 761	1 065 670	304 621	800 126
7403.21 to 7403.29	Other copper alloys				
	United States	25	101	176	475
	Indonesia	–	–	73	171
	Guyana	30	85	19	32
	South Korea	. . .	1	4	29
	Other countries	15	67	6	34
	Total	70	261	279	746

TABLE 1 (cont'd)

Item No.		1992 (tonnes)	1992 ($000)	Jan.-Sept. 1993p (tonnes)	Jan.-Sept. 1993p ($000)
EXPORTS (cont'd)					
7404.00	Copper waste and scrap				
	United States	92 176	197 251	76 602	164 460
	South Korea	1 185	2 327	1 800	3 231
	People's Republic of China	4 042	3 768	2 424	2 242
	Japan	556	1 129	1 204	2 202
	India	960	1 542	1 435	1 974
	Other countries	2 987	4 797	1 866	3 096
	Total	101 906	210 820	85 332	177 213
7405.00	Master alloys of copper				
	Trinidad-Tobago	–	–	2	8
	Spain	. . .	2	–	–
	Total	. . .	2	2	8
7406.10, 7406.20	Copper powders and flakes Powders of lamellar structure				
	Taiwan	49	454	48	441
	United States	66	570	41	400
	Venezuela	5	51	12	124
	South Korea	14	206	8	118
	Other countries	40	363	53	391
	Total	175	1 657	162	1 483
7407.10 to 7407.29	Copper and copper alloy rods and profiles				
	United States	6 323	25 163	4 789	18 447
	Colombia	60	205	535	1 815
	Ireland	404	1 124	240	645
	Trinidad-Tobago	–	–	3	12
	France	. . .	1	. . .	1
	Other countries	50	154	1	1
	Total	6 838	26 650	5 567	20 924
7408.11 to 7408.29	Copper and copper alloy wire				
	United States	6 934	22 908	12 558	35 528
	Colombia	897	3 190	40	134
	South Africa	4	38	4	29
	South Korea	. . .	2	1	27
	Chile	9	69	2	17
	Other countries	102	372	3	14
	Total	7 946	26 584	12 609	35 753
7409.11 to 7410.22	Copper and copper alloy plates, sheets, strip and foil				
	United States	8 705	35 021	6 158	25 711
	Saudi Arabia	775	3 232	463	2 049
	United Kingdom	95	414	155	620
	Taiwan	218	936	128	555
	Other countries	69	350	87	332
	Total	9 861	39 956	6 990	29 274
7411.10 to 7411.29	Copper and copper alloy tubes and pipes				
	United States	7 222	39 518	6 400	32 741
	Israel	1 339	5 216	675	2 728
	Argentina	–	–	21	136
	Cuba	1	5	17	81
	Germany	–	–	20	70
	Other countries	239	1 296	21	108
	Total	8 801	46 041	7 154	35 872

TABLE 1 (cont'd)

Item No.		1992		Jan.-Sept. 1993p	
		(tonnes)	($000)	(tonnes)	($000)
EXPORTS (cont'd)					
7412.10, 7412.20	Copper and copper alloy tube and pipe fittings				
	United States	. .	12 935	. .	11 206
	Germany		7 596		6 192
	Spain	. .	7 465	. .	2 576
	United Kingdom	. .	1 732	. .	1 382
	Other countries	. .	3 848	. .	1 506
	Total	. .	33 576	. .	22 862
7413.00	Stranded wire, cables, plaited bands and the like, of copper, not electrically insulated				
	United States	40	466	153	1 815
	Libyan Arab Jamahiriya	–	–	75	1 421
	South Korea	–	–	13	78
	Other countries	4	20	1	5
	Total	44	488	242	3 321
7414.90, 7415.10 to 7415.39, 7416.00, 7419.10 to 7419.99	Cloth, fasteners and other items of copper				
	United States	. .	10 071	. .	9 627
	Thailand	. .	75	. .	435
	Hong Kong	. .	. . .	. .	192
	Russia	. .	–	. .	161
	Germany	. .	25	. .	97
	Other countries	. .	2 130	. .	389
	Total	. .	12 301	. .	10 901
IMPORTS2					
2603.00.00.10	Copper ores and concentrates				
	Copper content				
	United States	35 999	85 758	49 604	96 280
	Portugal	18 380	34 490	15 110	23 628
	Chile	–	–	7 215	15 127
	Australia	6 740	12 659	8 976	12 421
	Sweden	–	–	2 826	4 798
	Spain	–	–	2 100	3 032
	Other countries	28 666	60 344	2 463	3 435
	Total	89 785	193 254	88 294	158 725
2604.00.00.10, 2607.00.00.10, 2608.00.00.10	Other ores and concentrates				
	Copper content				
	United States	1 253	2 363	532	776
	Peru	129	111	–	–
	Total	1 382	2 475	532	776
2825.50	Copper oxides and hydroxides	630	2 310	749	2 442
2833.25	Copper sulphates	3 302	3 174	1 799	1 780
7401.10	Copper mattes	. . .	2	–	–
7403.11 to 7403.19	Refined copper and copper alloys, unwrought				
	Refined copper				
	Total	8 916	26 275	16 875	48 477

TABLE 1 (cont'd)

Item No.		1992 (tonnes)	1992 ($000)	Jan.-Sept. 1993p (tonnes)	Jan.-Sept. 1993p ($000)
IMPORTS (cont'd)					
7403.21 to 7403.29	Refined copper and copper alloys, unwrought Other copper alloys				
	Total	3 348	10 431	1 880	5 956
7404.00	Waste and scrap, copper or copper alloy				
	United States	41 437	51 345	36 883	45 529
	Russia	–	–	166	338
	Germany	40	91	119	203
	United Kingdom	–	–	124	181
	Other countries	642	1 013	214	400
	Total	42 120	52 452	37 506	46 655
7405.00	Master alloys of copper	31	125	8	36
7406.10, 7406.20	Copper powders and flakes				
	Total	1 147	5 765	1 023	5 260
7407.10 to 7407.29	Bars, rods and profiles of refined copper				
	United States	26 859	83 292	24 510	74 739
	Poland	2 077	4 822	833	2 022
	Brazil	175	465	540	1 546
	New Zealand	218	777	294	1 035
	Germany	230	1 146	190	843
	United Kingdom	159	758	105	570
	Other countries	913	2 755	340	1 151
	Total	30 631	94 015	26 813	81 906
7408.11 to 7408.29	Copper and copper alloy wire				
	Total	9 768	37 722	8 412	30 219
7409.11 to 7409.90, 7410.11 to 7410.22	Copper and copper alloy plates, sheets, strip and foil				
	Total	16 711	69 036	14 231	65 463
7411.10	Pipes and tubes, refined copper	5 737	25 517	4 885	22 559
7411.21	Pipes and tubes, copper-zinc base alloy	2 818	15 953	2 455	14 815
7411.22	Pipes and tubes, copper-nickel base alloy or copper-nickel-zinc base alloy	136	1 090	144	1 022
7411.29	Plates and tubes, copper alloy, n.e.s.	426	2 201	371	1 907
7412.10	Fittings, pipe or tube, of refined copper	1 176	10 217	450	4 898
7412.20	Fittings, pipe or tube, copper alloy	4 250	32 022	2 386	23 961
7413.00	Stranded wire, cable, plaited bands and the like, of copper, not electrically insulated	3 653	16 298	3 381	15 490
7414.90	Cloth, grill and netting of copper wire and expanded metal of copper	55	369	54	311

TABLE 1 (cont'd)

Item No.		1992		Jan.-Sept. 1993p	
		(tonnes)	($000)	(tonnes)	($000)
IMPORTS (cont'd)					
7415.10	Nails, tacks, drawing pins, staples and similar articles of copper or of iron or steel with copper heads	107	631	50	316
7415.21	Washers, copper, including spring washers	. .	1 053	. .	935
7415.29	Articles of copper, not threaded, n.e.s., similar to those of headings 7415.10 and 7415.21	. .	1 020	. .	1 026
7415.31	Screws, copper, for wood	. .	256	. .	43
7415.32	Screws, bolts and nuts of copper, excluding wood screws	. .	2 842	. .	2 111
7415.39	Articles of copper, threaded, n.e.s., similar to bolts, nuts and screws	. .	1 217	. .	1 193
7416.00	Copper springs	. .	86	. .	73
7419.10	Chain and parts thereof of copper	. .	521	. .	356
7419.91	Articles of copper, not further worked than cast, moulded, stamped or forged	298	1 977	279	1 794
7419.99	Articles of copper, n.e.s.	. .	29 447	. .	23 192

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available or not applicable; . . . Amount too small to be expressed; n.e.s. Not elsewhere specified; p Preliminary.
[1] Anode copper recovered in Canada from domestic concentrates plus exports of payable copper in concentrate and matte.
[2] Imports from "other countries" may include re-imports from Canada.
Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, COPPER PRODUCTION, TRADE[1] AND CONSUMPTION, 1975, 1980, AND 1985-93

	Production		Exports				
	Shipments[2]	Refinery Output	Concentrates and Matte	Refined	Total	Imports Refined	Consumption[3] Refined
				(tonnes)			
1975	733 826	529 197	314 518	320 705	635 223	10 908	196 106
1980	716 363	505 238	286 076	335 022	621 098	13 466	208 590
1985	738 637	499 626	320 619	280 033	600 652	19 131	222 466
1986	698 527	493 445	341 390	306 822	648 212	20 901	225 586
1987	794 149	491 124	381 126	288 800	669 926	16 583	231 288
1988	758 478	528 723	348 404	268 680	617 084	4 659	236 280
1989	704 432	515 216	348 739	321 690	670 429	4 408	218 571
1990	771 433	515 835	374 875	335 941	710 816	2 611	184 497
1991	780 362	538 339	348 080	377 985	726 065	2 321	185 055
1992	761 694	539 302	346 843	385 761	732 604	8 916	175 737
1993p	698 799	552 795	230 410a	304 621a	535 031a	16 875a	. .

Sources: Natural Resources Canada; Statistics Canada.
. . Not available; p Preliminary.
a January to September 1993.
[1] Beginning in 1988, Exports and Imports are based on the new Harmonized System and may not be in complete accordance with previous method of reporting. [2] Anode copper recovered in Canada from domestic concentrate plus exports of payable copper in concentrates and matte. [3] Producers' domestic shipments of refined copper plus imports of refined shapes.

TABLE 3. WESTERN WORLD PRODUCTION OF RECOVERABLE COPPER IN CONCENTRATES, 1992 AND 1993

	1992	1993[e]
	(000 t)	
Chile	1 933	2 040
United States	1 761	1 775
Canada	764	699[a]
Zaire	144	80
Zambia	433	415
Peru	368	375
Australia	378	337
Mexico	277	297
Philippines	124	139
Papua New Guinea	193	204
Indonesia	292	278
Other	932	827
Total	7 599	7 466

Sources: Natural Resources Canada; World Bureau of Metal Statistics.
[e] Estimated.
[a] Data are for shipments.

TABLE 4. WESTERN WORLD PRODUCTION OF REFINED COPPER,[1] 1992 AND 1993

	1992	1993[e]
	(000 t)	
United States	2 144	2 226
Chile	1 242	1 267
Japan	1 161	1 185
Canada	539	553
Germany	582	632
Zambia	472	429
Belgium	306	295
Australia	303	301
Peru	250	248
Other	1 855	1 854
Total	8 854	8 990

Sources: Natural Resources Canada; World Bureau of Metal Statistics.
[e] Estimated.
[1] Includes primary, secondary and electrowon copper.

TABLE 5. WESTERN WORLD CONSUMPTION OF REFINED COPPER, 1992 AND 1993

	1992	1993[e]
	(000 t)	
United States	2 176	2 400
Japan	1 411	1 385
Germany	1 046	1 060
Italy	502	490
France	488	420
Belgium	372	370
United Kingdom	308	330
South Korea	354	400
Canada	176	200
Taiwan	416	480
Brazil	166	165
Other	1 660	1 600
Total	9 075	9 300

Sources: Natural Resources Canada; World Bureau of Metal Statistics.
[e] Estimated.

TABLE 6. COPPER AND COPPER-NICKEL SMELTERS IN CANADA, 1993

Company and Location	Product	Rated Annual Capacity	Remarks
		(tonnes of concentrates)	
Falconbridge Limited Falconbridge, Ontario	Copper-nickel matte	600 000	Copper-nickel concentrate processed in fluid bed roasters and electric furnaces; 1800-t/d sulphuric acid plant treats roaster gases. Matte from the smelter is refined in Norway.
Inco Limited Sudbury, Ontario	Molten "blister" copper, nickel sulphide and nickel sinter for the company's refineries; nickel oxide sinter for market, soluble nickel oxide for market	1 000 000[a]	Oxygen flash-smelting of copper sulphide concentrate. Copper converters produce blister copper. Oxygen flash furnace for smelting of nickel-copper concentrate, converters for production of nickel-copper Bessemer matte. Production of matte followed by matte treatment, flotation, separation of copper and nickel sulphides, then by roasting to make nickel oxides for refining and marketing. Oxygen flash conversion of copper sulphide to semi-blister followed by pyrorefining to blister copper.
Falconbridge Limited Timmins, Ontario	Molten "blister" copper	440 000	Mitsubishi-type smelting, separation and converting furnaces, acid plant and oxygen plant to treat continuous copper concentrate feed stream to yield molten 99%-pure copper.
Noranda Inc. Horne smelter Noranda, Quebec	Copper anodes	770 000[b]	One continuous Noranda process reactor, five converters and acid plant. Treats concentrates from Noranda's mining operations in Quebec and Ontario as well as custom concentrates and scrap.
Noranda Inc. Gaspé smelter Murdochville, Quebec	Copper anodes	221 500[b]	Green charge reverberatory furnace, two converters, rotary anode furnace and an acid plant. Treats Gaspé and custom concentrates and scrap.
Hudson Bay Mining and Smelting Co., Limited (HBMS) Flin Flon, Manitoba	Copper anodes	320 000	Five roasting furnaces, one reverberatory furnace and three converters. Company treats its own copper concentrate as well as custom copper concentrates; zinc plant residues and stockpiled zinc plant residues fed to reverberatory furnace. Project under way to replace concentrate roasting and calcine smelting with Noranda continuous converter technology.

Source: Data provided by each company.
[a] Nickel-copper concentrate and copper concentrate. [b] Concentrate and copper scrap.

TABLE 7. COPPER REFINERIES IN CANADA, 1993

Company and Location	Rated Annual Capacity	Remarks
	(tonnes)	
Noranda Inc. Division CCR East Montréal, Quebec	350 000	Refines anodes from Noranda's Horne and Gaspé smelters, from the Flin Flon smelter, and also from purchased scrap and blister. Precious metals, selenium and tellurium recovered from slimes.
Inco Limited Copper Cliff, Ontario	170 000	Casts and refines anodes from molten converter copper from the Copper Cliff smelter; also refines purchased scrap. Gold, silver, selenium and tellurium cake recovered from anode slimes, which are further processed at Port Colborne to recover platinum metals concentrates. Recovers and electrowins copper from Copper Cliff nickel refinery residue.
Falconbridge Limited Timmins, Ontario	95 000	Refines anodes from the Kidd Creek smelter.
Gibraltar Mines Limited McLeese Lake, British Columbia	5 000	Dissolved copper-in-solution from heap leaching operations is treated in a solvent extraction plant and then electrowinned to produce copper cathode.

Source: All data provided by the companies.

TABLE 8. SUPPLY OF WIRE MILL, BRASS MILL, FOUNDRY AND POWDER PRODUCTS, AND THEIR CONSUMPTION IN END-USE MARKETS, 1991 AND 1992

United States	1991		1992p	
	(000 t)	(% of total)	(000 t)	(% of total)
SUPPLY				
Domestic mill products				
Building wire	505	17.8	535	17.9
Magnet wire	222	7.8	240	8.0
Communication wire and cable	278	9.8	274	9.2
Power cable	124	4.4	133	4.5
Automotive wire and cable	98	3.4	102	3.4
Other wire and cable	193	6.8	200	6.7
Strip, sheet, plate and foil	388	13.7	418	14.0
Rod and bar	390	13.8	437	14.6
Tube and pipe	392	13.8	420	14.1
Mechanical wire	30	1.0	29	1.0
Foundry products	183	6.5	175	5.9
Powder products	15	0.5	18	0.6
Total, domestic mill products	2 817	99.4	2 982	99.9
Imported mill products	17	0.6	2	0.1
Total supply	2 834	100.0	2 984	100.0
USES				
Building construction	1 167	41.2	1 263	42.3
Electrical/electronic products	711	25.1	719	24.1
Industrial machinery/equipment	374	13.2	398	13.3
Transportation equipment	318	11.2	336	11.3
Consumer and general products	265	9.4	268	9.0
Total	2 834	100.0	2 984	100.0

Source: Copper Development Association Inc.
p Preliminary.
Note: Percentages may not add due to rounding.

TABLE 9. YEARLY AVERAGE COPPER PRICES[1]

Year	LME
	(current US¢/lb)
1980	99.3
1981	79.5
1982	67.2
1983	72.2
1984	62.6
1985	64.9
1986	62.3
1987	80.1
1988	118.0
1989	129.0
1990	121.1
1991	106.2
1992	103.7
1993	86.8

Sources: Metals Week; Reuters.
[1] Settlement price for highest grade of copper sold.

TABLE 10. MONTHLY AVERAGE COPPER PRICES, 1992 AND 1993

	LME[1]		COMEX[2]	
	1992	1993	1992	1993
	(current US¢/lb)			
January	97.0	102.3	96.2	100.6
February	100.0	100.3	100.5	98.3
March	101.0	97.6	101.6	95.8
April	100.5	88.4	100.3	87.0
May	100.5	81.4	100.6	80.4
June	104.3	84.0	104.7	83.0
July	114.3	87.4	113.7	85.9
August	114.4	88.3	112.3	85.1
September	109.5	84.4	107.4	80.4
October	102.0	74.6	100.1	73.8
November	97.9	73.9	96.2	74.1
December	100.1	78.2	99.1	79.2

Source: Metals Week.
[1] LME cash price for Grade A copper. [2] COMEX First Position Grade A price.

Diamonds

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INTRODUCTION

World production of natural rough diamonds in 1992, the latest year for which statistics are available, was about 107 million carats (Mct). Sales were estimated at some US$6.414 billion. About 80% by weight of rough diamonds produced in the world are marketed by the Central Selling Organization (CSO), established by De Beers in support of its "single-channel" marketing of diamonds. The CSO has reported that, in 1993, sales of rough diamonds were US$4.366 billion, compared with US$3.417 billion in 1992, an increase of 28%.

According to De Beers, the two main growth areas continued to be the United States and Southeast Asia. In the latter region, there was major growth in the sales of lower-value rough diamonds. Sales in Europe and Japan remained weak. Improved sales figures were also the result of a 1.5% price increase in February and increased restocking of diamonds by retailers, particularly in the United States. Retail jewellery sales have held up despite a weak world economy. Finally, the world supply/demand balance was affected by sales from Russian and U.S. stockpiles, which had been built up during the Cold War for industrial and technical uses.

Canada is not yet a commercial producer of natural diamonds. However, Canada's potential to become one was further defined during the year as several companies continued extensive exploration work at a number of locations.

CANADIAN DEVELOPMENTS

A large area of northern and central Canada is underlain by a huge craton, which forms the nucleus of the North American continent. (A craton is part of the earth's crust and upper mantle which has attained stability, has been little deformed over a prolonged period of time, and has segments that are very old.) Studies of the global distribution of diamond-bearing rocks known as kimberlites show that these rocks are mainly confined to ancient cratons such as the one found in Canada. In addition, diamonds and diamond indicator minerals (such as subcalcic high-chrome garnet, chrome diopside, high-magnesia ilmenite, and high-chrome chromite) have been found in glacial deposits in numerous localities in Canada. Together, these observations suggest that, given sufficient time and funds for exploration, the chances of discovering diamonds in Canada in commercial quantities are very good. In 1993, exploration for diamonds was extensive, especially in the Northwest Territories, but also in Alberta, Saskatchewan, Manitoba, Ontario and Quebec. (See chapter entitled "Canadian Mineral Exploration.")

WORLD PRODUCTION

Natural Diamonds

World production of natural rough diamonds in 1992, the latest year for which statistics are available, was estimated to be 107 Mct. Sales were estimated at some US$6.414 billion. Of the total production, about 55 Mct consisted of low-value industrial diamonds, 35-40 Mct were near-gems, and about 15 Mct were gem-quality diamonds. In terms of value, however, gems represented more than 75% of the total, near-gems about 20%, and industrial, 5%. World production of natural diamonds grew from 43 Mct in 1980 to 107 Mct in 1992; this represented an increase of more than 5 Mct/y. A large proportion of the increase was due to increased sales to Japan during the 1980s.

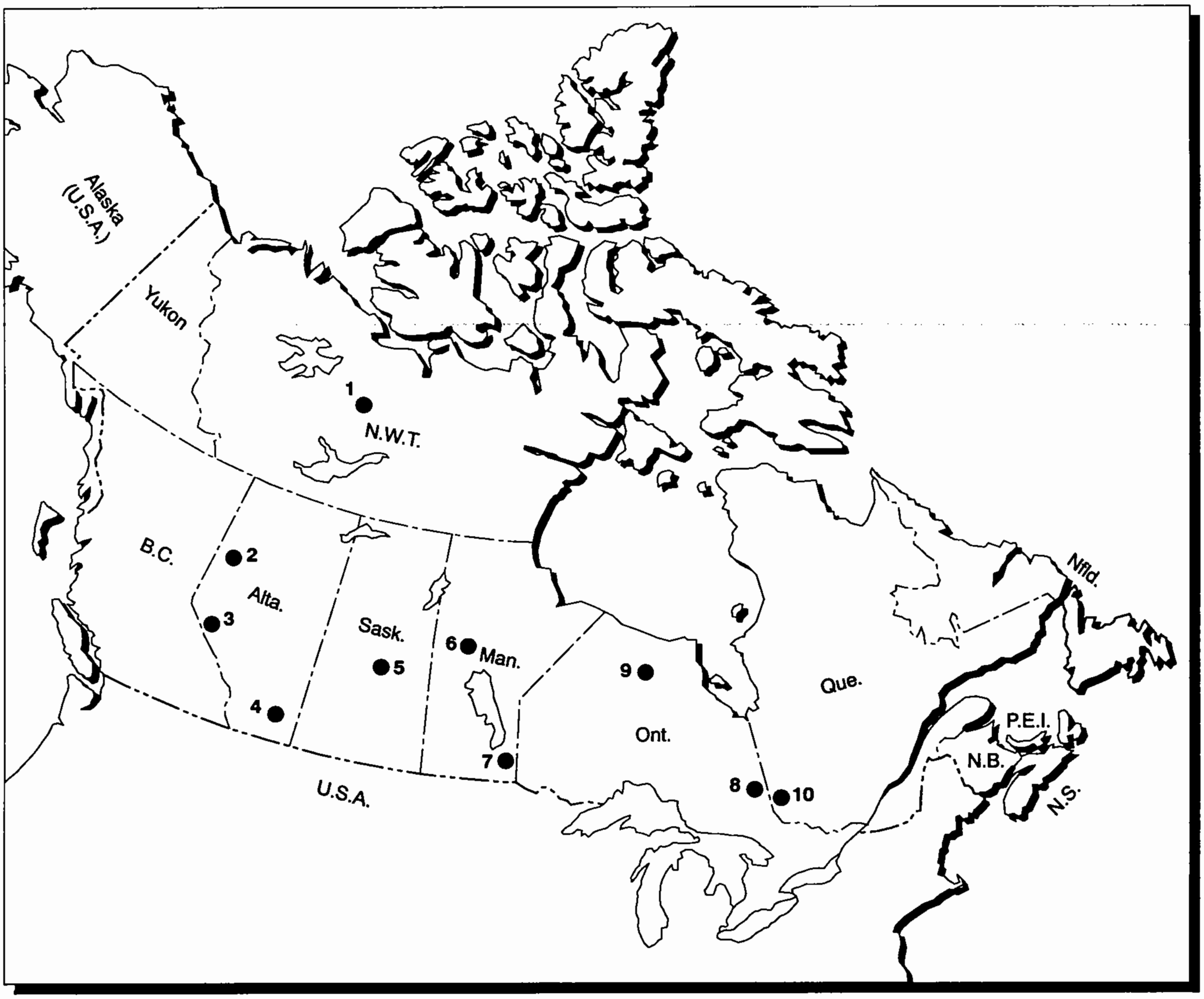
Natural diamonds are produced by some 20 countries. However, almost 95% of world production by weight came from only five nations in recent years. They are, in decreasing order: Australia (36-42 Mct), Botswana (15-17 Mct), Zaire (15-18 Mct), Russia (11-18 Mct) and South Africa (8-10 Mct). In terms of value, however, Botswana is the largest, with sales estimated in 1992 at

US$1553 million, followed by Russia ($1240 million), Angola ($961 million), South Africa ($906 million), Namibia ($583 million), Australia ($460 million), Zaire ($230 million), and others ($481 million).

Australia and Zaire account for about 50%-55%, by weight, of world production; however, more than 90% of the production of these countries consists of low-value industrial and near-gem diamonds. Diamonds mined in recent years have averaged about US$10/ct in Australia and US$15-20/ct in Zaire. At the other end, Namibia, which produces less than 2% by weight of world production, has a very high proportion (+95%) of gem-quality diamonds, averaging US$220-260/ct.

Figure 1

Major Diamond Exploration Areas in Canada, 1993



Numbers refer to locations on map above.

1. Lac de Gras
2. Peace River
3. Jasper
4. Badlands
5. Prince Albert
6. Snow Lake
7. Southeastern Manitoba
8. Kirkland Lake
9. James Bay Lowlands
10. Temiscamingue

Grade (the weight of diamonds expressed as carats per tonne (ct/t) of ore) varies widely from one mine to another. However, the grade generally falls between 0.3 and 1.3 ct/t. Grades as low as 0.05 ct/t and as high as 7.0 ct/t have been exploited. The value of the ore per tonne equals the grade times the average value per carat of all the individual diamonds.

Diamonds are mined from pipes (mainly kimberlites, but also lamproites), from alluvial deposits, and from beach and offshore (marine) deposits. During transport, the weak portions (cracks, inclusions, and other defects and impurities) of the diamonds are removed. This means that the gem ratio increases with transport and that, as a result, beach and offshore deposits usually have the highest gem ratio. Currently, there are less than 20 pipes being mined in the world in the following countries: Australia, Botswana, Russia, South Africa, Tanzania and Zaire. Nearly two thirds of world production by weight comes from only five pipes situated in Australia, Botswana, Russia and South Africa.

Synthetic Diamonds

Synthetic diamonds compete with natural industrial diamonds as an abrasive mineral and with silicon carbide (SiC), alumina (Al_2O_3) and cubic boron nitride (CBN) as a manufactured abrasive material. World production of synthetic diamonds in 1992 was estimated by the U.S. Bureau of Mines at 360 Mct. Most synthetic diamonds marketed are 0.6-0.8 mm and smaller. Synthetic diamonds were invented in Sweden in 1953 and have been produced commercially since the late 1950s.

The production of synthetic diamonds using the high-pressure and high-temperature method is labour-intensive and, contrary to silicon carbide and alumina, is not electricity-intensive. In 1993, synthetic diamonds were produced in at least 16 countries. The most important producing countries were, in decreasing order, the United States, Ireland, Russia, South Africa, China, Germany, Japan and Sweden. Smaller plants exist in the Czech Republic, the former Yugoslavia, Romania, France, England, Korea and Greece. New plants have been built in recent years in the United States, England and Korea. Leading producers are De Beers (South Africa), General Electric (United States), and Tomei (Japan).

Consumption of synthetic diamonds is reported to be growing at some 10%/y. Although they are expensive compared with silicon carbide and alumina, synthetic diamonds are more cost-effective because they cut much faster and last much longer. In many applications, synthetic diamonds are preferred to natural industrial diamonds because they can be tailored to the customer's needs. There are many types of synthetic diamonds, including those coated with metals such as copper or nickel for specific applications.

Japan is reported to be in the forefront of conversion to super-abrasives, including synthetic diamonds as well as cubic boron nitride (CBN), polycrystalline synthetic diamond shapes (PDS), and compacts (PDC). (Some 60% of all abrasive products used in Japan have diamond components.) Currently, 40% of abrasives used in Europe and 20% in North America are super-abrasives. For Canada, the gradual conversion from traditional abrasives (alumina and silicon carbide) to newer and better performing super-abrasives is slowly eroding our markets for traditional abrasives.

Crystalline Manufacturing Ltd. of Calgary reported that it has commenced production of synthetic diamond films by the Chemical (also called Carbon) Vapour Deposition (CVD) method, at a new plant in Calgary, built at a cost of some $4 million, excluding research and development. The process uses methane gas, argon and electricity as the key raw materials. Large quantities of electricity are required to disassociate methane gas at high temperature and separate carbon from hydrogen. In the process, diamonds are deposited as micron-sized crystals on a surface, and layers of crystals can be built up to about 0.5 mm thick. The films are used in applications such as diamond tooling and thermal management, such as in semiconductors and heat sinks. The company also plans to start producing diamond powder by the CVD method in early 1994. The powder will be used for lapping or final polishing of read/write heads for computer hard disks.

Major producers of industrial CVD products in the world are, in decreasing order: Sumitomo, De Beers, General Electric, St. Gobain (Norton), and Crystallume. These products are used in three major fields of applications: (1) tool inserts subject to wear; (2) optical-quality films (diamond is very hard, and transparent to X rays, infrared and visible light); and (3) heat sinks and electronic substrates (diamond dissipates thermal energy very well).

CANADIAN TRADE AND CONSUMPTION

Canada's imports of gem-quality diamonds and industrial diamonds were valued at $211 million in

1990, $189 million in 1991, and $187 million in 1992. Some 90% of the imports were estimated to be gem-quality diamonds. Imports of synthetic diamond dust or powder were 5.92 Mct valued at $4.64 million in 1990, 7.36 Mct valued at $4.45 million in 1991, and 5.32 Mct valued at $4.24 million in 1992.

THE DIAMOND-CUTTING INDUSTRY

Natural diamonds are cut in some 30-40 countries. The major diamond-cutting centres in the world are Antwerp and Kempen, Belgium; Ramat-Gan and Tel-Aviv, Israel; New York City, United States; and Surat and Bombay, India. With the exception of India, which is a very small producer of diamonds, none of these countries mines diamonds. Other countries with important cutting centres include South Africa and the C.I.S. (Russia, Ukraine, Belarus and Uzbekistan). Newcomers are Australia, Thailand, China, Botswana, Sri Lanka, Indonesia and Malaysia. Many other countries also cut diamonds; however, their factories are very small.

In Russia, most production of rough diamonds comes from Yakutia. Yakutia has only recently established its own diamond-cutting industry and, at year-end, there were reportedly five cutting plants with capacities varying from 30 000 rough ct/y to close to 100 000 rough ct/y. The plants were built as joint ventures with Belgian, Israeli, Japanese and reportedly South Korean companies. Several more plants are planned over the next few years. During the year, Yakutia also started sorting some of the diamonds it produces, with some being sold to its own cutting plants. An exchange for wholesale and retail trade in rough and cut diamonds is also planned.

Diamond cutting is labour-intensive, but not capital-intensive unless a factory is automated. A review of the literature suggests that, on average, an employee cuts close to 800 rough ct/y. However, this number varies widely, depending on the size of the rough diamonds to be cut (usually, more carats can be cut from bigger diamonds), the difficulty of the cut, and the level of automation of the factory. Because of high labour costs, factories in the United States usually cut bigger and better-quality diamonds. Belgium and Israel are in the middle of the labour-cost spectrum and, as a consequence, are generally involved in cutting stones of intermediate size and quality. India, with the lowest labour costs, cuts the smallest and least expensive diamonds.

Employment related to diamond-cutting varies widely from factory to factory, running anywhere from 1 to 1000 workers. Total employment in diamond-cutting varies widely from country to country, with fewer than 500 in the United States, 4000 in Belgium, some 8000 (35 factories) in Thailand, close to 10 000 each in Israel and Russia, and close to 800 000 in India.

The major steps in diamond-cutting are: (a) sawing (to remove flawed areas of the stone) with a saw and diamond dust or with a laser, or cleaving; (b) bruting (also known as "girdling"), to shape the diamond into a round, pear, oval or other form; (c) facetting (also known as "brillianteering"), by grinding sides into the diamond; and (d) polishing.

VALUATION AND SALES PROCEDURES

Rough Diamonds

Between 80% and 85% of the rough diamonds produced in the world are marketed through the Central Selling Organization (CSO). The valuation of rough mined diamonds is very complex, with diamonds being classified into some 5000 categories, according to the industry. Roughs are first sieved and sized; they are then classified.

The stones are classified according to their *shape* ("sawables," which can be sawn with a diamond saw or laser, and "makeables," i.e., unsawable and which must be shaped by cleaving or other methods), *clarity* (five categories), and *colour* (five grades, which are further sub-divided into categories). Brilliant-cut gem diamonds usually have a yield (weight of cut and polished stone/weight of rough diamond) of 45%-50% for sawables, and 35% or less for less expensive makeable rough diamonds.

The CSO has been very successful in maintaining balance between supply and demand of rough diamonds for some 60 years. It buys surplus production of rough diamonds from mines and stockpiles in periods of weak demand in the jewellery market and sells off its stockpiled roughs as demand picks up. Production quotas may be applied to major producers when sales fall.

Rough diamonds are released to the market in a controlled way (to maintain balance between the supply and demand of different quality diamonds) by the CSO at "sights," which are held about every five weeks in Europe (London and Lucerne) and in South Africa, to about 160 carefully chosen buyers known as "sightholders." The majority of the sightholders are manufacturers that cut and polish the stones in their factories, although some wholesale firms that deal in rough diamonds also attend the sights. Once the stones are cut and polished, they are sold to diamond merchants or wholesalers. Finally, the diamonds are sold to retailers and jewellers.

Cut and Polished Diamonds

To determine the value of an individual diamond, an appraiser looks at its combination of all the four Cs: cut, colour, clarity, and carat (weight).

Cut

The cut of a diamond is the most important factor. The cut **quality** of a diamond is less determined by its shape (round, pear shape, oval, heart shape, square, triangle, etc.) and its number of facets than by the relative proportions of the table size, crown height, and the pavilion depth of the diamond (which determines its brilliancy, i.e., the amount of light reflected through the stone), and by the angles of the facets (which determine the dispersion of light that creates the fiery rainbow colours).

Colour

The rarest and best colour in diamonds is no colour at all. The colour grade is a measure of the amount of colour present in a diamond. Most diamonds have a tinge of some colour (most often yellow or brown). Strong (intense)-coloured diamonds called "fancies" command very high prices. Among the fancies, the browns (cognac) are the most common, followed by intense yellows (canary and champagne). Orange and yellowish greens are rare; pink, blue, and dark green are the rarest and command the highest prices.

Clarity

This is a measure of the number, size, placement, and nature of flaws (inclusions and/or imperfections) within and on the surface of a diamond, visible at 10-power magnification. Inclusions are crystals, and imperfections are feathers, blemishes, cracks, etc.

Carat

One carat is equivalent to 0.2 grams. A carat is normally divided into 100 points. Because larger diamonds are rare, a 1-carat diamond will cost more than a cluster of 20 diamonds weighing a total of 1 carat.

Uses

Gem-quality diamonds are used mainly in jewellery. De Beers reports that, in 1992, world diamond retail jewellery sales had a diamond content valued at US$8.9 billion. The three major markets for diamond jewellery in terms of diamond value were the United States (30%), Japan (23%), and Europe (about 17%). Since a considerable proportion of the rough stones is lost during cutting and polishing, only about 12-15% by weight of rough stones mined end up in jewellery.

Because they are the hardest substance known to man, natural and synthetic industrial diamonds are used in equipment that drill, cut, grind and polish rocks (such as granite and marble), other materials (such as nonferrous metals, carbon fibre and composites), and a range of nonmetallic materials (such as glass, refractories, ceramics, concrete, plastics, and masonry bricks). Natural and synthetic diamonds are widely used in the automotive, advanced technology, and aerospace industries.

Prices

In 1992, published average mine prices of rough diamonds, including gem, near-gem and industrial diamonds, varied widely across producing countries: US$6/ct in Australia, US$27/ct in Zaire, US$67/ct in Botswana, US$95/ct in Russia, US$105/ct in South Africa, US$157/ct in Angola, US$208/ct in Sierra Leone, US$300/ct in Guinea, and US$315/ct in Namibia. This means that in Australia the diamonds have a very low gem ratio, while in Namibia the gem ratio is very high. South Africa produced rough diamonds that varied in price from US$60 to US$300/ct. Between 1949 and 1992, the average price of rough diamonds increased about 1800%. This means that a rough diamond that sold for US$100 in 1949 would sell for about US$1800 in 1992.

Prices of U.S.-cut diamonds, by size and quality, are shown in Table 3. The average U.S. wholesale asking price of the top 25 grades (D through H colour, and IF through VS2 clarity) of a 1-carat diamond was US$7208 at the end of 1992. (Taking into account losses during cutting and polishing and commissions paid to intermediaries between the mine and the jeweller, the retail price of a diamond in jewellery is an estimated 5-6 times the price of the rough stone at the mine.)

Natural industrial diamond grit (40 microns to 1 mm) and powder (–40 microns), synthetic grit and powder, and industrial stones (+1 mm) imported into the United States in 1992 were valued at US$1.14/ct, US$0.64/ct, and US$4.56/ct, respectively. The prices of synthetic diamonds vary widely from 20¢/ct for friable material with irregular shapes to $1-2/ct for polishing material, to several dollars per carat for blocky, regular shapes with excellent crystal structure.

OUTLOOK AND PRODUCTION FORECAST

In the short term, the oversupply of natural rough diamonds, especially in the lower-quality range categories, is likely to continue. However, industry sources predict that, by the mid- to late-1990s, consumption of diamonds should increase as Western economies recover and as sales in Southeast Asian countries increase due to their rapidly growing economies. After the year 2000, sales to Eastern Europe are expected to pick up.

Johnson, Marriott & von Saldern estimate that, by the year 2000, world production of natural diamonds will vary from 84 Mct to 136 Mct/y, with a best estimate of 113 Mct/y. An analysis by Yorkton Securities Inc. concludes that, without any production from Canada, world gem-diamond production should be around 17-18 Mct/y by the year 2000, and that an additional 3-4 Mct from Canada should be absorbable in world markets, if handled correctly.

Note: Information in this review was current as of February 1, 1994.

TARIFFS

Item No.	Description	Canada			United States
		MFN	GPT	USA	Canada
7102.10	Diamonds, unsorted, whether or not worked, but not mounted or set	Free	Free	Free	Free
7102.21	Diamonds, industrial, unworked or simply sawn, cleaved or bruted, but not mounted or set				
7102.21.10	Bort and black diamonds, for borers	Free	Free	Free	Free
7102.21.90	Other	10.2%	6.5%	Free	Free
7102.29	Diamonds, industrial, other, worked, not mounted or set				
7102.29.10	Bort and black diamonds, for borers	Free	Free	Free	Free
7102.29.90	Other	10.2%	6.5%	Free	Free
7102.31	Diamonds, non-industrial, unworked or simply sawn, cleaved or bruted	Free	Free	Free	Free
7102.39	Diamonds, non-industrial, other	Free	Free	Free	Free
7105.10.10	Diamond dust for borers; dust mixed with a carrier in cartridges or in tubes	Free	Free	Free	Free
7105.10.91	Natural diamond dust or powder	10.2%	6.5%	Free	Free
7105.10.92	Synthetic diamond dust or powder	Free	Free	Free	Free

Sources: Customs Tariff, effective January 1994, Revenue Canada, Customs and Excise; Harmonized Tariff Schedule of the United States, 1994.

TABLE 1. CANADA, DIAMOND TRADE, 1991-93

Item No.		1991		1992		Jan.-Sept. 1993p	
		(carats)	($000)	(carats)	($000)	(carats)	($000)
EXPORTS							
7102.10	Diamonds, unsorted, whether or not worked						
	United States	..	37	..	237	..	154
	Total	..	37	..	237	..	154
7102.21	Diamonds, industrial, unworked or simply sawn, cleaved or bruted						
	United States	4 257	30	14 098	120	–	–
	Total	4 257	30	14 098	120	–	–
7102.29	Diamonds, industrial, n.e.s., excluding mounted or set diamonds						
	Ireland	–	–	–	–	100	12
	United States	5 957	77	5 620	87	11	8
	Chile	15 284	76	–	–	–	–
	Total	21 241	154	5 620	87	111	20
7102.31	Diamonds, non-industrial, unworked or simply sawn, cleaved or bruted						
	United States	17	91	2 748	158	2	3 885
	New Zealand	103	89	40	40	–	–
	Total	120	180	2 788	198	2	3 885
7102.39	Diamonds, non-industrial, n.e.s., excluding mounted or set diamonds						
	United States	8 967	8 249	11 977	13 024	4 414	3 470
	Belgium	–	–	242	278	7	12
	Hong Kong	–	–	108	99	–	–
	Other countries	408	104	16	77	–	–
	Total	9 375	8 355	12 343	13 478	4 421	3 483
7105.10	Diamond dust or powder						
	United States	102 724	77	425 921	199	103 311	175
	Spain	–	–	2 000	4	–	–
	Other countries	–	–	270	1	50	...
	Total	102 724	77	428 191	205	103 361	176
IMPORTS							
7102.10	Diamonds, unsorted, whether or not worked, but not mounted or set						
	United States	..	12 355	..	10 664	..	13 019
	Belgium	..	20 464	..	22 703	..	12 715
	Israel	..	12 125	..	12 454	..	10 352
	India	..	3 911	..	3 770	..	3 718
	Iceland	..	43	..	689	..	1 867
	Other countries	..	1 158	..	1 848	..	1 297
	Total	..	50 056	..	52 128	..	42 968
7102.21.10	Diamonds, industrial, bort and black, for borers, unworked or simply sawn, cleaved or bruted, but not mounted or set						
	United States	202 273	848	209 899	1 022	175 661	738
	Zaire	73 676	304	27 009	99	23 209	107
	Belgium	–	–	3 346	33	4 511	45
	France	–	–	–	–	3 968	14
	Other countries	66 873	361	41 355	194	1 253	13
	Total	342 822	1 513	281 609	1 348	208 602	917
7102.21.90	Diamonds, industrial, other than bort and black, for borers, unworked or simply sawn, cleaved or bruted, but not mounted or set						
	United States	14 621	72	1 938	6	1 595	14
	South Africa	–	–	–	–	385	3
	Other countries	11 071	42	–	–	36	...
	Total	25 692	115	1 938	6	2 016	18

TABLE 1 (cont'd)

Item No.		1991		1992		Jan.-Sept. 1993p	
		(carats)	($000)	(carats)	($000)	(carats)	($000)
IMPORTS (cont'd)							
7102.29.10	Diamonds, industrial, bort and black, for borers, worked, but not mounted or set						
	Ireland	482 670	1 977	603 272	2 711	423 767	1 604
	United States	157 464	514	81 824	292	55 013	189
	Zaire	–	–	–	–	36 260	140
	Australia	–	–	–	–	2 351	9
	Other countries	4 000	22	105 182	450	1 500	4
	Total	644 134	2 514	790 278	3 453	518 891	1 946
7102.29.90	Diamonds, industrial, other than bort and black, for borers, worked, but not mounted or set						
	United States	4 042	38	14 325	100	2 008	11
	Australia	–	–	334	5	–	–
	Zaire	–	–	235	3	–	–
	Other countries	7 014	26	–	–	–	–
	Total	11 056	64	14 894	109	2 008	11
7102.31	Diamonds, non-industrial, unworked or simply sawn, cleaved or bruted, not mounted or set						
	Belgium	12	1	90	47	21	21
	United States	81	22	52	50	37	15
	India	6	5	–	–	–	–
	Total	99	29	142	98	58	36
7102.39.00.10	Diamonds, non-industrial, worked, of a weight not exceeding 0.5 carat each						
	Belgium	39 709r	20 858	38 580	18 199	38 075	15 577
	United States	30 340	12 541	22 330	11 030	11 569	7 282
	Israel	15 524	11 554	10 618	7 605	8 534	5 365
	India	3 515	1 330	6 549	2 365	5 543	1 744
	Iceland	192	68	200	171	684	667
	Former U.S.S.R.	88 272	20 000	53 821	19 229	. .	. .
	Other countries	1 984	1 702	2 678	1 047	1 668	1 590
	Total	179 536r	68 053	134 776	59 646	66 073	32 225
7102.39.00.20	Diamonds, non-industrial, worked, of a weight exceeding 0.5 carat each						
	Russia	. .	. .	. .	. .	10 684	15 731
	Belgium	17 722	13 563	18 999	14 412	15 464	12 961
	Israel	10 317r	12 490	8 065	6 152	6 437	7 215
	United States	11 168	7 731	10 322	10 873	6 162	6 693
	India	2 934	1 033	1 536	742	1 412	399
	Former U.S.S.R.	16 316	22 932	19 560	36 574	. .	. .
	Other countries	2 397	4 100	1 661	1 627	994	1 173
	Total	60 854r	61 849	60 143	70 380	41 153	44 172
7105.10.10	Diamond dust for borers; dust mixed with a carrier in cartridges or in tubes						
	United States	197 789	429	190 632	455	230 990	691
	Denmark	5 258	26	7 476	37	6 688	33
	Other countries	20 969	27	22 458	29	13 554	17
	Total	224 016	483	220 566	521	251 232	741
7105.10.91	Natural diamond dust or powder						
	United States	2 200	3	1 059	2	501	4
	Total	2 200	3	1 059	2	501	4
7105.10.92	Synthetic diamond dust or powder						
	United States	672 500	1 405	1 018 207	1 824	1 165 871	2 802
	Ireland	288 442	1 311	205 509	958	177 713	723
	Romania	–	–	113 500	189	133 000	94
	Former U.S.S.R.	6 395 317	1 715	3 933 263	1 096	. .	. .
	Other countries	6 401	24	49 660	178	3 756	8
	Total	7 362 660	4 455	5 320 139	4 245	1 480 340	3 627

Source: Statistics Canada.
– Nil; . . Not available or not applicable; . . . Amount too small to be expressed; n.e.s. Not elsewhere specified; p Preliminary; r Revised.
Note: Numbers may not add to totals due to rounding.

TABLE 2. DIAMONDS, WORLD PRODUCTION, BY TYPE AND COUNTRY,[1] 1991 AND 1992

(thousand carats)

Country	1991 Gem[2]	1991 Natural industrial	1991 Total	1991 Synthetic[3]	1992[e] Gem[2]	1992[e] Natural industrial	1992[e] Total	1992[e] Synthetic[3]
Angola[e]	899[r]	62[r]	961[r]	–	935	65	1 000	–
Australia	17 978	17 978	35 956	–	21 000	21 000	42 000	–
Botswana	11 550	4 950	16 506	–	10 000	5 000	15 000	–
Brazil	600	900	1 500	–	600	900	1 500	–
Central African Republic	296[r]	82[r]	379[r]	–	296	82	378	–
China[e]	200	800	1 000	15 000	200	800	1 000	15 000
Ivory Coast[5]	11	4	15	–	11	4	15	–
Czechoslovakia[e]	–	–	–	5 000	–	–	–	5 000
France[e]	–	–	–	4 000	–	–	–	4 000
Gabon	400	100	500	–	400	100	500	–
Ghana[6]	175[r]	525[r]	700[r]	–	175	525	700	–
Greece[e]	–	–	–	1 000	–	–	–	750
Guinea[6]	91[r]	6	97[r]	–	90	5	95	–
Guyana	7[r]	38[r]	45[r]	–	8	42	50	–
India	3	15[r]	18[r]	–	3	15	18	–
Indonesia[e]	8	24	32	–	6	21	27	–
Ireland[e]	–	–	–	60 000	–	–	–	60 000
Japan[e]	–	–	–	25 000	–	–	–	30 000
Liberia	40	60	100[e]	–	60	90	150	–
Namibia	1 170	20[r]	1 187[r]	–	1 500	50	1 549[a]	–
Romania[e]	–	–	–	4 500	–	–	–	4 500
Russia[7,8]	n.a.	n.a.	n.a.	n.a.	9 000	9 000	18 000	60 000
Sierra Leone[5]	160[r]	83[r]	243	–	165	85	250	–
South Africa, Republic of:								
Finsch mine	1 200[r]	2 280[r]	3 483[r]	–	1 200	2 250	3 446	–
Premier mine	700	1 550[r]	2 250[r]	–	740	1 700	2 444	–
Venetia mine	100	200	303	–	660	1 200	1 868	–
Other De Beers' properties[4]	1 500[r]	400[r]	1 897[r]	–	1 350	500	1 849	–
Other	400	100[r]	498[r]	–	450	100	549	–
Total	3 900[r]	4 530[r]	8 431[r]	60 000[e]	4 400	5 750	10 156	60 000
Swaziland	34[r]	23[r]	57[r]	–	36	24	60	–
Sweden[e]	–	–	–	25 000	–	–	–	25 000
Tanzania	70[r]	30[r]	100[r]	–	70	30	100	–
U.S.S.R.[e,8,9]	10 000[r]	10 000[r]	20 000[r]	60 000	–	–	–	–
United States	–	–	–	90 000	–	–	–	90 000
Venezuela	102[r]	112[r]	214[r]	–	108	115	223	–
Yugoslavia[e,10]	–	–	–	5 000	–	–	–	5 000
Zaire	3 000	14 814[r]	17 814[r]	–	3 000	12 000	15 000	–
Total, all countries	50 694[r]	55 156[r]	105 855[r]	359 500	52 063	55 703	107 771	358 750

Source: U.S. Bureau of Mines.
– Nil; [e] Estimated; n.a. Not applicable; [r] Revised.
[a] Reported figure.
[1] Table includes data through May 25, 1993. Total diamond output (gem plus industrial) for each country actually is reported, except where indicated by a footnote to be estimated. In contrast, the detailed separate production data for gem diamonds and industrial diamonds are U.S. Bureau of Mines estimates except for Brazil (1988-90), and Central African Republic (1988-90), for which source publications give details on grade as well as totals. The estimated distribution of total output between gem and industrial diamonds is conjectural, and for most countries, is based on the best available data at time of publication. [2] Includes near-gem and cheap-gem qualities. [3] Includes all synthetic diamond production. [4] Other De Beers' Group output from the Republic of South Africa includes Kimberley pool, Koffienfontein, Namaqualand. [5] Figures are estimates based on reported exports and do not include smuggled diamonds. [6] Figures do not include smuggled diamonds. [7] Formerly part of the U.S.S.R. [8] All production in the U.S.S.R. from 1988-91 came from Russia. [9] Dissolved in December 1991. [10] Dissolved in April 1992.

TABLE 3. PRICES OF U.S.-CUT DIAMONDS, BY SIZE AND QUALITY

Carat Weight	Description Colour[1]	Clarity[2] (GIA Terms)	Price range Per Carat[3] Jan. 1992-Jan. 1993	Average[4] July 1992
			($)	($)
0.25	G	VS1	1 400 - 1 400	1 400
.25	G	VS2	1 200 - 1 200	1 200
.25	G	SI1	970 - 970	970
.25	H	VS1	1 200 - 1 200	1 200
.25	H	VS2	1 100 - 1 100	1 100
.25	H	SI1	950 - 950	950
.50	G	VS1	2 700 - 2 900	2 900
.50	G	VS2	2 500 - 2 600	2 600
.50	G	SI1	2 300 - 2 300	2 300
.50	H	VS1	2 600 - 2 700	2 700
.50	H	VS2	2 400 - 2 500	2 500
.50	H	SI1	2 100 - 2 200	2 200
.75	G	VS1	3 500 - 3 500	3 500
.75	G	VS2	3 200 - 3 200	3 200
.75	G	SI1	2 800 - 2 800	2 800
.75	H	VS1	3 100 - 3 100	3 100
.75	H	VS2	2 800 - 2 800	2 800
.75	H	SI1	2 600 - 2 600	2 600
1.00	G	VS1	4 600 - 4 600	4 600
1.00	G	VS2	4 100 - 4 100	4 100
1.00	G	SI1	3 700 - 3 700	3 700
1.00	H	VS1	4 100 - 4 100	4 100
1.00	H	VS2	3 800 - 3 900	3 900
1.00	H	SI1	3 400 - 3 600	3 600

Source: U.S. Bureau of Mines.
[1] Gemological Institute of America (GIA) colour grades: D – colourless; E – rare white; G-H-I – traces of colour. [2] Clarity: FL – flawless; IF – internally flawless, minor surface blemishes; VVS1 – very, very slightly included; VS1 – very slightly included; VS2 – very slightly included, but not visible; SI1 – slightly included. [3] Jeweler's Circular-Keystone, V. 164, No. 3, March 1993. [4] Jeweler's Circular-Keystone, V. 163, No. 9, Sept. 1992.
Note: This table does not include prices for D, E, F, and I to Z, and the fancy colours' classification scale, nor does it include prices for FL, IF, VVS1, VVS2, SI2, and I1, I2 and I3 (imperfect) clarities.

TABLE 4. DE BEERS' CSO ROUGH DIAMOND SALES AND STOCKS, 1985-93

Year	Sales	Stocks
	(US$ billions)	
1985	1.80	1.90
1986	2.56	1.85
1987	3.07	2.30
1988	4.17	2.00
1989	4.09	2.47
1990	4.17	2.68
1991	3.93	3.03
1992	3.41	3.76
1993	4.37	. .

Sources: U.S. Bureau of Mines; American Diamond Industry Association.
CSO = Central Selling Organization.
. . Not available.

Gold

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After a decade of rapid growth, Canada's gold production decreased for the second consecutive year to 153 t in 1993 from 160 t in 1992 and a record 176 t in 1991. By surpassing Russia's production in 1993, Canada became the fourth largest gold producer behind South Africa, the United States and Australia.

The average price of gold in 1993 was US\$360/troy oz, compared to US\$344/oz in 1992 and US\$362/oz in 1991. Prices were relatively volatile and ranged from \$326.50/oz in March (the lowest level since January 1986) to \$406.70/oz in August. Gold price increases in 1993 were triggered by investor demand and strong fabrication demand, particularly in the jewellery sector in the Far East, as well as by low world production growth.

CANADIAN DEVELOPMENTS

There were about 50 primary gold mines in Canada at the end of 1993, and these mines, along with placer deposits, accounted for 89% of the gold produced, with the remainder coming from base-metal mines. Two mines closed while six opened during the year. Total employment in primary gold mines decreased to about 8700 from 9400 in 1992. Employment figures in the gold industry have been declining steadily from the 1988 peak of 12 600.

British Columbia

British Columbia's gold production decreased to 14.4 t in 1993 from 16.8 t in 1992.

At the Eskay Creek project, a share exchange takeover bid between Prime Resources Group and Stikine Resources Limited allowed Prime Resources Group to acquire full ownership of the Eskay Creek deposit. Homestake Mining Company maintains a controlling interest in Prime through a 54% controlling interest and will also be the mine operator. Placer Dome Inc. elected to sell its 17% ownership through a public offering.

Eskay Creek is one of the highest-grade precious metal deposits in the world with reserves of 1 Mt grading 70 g/t gold and 3210 g/t silver. The ore also contains 5.6% zinc and 0.77% copper. On September 24, 1993, Prime Resources Group announced the completion of the feasibility study that indicates production of 360 t/d is feasible from a small underground mine. Production is expected to start in 1995 at a rate of 8 t/y of gold. The capital cost at Eskay Creek is estimated at \$294 million, with cash operating costs of \$108/oz of gold equivalent. Prime Resources Group is assessing the possibility of shipping the ore directly to a smelter. Should this approach prove to be successful, it would reduce capital costs by approximately \$150 million-\$200 million; however, operating costs would increase.

Wheaton River Minerals bought Homestake's 85% interest in North American Metals Corp.'s Golden Bear mine. In 1993, North American Metals, which remains the mine operator, mainly processed stockpiled ore while conducting exploration to delineate additional reserves.

Northwest Territories

Gold production in the Yukon and Northwest Territories decreased slightly from 17.3 t in 1992 to 16.4 t in 1993.

After 18 months, the bitter labour-management dispute at the Giant mine of Royal Oak Mines Inc. was settled following a decision by the Canada Labour Relations Board. Some unsettled issues, such as the rehiring of dismissed workers, will be solved through an arbitration process.

Miramar Mining Corporation acquired the Con mine from RTZ's subsidiary, NERCO Minerals Company. The Con mine, which has been in operation for 55 years and has produced 150 t of gold, has reserves of 55 t, representing eight years of production.

Royal Oak Mines acquired the Colomac mine from Neptune Resources Corp. for $10 million. The Colomac mine was closed in 1991 due to high operating costs. Production at the Colomac mine will resume by the middle of 1994 at an annual rate of 5 t/y of gold. Current reserves are sufficient for seven years of production.

Saskatchewan

Despite financial difficulties, production continued at Claude Resources Inc.'s Seabee gold mine. Proven reserves at the Seabee mine are 200 000 t grading 10.5 g/t gold.

An update to the 1992 feasibility study of the Contact Lake property of Cameco and Uranerz Exploration was conducted in 1993. Contact Lake has geological reserves of 1.6 Mt grading 9.6 g/t gold. In 1994, Cameco will drive a decline to access the orebody in order to confirm the reserve estimates. If the reserve estimates are confirmed, Contact Lake could start production in 1995 at a rate of approximately 2.5 t/y of gold for five years.

Manitoba

In Manitoba, Cazador Resources Ltd. started production at the Keystone mine in the Lynn Lake area. (Subsequently, Cazador merged with Granduc Mines Ltd. to form Granduc Mining Corporation.) The Keystone open-pit mine has reserves of 1.2 Mt grading 2.8 g/t gold. Annual gold production is 1.3 t. The ore from the Keystone mine is trucked to the Lynn Lake mill.

Granduc Mining Corporation also acquired the Farley Lake property in the Lynn Lake area from Manitoba Mineral Resources Ltd., a provincial crown corporation. Reserves from the open-pit mine at Farley Lake are estimated at 1.6 Mt grading 3.6 g/t gold.

Ontario

Ontario's gold production in 1993 totalled 72 t, a decrease from the 1992 total of 74.3 t. Production at the three mines in the Hemlo area accounts for nearly 50% of Ontario's total production.

Deak Resources Corp./GSR Mining resumed operations at the Kerr mine in Virginiatown. The company discovered 400 000 t of ore grading 7.6 g/t gold.

Northfield Minerals Inc. (78.5%) and Towerland Properties Inc. (21.5%) continued pre-production at the Cheminis gold mine.

In early 1994, a production decision was taken on the Holloway Project of Hemlo Gold Mines Inc., Freewest Resources Ltd. and Teddy Bear Valley Mines Ltd. Total reserves at the Holloway project are 5 Mt grading 9.3 g/t gold, and production is expected to start in early 1996.

Placer Dome announced in January 1994 that it will develop a new enlarged pit in addition to the current underground mining operation. Annual production is expected to increase from 6 t/y to 10 t/y. To develop the new enlarged pit, some mining and administration buildings will have to be moved. Construction is expected to begin in April 1994 at a total cost of $150 million.

Placer Dome Inc. has sold the Dona Lake mine to Ross-Finlay Ltd. for $2 million.

Falconbridge Gold Corporation sold its Hoyle Pond and Bell Creek mines, as well as other mining assets, to Kinross Gold Corporation for $22 million.

Quebec

Quebec's gold production decreased by 6% from 44.6 t in 1992 to 41.9 t in 1993.

The Portage and Rand mines near Chibougamau re-opened following their purchase by MSV Resources Inc. from Westminer Canada Ltd., who had put the mine on care and maintenance in late 1992. Reserves at the Portage and Rand mines are estimated at 1 Mt grading 4.1 g/t gold.

The Sleeping Giant mine of Aurizon Mines Ltd., which closed in 1991 because of low gold prices, re-opened in May 1993 with Cambior Inc. as the operator. Cambior earned a 50% interest in the property after completing a three-year $12 million exploration program to delineate new reserves. Proven and probable reserves at the Sleeping Giant mine are estimated at 350 000 t grading 7.5 g/t gold. Annual production is expected to be 1 t.

Cambior Inc. also announced the closure of the Lucien Béliveau and Pierre Beauchemin mines due to exhaustion of reserves.

The Astoria mine of Deak Resources Corp./GSR Mining Corp. was brought into production. The mine is producing 10 000 t/m of ore, which is being trucked to the company's Virginiatown mill. Reserves at the Astoria mine are 1 Mt grading 7 g/t gold.

Also in 1993, KWG Resources started production at the Granada mine, where reserves are 3.7 Mt grading 5.1 g/t gold.

Production at the Casa Berardi Est mine of TVX Gold Inc. and Golden Knight Resources Ltd. was reactivated following an inflow of overburden material into the mine.

Newfoundland

Production at the Hope Brook mine continued following its purchase by Royal Oak Mines Inc. from BP Resources Canada Inc. in 1992. Royal Oak re-opened the mine in July 1992 after a one-year shut-down. Reserves at the Hope Brook mine are estimated at 10 Mt grading 3.5 g/t gold. The mine produces about 3 t/y of gold.

WORLD DEVELOPMENTS

South Africa

South Africa remains the world's largest gold producer with an output of 614 t in 1993. Its share of world production was estimated at around 27% in 1993, compared to approximately 66% in 1970.

With a cumulative output exceeding 44 000 t from 1870 to 1993, South Africa has been the dominant gold supplier. About 98% of South Africa's gold comes from mines in the Witwatersrand Basin in the Johannesburg area.

South Africa has moved from being the lowest-cost gold producer in 1985 to being one of the highest-cost producers. Cash costs in South Africa in 1985 were approximately US$147/oz, while costs at other major Western World producers averaged about $200/oz. However, in 1992, South Africa was considered to be the highest-cost producer with a cash cost of $286/oz, compared to the average Western World cost of $247/oz. Gold production, valued at around US$6 billion per year, accounts for over 35% of South Africa's export earnings.

Despite a large reserve base, South Africa's mine production faces major difficulties due to declining ore grades, deep gold reserves, and high domestic inflation. However, rationalization is taking place to increase productivity. Production cost increases in the gold mining industry in the last two years were reported to have been below 3%.

The South African mines' ability to keep reducing costs is limited by their relatively low-grade reserves. As most South African primary gold mines are over 30 years old, they have generally mined out their higher-grade reserves. From 1970 to 1993, grades of the ore being mined declined from 13 g/t to 5 g/t.

According to the Chamber of Mines, a total of about 360 000 are employed in the gold mining industry in South Africa. Throughout its history, the Chamber of Mines has assumed responsibility for overall policy coordination, research, recruitment of labour and, until recently, marketing and promotion of the Krugerand through its former subsidiary, the International Gold Corporation.

Following the removal of various economic and political sanctions by the majority of its trading partners, South Africa is contemplating relaunching the Krugerand gold coin. Prior to the sanctions in 1984, the Krugerand coin accounted for between 40% and 60% of the Western World's gold coin market.

Anglo American Corporation of South Africa Ltd. is the world's most important gold producer, with gold production of 277 t in 1992. Anglo American announced that the Moab mine would be developed, with production start-up scheduled for 1997. The Moab mine is expected to produce 13 t/y of gold.

Gold Fields of South Africa Ltd. is the world's second largest gold producer with output of 120 t in 1992, while Gencor ranked third with production of 75 t. Gencor announced that the first-phase development of the US$430 million Oryx mine in the Orange Free State that started in 1993 faced an important cost overrun. Gencor's Winkelhaak Mines Ltd. commissioned a new sub-vertical shaft and extended its mine life by 11 years. This project has provided access to 20 Mt of ore grading 5.7 g/t gold, representing 120 t of gold.

The South African Department of Minerals and Energy Affairs indicated that several mines could be developed if its mining industry could solve current financial and technical problems. Most new major gold mines in the Witwatersrand Basin would operate at depths in excess of 2000 m.

United States

Gold production increased from 44 t in 1981 to an estimated 330 t in 1993, thereby making the United States the second largest producer behind the Republic of South Africa. According to the U.S. Bureau of Mines, 25 mines yielded 76% of the gold produced in the country in 1992. Nevada accounted for about two thirds of U.S. production with 210 t produced. The other major producing states are California, South Dakota and Montana. Growth in gold production in Nevada was made possible by the application of the heap leach process, designed to treat low-grade ores.

The cumulative production of Newmont Gold Company's Gold Quarry mine and American Barrick's Goldstrike mine exceeded 80 t in 1993. American Barrick announced production start-up at the Meikle deposit for the middle of 1996. The Meikle deposit is located 2 km north of the Goldstrike deposit. It contains 6.5 Mt of ore grading 21.6 g/t gold. The Meikle underground mine is expected to produce 11 t/y for 11 years.

American Barrick decided to take court action against the U.S. government to secure patents from the Goldstrike mine. Under the 1872 mining law, federal land can be bought for between $2.50 and $5.00 per acre. However, the U.S. federal government is contemplating extensive revisions to its 1872 mining law, particularly regarding the treatment of compensation for land claims and patents, and the imposition of royalty fees on the mineral resources extracted from public lands.

Production at Cyprus Amax's Hayden Hill mine in California, which started in 1992, will be brought down from 3 t to 2 t due to lower grades, difficult weather conditions and mill dilution. Consequently, Cyprus Amax took a $69 million write-down on the property. Revised reserves at Hayden Hill are 20 Mt grading 0.79 g/t gold.

Battle Mountain Gold is expected to start production at the Crown Jewel mine in Washington State once the permits are obtained. The Crown Jewel mine is expected to produce about 5 t/y of gold.

Australia

Australian gold production has shown a spectacular increase over the past 10 years from 39 t in 1984 to an estimated 245 t in 1993. As was the case for South Africa, Canada and some other producers, currency devaluation vis-à-vis the U.S. dollar in the last few years, coupled with increasing gold prices, helped the competitiveness of Australia's gold industry. Its production is mainly derived from Western Australia, Queensland, New South Wales and the Northern Territory.

Amongst Australia's most important mines are the Super Pit of Kalgoorlie Consolidated Gold Mines (15 t/y), Homestake's Kalgoorlie mine (9 t), Western Mining's St. Yves mine (8 t), MIM Holdings' Tick Hill mine (6 t), and the Kidston (6 t) and Granny Smith (5 t) mines of Placer Pacific. Poseidon Gold Ltd. spent A$100 million to develop the Big Bell underground project. The company expects to produce around 35 t of gold over the 10-year life of the project. Peak annual production is expected to be at a rate of 5 t/y. Posgold recently acquired the remaining 50% ownership of the Big Bell mine from Placer Pacific Limited, a subsidiary of Placer Dome Inc., for US$8.6 million. Because of dilution difficulties, the Big Bell open-pit mine has never met its production forecasts.

North Broken Hill Peko Ltd. and Delta Gold NL announced that they will develop the second phase of the Kanowna Belle mine in Western Australia. Both partners will spend A$35 million on a new roasting plant to increase ore recovery to 90%. The deposit has reserves of 22 Mt grading 5.7 g/t gold (a total of 125 t of gold). Production is expected to reach 5.5 t/y by 1995. Kanowna Belle is one of Australia's richest gold discoveries in the past few years.

Zapovan announced that it is proceeding with the development of the Mount Todd gold mine in the Northern Territory. The A$135 million project is expected to produce over 5 t/y of gold. Reserves are 42 Mt of low-grade material, representing approximately 60 t of gold.

Delta Gold NL and Placer Pacific Ltd. announced that they will develop two gold deposits near Placer Pacific's Granny Smith mine. The Keringal deposit has reserves of 5.5 Mt grading 2 g/t gold, while the Sunrise deposit has proven and probable reserves of 1.8 Mt grading 3.7 g/t gold. These deposits are expected to increase the Granny Smith mine life by about two years, to 1999. The costs of mining and treatment and sales revenues will be allocated between Placer and Delta on a 60:40 basis.

Placer Pacific announced that a full feasibility study will be completed in the second quarter of 1994 on the A$100 million Osborne copper-gold deposit. Annual production is expected to reach 40 000 t/y of copper and over 1 t/y of gold.

Australia's gold production is expected to remain strong for several years at least, because of major new discoveries such as the Callie and Bronzewing projects of North Flinders and Great Central Mines NL. Some of these projects are expected to be very cost-competitive.

The Australian Mint is one of the world leaders in gold coin production. The series of Australian Nugget coins issued in 1993 came in denominations of two ounces, ten ounces, and one kilogram.

The Australian Mint also has a series of platinum and silver coins.

New Zealand

New Zealand's gold production increased to 13 t in 1993 from 7 t in 1991. The Macraes Gold Project open-pit mine and the Golden Cross underground open-pit mine each produced around 3 t. Production from alluvial mines was 2.5 t.

Production started at the Macraes Globe-Progress mine, which is expected to be in full production of 3 t/y by 1995.

Papua New Guinea

Papua New Guinea's gold production in 1993 was expected to have declined to 60 t from its 1992 peak of 70 t. This compares to production of 34 t in 1990.

The Porgera gold mine decreased its production from 46 t in 1992 to 36 t in 1993. The decrease is attributed to gold grades decreasing from 36 g/t to 16 g/t. However, the drastic grade decrease was partly offset by an increase in milling capacity to 8500 t/d. Cash operating costs at Porgera in 1993 were US$155/oz, compared to $100/oz in 1992. Grades at the Porgera mine have been consistently falling from a peak of 64 g/t gold in 1991. The operation has 99.2 Mt of mineable reserves grading 4.7 g/t gold. The mine, located in Enga Province, is owned by Placer Pacific Ltd. (25%), and the operator, Highlands Gold (a 65% subsidiary of Australia's MIM Holdings), and Renison Goldfields Consolidated each own 25%. The government of Papua New Guinea, which previously held a 10% stake, increased its ownership to 25%.

Amoco Corp. sold its equity interest in the O.K. Tedi mine. As a result, Broken Hill Pty. Co. Ltd. increased its ownership from 30% to 50%. Metal Mining Corp. bought a 20% interest in the mine and the government increased its ownership from 20% to 30%. The O.K. Tedi mine produces 11 t of gold and 200 000 t of copper per year. Reserves are 400 Mt grading 0.75% copper and 0.67 g/t gold, with a mine life of 15 years.

Another operating gold mine in Papua New Guinea is Placer Dome's 60%-owned Missima mine with production of 10 t.

Kare Puga Development Corp. Pty (KDC), a company representing 6000 land-owners, was given 100% ownership of the Mount Kare alluvial deposit following CRA's transfer to the land-owners of its 51% ownership. Kare Puga has transferred the management of the Mount Kare deposit to Oakland pty in return for a 40% ownership of the deposit. Subsequently, Venezuelan Goldfields Ltd. of Canada acquired a 40% interest in Oakland for $4 million. The mine has been closed since January 1992 when it was firebombed. Production at Mount Kare is expected to resume in 1994.

A production decision on the Lihir gold project is expected in the first part of 1994, with possible initial production by 1996. Lihir is owned by RTZ Corporation PLC (40%), Niugini Mining (30%), and the Papua New Guinea government (30%). Lihir is considered to be one of the world's largest undeveloped deposits outside South Africa, with mineable reserves of around 200 Mt at an average grade of 3.25 g/t gold, representing over 600 t of gold. The deposit could produce 18 t/y of gold and the cash operating cost is projected to be $186/oz in the first five years of the project.

Former Soviet Union

Gold production in the former Soviet Union (FSU) was estimated to be 225 t in 1993. The general decline in production from a peak of over 285 t in 1989 is largely attributed to the exhaustion of some placer deposits (particularly in Russia) and a shortage of hard currency to buy equipment and supplies. In addition, energy costs and labour problems have also increased. About 20% of the FSU's annual gold production is believed to originate as by-product from base-metal operations, with the copper industry accounting for 15% of gold production and the lead and zinc industry accounting for about 5%.

After the break-up of the Soviet Union, the various producing republics decided to establish state-owned gold mining enterprises to market their own gold reserves. In return for Russia agreeing to take on all of the foreign debt of the FSU, all republics, except Ukraine and Kyrghyzstan, renounced all claims on FSU gold reserves. The various federations market their gold assets through their own local agencies. Rosalmazzoloto markets gold for Russia, Uzbekzoloto markets gold for Uzbekistan, and Kazzoloto markets gold for Kazakhstan.

Russia

Russian gold production in 1993 was reported to have fallen to 130 t from 140 t in 1992. The largest areas of gold production in 1993 were in Magadan (39 t), Yakutia (30 t), Krasnoyarsk (10 t) and Amur (10 t). Decreased Russian production can be attributed to declining reserves at several alluvial operations. About 70% of Russia's gold production comes from placer deposits, but these deposits account for only 30% of the total proven reserve base. As gold reserves are generally concentrated in large low-grade deposits, Russian gold production will likely continue to decline in the medium term.

Gold-trading rights were transferred from Vneshekonombank to Vneshtorgbank. Glavalmazzoloto, which controlled all gold-mining enterprises, was also replaced by Rosalmazzoloto, which now operates as an industry association. Each gold-producing region in Russia has at least one state-owned gold mining company.

To address the problem of declining productivity, the various republics have negotiated agreements with the Russian Federation authorities whereby the republics receive between 10% and 25% of the proceeds of their gold production (in hard currency). They also keep 5% of production and all of the gold produced over the production quota, which is set by Moscow each year.

Russia's gold production is equally divided between state-owned enterprises and cooperatives known as Artels. The Artels generally operate small placer deposits and account for approximately 50% of total gold production. Many of the Artel members are also part of the Prospector's Union, which has a membership of 80 000. Gold production from individual prospectors has increased by 50% over the last six years, but the future of the Artels is threatened by competition from the large state mining companies. The Artels' gold production mostly originates from Magadan (20 t), Yakutia (16 t) and Chita (7.5 t).

The gold industry is of great importance to the Russian Federation. To address the problem of declining production, Russia has decided to open gold exploration to tenders in several regions. Until new mines enter into production, output is expected to continue to decline. Cyprus Amax announced in late 1993 that an agreement was reached with the government of Russia for the development of the Kubake gold project. Production at Kubake is expected to start in 1995 with full production at 11 t/y.

Star Technology Systems of Australia agreed to invest US$250 million for a 31% interest in a local state company, Lenzoloto, to develop the Sukhoi Log in eastern Siberia. However, Lenzoloto still must receive a licence by the federal and local governments before the project can proceed. Several factions in the government oppose foreign involvement in this project and have tried to exclude Lenzoloto from the tendering process.

Attempts to update laws on concessions and other agreements signed with foreign investors on precious metals and stones did not pass due to conflicts within the Russian government.

Russia's gold exports in 1993 were estimated at 50 t. The threat of major gold exports from FSU countries has diminished considerably in the past few years following the reduction of estimated bank reserves to 300 t.

In the future, increasing pressure from the republics to receive a greater return from their gold sales, declining reserves, and increased domestic consumption will reduce Russia's ability to sell gold to Western countries. It is also reported that a gold exchange could start in 1994 if the government ends a domestic ban on gold trade. In November the government issued gold-denominated certificates backed by a total of 100 t of gold. Investors who have the option to receive gold when cashing the papers, however, cannot sell due to the domestic ban on gold trade.

Uncertainty about Russia's legal framework and the jurisdiction conflicts between local and central authorities, as well as the state's monopoly over gold extraction, make the current investment climate unattractive. In addition, local gold producers have to deal with the country's inflation rate of 20% per month, coupled with major delays in payments from the central government. Russia's gold mining industry would require substantial investment in exploration, development and equipment replacement to keep production near the current level.

Uzbekistan

Uzbekistan's gold production in 1992 was estimated at 70 t. The Muruntau low-grade open-pit mine was commissioned in 1969 and is reported to have an annual production of 55 t. The remainder of Uzbekistan's gold production is from the Almalik complex.

The government of Uzbekistan signed an agreement in early 1992 with Newmont Mining Corp. to create a 50:50 joint venture to process gold tailings from the Muruntau mine. Newmont expects that the leaching of the stockpile will yield 150 t of gold. Production at the Zarafshan-Newmont joint venture is expected to start in early 1995 at an initial rate of 14 t/y. The capital cost has been estimated at US$150 million with a project life of 16 years. The European Bank for Reconstruction and Development and a private bank consortium led by Barclays de Zoete Wedd are each lending $52.5 million for the project.

Representatives of Lonrho Plc, the Uzbekistan government and the International Finance Corporation agreed to develop the Amantaytau gold fields. The mine will extract ore from two main deposits south of the Zarafshan. Production is expected in early 1996 at an initial rate of 10 t/y, rising to 16 t/y after four years. Reserves are expected to last at least 27 years. Lonrho, who will be the operator, will contribute processing know-how, such as the biological leaching process developed at the Ashanti mine in Ghana.

Kazakhstan

Kazakhstan's 15-t/y gold production is derived mostly from the Ust-Kamenogorsk base-metal operation and the Tselinny mining and chemical plant slag heaps. To attract foreign investors, various measures were implemented, including a new law to regulate the extraction, processing, storage and export and import of precious metals and stones.

BK Gold, a joint venture between Minproc Corporation and Chilewich International, entered into an agreement with the Kazakhstan government to develop the Bakyrchik mine. BK Gold will retain 40% ownership of the mine and will be the mine operator. BK Gold announced that, in 1994, a $20 million heap leach and sulphide plant will be built to produce 1 t/y of gold. Bakyrchik contains proven and estimated reserves of 28 Mt grading 9.11 g/t gold, equivalent to about 240 t of gold. The mine has been operating since 1965 with an estimated output of 1 t/y of gold. The capital cost to expand the Bakyrchik mine is estimated at US$100 million. Production from the expansion could start by 1995, raising total output to 8 t/y. The cash production cost is expected to be US$120/oz.

Goldbelt Resources of Vancouver entered into a joint venture with Kazakhstan whereby Goldbelt can earn a 50% interest in a gold tailings project in Leninogorsk. The gold tailings contain 150 Mt of material grading 0.018 oz/t gold and 0.14 oz/t silver. The capital cost of this project is estimated to be US$40 million. Pegasus Gold later signed an agreement in principle to provide US$18 million to finance construction of the gold tailings project and to earn 62% of Goldbelt.

Kyrghyzstan

Kyrghyzstan's gold production is almost exclusively produced at the Machmal mine at a rate of 3 t/y.

Cameco Corporation signed an agreement with Kyrghyzstan to assess the feasibility of mining the Kumtor gold deposit. Kumtor has estimated reserves of 450 t of gold. After completing the US$10 million feasibility study, Cameco will decide whether to invest an additional US$35 million to obtain a 33% interest in the project. The rest of the ownership would be held by the government of Kyrghyzstan. Development at the Kumtor project could start by 1994, with production in 1997.

Brush Creek Mining and Development Co. Inc. and Kyrghyztan signed an agreement to set up a joint venture to develop the Jerul gold deposit. The capital cost of the project is expected to reach US$200 million, with Brush Creek retaining a 30% interest. The deposit, which hosts reserves of 80 t, should allow a production of 5 t/y starting in 1995.

Armenia and Tajikistan

Armenia and Tajikistan annually produce 2 t and 1 t of gold, respectively.

China

China's gold production was estimated at 130 t in 1993. It is reported that the majority of China's 400 mines produce less than 0.3 t/y of gold. Currently, small- and medium-sized gold mines account for 80% of the country's gold production, but China plans to invest in large-scale operations over the next few years. Gold production has increased annually by 10% in the past few years due to a number of government actions, including the introduction of the State Gold Administration in late 1988 and increased funding for mining and prospecting. The Chinese government announced that the State Gold Bureau (SGB) and China National Gold Corporation (CNGC) will become two separate entities. Some staff of the CNGC will move to the Ministry of Metallurgical Industry.

Several factors prevent China from increasing its gold production faster. Chinese gold producers have to sell their entire production to the People's Bank of China at well below the international market price. It was reported that individual miners sell less than half of their 20 t of production to the state. However, on September 1, the Chinese government officially announced that the state purchasing price of gold had been raised to 96 yuan (US$10.81/g) from 51.2 yuan. Although the price remains 10% below world market price, Chinese authorities believe that, due to the increase, gold smuggling to neighbouring countries will be reduced. Another factor that impacts on China's production growth is the 10% inflation rate for fuel, electricity and construction materials. It is also reported that certain high-cost mines employ up to 3000 employees while they produce only 1 t/y of gold.

To pursue its gold industry growth rate target, the country is drafting new regulations that will allow foreign companies and individuals to engage in mining in China. China is particularly eager to benefit from new technology to exploit low-grade deposits with refractory ore.

The Shandong Province is reported to be the largest producer with about 20% (26 t) of China's gold production. Linglong, in the Shandong Province, is reported to be the largest mine with gold production of 2.5 t/y.

China mints gold and silver Panda coins that are 99.9% pure. The gold coins are available in five sizes ranging from one ounce to one twentieth of an ounce. The Chinese normally mint between 6 and 9 t/y of the Panda gold coins.

According to estimates by the World Gold Council, China's gold consumption in pure gold jewellery in 1993 was approximately 300 t, a 20% increase over 1992. Jewellery alone accounts for two thirds of the country's fabrication demand. It is expected that Chinese consumers will continue to use gold as a hedge because of fear that Chinese currency will be devalued. China's prospects for strong economic growth (around 10% in 1994) and high inflation should encourage further consumption of gold, particularly in jewellery. Also, it is expected that, as the disposable income of Chinese people increases, an important portion of their savings will be held in the form of gold. Currently, China's Central Bank markets gold internally at a market price of around US$460/oz. This situation stimulates gold smuggling from Taiwan and Hong Kong. It is believed that Chinese authorities are considering the establishment of a national gold market to solve the problem of illegal gold imports and exports.

Japan

The Hishikari gold-silver mine of Sumitomo Metal Mining Co., Ltd., located on the Kyushu Island, has been in operation since 1985. In 1993, production increased to 10 t/y following Sumitomo's decision to start production in the Yamada zone. The Yamada zone contains reserves of about 50 t of gold, which represent 20% of the total reserves of the Hishikari mine. Hishikari is reported to be the richest gold mine in the world with average grades of 70 g/t gold and 35 g/t silver.

Japan consumes around 200 t/y of gold, mainly in the jewellery and electronics industries. However, the recession has considerably dampened growth in these markets. The most encouraging prospect for future Japanese gold consumption is coinage. After completing the sale of 220 t of commemorative coins of former Emperor Hirohito in 1990 and 60 t of coins of the new Emperor Akihito in 1991, the Japanese Mint announced the introduction of a new coin for the wedding of Crown Prince Naruhito. The new gold coins issue, which totalled 36 t, was made using existing stocks.

Indonesia

Indonesia's gold output quadrupled in the last four years to reach 40 t in 1993. The bulk of Indonesia's production is from Freeport McMoran's Ertsberg/Grasberg copper-gold mine. The company is currently studying the feasibility of further expanding the operation by 1996 to produce around 45 t/y of gold. Indonesian gold production also increased due to the recent start-up of CRA's Kelian mine. Output of the Kelian mine in 1993 was 15 t. The Mount Munro mine of Ashton Mining came on stream in 1993 at a production rate of 2.5 t/y of gold.

Ghana

Ghana's gold production, which has grown steadily in the past five years, exceeded 35 t in 1993. According to national authorities, production should double from its current level by the end of the century due to good mineral potential and the recent liberalization of the country's mining laws.

Gold production at the Ashanti gold mine is estimated to be 24 t/y. This should increase to 30 t/y by 1996 following the construction of a 220 000-t/m bioleaching plant. The mine is owned by Lonhro plc (45%) and the Ghana government (55%). Ghana announced that it would sell 25% of its ownership in the mine.

The Iduapriem mine of Golden Shamrock Mines (70%), the International Finance Corporation (20%) and the Ghanean government (10%) was commissioned in 1993. Proven and probable reserves are estimated at 19 Mt grading 1.85 g/t gold. Production is expected to reach 4 t/y of gold. Ghana's other major gold producers are Pioneer Inc.'s Terebie Goldfields mine and Billiton Metal's Bogosu mine, with a total production of 6 t in 1993. Expansions are expected at both of these mining operations.

The government of Ghana announced that it had sold the Presta and Tarkwa mines to Gold Fields of South Africa. Production at these smaller operations totalled about 2 t in 1993.

Mali

Production at the Syama gold mine in Mali is expected to increase to 6 t/y. The mine is owned by BHP Minerals (65%), the government of Mali (20%) and the International Finance Corporation (15%). Reserves of oxidized material at the Syama mine are 2.1 Mt grading 3.7 g/t gold, and 4.5 Mt of sulphide ore grading 7.2 g/t gold.

Anglo American Corporation is currently conducting a feasibility study on the Sadiola project. Sadiola hosts reserves estimated at 50 Mt grading 2 g/t gold. Anglo American and IamGold Corporation each own 40% of the project with the government of Mali owning the remaining 20%.

Côte d'Ivoire

Société des Mines d'Aféma (SOMIAF), a joint venture between Eden Roc Minerals of Canada and Société pour le Développement Minier de la Côte d'Ivoire (SODEMI), started production at the Aniuri mine. Annual production is expected to total 1 t at a cost of US$150/oz. Reserves are estimated at 4.4 Mt grading 4 g/t gold.

Latin America

Major changes in investment and mining laws and relatively unexplored land have made Latin America a very active area for gold mining exploration and development. Currently, there are several companies with mining interests in Latin America, particularly in Chile, Mexico and Venezuela.

Brazil

Brazil's estimated gold production declined to 70 t in 1993, compared to 76 t in 1992. Mining companies accounted for 57% (40 t) of production in 1993, while the Garimpeiros' share of output continued to decline to 43% (30 t). The decline in 1993 was reported to be mainly due to the depletion of easily accessible alluvial gold deposits exploited by the Garimpeiros, falling investment in mining, and more stringent environmental regulations. Mining investments have decreased since the signing of the 1988 Constitution which limits foreign direct investment in new mining projects to a 49% ownership. Some states have prohibited gold prospecting by the estimated 800 000 Garimpeiros, mainly because of pollution problems and because their presence usually discourages conventional mining companies from investing in the area.

At the request of Indian bands, Brazilian government authorities attempted to evict the Garimpeiros from certain areas. Part of the concern results from the relatively uncontrolled mercury discharges from the Garimpeiros' operations. (Several organizations are pressuring Brazilian authorities to ensure that each miner uses a retort for greater recovery of mercury.) The Garimpeiros were also accused of causing the deaths of several Yanomami Indians near the Venezuela border.

Production by the state-owned Companhia Vale Rio Doce (CVRD) rose to 11.3 t from 8 t, making it Brazil's single largest gold producer. The company expects to increase its output to 17 t by 1995, largely because of a doubling of production to 9 t at the Igarape mine. CRVD signed a joint-venture contract involving Anglo American Corporation and Mineracao Morro Velho to conduct a $20 million feasibility study on the Salobo copper and gold deposit. The capital cost of the project is US$765 million and production is expected to start in 1998 at a rate of 8 t/y of gold and 150 000 t/y of refined copper. To find new gold deposits, CVRD doubled its 1993 exploration budget to US$20 million.

Also, Mineracao Morro Velho S.A. (a joint venture between Anglo American Corporation and Bozzano Simonson) produced approximately 12 t of gold from its Raposos, Jacobina, Crixas and Cuiaba mines in 1993. Rio Paracatu Mineracao S.A., an association involving a Brazilian investor and RTZ Corporation PLC, produced around 5 t.

TVX Gold Inc. owns portions of three Brazilian operations. It has a 50% share in the Crixas Goias mine, a 23% share in the Brasilia mine, and a 50% share in the Novo Astro mine. Together these three mines produced 12 t of gold in 1993. TVX's share of the production was 4.5 t of gold.

Chile

Chile's 1993 gold production remained stable at around 40 t. In 1993, approximately 6 t of gold, or 15% of Chile's production, was as a by-product of copper mining, with 60% coming from the two largest copper mines, Chuquicamata and La Escondida.

In its second full year of production, the La Coipa mine of Placer Dome Inc. and TVX Gold Inc. produced around 8 t of gold and 400 t of silver. The capacity of the processing plant at the La Coipa mine is expected to increase from 15 400 to 18 000 t/d. Reserves at the La Coipa mine are 60 Mt grading 1.27 g/t gold and 75 g/t silver. The mine, which is located at an altitude of 4000 m, should have a life of 12 years.

Lac Minerals Ltd. operates the El Indio and El Tambo mines, which produced 5 t of gold in 1993. Lac Minerals is conducting a feasibility study on a possible production increase at the El Tambo mine from 3 to 5 t/y. Lac Minerals also announced that it calculated a resource of 80 t of gold at the El Nevada exploration project.

Cia Minera Can Can indicated that the Can Can mine, which came on stream in the spring, will increase gold production from 1.3 t in 1993 to 2.2 t in 1994. The Can Can mine hosts reserves of 1.2 Mt grading 8 g/t gold and 60 g/t silver.

The Chilean government approved plans to develop the La Candeleria copper-gold mine owned by Phelps Dodge Corp. and Sumitomo Metal Mining Company Ltd. The US$1.5 billion project has reserves for 30 years containing 90 t of gold. Production start-up is expected in 1995 at a rate of 100 000 t/y of copper and 2.5 t/y of gold.

Codelco, with private joint-venture partners, has decided to proceed with the exploitation of the Pajonales Occidental and Silica Roja deposits in the Copiaco region. These deposits, with reserves of 2 Mt grading 1.4 g/t gold, are adjacent to the El Hueso deposits of Homestake Mining.

Commercial production started at Cyprus Amax's Guanaco heap leach mine. Production is expected to reach 2.5 t/y.

Cyprus Amax and Bema are also expected to announce a production decision concerning the Refugio property. The US$130 million heap leach mine could produce 7 t/y of gold. Total reserves are estimated at 70 t of gold.

Guyana

Commercial production began at Cambior inc.'s Omai mine in December 1992. The US$160 million Omai gold mine produced 6.6 t in 1993. At full capacity, production is expected to be 8 t/y of gold. The 12 000-t/d mill will process ore grading 1.7 g/t gold. In 1993, total reserves at Omai were increased by over 20% to 56 Mt grading 1.5 g/t gold. Omai Gold Mines Limited is owned by Cambior (65%), Golden Star Resources (30%) and the government of Guyana (5%).

Bolivia

Battle Mountain Gold Co. (85%) and Zeland Mines SA (15%) started production at the Korri Kollo mine in 1993. Construction costs for the 14 000-t/d mine were US$350 million and the mine is expected to produce 6 t/y of gold. Reserves at Korri Kollo are 45 Mt grading 2.3 g/t gold and 14.5 g/t silver.

Peru

The Yanacocha open-pit mine of Newmont Mining (40%), Compania Minera Condessa (34%) and the Bureau de Recherches Géologiques et Minières (BRGM) (26%) opened in 1993. The Yanacocha mine was brought on stream at a cost of US$34 million and is expected to produce 3 t/y of gold for a period of 10 years.

A privatization committee of the state-owned Minero Peru was created to auction various gold and other mining properties. Privatization of gold concessions is expected to accelerate production decisions and to increase output considerably from the 1993 level of 21 t.

CONSUMPTION AND USES

According to Gold Fields Mineral Services Ltd., total Western World fabrication demand for gold in 1993 was expected to decrease by about 6% to reach 3000 t. Jewellery demand has nearly tripled in the past eight years, and exceeded total Western World production of gold by more than 400 t in 1993. Western World jewellery manufacturing decreased by about 7% to reach 2300 t in 1993. The outlook for an increase in jewellery demand is very favourable for the next few years, particularly in China, Singapore, Thailand and Taiwan. Other important sectors where gold is in demand include electronics, dentistry and coinage. However, demand from the electronics sector should experience a minor decrease, and demand from the coinage sector should increase by slightly more than 10% for a total of 100 t.

In Canada, the largest use of gold is for official coins. The Royal Canadian Mint produces two official coins that contain gold: a numismatic gold coin containing one quarter of an ounce of gold, and the gold Maple Leaf coin. According to the Royal Canadian Mint, sales of gold Maple Leaf coins decreased by nearly 15% in 1993. Since its introduction in 1979, the Maple Leaf program has consumed some 483 t of gold, or 35.6% of total Canadian production during that period.

The domestic jewellery industry has two main components: smaller manufacturers producing jewellery pieces in Canada, and larger sales companies importing stock jewellery pieces for direct sale. On average, Canadian gold consumption for jewellery is estimated to be between 8 and 10 t/y.

Most other gold products used in Canada are imported either in end-use form or in semi-manufactured alloy form. Canadian consumption of gold in electronics, dentistry and other industrial uses totalled about 1 t in 1993.

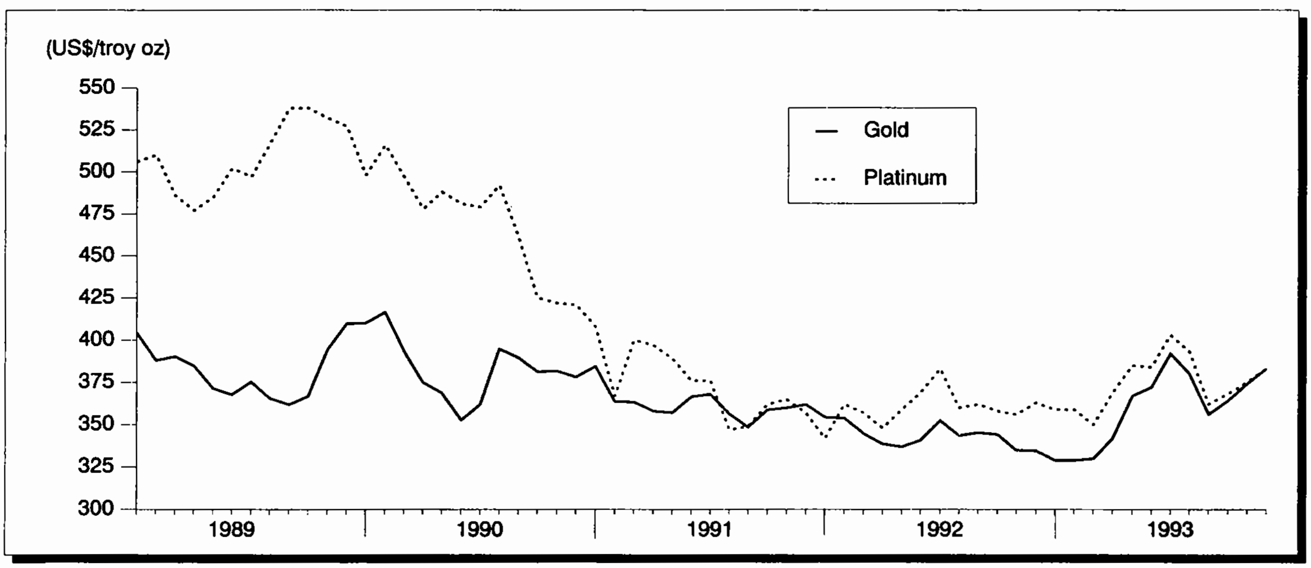
OUTLOOK

The current economic slowdown (mainly in Europe and Japan), low inflation rates, low interest rates and the relatively stable world political climate should help gold prices to stay near, or slightly higher than, 1993 levels. In 1994, the average gold price is forecast to be US$370/troy oz. In the medium term, the combined effect of increased demand for gold products, particularly in the jewellery sector, along with the peaking of world gold production, should result in some strengthening in the price of gold. For the rest of the decade, an average annual gold price of between US$350 and $400/oz, in constant 1993 dollars, is forecast.

Over the next few years, Canadian gold production should gradually recover from its decline in the last two years. The possible start-up in 1996 of projects such as Homestake Mining Company's Eskay Creek mine and Metall Mining Corporation's Troilus mine should result in production increasing to above 170 t/y. However, if no new mines are brought on stream towards the end of the decade, annual production could range between 150 and 160 t of gold.

Note: Information in this review was current as of February 18, 1994.

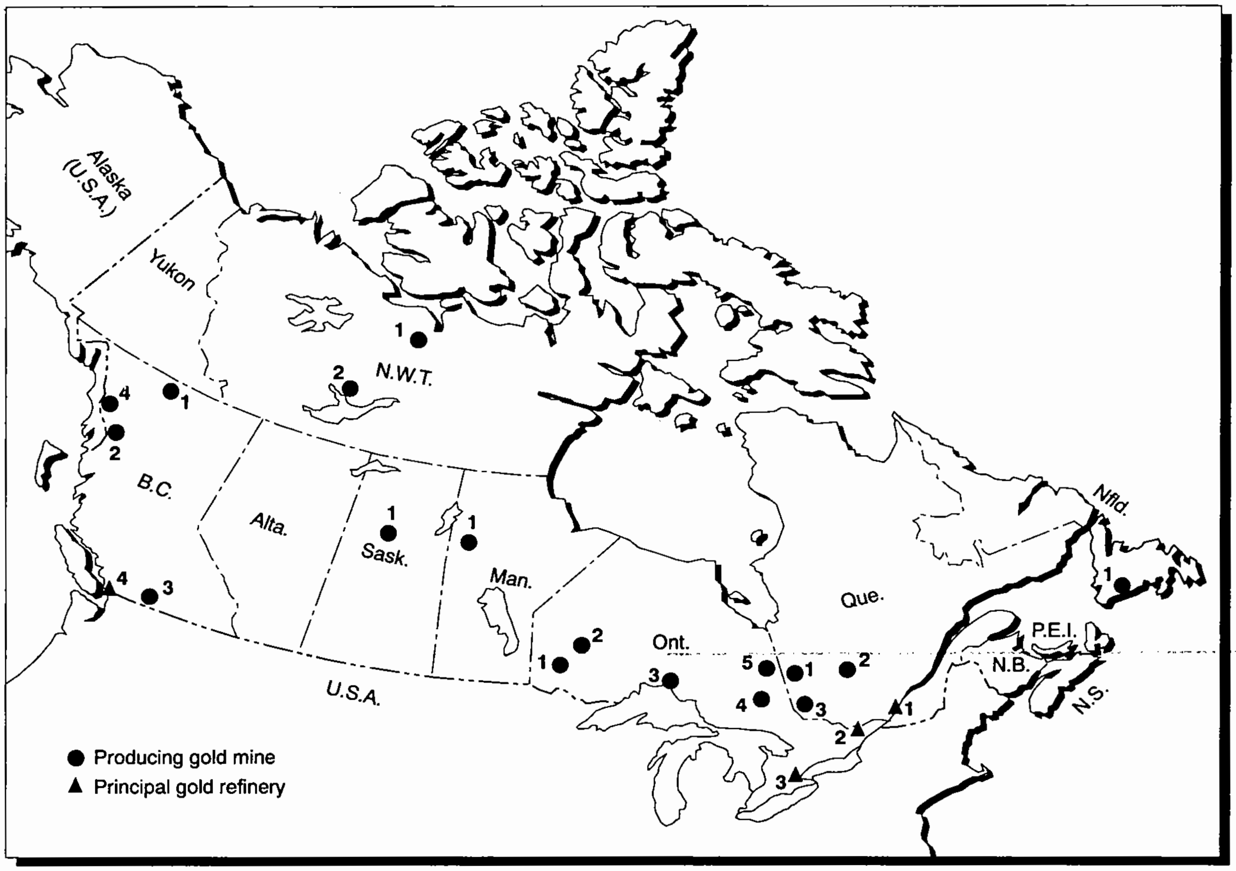
Figure 1
Precious Metal Prices, Monthly Averages, 1989-93



Sources: London Bullion Market Association; Johnson Matthey Public Limited Company.

Figure 2

Primary Canadian Gold Mines and Principal Gold Refineries, 1993



PRIMARY GOLD MINES

Northwest Territories

1. Echo Bay Mines Ltd. – Lupin mine
2. Royal Oak Mines Inc. – Giant mine
   Miramar Mining Corporation – Con mine
   Treminco Resources Ltd. – Ptarmingan and Tom mines

British Columbia

1. North American Metals Corporation – Golden Bear mine
2. Westmin Resources Limited – Premier mine
   Westmin Resources Limited – SB project
3. Homestake Mining Company – Nickel Plate mine
4. Cominco Limited – Snip mine

Saskatchewan

1. La Ronge Area
   Claude Resources – Seabee mine

Manitoba

1. Granduc Mining Corporation
   Keystone Gold Project

Ontario

1. Red Lake Area
   Placer Dome Inc. – Campbell mine
   Dickenson Mines Limited – Arthur W. White mine
2. Pickle Lake Area
   Lac Minerals Ltd. – Golden Patricia mine
   Ross-Finlay Ltd. – Dona Lake mine
3. Hemlo Area
   Homestake Mining Company/Teck Corporation – Williams mine
   Hemlo Gold Mines Inc. – Golden Giant mine
   Homestake Mining Company/Teck Corporation – David Bell mine

Ontario (cont'd)

4. Timmins – Kirkland Lake Area
   Placer Dome Inc. – Dome mine
   Royal Oak Mines Inc. – Pamour and Hoyle mines
   Kinross Gold Corporation – Hoyle Pond and Bell Creek mines
   Lac Minerals Ltd. – Macassa and Lake Shore tailings project
   American Barrick Resources Corporation – Holt-McDermott mine
   Deak Resources Corporation – Kerr mine
   St. Andrew Goldfields Ltd. – Stock Township mine
5. Placer Dome Inc. – Detour Lake mine

Quebec

1. Northwestern Area
   Agnico-Eagle Mines Limited – Agnico-Eagle and Telbel mines
   TVX Gold Inc. – Golden Pond Est and Ouest mines
2. Desmaraisville – Chibougamau Area
   Campbell Resources Inc. – Joe Mann mine
   MSV Resources Inc. - Copper and Rand mines
3. Rouyn-Noranda – Val-D'Or Area
   Lac Minerals Ltd. – Doyon and Bousquet 1 and 2 mines
   Agnico-Eagle Mines Limited – LaRonde mine
   Placer Dome Inc. – Sigma and Kiena mines
   Aur Resources Inc. – Ferderber and Dumont mines
   Cambior Inc. – Chimo and Mouska mines
   Hemlo Gold Mines Inc. – Silidor mine
   Mine Richmont Inc. – Francœur mine
   Deak Resources Corporation - Astoria mine
   Western Quebec Mines - Joubi mine

Newfoundland

1. Royal Oak Mines Inc. – Hope Brook mine

PRINCIPAL GOLD REFINERIES

1. Noranda Minerals Inc. Canadian Copper Refiners
2. Royal Canadian Mint
3. Johnson Matthey Limited
4. Nesmont Precious Metals Corporation

TARIFFS

Item No.	Description	Canada MFN	Canada GPT	Canada USA	United States Canada	EEC MFN	Japan[1] MFN
71.08	Gold (including gold plated with platinum) unwrought or in semi-manufactured forms, or in powder form						
	Non-monetary						
7108.11.00	Powder	11%	7%	Free	Free	4.1%	Free
7108.12.00	Other unwrought forms containing by weight not less than 99.95% of gold	Free	Free	Free	Free	Free	Free
7108.13	Other semi-manufactured forms						
7108.13.10	Of a purity of 10 carats or more	Free	Free	Free	Free	0.5%-1.8%	Free
7108.13.20	Of a purity of less than 10 carats	10.3%	6.5%	Free	Free	0.5%-1.8%	Free

Sources: Customs Tariff, effective January 1994, Revenue Canada, Customs and Excise; Harmonized Tariff Schedule of the United States, 1994; The International Customs Journal, European Economic Community, 1992-93, No. 14, "Conventional" column; Custom Tariff Schedules of Japan, 1993.
[1] GATT rate is shown; lower tariff rates may apply circumstantially.

TABLE 1. CANADA, GOLD PRODUCTION AND TRADE, 1992 AND 1993

Item No.		1992		1993p	
		(kilograms)		(kilograms)	
PRODUCTION					
	Newfoundland	x		x	
	Prince Edward Island	–		–	
	Nova Scotia	–		–	
	New Brunswick	490		492	
	Quebec	44 589		41 891	
	Ontario	74 343		71 957	
	Manitoba	3 106		3 045	
	Saskatchewan	x		x	
	Alberta	34		19	
	British Columbia	16 773		14 357	
	Yukon	3 737		3 407	
	Northwest Territories	13 518		13 016	
	Total	159 858		152 578	
	Total value ($000)	2 134 586		2 258 007	
	Mine output (kg)	160 940		152 929	
EXPORTS				(Jan.-Sept.)	
		(kilograms)	($000)	(kilograms)	($000)
2600.001	Gold in ores and concentrates	6 545	72 063	2 908	30 174
7108.11	Gold powder				
	United States	147	1 965	870	11 734
	Total	147	1 965	870	11 734
7108.12	Other unwrought forms				
	United States	102 989	1 379 225	89 787	1 300 623
	Switzerland	66 216	894 014	34 736	498 390
	United Kingdom	4 180	57 254	4 617	68 584
	Hong Kong	18 938	255 244	4 152	55 079
	Germany	1 800	25 258	1 544	21 258
	Taiwan	3 897	50 528	1 480	20 136
	South Korea	1 750	23 756	500	7 177
	Singapore	572	9 395	200	2 948
	Other countries	3 757	53 775	62	831
	Total	204 099	2 748 449	137 078	1 975 026

TABLE 1 (cont'd)

Item No.		1992		Jan.-Sept. 1993p	
		(kilograms)	($000)	(kilograms)	($000)
EXPORTS (cont'd)					
7108.13	Other semi-manufactured forms				
	United States	6 811	86 540	18 714	259 191
	Portugal	–	–	236	3 050
	Venezuela	–	–	2	32
	Switzerland	65	859	. . .	19
	Other countries	1 296	16 665	–	–
	Total	8 172	104 064	18 953	262 294
	Total refined gold exports	212 418	2 854 478	156 901	2 249 054
IMPORTS[2]					
2600.00[3]	Gold in ores and concentrates	4 324	46 209	2 306	22 104
7108.11	Gold powder				
	United States	8	90	10	87
	United Kingdom	–	–	. . .	5
	Total	8	90	10	92
7108.12	Other unwrought forms				
	United States	33 670	369 254	37 970	480 955
	Guyana	2 473	33 172	5 954	84 762
	Peru	4 338	57 616	1 728	25 195
	Nicaragua	2 923	16 077	2 678	12 116
	South Africa	1	40	257	3 543
	Switzerland	. . .	4	34	489
	Cayman Islands	–	–	11	139
	Germany	14	164	10	108
	Other countries	97	620	8	149
	Total	43 516	476 947	48 650	607 456
7108.13	Other semi-manufactured forms				
	United States	346	4 168	526	3 714
	Switzerland	105	1 152	67	808
	Germany	28	337	11	157
	South Africa	1	13	2	54
	Italy	3	42	2	35
	Hong Kong	–	–	2	30
	Other countries	10	136	. . .	11
	Total	493	5 848	610	4 809
	Total refined gold imports	44 016	482 885	49 270	612 357

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . . Amount too small to be expressed; p Preliminary; x Confidential.
[1] Includes HS classes 2603.00.00.82, 2604.00.00.82, 2607.00.00.82, 2608.00.00.82 and 2616.10.00.82. [2] Imports from "Other countries" may include re-imports from Canada. [3] Includes HS classes 2603.00.82, 2607.00.82, 2608.00.82, 2616.10.82 and 2616.90.82.
Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, GOLD PRODUCTION BY SOURCE, 1975, 1980, AND 1985-93

	Auriferrous Quartz Mines		Placer Operations		Base-Metal Ores		Total	
	(kg)	(%)	(kg)	(%)	(kg)	(%)	(kg)	(%)
1975	37 530	73.0	335	0.6	13 569	26.4	51 433	100.0
1980	31 929	63.1	2 060	4.0	16 632	32.9	50 620	100.0
1985	67 241	76.8	3 464	4.0	16 857	19.2	87 562	100.0
1986	83 197	80.9	2 802	2.7	16 900	16.4	102 899	100.0
1987	94 723	81.8	4 009	3.5	17 086	14.8	115 818	100.0
1988	112 404	83.4	4 879	3.6	17 530	13.0	134 813	100.0
1989	138 211	86.6	5 354	3.4	15 930	10.0	159 494	100.0
1990	147 355	88.0	3 993	2.4	16 025	9.6	167 373	100.0
1991	153 859r	87.8	3 834	2.2	17 589	10.0	175 282r	100.0
1992	141 472	88.5	3 469	2.2	14 917	9.3	159 858	100.0
1993p	136 326	89.3	3 600	2.4	12 652	8.3	152 578	100.0

Sources: Natural Resources Canada; Statistics Canada.
p Preliminary; r Revised.
Note: Numbers may not add to totals due to rounding.

TABLE 3. CANADA, GOLD PRODUCTION, AVERAGE VALUE AND PERCENT OF TOTAL MINERAL PRODUCTION, 1975, 1980, AND 1985-93

	Total Production	Total Value	Average Value[1]	Gold as a Percent of Total Mineral Production
	(kg)	($000)	($/g)	(%)
1975	51 433	270 830	5.27	2.0
1980	50 620	1 165 416	23.02	3.7
1985	87 562	1 219 653	13.93	2.7
1986	102 899	1 689 292	16.42	5.2
1987	115 818	2 204 472	19.03	6.1
1988	134 813	2 331 989	17.30	6.3
1989	159 494	2 315 860	14.52	5.9
1990	167 373	2 407 654	14.38	5.9
1991	175 282r	2 338 614r	13.34	6.7
1992	159 858	2 134 586	13.35	6.0
1993p	152 578	2 258 007	14.80	6.3

Sources: Natural Resources Canada; Statistics Canada.
p Preliminary; r Revised.
[1] Value is based on average reported sales.

TABLE 4. GOLD FABRICATION IN DEVELOPED AND DEVELOPING COUNTRIES, 1980, AND 1987-92

Fabricated Gold	1980	1987	1988	1989	1990	1991	1992
				(tonnes)			
DEVELOPED COUNTRIES							
Carat jewellery	318	588	675	817	871	884	928
Electronics	93	120	128	131	139	142	131
Dentistry	63	46	49	48	50	52	55
Other uses	58	53	56	59	58	58	62
Medals and fake coins	18	7	8	8	9	9	6
Official coins	170	170	99	99	99	122	77
Total	719	984	1 014	1 162	1 226	1 268	1 258
DEVELOPING COUNTRIES							
Carat jewellery	196	634	866	1 096	1 175	1 247	1 533
Electronics	2	6	7	8	9	10	11
Dentistry	2	2	3	3	4	4	4
Other uses	4	4	5	7	9	9	19
Medals and fake coins	3	10	11	12	13	17	22
Official coins	21	32	31	37	19	16	12
Total	228	689	924	1 163	1 228	1 303	1 601
TOTAL							
Carat jewellery	514	1 222	1 541	1 913	2 046	2 131	2 461
Electronics	95	126	135	139	148	152	142
Dentistry	65	48	52	51	54	56	59
Other uses	62	57	61	66	67	67	81
Medals and fake coins	21	17	19	20	22	26	28
Official coins	191	202	130	136	118	138	89
Total	946	1 672	1 938	2 325	2 455	2 570	2 860

Source: Consolidated Gold Fields PLC, "Gold 1993."
Note: Numbers may not add to totals due to rounding.

TABLE 5. WORLD GOLD MINE PRODUCTION, 1980 AND 1987-92

	1980	1987	1988	1989	1990	1991	1992
				(tonnes)			
South Africa	675.1	607.0	621.0	607.5	605.1	601.1	614.1
Canada[1]	50.6	115.8	134.8	159.5	167.4	175.3	159.9
United States	30.5	154.9	201.0	265.5	294.2	293.5	322.2
Other Africa							
Ghana	10.8	11.7	12.1	15.3	17.3	27.3	34.0
Zimbabwe	11.4	14.7	14.8	16.0	16.9	17.8	18.5
Other	11.0	37.0	40.0	35.8	34.3	39.0	40.2
Total, other Africa	33.2	63.4	66.9	67.1	68.5	84.1	92.7
Latin America							
Brazil	35.0	84.8	102.2	101.2	84.1	78.6	76.5
Colombia	17.0	32.5	33.4	31.7	32.5	33.0	39.5
Chile	9.3	23.3	26.7	29.0	33.3	30.7	29.9
Peru	5.0	10.8	10.0	12.6	14.6	15.1	15.6
Venezuela	1.0	16.0	20.0	17.1	14.2	13.2	11.7
Bolivia	2.0	6.0	9.0	11.5	10.4	10.0	9.9
Mexico	5.9	9.0	10.4	10.8	9.6	8.5	7.9
Ecuador	0.7	8.0	9.0	11.3	9.3	7.5	6.8
Other	15.6	15.0	13.8	11.7	11.5	11.6	11.9
Total, Latin America	91.5	205.4	234.5	236.9	219.5	208.2	209.7
Asia							
Indonesia	2.1	12.2	12.3	10.8	13.3	18.4	40.4
Philippines	22.0	39.5	39.2	38.0	37.2	30.5	27.2
Japan	6.7	8.6	7.3	6.1	7.3	8.3	8.9
Other	5.0	8.1	11.1	13.5	13	13.8	15.4
Total, Asia	35.8	68.4	69.9	68.4	70.8	71.0	91.9
Europe	11.8	21.9	23.2	29.5	32.2	33.1	28.1
Oceania							
Australia	17.0	110.7	157.0	203.6	243.1	236.1	240.0
Papua New Guinea	14.3	33.9	36.6	33.8	33.6	60.8	71.2
Other	1.0	4.0	6.6	9.4	10.1	10.3	13.2
Total, Oceania	32.3	148.6	200.2	246.8	286.8	307.2	324.4
Total, Western World	960.8	1 385.4	1 551.5	1 681.2	1 744.5	1 780.2	1 843.0
Other countries							
C.I.S.	. .	277.0	280.0	285.0	270.0	252.0	237.0
China	. .	72.0	78.0	86.0	95.0	110.0	118.0
North Korea	. .	. .	. .	9.5	13.0	13.0	17.0
Mongolia	. .	. .	. .	. .	5.0	4.0	4.0
Total, other countries	. .	349.0	358.0	380.5	383.0	379.0	376.0
Total, world production	. .	1 734.4	1 909.5	2 061.7	2 127.5	2 159.2	2 219.0

Source: Consolidated Gold Fields PLC, "Gold 1993."
. . Not available.
[1] Production figures for Canada were obtained from Natural Resources Canada.

TABLE 6. AVERAGE ANNUAL GOLD PRICES, 1934-93, AND MONTHLY, 1990-93

Year	US$/oz	C$/oz	Year	US$/oz	$C/oz
1934-67	35	. .	1980	614.38	719.08
1968	38.82	41.82	1981	459.22	550.57
1969	41.13	44.29	1982	375.52	463.51
1970	35.97	37.54	1983	423.52	521.82
1971	40.87	41.27	1984	360.63	466.99
1972	58.22	57.66	1985	317.35	433.21
1973	97.22	97.24	1986	367.58	510.73
1974	158.80	155.36	1987	446.66	592.18
1975	160.96	163.76	1988	436.45	554.76
1976	124.78	123.01	1989	381.27	451.33
1977	147.80	157.10	1990	383.72	447.79
1978	193.51	220.74	1991	362.34	415.09
1979	305.69	358.12	1992	343.86	415.23
			1993	360.06	464.35

Month	1990		1991		1992		1993	
	(US$/oz)	(C$/oz)	(US$/oz)	(C$/oz)	(US$/oz)	(C$/oz)	(US$/oz)	(C$/oz)
January	410.12	480.32	384.59	444.35	354.44	409.66	328.99	420.28
February	416.54	498.35	363.75	420.08	353.85	418.14	329.31	415.13
March	393.67	464.76	363.39	420.37	344.70	410.88	329.89	411.34
April	374.93	436.49	358.05	412.85	338.63	402.36	341.95	431.37
May	368.85	433.20	357.12	410.54	336.95	404.10	367.04	465.96
June	352.66	413.69	366.45	419.08	340.78	407.68	371.98	475.61
July	361.83	418.71	367.98	422.65	352.45	420.05	392.03	502.66
August	394.86	452.18	356.31	408.00	343.60	408.99	379.80	496.28
September	389.56	451.05	348.50	396.19	345.30	421.51	355.56	469.45
October	381.33	442.08	358.82	404.88	344.28	428.73	363.99	482.54
November	381.71	444.11	359.96	406.78	334.92	424.48	373.94	492.37
December	378.16	438.76	361.88	414.40	334.66	425.96	383.40	510.57

Source: London Gold Market. Compiled by Natural Resources Canada.
. . Not available.

Graphite

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Summary

In 1993, natural flake graphite was produced in Quebec by Stratmin Graphite Inc. and in Ontario by Applied Carbon Technology Inc. (previously known as Cal Graphite Corporation). Graphicor Resources Inc., which owns a processing plant adjacent to Stratmin's Quebec operation, remained inactive in 1993. Although world demand for graphite was weak during most of the year, Canada's production increased slightly from 21 714 t in 1992 to an estimated 22 257 t in 1993. Total shipments, however, decreased from 21 437 t in 1992 to an estimated 20 443 t in 1993. Stratmin sold nearly 16 000 t during the year. The company reports that its Lac-des-Îles mill has operated at full capacity (24 000 t/y of concentrates) since October 1993, mainly as a result of a stronger U.S. economy. Stratmin also reports that, since November 1993, it is "ISO 9003 certified," which is an internationally recognized standard of quality-product assurance.

Victoria Graphite Inc., with a deposit near Portland, Ontario, announced that it would start a pilot plant in early 1994, to be followed by full-scale production during the summer of 1994. Mill capacity is 2500 t of concentrates a year.

Published prices of crystalline flake graphite continued to decrease due to very strong competition. During the past three years, the price of some grades of flake graphite has decreased by close to 55%.

Natural Graphite

Graphite is a natural form of carbon. Natural graphite is a lustrous black carbon mineral, crystallized in the hexagonal system with rhombohedral symmetry. Flake graphite is opaque, flexible and sectile, and exhibits perfect basal cleavage. Natural graphite is unctuous and relatively soft with a hardness of 1-2 on the Mohs scale. It has a black colour and a black streak on glazed porcelain. Its specific gravity is 2.26 g/cm^3. Graphite is an excellent conductor of heat and electricity and has a high melting temperature of 3500°C. It is extremely resistant to acid, chemically inert, and highly refractory.

Natural graphite is widely distributed throughout the world and is of common occurrence in metamorphic rocks produced by regional or contact metamorphism. Commercially, natural graphite is classified as amorphous, crystalline lump (or vein), and flake. Amorphous graphite is a microcrystalline graphite formed by crystallization of the carbon from organic sediments. The graphite occurs as distorted seams of minute microcrystalline particles intermixed with ungraphitized materials. The graphite content may vary from 15%-98%, depending on the degree of metamorphism and the original carbon content in the sediments. Crystalline lump occurs in the form of massive vein or circular accumulation formed probably from hydrothermal origin. Deposits are found in fissures or other cavities in igneous or metamorphic rocks. The size of the particles varies from fine grains to large lumps. The vein deposits vary widely in width from 2 mm to more than 2 m. Flake graphite is found disseminated in metamorphosed siliceous or calcareous sediments such as marble, gneiss and schist. Flake is defined as thin flakes which are classified from coarse to fine and which are graded according to their graphitic carbon content.

Occurrences

Graphite deposits of potentially commercial interest in Canada occur principally in rocks of the Grenville series of eastern Canada. The mineral is found in disseminated crystalline flake and vein forms. Most Canadian graphite deposits are associated with graphite gneiss and crystalline limestones which have been subjected to contact metamorphism associated with tectonic features such as folding, compression and fracturing, and with pegmatitic intrusions. The richest ore zones occur as a succession of veins or lenticular bodies that gradually merge into the adjacent non-graphitic host rock and that are bordered by lenses of lower-grade ore.

Fine-to-coarse flake graphite deposits have been reported mainly in Quebec and Ontario, but also in New Brunswick, Nova Scotia, Saskatchewan, Labrador and British Columbia.

In Quebec, graphite deposits are located mainly along the Grenville series in several townships of western Quebec: Buckingham, Argenteuil and Pontiac. The disseminated flake graphite variety is dominant in biotite gneiss and crystalline limestone associated with biotite quartzite, but the vein variety is also reported along the contact of intrusive rocks and crystalline limestone. Occurrences of graphite are associated with metasedimentary rocks which have been subjected to several deformations and where metamorphism has reached amphibolitic or granulitic phases.

Graphite also occurs in Esmanville Township, south of Fermont. Several graphite-rich schist zones, measuring 1-25 m in thickness, are found interlayered with quartz-feldspar gneiss. Some graphite zones locally contain more than 15% graphite in the form of fine and well-crystallized flakes.

In Ontario, graphite deposits are found in several townships of Eastern Ontario in rocks of the Grenville Geological Province. Flake graphite occurs disseminated in marbles and gneiss. The occurrences of major interest are in semipelitic and pelitic gneiss units within paragneiss sequences. Graphite is present in amounts up to 10%. Accessory minerals consist of biotite, garnet and pyrite; trace elements in these graphitic rocks are nickel, cobalt, boron and vanadium.

CANADIAN PRODUCTION AND DEVELOPMENT

In 1993, Canada's production of natural flake graphite came from Stratmin Graphite Inc., which operates a mine and concentrator at Lac-des-Îles, Quebec, and from Applied Carbon Technology Inc., which operates a mine and a processing plant near Kearney, Ontario.

The year was again marked by a decline in exploration and development activity in Canada.

Despite difficult market conditions, Stratmin sold nearly 16 000 t of graphite concentrates from its Lac-des-Îles mill in 1993. The company reported that the mill has operated at full capacity (24 000 t/y concentrates) since October, mainly as a result of a stronger U.S. economy. During the year, the company continued to improve the quality of its products and, since November, has been "ISO 9003 certified," an internationally recognized standard of quality-product assurance.

Applied Carbon reported it had established a distribution office in Brocton, New York, to store inventory in order to ensure expedited delivery to its customers, most of whom are based in the United States. At the mine, the company continued to make improvements in the grinding and milling circuits in order to increase the percentage of coarser material and, in so doing, improve recovery. The mill has a designed production capacity of some 62 t/d of graphite concentrates.

Victoria Graphite Inc. announced that it expects to start pilot plant production in early 1994 on its 400-ha graphite property at Portland, half way between Ottawa and Kingston, followed by full-scale production at a rate of 2500 t of graphite concentrates during the fall of 1994. To date, diamond drilling has been done to outline the graphite ore deposits and pilot plant testing has been carried out. Research has indicated that the Portland graphite is suitable for the production of exfoliated graphite, a product which is used in the manufacture of graphite foil.

Stewart Lake Resources Inc. of Oakville, Ontario, reported no new developments in 1993. The feasibility study on its Kirkham, Ontario flake graphite project, completed in 1990, concluded that the project could be successfully developed and placed into production at an estimated cost of $9.8 million. Graphite ore would be mined by open-cast method at the beginning, moving to an underground operation eventually. Approximately 8000 t/y of graphite concentrate would be produced.

No new developments were reported by Consolidated North Coast Industries Ltd. Its flake graphite deposit at Bissett Creek, Ontario, has established reserves of 20 Mt of proven and probable flake graphite ore with an average grade of 3.2% carbon. The company is proposing an annual production of 17 000 t of flake graphite grading 92%-94% carbon.

Mazarin Mining Exploration Inc. of Quebec City is seeking financing to develop its Fermont, Quebec, flake graphite deposit. A feasibility study on putting the property into production was prepared a couple of years ago. The study proposed an open-pit mining operation for six months of the year, which would supply enough ore to feed a 400-t/d concentrator on a year-round basis for an annual production of 23 000 t of graphite concentrate. A second feasibility study was prepared in early 1991 by Cambior inc. The total capital cost of the project was estimated by Cambior at $30.6 million. Geological reserves are 8.1 Mt, averaging 16.7% carbon. The 20-year mining reserves are 2.5 Mt grading 17.4% carbon after dilution, and they are mineable by open-pit with a waste-to-ore ratio of 1.0/1.0. The graphite from the deposit is suitable for all major applications without chemical upgrading. The project is ready for construction, and could be in production in about one year.

Graphicor Resources Inc., which faced a declining world market and low recoveries from its Diotte orebody, suspended its operations and mothballed its Lac-des-Îles beneficiation plant in December 1991.

Mart Mining and Exploration Limited indicated it is seeking a partner to facilitate further exploration drilling and beneficiation testing on its Labrador deposit, which has probable reserves of 10.5 Mt of ore grading 21.9% carbon and a stripping ratio of 0.9:1.0.

Quinto Mining Corporation announced it holds a 100% interest in a sericite-graphite-gold deposit near Lumby, British Columbia. The graphite-sericite combination consists of grains that vary in size between 0.3 and 100 microns. Credits from gold can be obtained from the deposit. Reserves remain to be determined.

Canadian Consumption and Trade

Reported consumption of natural flake graphite in 1992, the latest year for which data are available, amounted to 7473 t. Graphite was used mainly in foundries, but also in the metallurgy and refractories industries.

In 1993, imports of natural graphite for the first nine months were 3883 t and exports were 16 062 t. Some 90% of Canada's trade is with the United States. Crude graphite is used mainly in Ontario (70%) and Quebec (15%).

Uses and Specifications

The uses of natural graphite flow from its physical and chemical properties. It has a high melting temperature, high thermal and electrical conductivity, is chemically inert (resistant to slags), is thermal shock-resistant, has a low coefficient of friction, and has a low absorption coefficient for X rays and electrons.

The principal use for graphite is in refractories manufacture. This is followed by foundries, lubricants, brake linings, crucibles, and pencils. All of the aforementioned together account for 80% of total usage. Most of the remaining 20% is accounted for by uses such as carbon brushes, batteries, and expandable graphite for the production of graphite foil, for example. It is reported that in Europe refractory producers still use graphite that has a carbon content under 90%. In the United States, most producers use graphite that contains a minimum of 94% carbon. In Japan, the average is 95%-99%. In the United States, **flake** graphite is used mainly in refractories, followed by lubricants, pencils, brake linings, powdered metals, crucibles, and foundries, in decreasing order.

The graphite content of magnesia-carbon refractory bricks, which are large users of flake graphite, varies between 15% and 25% with an average carbon content of 87%-90%, and an average flake size of 0.15-0.71 mm. Mag-Carbon bricks are used in high-temperature and corrosion-prone applications such as in steel furnace lining, ladles, slag-lines, hotpots, nozzles, and blast furnaces. Graphite is used because of its thermal conductivity and thermal and chemical resistance.

Graphite crucibles are used in steel-making and in the production of nonferrous and precious metals. Here, flake graphite is preferred to microcrystalline graphite because it burns more slowly, has a high attrition resistance, and imparts structural strength through the orientation of the flakes. Average carbon content is 80%-90% and average flake size is 0.15 mm.

Lubricants for industrial usage are also made from graphite because of its softness, low friction, inertness, and heat resistance. High-carbon (between 98% and 99%) graphite, 53-106 microns in size, is used.

In the manufacture of lead pencils, natural graphite is used because of its marking properties. The degree of hardness of a pencil is determined by the clay-to-graphite ratio of its lead; softer pencils use more graphite. High-quality pencils use crystalline graphite, while cheaper grades use amorphous graphite. The lead is a mixture of kaolin and bentonite mixed with graphite, and baked.

The use of graphite in brake linings reduces the wear rate. High-carbon crystalline graphite, below 75 microns, is used with a minimum carbon content of 98%, although a concentrate of 90% can be used if abrasive impurities such as silica are at a low level.

Graphite has traditionally been used in dry-cell zinc-carbon batteries due to its electrical conductivity. Fine-grain carbon, 85% below 75 microns, or microcrystalline graphite with a minimum carbon content of 88%, is required. Alkaline batteries require a purer natural graphite, very fine-grain size, with a carbon content of at least 98% or a synthetic grade. Carbon material should be free of metallic impurities such as copper, cobalt, arsenic or antimony.

Electric motor components use a wide variety of graphite, natural or synthetic. Powdered graphite, 150 microns, with a minimum carbon content of 95%-99% is required. Lump graphite, low-silica microcrystalline graphite and synthetic graphite are usually suitable.

In powder metallurgy, where steel is reinforced by the absorption of carbon, high-purity graphite is required for the sintering. It also acts as a lubricant and as a source of carbon. Dry powder graphite should be of an average particle size of 5 microns and must have a carbon content of between 96% and 99%.

In paint manufacture, graphite is used to protect metal surfaces exposed to a corrosive environment and to eliminate the accumulation of static electricity in floor coatings. Microcrystalline graphite of low carbon content, 50%-55%, is usually required.

For foundry applications such as mould coating, graphite prevents the adhesion of metals. Foundry facings are usually made of microcrystalline graphite, between 53 and 75 microns, with a low carbon content of 40%-70%.

Iron foundries use microcrystalline graphite as a recarburizer for raising the carbon content of iron melted in electrical furnaces from charges containing large proportions of scrap. A wide variety of material, such as synthetic graphite and coke, may serve as a substitute.

Other uses for natural graphite include paints and polishes, anti-knock compounds, electrical and electronic products, and rubber.

Growth Areas

Growing markets include: a) exfoliated flake graphite rolled into sheet for the manufacture of gaskets and seals used in the automotive industry, heat exchangers, and other products; b) high-alumina and magnesia-graphite bricks for the refractory industry; c) zirconia-graphite coatings; d) flake graphite-silicon carbide refractories; and e) friction materials. Other growing markets are very high-purity graphite for specialty applications, metal powders, and motor brushes.

Flexible Graphite

According to UCAR Carbon Company Inc., the world's largest producer of graphite foil (grafoil or flexible graphite), the world market for flexible graphite products was 5700 t/y in 1992. That market required some 8000 t/y of flake graphite raw material due to losses in the manufacturing process. Natural flake graphite normally used to manufacture flexible graphite comes from mines located in Madagascar, China, Brazil, Canada, India, Zimbabwe, Sri Lanka, Mexico and Norway. The flake quality and price are dependent upon the flake size distribution, fines content, carbon content, and ash content and distribution. Ash is defined as those elements present other than graphite. The size of ash particles as well as the content has an effect on the quality of the finished flexible graphite product. The ash normally consists of varying amounts of trace elements plus larger quantities of silica, sulphur, iron, aluminum and magnesium. The quality of the graphite raw material is also dependent on the quality and process control of the beneficiation process at the mine site, and must be closely monitored by the flexible graphite producer.

The markets for flexible graphite by use and geographic regions are as follows:

FLEXIBLE GRAPHITE MARKETS, 1992

Region	Industrial	Automotive
	(t/y)	
North America	500	2 600
Japan	100	1 700
Europe	400	250
Other	100	50
Total	1 100	4 600

Source: UCAR Carbon Company Inc.

The world market for flexible graphite was 5700 t in 1992, compared to 5500 t in 1990. World producers of flexible graphite are: UCAR Carbon Company Inc. and Polycarbon Inc. in the United States; SIGRI GmbH in Germany; Le Carbone Lorraine in France; and Nippon Carbon, Hitachi Chemical, and Toyo Tanso in Japan. There are very small producers in China and in the former Soviet Union. It is reported by industry that markets for grafoil in the automotive industry are still growing. Prices for flexible graphite averaged US$12/kg in 1992, the same as in 1990.

World Production, Trade and Consumption

Preliminary figures for 1992 indicated that world production of natural graphite was close to 571 000 t. Some 35% was flake graphite. The major producers of graphite were: China with an estimated 200 000 t; South Korea, 75 000 t; Ukraine, 50 000 t; North Korea, 38 000 t; Mexico, 32 000 t; and Brazil, 30 000 t.

The major producing countries, by type of graphite and by decreasing order of importance, are as follows:

- **Flakes**: China, Ukraine, Brazil, India, Madagascar, Germany, Canada and Norway;
- **Microcrystalline**: China, South Korea, Mexico, Czechoslovakia, Austria, North Korea, Russia, and Zimbabwe; and
- **Lump**: Sri Lanka.

A summary of the largest exporter and importer countries of graphite in recent years is as follows:

MAJOR EXPORTER AND IMPORTER COUNTRIES OF GRAPHITE, IN RECENT YEARS

Country	Exports	Country	Imports
	(000 t/y)		(000 t/y)
China	100-130	Japan	90-95
South Korea	35-45	United States	40-45
Mexico	20	Germany	35-40
Canada[1]	15-20	United Kingdom	23-25
Madagascar	15	Taiwan	12-15
Zimbabwe	15	Italy	7
Brazil	15	France	6
Austria	7-10	Austria	5
Norway	3		
Germany[2]	2		

[1] Exports are expected to increase during the next few years as production capacity increases. [2] Excludes re-exports.

The largest consumers of graphite are large producers of iron and steel, base metals, and precious metals. Together they consume about 50% of all graphite and are the largest users of flake graphite. The largest consumer countries are the former Soviet Union, Japan, the United States, China, Germany, the United Kingdom, Italy, France and Brazil.

Prices

Published prices for natural graphite provide only a range and are not representative of market prices, which are contracted prices negotiated between suppliers or distributors and consumers. The prices for flake graphite and lump graphite are higher than those for microcrystalline (amorphous) graphite because of the nature of mining and processing operations. Prices for flake graphite concentrate vary depending on the carbon content, the size of the flakes and their distribution, and the ash content. Published prices of crystalline flake graphite continued to decrease due to very strong competition. During the past three years, the price of some grades of flake graphite has decreased by close to 55%.

Substitutes

Molybdenum disulfide competes as a dry lubricant, but is more sensitive to oxidizing conditions. Finely ground coke mixed with olivine is a potential competitor in foundry-facing applications. Kish, a residue from steel-making, is a potential substitute for flake graphite, and is under study by the U.S. Bureau of Mines in cooperation with the steel industry and Asbury Graphite Mills Inc.

Outlook

Natural graphite has excellent physical and chemical properties, its resource base is large, and it is readily available from several countries. For these reasons, growth should continue, unless substitutes are developed. Canadian deposits are of the flake type, relatively easy to upgrade to +90% carbon; many contain graphite that is expandable. Products made from expandable graphite command high prices and the outlook for growth for these products is good. World supply of natural graphite will continue to be abundant as many deposits await development.

Note: Information in this review was current as of January 14, 1994.

PRICES

"Industrial Minerals"[1] pricing quotation, c.i.f., United Kingdom port, US$ per tonne

		1989	1990	1991	1992	1993
		Dec.	Dec.	Dec.	Dec.	Dec.
Crystalline lump	92%-95% C	750 – 1 500	750 – 1 500	750 – 1 500	750 – 1 500	650 – 850
Crystalline large flake	85%-90% C	820 – 1 300	820 – 1 300	650 – 1 200	400 – 800	400 – 600
Crystalline medium flake	85%-90% C	770 – 1 120	770 – 1 120	450 – 1 000	350 – 750	300 – 500
Crystalline small flake	80%-95% C	540 – 900	540 – 900	400 – 600	300 – 550	250 – 500
Amorphous powder	80%-85% C	220 – 440	220 – 440	220 – 440	220 – 440	220 – 440
Synthetic (Swiss border per kg)	99.95% C					2.23

c.i.f. Cost, insurance and freight; C Carbon.
1 "Industrial Minerals," December 1988, December 1989, December 1990, December 1991, December 1992 and December 1993.

TARIFFS

Item No.	Description	Canada MFN	Canada GPT	Canada USA	United States Canada
25.04	Natural graphite				
2504.10.10	In powder	9.2%	6%	Free	Free
2504.10.20	In flakes	4%	2.5%	Free	Free
2504.90	Other	Free	Free	Free	Free
69.02	Refractory bricks, blocks, tiles and similar refractory ceramic constructional goods, other than those of siliceous fossil meals or similar siliceous earths				
6902.90.10	Other, containing by weight 85% or more of carbon or graphite	6.8%	4.5%	2.7%	Free
6902.90.90	Other	Free	Free	Free	1.9%
69.03	Other refractory ceramic goods (for example, retorts, crucibles, muffles, nozzles, plugs, supports, cupels, tubes, pipes, sheaths and rods), other than those of siliceous fossil meals or of similar siliceous earths				
6903.10	Containing by weight more than 50% of graphite or other forms of carbon or of a mixture of these products				
6903.10.10	Crucibles and covers therefor	6.8%	Free	2.7%	1.9%
6903.10.91	Containing by weight 85% or more of graphite or other forms of carbon	6.8%	4.5%	3.6%	1.9%
6903.10.99	Other	Free	Free	Free	1.9%
8545.20	Carbon or graphite brushes	10.2%	6.5%	4%	1.4%[a]

Sources: Customs Tariff, effective January 1994, Revenue Canada, Customs and Excise; Harmonized Tariff Schedule of the United States, 1994.
[a] Equipment, originating in Canada, intended for use in the repair or maintenance of certain motor vehicles is subject to accelerated rate reductions.

TABLE 1. IMPORTS[1] OF CRUDE GRAPHITE AND GRAPHITE-RELATED PRODUCTS, 1992 AND 1993

Item No.		1992		Jan.-Sept. 1993p	
		(tonnes)	($000)	(tonnes)	($000)
2504.10	Natural graphite in powder or flake				
	United States	1 484	1 591	1 487	1 766
	Sri Lanka	22	26	44	55
	Germany	11	16	–	–
	People's Republic of China	149	72	102	69
	Switzerland	31	23	9	21
	Other countries	11	26	16	38
	Total	1 708	1 754	1 658	1 949
2504.90	Natural graphite n.e.s.				
	United States	6 491	1 984	2 225	623
	Total	6 491	1 984	2 225	623
6902.90	Refractory bricks, etc., n.e.s. (containing by weight more than 50% carbon or graphite)				
	United States	19 189	11 676	9 693	7 101
	Japan	758	2 202	1 683	3 897
	United Kingdom	2 062	1 985	1 583	1 154
	Poland	229	266	385	531
	Germany	919	761	214	487
	France	31	85	107	314
	Sweden	210	45	42	23
	Other countries	417	709	–	–
	Total	23 815	17 729	13 707	13 510
6903.10	Refractory ceramic goods n.e.s., more than 50% of graphite or other forms of carbon, etc. (including crucibles)				
	United States	. .	878	. .	840
	Germany	. .	127	. .	548
	United Kingdom	. .	249	. .	530
	France	. .	252	. .	410
	South Africa	. .	168	. .	228
	Japan	. .	82	. .	224
	Other countries	. .	34	–	–
	Total	. .	1 792	. .	2 783
8545.20	Carbon or graphite brushes				
	United States	207	5 717	178	4 844
	Germany	7	382	4	194
	Japan	10	199	5	136
	Brazil	6	111	6	71
	United Kingdom	1	38	. . .	28
	Taiwan	1	11	2	21
	Other countries	5	147	1	62
	Total	237	6 605	196	5 356

Source: Statistics Canada.
– Nil; . . Not available; . . . Amount too small to be expressed; n.e.s. Not elsewhere specified; p Preliminary.
[1] Imports from "other countries" may include re-imports from Canada.
Note: Numbers may not add to totals due to rounding.

TABLE 2. EXPORTS OF NATURAL GRAPHITE, 1992 AND 1993

Item No.		1992		Jan.-Sept. 1993p	
		(tonnes)	($000)	(tonnes)	($000)
2504.10	Natural graphite in powder or flake	19 436	15 403	15 498	12 462
2504.90	Natural graphite n.e.s.	1 534	993	564	310

Source: Statistics Canada.
n.e.s. Not elsewhere specified; p Preliminary.

TABLE 3. REPORTED CONSUMPTION[1] OF GRAPHITE IN CANADA, 1987-92

	1987	1988a	1989	1990	1991	1992p
	(tonnes)					
Natural graphite						
Foundry facing	3 030	2 722	1 723	1 892	1 605	2 366
Refractories	740	673	643	415	274	97
Other uses[2]	1 499	1 522	1 625	2 876	2 186r	2 188
Synthetic graphite						
Foundry facing	7 003	3 928	3 790	2 680	1 265	1 893
Other uses[3]	2 131	7 002	5 626	4 287	918	929
Total	14 403	15 847	13 407	12 150	6 248r	7 473

Source: Natural Resources Canada.
p Preliminary; r Revised.
a Increase in number of companies being surveyed.
1 Reported from NRCan survey on the consumption of nonmetallic minerals by Canadian manufacturing plants.
2 Includes brake linings, chemicals, abrasives, primary steel and other end uses. 3 Includes abrasives, batteries, bearings and brake linings, cement, chemicals, primary steel and other uses.

TABLE 4. WORLD GRAPHITE PRODUCTION, BY COUNTRY[1]

Country	1988	1989	1990	1991	1992[e]
			(tonnes)		
Argentina	24	100	100[e]	100[e]	90
Austria	7 577	15 307	22 205	20 000[r]	20 000
Brazil (marketable)[2]	34 520	31 650	28 890[r]	26 965[r]	30 000
Burma (Myanmar)	–	–	45	40[e]	–
Canada (exports)	4 900	6 000	10 200	6 200	20 900[b]
China (exports)[e]	120 000[r]	150 000[r]	140 000[r]	150 000[r]	115 000
Czechoslovakia[e]	15 000[e]	14 676	12 171	12 000[e]	11 800
Germany	9 666	10 584[r]	10 437	10 400[r]	10 000
India (mine)[3]	57 325	58 000	61 000	69 922[r]	70 000
Korea, North[e]	25 000	35 000	35 000	35 000	38 000
Korea, Republic of					
Amorphous	107 767	100 282	98 987	75 239[r]	75 000
Crystalline flake	678	1 186	703	1 552[r]	1 500
Madagascar	14 106	15 863	18 036	14 079[r]	14 000
Mexico					
Amorphous	47 871	38 304	22 553[r]	35 315[r]	30 400
Crystalline flake	1 735	1 942	2 365[r]	1 943[r]	2 000
Namibia	–	–	–	200[e]	200
Norway	–	1 800	5 000[r]	6 930[r]	7 000
Romania[e]	12 000	10 000[a]	10 000	10 000	10 000
Russia[4]	. .	. .	. .	. .	15 000
Sri Lanka	8 547	4 163	5 469	6 381[r]	7 000
Turkey (mine)	12 911	11 873[r]	18 712[r]	25 867[r]	30 000
Ukraine[4]	–	–	–	–	50 000
U.S.S.R.[e,5]	84 000	84 000	80 000	75 000	–
United States	w	w	–	–	–
Zimbabwe	11 441	18 147	16 383	12 903[r]	13 000
Total	575 068[r]	608 877[r]	598 256[r]	596 036[r]	570 890

Source: U.S. Bureau of Mines.
– Nil; . . Not available; [e] Estimated; [r] Revised; w Withheld to avoid disclosing company proprietary data.
[a] Reported figure. [b] Natural Resources Canada.
[1] Table includes data available through May 10, 1993. [2] Does not include the following quantities sold directly without beneficiation, in metric tonnes: 1988, 18 200 t (revised); 1989, 14 250 t; 1990, 13 000 t; 1991, 13 500 t; and 1992, 14 400 t (estimated). [3] Indian marketable production is 10% to 20% of mine production. [4] Formerly part of the U.S.S.R.; data were not reported separately until 1992. [5] Dissolved in December 1991.

Gypsum and Anhydrite

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GYPSUM

Canadian shipments of crude gypsum were 7 835 884 t valued at $83.1 million in 1993, compared to 7 294 700 t valued at $71.8 million in 1992. This increase of about 7% was mainly a result of higher exports from Nova Scotia to the United States. Shipments from Ontario and British Columbia, destined for local use, were lower than in 1992, based on preliminary data.

The Canadian Industry

Most deposits of gypsum being mined in the Atlantic provinces are characterized by high quality, amenability to inexpensive mining methods, and close access to coastal bulk-shipping facilities. Nova Scotia accounts for more than 75% of Canada's output and nearly all of its exports. Ontario production is used on site, except in the case of Westroc Industries Limited at Drumbo, which ships to the company's Mississauga wallboard plant. Production from Manitoba and from Windermere, Canal Flats (Lussier River), and Falkland, British Columbia, serve the Prairie region and a portion of the B.C. market not served by imports. Domtar Inc. meets most of the requirements of its wallboard plant in Surrey, British Columbia, with gypsum provided under a long-term contract by a 49% Domtar-owned Mexican affiliate, which supplies other company-owned plants further south along the U.S. West Coast. About 60% of Canadian shipments of crude gypsum of domestic origin are moved by rail, according to the National Transportation Agency.

Canadian operations are mainly subsidiaries of U.S. and U.K. gypsum product manufacturers. In Nova Scotia, National Gypsum (Canada) Ltd. is owned by the National Gypsum Company, and both Fundy Gypsum Company Limited and Little Narrows Gypsum Company Limited are owned by USG Corporation, the leading manufacturer of gypsum products in the United States. Westroc Industries Limited, a subsidiary of BPB Industries Plc., which has worldwide interests and is the largest gypsum products manufacturer in Europe, operates mining and manufacturing facilities across most of Canada. CGC Inc. (formerly Canadian Gypsum Company) with operations at Montréal and Hagersville, Ontario, is 75% controlled by USG of the United States.

Westroc Industries Limited announced in July that it will be closing its gypsum mine at Drumbo, Ontario. The company has signed a long-term contract to receive desulphogypsum from Ontario Hydro's Lambton facility, the site of the first flue-gas desulphurization (FGD) system at a thermal-electric generating station in Ontario. Gypsum mining and related production plants are listed in Table 2. During the past few years, there has been a trend toward closing smaller, less efficient plants and improving the distribution systems associated with larger, more efficient plants.

Domtar Inc. of Caledonia, Ontario, continued to use continuous mining technology at its No. 3 mine to supply the company's adjacent board complex at Caledonia, Ontario. This allowed the complete phasing out of the No. 2 mine. Domtar's long-established mine at Flat Bay, Newfoundland, continued to supply the company's board plant in Newington, New Hampshire. In addition, the Flat Bay mine supplied raw material to the wallboard manufacturing plant owned by Atlantic Gypsum, a division of Atlantic Group Limited (formerly Lundrigans-Comstock). CGC Inc. continued its six-year project, which began in 1989, to develop ore reserves at its mine at Hagersville, Ontario. Production from the new eastern reserves will be phased in gradually as present reserves are depleted. However, at its Montréal wallboard plant, the company made adaptations to accept synthetic gypsum to be supplied by Kronos Canada Inc. (CGC's other wallboard plant in St-Jérome, Quebec, was mothballed in 1991 because of weak demand.)

Louisiana-Pacific Corp., a major Oregon-based wood products manufacturer, continued to produce fibre-gypsum board at its new $65 million fibre-gypsum board plant at Port Hawkesbury, Nova Scotia. Gypsum is purchased locally, perlite is imported, and large quantities of recycled paper are backhauled, mainly from the United States. This project marks the first time that a gypsum board product has been produced for both regional and export markets.

The Nova Gypsum Inc. wallboard plant in McAdam, New Brunswick, went into receivership in 1993, after operating for about 10 months. Nova's parent company, based in Antigonish, Nova Scotia, had purchased the mothballed plant from the receiver for Eastern Gypsum Inc., which also had been in receivership. Weak demand for wallboard and the lack of a dependable source of paper were cited as the major barriers to success.

Several companies now use recycled gypsum wallboard in their production process; Domtar's Surrey, British Columbia, wallboard plant was the first in North America to use large quantities. This was possible through arrangements with a reclaimer, New West Gypsum, of Vancouver, British Columbia, which operates a plant with a capacity of about 40 000 t/y. The source of the material is about 75% scrap from new construction sites and 25% waste from wallboard plants. Westroc currently recycles about 20 000 t and 30 000 t of board at its Vancouver and Mississauga, Ontario, plants, respectively. (In recognition of its contribution to minimizing waste at its Mississauga plant, Westroc received the award "Outstanding Industrial 3Rs Initiative" from the Recycling Council of Ontario.) Finally, CGC Inc. and Domtar have developed programs for accepting scrap wallboard from construction sites.

Occurrences of gypsum, other than reserves being mined, are known to exist in a number of locations: in the southwest lowlands, west of the Long Range Mountains in Newfoundland; throughout the central and northern mainland of Nova Scotia, as well as on Cape Breton Island; in the southeastern counties of New Brunswick; on the Magdalen Islands of Quebec; in the Moose River, James Bay and southwestern regions of Ontario; in Wood Buffalo National Park, in Jasper National Park, along the Peace River between Peace Point and Little Rapids, and north of Fort Fitzgerald in Alberta; on Featherstonhaugh Creek, near Mayook, at Canal Flats, at Loos, and at O'Connor River in British Columbia; on the shores of Great Slave Lake, the Mackenzie River, Great Bear River and Slave River in the Northwest Territories; and on several Arctic islands. Of recent interest, Industrial Mineral Background Paper No. 12 entitled *Gypsum in Northern Ontario* describes the resources and market potential for high-purity gypsum in the Moose River Basin. This paper was published in 1990 by the Ontario Ministry of Northern Development and Mines.

World Developments and Trade

Gypsum-related projects are generally limited to industrialized countries because of dependence on the building construction sector. However, world reserves are widespread and are conservatively estimated to be about 2.4 billion t. World production of gypsum in 1993 was an estimated 98.5 Mt, according to the U.S. Bureau of Mines. The United States ranked number one with 15.4 Mt, followed by China (10.2 Mt) and Canada (7.8 Mt).

International trade has become more important in North American markets in recent years as a result of low production costs and competitive shipping rates. In particular, U.S. imports of gypsum from Spain remain relatively high, amounting to several hundred thousand tonnes per year. Relatively low east-to-west backhaul freight rates are the main factors at work. Canada's imports of gypsum from Mexico, as described earlier, as well as those from the United States, are used by both wallboard and cement manufacturers. Imports from Spain, however, are used only by specific cement manufacturers.

Imports of low-priced wallboard from the United States into Canada have increased since 1986, and amounted to about 6% of domestic consumption in 1992. Revenue Canada determined in late 1992 that U.S. gypsum exporters had dumped product in Canada. Eight exporters were identified and, in 1993, an overall weighted average percentage margin was established at an estimated 27%. Separate appeals of the ruling followed and a response by Revenue Canada is expected in 1994.

Both USG Corporation and National Gypsum Company, the leading producers and distributors of wallboard in the United States, emerged from Chapter 11 bankruptcy protection in 1993. USG now has a more satisfactory de-leveraged capital structure. The new National Gypsum, with the same name following new financial arrangements that involved the Lafarge Coppée Group (LCG), is now believed to be owned about 60% by LCG.

Processing and Markets

Gypsum is a hydrous calcium sulphate ($CaSO_4 \cdot 2H_2O$) which, when calcined at temperatures ranging from 120° to 205°C, releases three quarters of its chemically combined water. The resulting hemihydrate of calcium sulphate (commonly referred to as plaster of Paris), when mixed with water, can be moulded, shaped or spread and subsequently dried, or set, to form a hard plaster. This is particularly suited to products including wallboard, lath and tile. Anhydrite, an anhydrous calcium sulphate ($CaSO_4$), is commonly associated geologically with gypsum but is not a suitable substitute for most uses.

The type of processing necessary depends upon end-use requirements. Crude gypsum is crushed, pulverized and calcined to make a stucco, mainly for the production of wallboard, lath and sheathing, which together account for more than 75% of end uses in North American markets. These products are formed by introducing a slurry of stucco, foam, pulp and starch between two unwinding rolls of absorbent paper, resulting in a continuous "sandwich" of wet board. As the stucco hardens, the board is cut to pre-determined lengths, dried, bundled and stacked for shipment. These products may also be manufactured with asphalt-impregnated paper and with asphalt added to the gypsum core to improve water resistance. Stucco may also be adapted for other construction uses after mixing with water and aggregate (sand, vermiculite or expanded perlite) for application over wood, metal or gypsum lath to form interior wall finishes.

In general, the wallboard industry serves the residential, institutional and commercial building sectors. Housing starts have become a less reliable indicator of the demand for gypsum wallboard because its improved fire-retardant qualities, along with increased renovation activity, have encouraged its broader use.

The Portland cement industry accounts for about 15% of the gypsum used in North America. Crushed, uncalcined gypsum, acting as a set regulator, in a proportion up to 5% by total weight, is ground with the primary stage clinker to produce the final cement product. Based on this proportion of gypsum, the total amount required by cement producers in Canada is estimated to be about 400 000 t/y.

For agricultural purposes, specifications mainly relate to the degree of fineness. Gypsum combines with potassium aluminum silicates in the soil resulting in the release of potassium for use as a nutrient. Also, gypsum serves to reduce sub-soil acidity, which is particularly beneficial in aluminum-rich lateritic soils. In addition, it provides a source of calcium and sulphur trioxide and helps break up hard soils, allowing better aeration and water penetration and retention.

For filler uses, gypsum is dried and finely ground to a range of particle sizes for use in joint compounds (mainly with gypsum wallboard), plastics, paint, and paper. Relatively pure uncalcined gypsum, depending on glass batch chemistry, may also substitute for salt cake (sodium sulphate) in glass manufacturing. Special high-purity gypsum may be used in foods and pharmaceutical products.

Ortech Corporation sponsored its third conference on flue-gas derived gypsum, the "Third International Conference on FGD and Chemical Gypsum," held in Toronto in September 1993. As planned, much new information was disseminated, all within the context of gaining a better understanding of issues affecting power utilities, other producers of synthetic gypsum, gypsum consumers, and, FGD and pollution control system suppliers. By-product gypsum produced by the acidulation of phosphate rock during the manufacture of phosphate fertilizer has not been utilized in Canada. In the case of phosphogypsum produced from sedimentary phosphate rock, which may contain significant quantities of uranium and radium, studies have indicated that a potential radiation hazard exists.

In the United States, an estimated 700 000 t/y of FGD gypsum is consumed as a complete or partial substitute for natural rock in the manufacture of wallboard. The United States Gypsum Company, a subsidiary of USG Corporation, which operates 22 gypsum board plants and 11 mines and quarries, is the largest consumer. (This estimated consumption accounts for less than 5% of total U.S. consumption of gypsum for all uses.)

Increased interest in flue gas desulphurization (the most widely used sulphur dioxide control technology), and the related role of industrial minerals, prompted a cooperative effort by Natural Resources Canada and the U.S. Bureau of Mines (USBM) to produce a bibliography on the subject. A free copy of *Flue Gas Desulfurization and Industrial Minerals: A Bibliography* – having more than 4000 references covering the period 1982 through June 1993 – may be obtained from Natural Resources Canada or the USBM.

Gypsum and Anhydrite is one of a series of 19 reports published by the Canada Centre for Mineral and Energy Technology (CANMET Summary Report No. 7). Each of these industrial mineral reports summarizes information on mineral occurrences, deposits of specific interest, product uses and specifications, and process technology.

Prices

Prices for gypsum in non-captive markets are negotiated, the only published figure being an approximate minimum price for crude material, ex-mine or c.i.f. United Kingdom, published in *Industrial Minerals*. In the United States, prices for crude material, f.o.b. mine, have fallen from US$8.00/t in 1989 to US$6.80/t in 1993, according to preliminary information from the USBM.

Outlook

In 1994, Canadian shipments of gypsum are expected to be more than 8 Mt, the highest since 1988/89, based on improved strength in the construction sector in both the United States and Canada. Housing starts in Canada were 156 000 in 1991, 168 000 in 1992 and 155 000 in 1993; according to the Canada Mortgage and Housing Corporation, 168 000 starts are forecast in 1994. In addition, the outlook in the office and industrial building sectors is expected to improve.

Housing starts in the United States were the highest since 1989; it is expected that this sector, along with institutional building, will lead construction-related expenditures, which have been forecast to increase about 9% in 1994.

Although new construction materials are being introduced, the demand for gypsum wallboard is expected to remain popular because of its low price, ease of installation, and well-recognized fire-retarding properties. The present structure of the industry in Canada is not expected to change greatly, although future availability of synthetic gypsum resulting from more strenuous emission controls will likely influence developments in some areas. The recycling of scrap and waste gypsum from construction sites and wallboard manufacturing lines is expected to become more important in both Canada and the United States.

ANHYDRITE

Production and trade statistics for anhydrite are included with gypsum. Anhydrite, the anhydrous form of gypsum (about twice as hard and also heavier than gypsum), is produced by Fundy Gypsum Company Limited at Wentworth, Nova Scotia, and by Little Narrows Gypsum Company Limited at Little Narrows, Nova Scotia.

Production of anhydrite in 1992 was 152 770 t based on final figures, and in 1993 was an estimated 181 700 t, according to the Nova Scotia Department of Natural Resources. Shipments were mainly to the United States for use in manufacturing Portland cement and as a peanut crop fertilizer. Also, minor quantities were shipped to Quebec and Ontario for the manufacture of cement.

Testwork was conducted in Nova Scotia on the utilization of anhydrite in floor screed and suspended floor systems. This was undertaken as part of the Canada-Nova Scotia Mineral Development Agreement (MDA-II, 1990-93). The project, involving the private sector and, in part, the Canada Centre for Mineral and Energy Technology (CANMET) of Natural Resources Canada, relates to optimizing compressive strength and dry shrinkage using suitable plasticizers. More product demonstrations are planned.

On-site testing continued for using anhydrite (in combination with water and special chemicals) as a mine "pack" construction material to improve underground support in coal mines. This work is based on an earlier cooperative program (MDA-I) involving CANMET and the Technical University of Nova Scotia.

Note: Information in this review was current as of February 1, 1994.

TARIFFS

Item No.	Description	Canada			United States
		MFN	GPT	USA	Canada
2520.10	Gypsum; anhydrite	Free	Free	Free	Free
68.09	Articles of plaster or of compositions based on plaster: Boards, sheets, panels, tiles and similar articles, not ornamented				
6809.11	Faced or reinforced with paper or paperboard only				
6809.11.10	Gypsum wallboard	9.4%	Free	3.7%	0.9%
6809.11.90	Other	9.2%	Free	3.6%	0.9%
6809.19.00	Other	10.2%	6.0%	4.0%	2.4%
6809.90	Other articles				
6809.90.10	Models and casts, of a kind used in the manufacture of dental prosthesis	Free	Free	Free	1.7%
6809.90.90	Other	10.2%	6.5%	4.0%	1.7%

Sources: Customs Tariff, effective January 1994, Revenue Canada, Customs and Excise; Harmonized Tariff Schedule of the United States, 1994.

TABLE 1. CANADA, GYPSUM PRODUCTION AND TRADE, 1991-93

Item No.		1991		1992		1993p	
		(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
PRODUCTION (shipments)							
	Crude gypsum						
	Nova Scotia	5 229 127	49 856	5 502 562	47 251	6 129 576	57 707
	Ontario	804 653	13 388	915 008	14 120	865 600	14 350
	British Columbia	308 298	x	482 141	x	414 441	x
	Manitoba	x	x	x	x	x	x
	Newfoundland	x	x	x	x	x	x
	Total[1]	6 727 221	71 654	7 294 700	71 820	7 835 884	83 107
IMPORTS						(Jan.-Sept.)	
2520.10	Gypsum, anhydrite						
	Mexico	168 917r	4 325	211 493	4 692	170 668	3 644
	United States	48 171	1 376	48 806	1 398	28 565	1 117
	Hong Kong	25	1	62	3	82	5
	People's Republic of China	50	2	3	. .	70	4
	Spain	42 448	341	–	–	–	–
	Other countries	252	17	141	8	–	–
	Total	259 863r	6 062	260 505	6 101	199 385	4 772
		(square metres)		(square metres)		(square metres)	
6809.11	Plasterboards, etc., not ornamental; faced or reinforced with paper or paperboard						
	United States	18 628 643	20 741	14 656 852	14 510	1 789 695	2 231
	United Kingdom	1 227	99	20 335	172	. .	103
	Total	18 629 870	20 840	14 677 187	14 683	1 789 695	2 335
6809.19	Plasterboards, etc., not ornamental; faced or reinforced, n.e.s.						
	United States	. .	1 233	. .	1 912	. .	1 906
	United Kingdom	–	–	. .	23	. .	2
	Other countries	. .	52	–	–	–	–
	Total	. .	1 286	. .	1 936	. .	1 909
6809.90	Articles of plaster or compositions based on plaster, n.e.s.						
	United States	. .	1 600	. .	1 893	. .	1 750
	United Kingdom	. .	733	. .	806	. .	809
	People's Republic of China	. .	10	. .	81	. .	62
	Mexico	. .	27	. .	79	. .	52
	Other countries	. .	215	. .	176	. .	103
	Total	. .	2 585	. .	3 035	. .	2 776
	Total imports of gypsum and gypsum products	. .	30 773	. .	25 755	. .	11 792
EXPORTS							
2520.10	Gypsum, anhydrite						
	United States	4 929 036	44 381	5 041 748	46 903	3 897 546	43 844
	Denmark	–	–	–	–	17 700	178
	Other countries	11 157	119	7	. .	123	65
	Total	4 940 193	44 500	5 041 755	46 903	3 915 369	44 087
		(square metres)		(square metres)		(square metres)	
6809.11	Plasterboards, etc., not ornamental; faced or reinforced with paper or paperboard						
	United States	9 919 679	9 500	12 245 469	11 883	15 347 372	14 987
	Other countries	43 200	96	299 059	765	81 505	159
	Total	9 962 879	9 596	12 544 528	12 648	15 428 877	15 146
6809.19	Plasterboards, etc., not ornamental; faced or reinforced, n.e.s.						
	United States	. .	5 364	. .	4 288	. .	6 014
	Other countries	. .	420	. .	284	. .	283
	Total	. .	5 784	. .	4 572	. .	6 297

TABLE 1 (cont'd)

Item No.		1991		1992		1993p	
		(square metres)		(square metres)		(square metres)	
6809.90	Articles of plaster or compositions based on plaster						
	United States	. .	967	. .	1 448	. .	1 717
	Other countries	. .	66	. .	24	. .	167
	Total	. .	1 033	. .	1 472	. .	1 884
	Total exports of gypsum and gypsum products	. .	60 913	. .	65 595	. .	67 414

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available; n.e.s. Not elsewhere specified; p Preliminary; r Revised; x Confidential.
1 Totals do not include gypsum produced or shipped for use by Canadian Portland cement producers.
Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, GYPSUM MINING AND GYPSUM PRODUCTS MANUFACTURING OPERATIONS, 1993

Company	Location	Operation
NEWFOUNDLAND		
Domtar Inc.	Flat Bay	Open-pit mining
Atlantic Gypsum Limited	Corner Brook	Wallboard manufacture
NOVA SCOTIA		
Domtar Inc.	McKay Settlement	Open-pit mining
	Windsor	Plaster and "Gypcrete" manufacture
Fundy Gypsum Company Limited	Wentworth and Miller Creek	Open-pit mining of gypsum and anhydrite
Georgia-Pacific Corporation	Sugar Camp	Open-pit mining of gypsum
Little Narrows Gypsum Company Limited	Little Narrows	Open pit mining of gypsum and anhydrite
National Gypsum (Canada) Ltd.	Milford	Open-pit mining of gypsum
QUEBEC		
CGC Inc.	Montréal	Wallboard manufacture
	St-Jerome	Wallboard plant mothballed
Domtar Inc.	Montréal	Distribution terminal only
Westroc Industries Limited	Montréal	Wallboard manufacture
ONTARIO		
CGC Inc.	Hagersville	Underground mining and wallboard manufacture
Domtar Inc.	Caledonia	Underground mining and wallboard manufacture
Westroc Industries Limited	Drumbo	Underground mining
	Clarkson	Wallboard manufacture
MANITOBA		
Domtar Inc.	Amaranth	Open-pit mining
	Winnipeg	Wallboard manufacture
Westroc Industries Limited	Amaranth	Open-pit mining
	Winnipeg	Wallboard manufacture
ALBERTA		
Domtar Inc.	Edmonton	Wallboard manufacture
Westroc Industries Limited	Calgary	Wallboard manufacture
BRITISH COLUMBIA		
Domtar Inc.	Canal Flats	Open-pit mining
	Vancouver	Gypsum products manufacture
Westroc Industries Limited	Vancouver	Gypsum products manufacture
	Windermere	Open-pit mining

Source: Natural Resources Canada.

TABLE 3. CANADA, GYPSUM PRODUCTION, TRADE AND CONSUMPTION, 1975 AND 1980-93

	Production[1]	Imports[2]	Exports	Apparent Consumption[3]
	(tonnes)			
1975	5 719 451	553 338	3 691 676	2 581 113r
1980	7 336 000	154 717	4 960 240	2 530 477
1981	7 025 000	143 500	5 094 873	2 073 627
1982	5 987 000	93 843	4 775 755	1 305 088
1983	7 507 000	100 939	5 187 032	2 420 907
1984	7 775 082	131 809	6 224 574	1 682 317
1985	7 760 783	121 802	5 879 664	2 002 921
1986	8 802 805	221 644	5 921 982	3 102 467
1987	9 093 926	217 625	5 704 853	3 606 698
1988a	8 813 760	274 917	5 651 286	3 437 391
1989	8 179 588	291 373	5 357 055	3 113 906
1990	7 977 685	318 114	5 757 327	2 538 472
1991	6 727 221	259 863r	4 940 193	2 046 891r
1992	7 294 700	260 505	5 041 755	2 513 450
1993p	7 835 884	280 581	5 330 677	2 785 788

Sources: Natural Resources Canada; Statistics Canada.
p Preliminary; r Revised.
a Beginning in 1988, imports and exports are based on the new Harmonized System and may not be in complete accordance with previous method of reporting. Imports and exports include HS class 2520.10.00 gypsum, anhydrite.
[1] Producers' shipments, crude gypsum. [2] Includes crude and ground, but not calcined. [3] Production plus imports minus exports.

TABLE 4. CANADA, HOUSE CONSTRUCTION, BY PROVINCE, 1992 AND 1993

	Starts			Completions			Under Construction		
	1992	1993	% Diff.	1992	1993	% Diff.	1992	1993	% Diff.
Newfoundland	2 271	2 405		2 556	2 457		2 464	2 378	
Prince Edward Island	644	645		595	674		326	296	
Nova Scotia	4 673	4 282		5 485	4 545		2 751	2 298	
New Brunswick	3 310	3 693		3 051	3 631		1 599	1 676	
Subtotal, Atlantic provinces	10 898	11 025	+1	11 687	11 307	–3	7 140	6 648	–7
Quebec	38 228	34 015	–11	42 323	34 859	–18	11 033	9 811	–11
Ontario	55 772	45 140	–19	63 134	51 130	–19	31 653	25 047	–21
Manitoba	2 310	2 425		2 190	2 572		1 136	1 002	
Saskatchewan	1 869	1 880		1 554	2 020		871	710	
Alberta	18 573	18 151		16 307	17 859		7 536	7 595	
Subtotal, Prairie provinces	22 752	22 456	–1	20 051	22 451	+12	9 543	9 307	–2
British Columbia	40 621	42 807	+5	36 050	42 047	+16	28 149	28 948	+3
Total Canada	168 271	155 443	–8	173 245	161 794	–7	87 518	79 761	–9

Source: Canada Mortgage and Housing Corporation.

TABLE 5. CANADA, VALUE OF CONSTRUCTION BY TYPE,[1] 1991-93

	1991	1992	1993
		($ millions)	
BUILDING CONSTRUCTION[2]			
Residential	34 768	37 315	38 432
Industrial	3 642	2 777	2 594
Commercial	13 436	11 185	11 146
Institutional	5 845	5 964	6 205
Other building	3 210	2 707	2 937
Subtotal	60 901	59 948	61 315
ENGINEERING CONSTRUCTION[2]			
Marine	553	556	576
Highways, airport runways	6 334	6 374	6 800
Waterworks, sewage systems	2 660	2 701	3 026
Dams, irrigation	399	306	334
Electric power	6 859	7 867	7 645
Railway, telephones	3 135	3 053	3 070
Gas and oil facilities	9 629	7 790	8 081
Other engineering	3 686	3 267	3 565
Subtotal	33 254	31 913	33 096
Total construction	94 154	91 861	94 411

Sources: Natural Resources; Statistics Canada.
[1] Actual expenditures 1991, preliminary 1992, intentions 1993. [2] Includes total value of new and repair work purchased.
Note: Numbers may not add to totals due to rounding.

TABLE 6. WORLD PRODUCTION OF GYPSUM, 1992 AND 1993

	1992	1993[e]
	(000 tonnes)	
United States	14 759	15 400
People's Republic of China	10 977	10 900
Iran	7 983	8 000
Canada	7 295	7 800
Thailand	6 985	7 000
France	5 715	5 700
Mexico	5 534	5 600
Japan	5 443	5 400
Spain	4 990	5 000
United Kingdom	2 993	3 100
Australia	2 000	2 100
Other countries	23 356	22 500
Total world	98 030	98 500

Sources: Natural Resources Canada; U.S. Bureau of Mines' Mineral Commodity Summaries, January 1994.
[e] Estimated.

Iron Ore

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SUMMARY

The phenomenal growth of China's economy was a major development in 1993 that affected the iron ore industry in Canada and in other major exporting countries. In spite of a more than 2-Mt increase in production, the Chinese steel industry was unable to meet domestic demand, and a record 3.4 Mt of steel was imported from Japan. With this boost to the Japanese steel industry and China's own need for imported iron ore, the Asian market increased imports of iron ore by 14% in the first six months of 1993. On a world scale, this demand reversed the trend of declining iron ore trade and, for a short time, strained the capability of the bulk shipping industry to deliver the iron ore from Australia, Brazil and other exporters to the Far East.

World iron ore production in 1993 levelled out at about 915 Mt after three years of decline. A continuing decrease in Ukraine, Russia and Kazakhstan production was balanced by increased production in China and Australia. World trade also recovered a little from the low of 1992 but, at 365 Mt, it was still below the level of the previous four years.

Iron ore prices dropped again in 1993 and for some contracts were the lowest level in four years. Negotiations for 1994 deliveries also started out with the major steel mills in Europe and Japan asking for cuts of 10% and more. No major contracts were concluded by year-end since producers were looking for no change in prices.

Canadian iron ore producers experienced very little net change in shipments relative to 1992, which was a very difficult year. The average value per tonne of ore decreased, which further stressed the financial viability of the mines. The industry had been expecting low sales and prices, and had planned shut-downs and cutbacks which kept production below sales, and costs under control.

CANADIAN DEVELOPMENTS

The four Canadian iron ore mines and ancillary plants produced 32 Mt of concentrate, pellets and sinter from hematite and siderite ores in 1993. The production of concentrate that was not further processed to pellets or sinter remained at the 1992 level. Ore stockpiles were drawn down in the second half of the year to supply a slight increase in shipments to Europe and Japan. As a result, acid and fluxed pellet production also remained near 1992 levels as exports to Germany and Japan were higher than expected. These sales allowed shorter summer shut-downs than originally planned.

Employment at Canadian iron ore mines, concentrators, agglomerating plants and support services declined by nearly 500 to about 5200 by the end of 1993.

There are three mines in the Labrador Trough area of northern Quebec and Labrador, and these account for over 96% of Canadian iron ore production. The mines belong to Quebec Cartier Mining Company (QCM), Iron Ore Company of Canada (IOC), and Wabush Mines. There is also one mine in Ontario. Other iron ore mines, which were operating in various provinces over the last 20 years, have closed due to high operating costs and depleted reserves. In British Columbia, by-product iron concentrate production is less than 60 000 t/y. QIT-Fer et Titane Inc. makes pig iron from ilmenite mined near Havre St. Pierre, Quebec; its production is counted in primary iron statistics (refer to chapter on Primary Iron).

The contracts between the three iron ore companies and the United Steelworkers of America (USWA) expired in February 1993. Negotiations led to new contracts with QCM and the Labrador City locals of the Iron Ore Company of Canada, but negotiations had not concluded with Wabush Mines by year-end.

QCM produced 13.1 Mt of ore in 1993, which was 2.3 Mt less than in 1992 and 3.2 Mt less than in 1991. A stockpile of about 1.7 Mt of concentrate at QCM's pellet plant in Port Cartier had accumulated by the end of 1993. As a result, QCM shut down operations from December 15, 1992 to January 12, 1993, and planned a long summer shut-down. As the market improved during 1993, QCM cut the length of the summer shut-down. The mine was shut from May 1 to June 1, while all operations were shut from July 25 to August 23. QCM completed its workforce reductions of 55 management and 245 unionized employees during the first quarter of the year.

QCM was the first of the mines to settle with the USWA for what was essentially a "stand pat" contract that will maintain wages at the former level until February 1996.

QCM shipped 14.7 Mt of ore, of which 7.7 Mt was concentrate destined mainly for Europe. The remaining shipments were low-silica pellets for direct reduction, acid pellets and fluxed pellets. Forecast sales for 1994 are 15.2 Mt.

QCM continued research on magnetic separation and column flotation of tailings from the concentrate circuit to improve iron recoveries. Success in this research would also increase QCM's supply of low-silica concentrate and pellets, which could be marketed for direct reduction and new smelting techniques.

IOC had planned to suspend operations at Carol Lake for 56 days during the summer of 1993, but was able to cut the shut-down to 36 days because of improved markets in the United States and Japan. In fact, the company increased shipments by about 1 Mt to about 13.9 Mt, of which 5.6 Mt was concentrate. IOC produced 13.2 Mt of concentrate, 5.5 Mt of acid pellets and 2.0 Mt of fluxed pellets in 1993. With shipments running at 60% of production capacity, the company needs to increase sales by a much greater amount.

IOC also continued research in 1993. It operated a new high-grade magnetic separator for most of the year in an attempt to improve recovery and produce a low-silica concentrate. Other technologies were also being tested in 1993 to increase the iron recovery and reduce costs.

Stockpiles were drawn down toward the end of the year and IOC is expecting to increase its production of iron ore in 1994, although shipments will remain at the 1993 level. No shut-down is planned for the summer of 1994.

Contract negotiations at IOC were delayed by a restructuring of the locals of the union representing many of the company's workers. A three-year contract, which did not provide wage increases, was finally agreed to in mid-December 1993, nine months after the expiry of the old contract. At year-end, workers at the Sept-Îles facilities and the Quebec North Shore and Labrador Railway had not settled.

Wabush Mines produced six products in 1993: concentrate, fluxed pellets, and acid pellets, each available with either 1% or 2% manganese content. Wabush shipped 4.8 Mt of pellets (about evenly split between 1% and 2% manganese) and 142 000 t of concentrate. Shipments for 1994 are forecast to decline to the 1992 level of 4.6 Mt of pellets.

Wabush workers were without a contract from February 1993 to the end of the year and had still not reached an agreement at the start of the new year. The USWA asked for no change in wages while the company sought to reduce labour costs with a $4.87/hour average pay cut. In spite of this uncertainty, production and shipments continued uninterrupted.

Wabush continued research on improving iron ore recovery rates and also on producing a 60% manganese concentrate in a circuit which removes manganese from the iron ore concentrate. This flow of manganese-containing material has previously gone to tailings. Changes made in 1992 and 1993 increased the proportion of 1% manganese-content ore from 50% to 70% of total iron ore concentrate production in 1993.

The Algoma Ore Division (AOD) of Algoma Steel Inc. produced about 1 Mt of superfluxed sinter at its plant at Wawa, Ontario. The plant used siderite ore from the adjacent mine, but over 40% of the feed was recycled material from steel mills. Shipment figures in Table 1 show only the volume of sinter that can be attributed to the iron ore mined in Canada.

The high level of recycled material, some of which has been processed on a toll basis for outside clients, has improved prospects for keeping the sinter plant and mine open for several more years.

Canadian iron ore exports were little better than in 1992, but were not as low as had been expected at the end of that year. Sales to Germany and Japan were higher than planned and exports to the United States were aided by a strike at four U.S. mines.

World Developments

World iron ore production in the first six months of 1993 amounted to about 455 Mt; Natural Resources Canada (NRCan) estimates full-year production at 915 Mt, nearly as low as in the previous year. China, Brazil, Australia, Russia and the Ukraine are the world's largest iron ore producers, accounting for over half of the total.

World trade in iron ore was 184 Mt for the first six months of 1993 and, by NRCan estimates, reached 365 Mt for the year. Australia, with 117 Mt of exports, regained its position as the largest exporter of iron ore in the world. Brazil, at 107 Mt, was second and, as in 1992, exports remained below the 114-Mt/y level of the 1989-91 period. The next largest exporters were India (30 Mt) and Canada (26 Mt). Japan's imports of iron ore continued to slide from 114 Mt in 1992 to about 105 Mt in calendar year 1993. The European Community maintained steel production at the 1992 level of 132 Mt, but imports of iron ore were cut in order to reduce inventories.

China, the largest producer of iron ore in the world, has tremendous reserves of low-grade iron ore but has been importing ore to supplement domestic supplies for its steel industry. China imported a record 28 Mt of ore in 1993. Its steel industry is expected to grow from 80 Mt in 1992 to 100 Mt by the year 2000. Technical problems are keeping the domestic iron ore industry from expanding fast enough to meet demand. In spite of transportation problems at ports and within China, imports of iron ore are expected to increase to the end of the decade.

Exports account for more than three quarters of Canada's iron ore shipments and, although the largest single customer is the United States, European destinations account for 50% of all shipments of Canadian iron ore. The Canadian industry is, therefore, very sensitive to competition from U.S. mines in the North American market and to competition from countries that ship to the European market.

In the United States, steel production increased in 1993 for the second year in a row and iron ore consumption increased by 1 Mt. A major strike affecting four U.S. mines removed some 2.5 Mt from the 1993 production capacity, which gave a boost to imports, including some 500 000 t more from Canada. Venezuela and Brazil also benefitted from the U.S. labour difficulties.

Brazil's largest iron ore producer, Companhia Vale do Rio Doce (CVRD), charted two new strategies for continued growth: it plans to increase sales to the domestic steel industry which itself has been growing dramatically to meet domestic and export demand, and it opened negotiations with the Chinese government for a joint venture to develop another mine in the Carajas region dedicated to exports to China.

Australian iron ore production capacity is being increased and consolidated at about 140 Mt/y. Over 90% of Australian iron ore production is exported from production in the Pilbara region of Western Australia. Incremental additions to capacity are giving the producers better quality control and a greater product range. Hamersley Iron Pty Ltd., which operates four mines, is planning to open the Marandoo deposit in 1994 and is drilling its Yandicoogina deposit for later development. BHP Iron Ore Pty Ltd. increased production capacity at its Yandicoogina mine from 5 Mt/y to 10 Mt/y in April 1993. Portman Mining Limited has entered into an agreement with the Anshan iron and steel complex of China to jointly operate the Koolyanobbing iron ore mine and the Cockatoo Island beneficiation plant beginning in 1994.

The Ukraine produced an estimated 67.1 Mt of iron ore in 1993, of which some 15.6 Mt was pellets. Exports are estimated at under 12 Mt. Both production and exports were therefore below the 1992 levels. Russia also experienced lower production, estimated at 76 Mt.

Mauritania, which in 1992 had suffered its worst year since 1983, in terms of iron ore sales, has looked to Japan to reduce its dependence on the European steel industry. Shipments, which reached a high of 12 Mt in 1989, declined steadily to 8 Mt in 1992 and recovered to 9 Mt in 1993. The depressed iron ore market worldwide has made it difficult for the Mauritanian iron ore mining company SNIM to increase sales. The iron ore production capacity was increased by the opening of the 6-Mt/y Mhaoudat mine in 1993.

Hierro Peru, a producer of iron ore with a capacity of 6 Mt/y, was purchased by Shougang Corp. of China at the end of 1992. The mine will continue to ship under existing contracts to customers in Korea and Japan but is expected to become a significant supplier to the Chinese steel company.

The Swedish iron ore industry produced 19 Mt, shipped 20 Mt and exported 16 Mt of ore and pellets in 1993. In December 1992, LKAB took the decision to increase pelletizing capacity by 4 Mt at its Kiruna mine.

Civil unrest in Liberia continued to hinder mining and rail transportation of iron ore to the ports in that country. Shipments were 1.3 Mt in 1992 and apparently stopped in 1993.

UNCTAD Work on Iron Ore

In 1989, several countries, including Canada, cooperated in setting up a trust fund under the United Nations Conference on Trade and Development (UNCTAD) to collect and publish statistics on iron ore for all the major producing, consuming and trading countries. The project is the primary source of trade flow data on the major importing and exporting countries, giving exports by destination and imports by source. The trust fund project produced two statistical reports and a market review in 1993. Supporting countries will provide sufficient funds to continue the project until March 1995.

The Intergovernmental Group of Experts on Iron Ore (IGE), also under UNCTAD, met in Geneva October 27-29, 1993, with representation from 32 countries and several international agencies. The quality of the information benefitted from the active participation of industry advisors. A presentation, "The Current and Future Iron Ore Requirements in China," by Mr. Dong Zhi Xiong of China Metallurgical Import & Export Corp., was especially important for its insight into China's strategy for sourcing iron ore over the next 10 years.

The UNCTAD Secretariat, working for the IGE, also published iron ore statistics which were complementary to the trust fund project publications. The UNCTAD reports cover more countries, include the iron content of the ore, and provide forecasts on iron ore, pig iron and steel. The Secretariat has contacts in 87 countries covering all significant producers and consumers.

The IGE is scheduled to meet again in October 1994 to discuss developments in the production, marketing and consumption of iron ore.

PRICES

Iron ore exporters were obliged to take price reductions for deliveries in 1993. In Europe, the price decreased by 4% for fines and concentrate used as sinter feed, and by 10% for pellets. The Japanese steel mills negotiated decreases of 11% for fines and concentrate and 9.01% for lump ore.

The price difference between pellets and fines narrowed, for the third year running, to 15.75¢ on the basis of US¢/Fe unit.[1] The pellet producers had regarded the 1990 premium of 21¢ for pellets as reasonable, given the higher costs of production relative to concentrate.

Negotiations for 1994 deliveries are expected to lead to price cuts again in both the European and Japanese markets. Although steel companies in both markets are claiming that the requirements in 1994 will be lower than in 1993, there are signs of overall strength in the world market as China, India, Brazil and other developing countries increase their steel production and demand for iron ore. Negotiations had not led to settlements in either market by the end of 1993.

OUTLOOK

Steel-making worldwide is a growing industry in spite of serious changes in the structure of the industry. A major shift in the geographic structure was observed in recent years. This shift of steel production from developed Western nations to newly developed nations, especially in Asia and South America, is expected to continue in the near term. The dramatic reductions in steel production in the former Soviet Union and Eastern Europe were coupled with capacity cuts in Japan and Europe. On the other hand, the steel industry in China grew by 13%, in the Republic of Korea by 8%, and in India by 5% in 1992. The steel industry in the United States and Canada strengthened in 1993 relative to the previous two years; this recovery is expected to continue in the near term.

For Canadian iron ore producers the shifts are a mixed blessing. Improvements in the North American market will certainly help Canadian and U.S. mines more than any others. However, Canadian mines depend on Europe to take half the iron ore they produce, and that market continues to shrink. Canadian mines are also the farthest from the Asian market, which means they are unlikely to be the major beneficiaries of any growth there.

The potential for Canadian mines continues to be linked to technological developments. Ongoing research is directed at reducing production costs and providing iron ore that will meet the changing specifications of existing steel mills and the quality demands of new steel-making technologies. Restructuring and careful cost control have already brought Canadian mining costs down to levels competitive with producers in Brazil and other countries with higher-grade reserves.

Note: Information in this review was current as of February 1, 1994.

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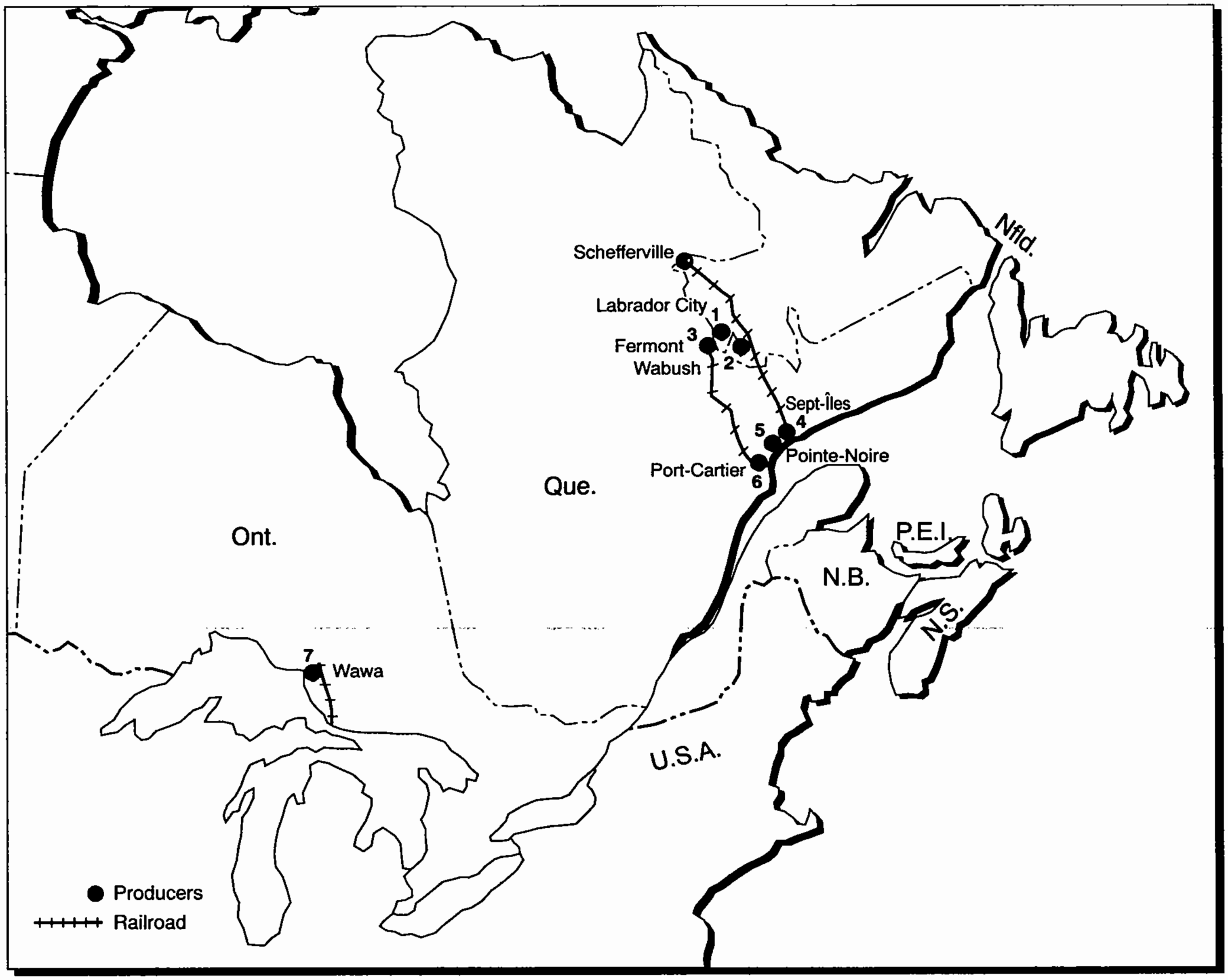
[1] Price is reported in cents, U.S. currency, for each percentage point of iron in a tonne of ore, e.g., at 30¢/Fe unit, ore grading 65% iron would bear a price of 65 x 30¢ = US$19.50/t.

Figure 1
Iron Ore in Canada, 1993



Numbers refer to locations on map above.

PRODUCERS

1. Iron Ore Company of Canada, Carol Division (mine/concentrator/pellet plant)
2. Wabush Mines (mine/concentrator)
3. Quebec Cartier Mining Company (mine/concentrator)
4. Iron Ore Company of Canada (port)
5. Wabush Mines (pellet plant/port)
6. Quebec Cartier Mining Company (pellet plant/port)
7. Algoma Ore, division of Algoma Steel Inc. (mine/concentrator/sinter plant)

TABLE 1. CANADA, IRON ORE PRODUCTION AND TRADE, 1992 AND 1993

Item No.		1992		1993p	
		(tonnes)[1]	($000)	(tonnes)[1]	($000)
PRODUCTION (mine shipments)					
	Newfoundland	17 691 747	645 333	17 547 000	636 989
	Quebec	13 349 569	x	13 626 000	x
	Ontario	481 994	x	490 110	x
	British Columbia	58 733	1 353	57 354	1 327
	Total[2]	31 582 043	1 084 773	31 720 464	1 036 587
IMPORTS				(Jan.-Sept.)	
2601.11	Iron ore concentrates, non-agglomerated				
	United States	24 555	732	9 365	280
	Brazil	6 500	340	–	–
	Total	31 055	1 072	9 365	280
2601.12	Iron ore, agglomerated				
	United States	5 103 219	214 463	3 294 698	131 529
	Brazil	184 072	6 921	207 878	7 209
	Venezuela	5 000	600	6 215	939
	Total	5 292 291	221 985	3 508 791	139 678
EXPORTS					
2601.11	Iron ore concentrates, non-agglomerated				
	United Kingdom	2 127 508	51 026	1 933 956	41 486
	Germany	2 838 187	70 015	1 680 823	38 530
	Netherlands	1 516 945	28 175	1 237 093	24 340
	France	1 435 786	33 346	978 028	21 261
	United States	201 917	4 615	566 156	12 920
	Japan	1 188 088	18 995	785 035	12 387
	South Korea	792 076	14 401	640 509	10 702
	Spain	205 552	5 320	255 690	6 086
	Belgium	349 169	9 974	240 076	6 036
	Sweden	161 318	4 010	191 798	4 431
	Philippines	464 348	7 327	219 358	4 003
	Italy	394 846	9 599	173 519	3 672
	Switzerland	–	–	75 757	1 664
	Finland	61 294	1 118	69 402	1 266
	Portugal	96 436	2 357	38 330	790
	Total	11 833 470	260 284	9 085 530	189 581
2601.12	Iron ore, agglomerated				
	United States	6 556 279	289 723	4 461 321	199 507
	Germany	1 434 684	54 743	1 201 197	43 829
	Belgium	1 144 592	42 641	870 314	30 438
	Italy	774 744	37 011	523 742	25 278
	Netherlands	1 398 314	46 983	577 957	17 821
	Spain	416 694	15 593	386 377	14 017
	United Kingdom	968 954	34 379	285 145	9 791
	France	233 696	8 323	276 332	9 267
	Turkey	–	–	223 803	9 201
	Portugal	215 736	7 979	203 191	7 170
	Sweden	–	–	105 836	3 810
	Venezuela	605	131	629	71
	Switzerland	91 444	2 935	–	–
	Poland	62 625	2 989	–	–
	Total	13 298 367	543 436	9 115 844	370 209
	Total exports, all classes				
	United States	6 758 196	294 338	5 027 477	212 428
	Germany	4 272 871	124 758	2 882 020	82 360
	United Kingdom	3 096 462	85 406	2 219 101	51 278
	Netherlands	2 915 259	75 159	1 815 050	42 162
	Belgium	1 493 761	52 615	1 110 390	36 475
	France	1 669 482	41 670	1 254 360	30 529
	Italy	1 169 590	46 610	697 261	28 950
	Spain	622 246	20 914	642 067	20 104
	Japan	1 188 088	18 995	785 035	12 387
	South Korea	792 076	14 401	640 509	10 702
	Turkey	–	–	223 803	9 201
	Sweden	161 318	4 010	297 634	8 241
	Portugal	312 172	10 337	241 521	7 961
	Philippines	464 348	7 327	219 358	4 003
	Switzerland	91 444	2 935	75 757	1 664
	Finland	61 294	1 118	69 402	1 266
	Venezuela	605	131	629	71
	Poland	62 625	2 989	–	–
	Total	25 131 837	803 721	18 201 374	559 790
Consumption of iron ore at Canadian iron and steel plants		13 251 688r	. .	13 474 188	. .

Sources: Natural Resources Canada; Statistics Canada; American Iron Ore Association.
– Nil; . . Not available; p Preliminary; r Revised; x Confidential.
[1] Dry tonnes for production (shipments) by province; natural weight for imports and exports. [2] Total iron ore shipments include shipments of by-product iron ore.
Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, IRON ORE SHIPMENTS, 1989-93

Company and Location	Ore Mined	Product Shipped	1989	1990	1991	1992	1993p
				(000 tonnes, natural or wet)			
Adams Mine Kirkland Lake, Ontario	Magnetite	Fluxed pellets	1 078	244	–	–	–
Algoma Ore Division Algoma Steel Inc. Wawa, Ontario	Siderite[1]	Sinter	1 243	735	1 137	1 037	1 165
Iron Ore Company of Canada Schefferville, Quebec	Hematite, goethite and limonite	Direct shipping	177	38	264	120	65
Carol Lake, Labrador	Specular hematite and magnetite	Concentrate	5 130	5 543	7 096	4 818	5 640
		Acid pellets	8 106	5 473	5 927	6 346	6 161
		Fluxed pellets	1 732	2 797	1 873	1 467	2 010
		Chips	–	147	106	18	11
		Blended ore					65
Quebec Cartier Mining Company Mount Wright, Quebec	Specular hematite	Concentrate	7 734	7 573	7 655	7 213	7 800
		Acid pellets	6 031	3 743	4 630	2 919	3 200
		Fluxed pellets	857	2 952	1 864	2 467	2 700
		Low Si pellets	1 176	1 038	925	1 100	1 000
Sherman Mine Temagami, Ontario	Magnetite	Fluxed pellets	1 023	281	–	–	–
Wabush Mines Wabush, Labrador and Pointe-Noire, Quebec	Specular hematite and magnetite	Acid pellets	5 953	3 921	2 997	3 146	2 847
		Fluxed pellets		1 771	1 693	1 547	1 981
		Concentrate			106	483	141
British Columbia producers	Magnetite	Concentrate	73	100	67	59	57
Other Ontario	Magnetite	Concentrate	1	–	–	–	–
Total			40 314	36 357	36 314	32 741	34 843

– Nil; p Preliminary.
1 Includes 458 460 t of iron-bearing material not from the mine.

TABLE 3. RECEIPTS, CONSUMPTION AND INVENTORIES OF IRON ORE AT CANADIAN IRON AND STEEL PLANTS, 1992 AND 1993

	1992	1993
	(000 tonnes)	
Receipts imported	5 128	5 514
Receipts from domestic sources	7 613	7 804
Total receipts at iron and steel plants	12 112	13 318
Consumption of iron ore	13 060	13 327
Inventory at docks, plants, mines and furnace yards, December 31	9 491	6 929
Inventory change	1 132	2 716

Source: American Iron Ore Association.

TABLE 4. WORLD IRON ORE PRODUCTION, 1991-93

	1991	1992	1993e
		(000 tonnes)	
People's Republic of China	175 300	195 938	220 000
Brazil	150 657	145 820	145 000
Ukraine (included with C.I.S.)	86 813	74 000	67 100
U.S.S.R. (C.I.S.)	198 862	162 000	157 000
Australia	122 000	112 115	119 700
India	56 884	54 872	56 000
United States	55 515	54 913	55 500
Canada	37 111	34 449	31 500
Republic of South Africa	28 952	28 226	30 000
Venezuela	19 959	18 054	20 500
Sweden	19 328	19 277	19 200
Mauritania	10 194	8 094	9 000
Other countries	75 183	65 928	51 600
Total	949 945	899 686	915 000

Source: Trust Fund Project on Iron Ore Information.
e Estimated by Natural Resources Canada.

TABLE 5. CANADIAN CONSUMPTION OF IRON-BEARING MATERIALS BY INTEGRATED[1] IRON AND STEEL PRODUCERS, 1992

Material Consumed	Consumed In				
			Iron and Steel Furnaces		
	Sinter Plants at Steel Mill	Direct Reduction Plants	Production of Pig Iron	Steel Furnaces	Total in Furnaces
			(tonnes)		
Iron ore					
Crude and concentrate	626 904	151 572	–	–	–
Pellets	62 602	778 310	11 100 542	17 967	11 118 509
Sinter	–	–	1 013 953	–	1 013 953
Sinter produced at steel plant	–	–	345 238	–	345 238
Direct reduced iron	–	–	–	627 007	627 007
Other iron-bearing materials including flue dust, mill scale, cinder, slag, etc.	704 949	–	451 894	100 854	552 748
Total	1 394 455	929 883	12 911 628	745 828	13 657 456

Source: Company data.
– Nil.
[1] Dofasco Inc.; Sidbec-Dosco Inc.; Sydney Steel Corporation; The Algoma Steel Corporation, Limited; Stelco Inc.

TABLE 6. NORTH AMERICAN PRICES OF SELECTED ORES AT YEAR-END 1980, 1985, AND 1991-93

	1980	1985	1991	1992	1993
			(US$/t)		
Mesabi non-bessemer[1]	27.61	29.557-31.03	29.557-31.03	29.557-31.03	30.03-31.53
Old range non-bessemer and manganiferous	27.85	32.264	32.264	32.264	–
			(US¢/t iron unit)[2]		
Pellets					
Lake Erie base price[3]	71.36	85.53	71.31-73.47	71.31-73.47	72.45-74.65
USX Corporation[4]	–	–	36.756	36.756	37.344
Upper Lakes[5]	–	58.46	46.10-58.46	46.10-58.46	46.84-59.40
Wabush[6]	–	62.5	62.5	62.5	63.50
Cyprus Northshore[7]	–	–	47.99	47.99	48.76
			(US$/t)		
Direct reduced iron	–	115-135	115-135	115-135	115-135

Sources: Skillings Mining Review; Iron Age.
– Nil; f.o.b. Free on board.
[1] US$/t, 51.5% of iron natural, at rail of vessel, lower lake port. [2] One iron unit equals one percentage point of iron content in a tonne of ore; therefore, an ore containing 60% iron has 60 iron units. [3] Cleveland-Cliffs Inc., M.A. Hanna Company, Oglebay Norton Company at rail of vessel, lower lake port. [4] At mine. [5] Pickands-Mather & Co. and Inland Steel Mining Co. in hold of vessel, upper lake port. [6] F.o.b. Pointe-Noire. [7] F.o.b. Silver Bay.

TABLE 7. SELECTED PRICES OF IRON ORE BOUND FOR JAPAN AND EUROPE, 1989-93

Ore	Market	Source	1989	1990	1991	1992	1993
				(US¢/Fe Unit Dmt, f.o.b.)			
Fines (including concentrate)	Europe	CVRD	26.56	30.80	33.25	33.10	29.09
		Iscor	20.70	24.75			
		Kiruna	30.00	35.70	37.1	36.50	30.50
		Carol Lake	27.00	31.77	34.6	31.16	26.80
		Mt. Wright	27.00	31.77	34.6	33.15	28.50
	Japan	CVRD	23.61	27.38	30.05	28.11	25.02
		Iscor	20.37	23.62	25.49	24.24	21.57
		Hamersley[1]	26.34	30.54	32.96	31.35	27.05
		Carol Lake	22.52	26.11	28.18	27.26	24.26
Lump	Europe	CVRD Carajas	–	–	–	–	
		Hamersley[2]	43.00	49.97	50.25	48.28	42.06
	Japan	CVRD Itabira	25.20	29.22	30.96	29.00	25.91
		Iscor	26.05	30.21	32.01	30.27	27.60
		Hamersley[1]	33.23	38.53	40.83	38.23	34.78
Pellets	Europe	CVRD	47.33	51.60	52.15	48.47	43.64
		Kiruna	53.50	59.00	57.50	53.48	45.70
		Carol Lake	48.35	52.58	53.00	49.35	44.25
		Mt. Wright	48.35	52.58	53.00	49.35	44.25
	Japan	CVRD (Nibrasco)	44.49	48.50	49.03	45.57	41.03
		Savage River	42.10	45.90	46.39	43.12	38.83

Source: The Tex Report.
– Nil; c.i.f. Cost, insurance and freight; Dmt Dry metric tonne; f.o.b. Free on board.
[1] F.o.b. Dampier; [2] C.i.f. Rotterdam.

Lead

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According to preliminary figures from the International Lead and Zinc Study Group, Western World lead consumption in 1993 was 4 483 000 t, which was an increase of 1% from the total in 1992 following three consecutive years of decline. Lead mine production reached 2 034 000 t, a 12% decrease from 1992, as mine closures and production cuts were initiated in response to low metal prices. Metal production, both primary and secondary, was 4 397 000 t, a decline of 1% from 1992, as smelters cut production in response to low prices and shortages of secondary materials.

Total refined metal stocks rose early in the year but began to fall in the second half, mainly due to decreases in producer stocks. However, stocks on the London Metal Exchange (LME) rose to 304 000 t by year-end.

CANADIAN DEVELOPMENTS

Canadian mine production in 1993 totalled 181 000 t, compared to 342 000 t in 1992. The large decrease was primarily due to the closure of the Yukon mines of Curragh Inc. in December 1992 and production cuts by other Canadian lead producers in response to low lead prices.

Lead metal production in 1993 totalled 222 000 t, a decrease of 33 000 t from 1992. Temporary closures at Canada's two primary lead smelters and production cuts at secondary smelters were responsible for the lower tonnage.

British Columbia

Cominco Ltd. announced in April that it had abandoned the QSL smelting technology at its Trail metallurgical complex. The 160 000-t/y QSL smelter began operation in December 1989, but closed in March 1990 due to design and mechanical problems. Extensive tests by German manufacturer Lurgi GmbH in Germany to resolve the problems were unsuccessful. The Trail lead smelter must be capable of treating residues from zinc refining operations as well as a large stockpile of residues at the Trail facility. Meanwhile, Cominco has commenced reviewing the Russian Kivcet process as a possible alternative and has completed commercial-scale testing of Trail-type feedstock at the Kivcet lead smelter in Kazakhstan. However, no final decision on installation of the Kivcet process, estimated to cost an additional $100 million, has yet been made.

Cominco closed its Trail metallurgical complex, including its 135 000-t/y capacity lead smelter, for the month of April. Low lead and zinc prices were the reasons for the closure. The company also closed its Sullivan lead-zinc mine near Kimberley from June 26 to September 12.

Treminco Resources Ltd. closed its Silvana mine near New Denver in April, to correspond with the closure at Trail. The mine, which has a capacity of 1100 t/y of lead in concentrate, remained closed throughout the year due to low lead and zinc prices.

The Stronsay zinc-lead property near Mackenzie was placed in receivership in September, along with the other assets of Curragh Inc., when the company failed to present a restructuring plan to an Ontario court. The company had been granted protection from its creditors on April 1. In mid-December, a consortium consisting of Cominco, Teck Corporation, Korea Zinc Co., Ltd., and Samsung Corporation announced that it had agreed to purchase the Stronsay deposit. Development of Stronsay (also known as the Cirque) will be dependent upon an increase in metal prices.

Yukon

The Sa Dena Hes and Faro mines of Curragh remained closed throughout 1993, although milling of stockpiled ore at Faro continued until the end of March. The company failed to secure a $29 million loan to complete the stripping of the

Grum deposit at Faro and an offer from Korea Zinc and Samsung for 50% of the company for $50 million was rejected by Curragh. Without an adequate restructuring plan, both mines, along with Curragh's other assets, were placed in receivership in September. Capacity at the mines was 150 000 t/y of lead in concentrate.

In mid-December, the consortium which agreed to purchase the Stronsay zinc-lead deposit in British Columbia also agreed to purchase the Sa Dena Hes mine near Watson Lake. The Cominco/Teck/Korea Zinc/Samsung joint venture indicated that the restarting of production at Sa Dena Hes would be dependent upon improving metal prices.

Northwest Territories

San Andreas Resources Corporation continued exploration of its Prairie Creek lead-zinc deposit in the Nahanni River area. The orebody was initially developed in 1969; it was further developed in the early 1980s and a 1200-t/d mill was constructed on-site. However, due to the collapse of silver prices, the mine never went into production. Current proven reserves are 4 Mt grading 15.6% zinc, 13.7% lead and 192 g/t silver.

Ontario

Tonolli Canada Ltd. closed its 35 000-t/y secondary lead plant in Toronto for the month of April. The closure was due to feed shortages. The Canada Metal Company's 12 000-t/y lead smelter in Toronto, which closed in 1992 due to weak metal markets and high scrap prices, remained closed in 1993.

New Brunswick

Brunswick Mining and Smelting Corporation Limited closed its 72 000-t/y Belledune lead smelter from November 22, 1993, to January 3, 1994. The shortage resulted from a four-week closure of the company's nearby Brunswick lead-zinc mine in the summer. Due to worldwide shortages of lead concentrates caused by low lead prices and concentrate treatment charges, the company decided to close the smelter rather than try to source concentrates elsewhere. Meanwhile, the company announced that it was cutting its 1140-member workforce by 112 by year-end in an effort to save $5.6 million annually.

Brunswick also closed its Heath Steele mine near Bathurst on June 28 due to low lead and zinc prices. The mine remained closed for the remainder of the year. Brunswick indicated that the re-opening of the mine would depend on improved metal prices. Heath Steele has a capacity of 11 000 t/y of lead in concentrate. Stratabound Minerals Corp. closed its CNE lead-zinc mine early in the year due to low metal prices. The mine intermittently supplied ore to the Heath Steele mill on a custom basis.

Brunswick undertook metallurgical tests at its Half Mile Lake lead-zinc-silver deposit located 20 km west of the Heath Steele mine. The deposit currently contains a geological reserve of 7.8 Mt grading 3.7% lead, 10.6% zinc, 0.1% copper and 44 g/t silver.

World Developments

Western World lead mine production fell to 2 034 000 t in 1993 from 2 299 000 t in 1992. A fall of 46% in Canada was accompanied by lesser decreases in Europe, the United States and Australia. Western World refined lead production in 1993 was 4 397 000 t, a decline of 45 000 t from 1992.

Primary Production

Asia/Oceania

In Australia, Pasminco Ltd. closed its North mine operation at Broken Hill in New South Wales in February. The North mine had a capacity of 54 000 t/y of lead in concentrate. However, Pasminco increased production at its South mine, resulting in a net loss of only about 15 000 t/y of lead in concentrate.

Aztec Mining Co. Ltd. deferred an A$67 million expansion of its Woodcutters mine in the Northern Territory due to low lead and zinc prices. The expansion would have raised lead capacity by 7000 t/y to 27 000 t/y of lead in concentrate.

Construction of the US$165 million McArthur River lead-zinc mine in the Northern Territory commenced late in the year. The new mine, owned 70% by MIM Holdings Ltd. and 30% by a Japanese consortium, is expected to start up in 1995 and will, at full capacity, produce a bulk concentrate yielding 45 000 t/y of lead in concentrate. The McArthur River orebody contains proven reserves of 227 Mt grading 9.2% zinc, 4.1% lead and 41 g/t silver. A portion of the bulk concentrate is to be shipped to MIM's newly acquired Avonmouth plant, which uses the Imperial Smelting Process (ISP), in the United Kingdom. MIM acquired the 40 000-t/y Avonmouth smelter in October from Pasminco for US$72 million.

Pasminco announced in April that it would cut the workforce at its 235 000-t/y capacity Port Pirie lead-zinc smelter by 140. The company indicated that it planned to maintain the current level of production after the reductions. At its Cockle Creek ISP lead-zinc smelter in New South Wales, Pasminco undertook a seven-week closure beginning August 1 in order to increase zinc capacity at the plant. The Cockle Creek smelter has a capacity of 30 000 t/y of refined lead.

Several lead-zinc projects in Queensland hold great potential for development. BHP Minerals Ltd. completed a surface diamond drilling program at its Cannington deposit which indicated an inferred geological reserve of 47 Mt grading 10.7% lead, 4.6% zinc and 470 g/t silver. The company was to commence a decline in order to carry out underground exploration in preparation for a feasibility study on mining the deposit. It hopes to commence production at Cannington in 1997.

Meanwhile, CRA Ltd. announced that production from the company's Century deposit, originally scheduled for 1995, has been delayed due to metallurgical problems which require further testing. The large Century deposit has geological reserves of 118 Mt grading 10.2% zinc, 1.5% lead and 35 g/t silver. A third promising project is the Dugald River zinc-lead deposit, a joint venture between CRA and Pasminco, which is undergoing advanced mining and metallurgical investigations.

In Japan, MIM and partners Mitsui Mining and Smelting Co. Ltd. and Nippon Mining & Metals Co. Ltd. announced that they plan to delay the construction of their Hachinohe lead-zinc smelter. The joint venture cited the high value of the yen and low lead and zinc prices as reasons for the postponement. The smelter, originally scheduled to begin production in late 1994 with a capacity of 60 000 t/y of refined lead, will now not begin until the business environment improves.

Dowa Mining Co. Ltd. announced in mid-November that it would close its Matsumine, Fukazawa and Nurukawa mines in Japan at the end of March 1994. The loss in capacity will be 6000 t/y of lead in concentrate.

Korea Zinc closed its 120 000-t/y Onsan QSL smelter in early October for repairs. The smelter has experienced a shortage of lead concentrates with the closure in April of the Faro mining operations in Canada.

Metallgesellschaft AG and partner Padaeng Industry Co. Ltd. announced plans to construct a new lead-zinc smelter in Thailand. The new US$320 million ISP smelter would have a capacity of 40 000 t/y of refined lead and is expected to commence production in 1996.

The large open-pit Lanping zinc-lead mine in Yunnan province began construction with expected start-up in 1995. Although predominantly a zinc project, the new mine would have a capacity of 5000 t/y of lead in concentrate. In addition, the Changba zinc-lead mine began an expansion, scheduled for completion in 1994, which would raise capacity to 5000 t/y of lead in concentrate from the present 3200 t/y.

Asia Minerals Corp. and China National Nonferrous Metals Industry Corp. completed a feasibility study on their Qiandongshan zinc-lead-silver deposit in Shaanxi province. The underground orebody contains probable reserves of 12 Mt grading 7.9% zinc, 1.7% lead and 23 g/t silver. The mine could come on stream in late 1996 with a capacity of 4000 t/y of lead in concentrate.

Technical problems continued at the Chinese state-owned Baiyin QSL lead smelter. Difficulties with fuel injectors have resulted in a loss of control on reaction temperatures. The Chinese government has spent US$27 million on the project so far. The Baiyin smelter has a capacity of 52 000 t/y of refined lead.

Americas

The Doe Run Company closed its 204 000-t/y capacity Herculaneum lead smelter in Missouri from July 18 to August 8 due to flooding of the Mississippi River. The company made up shipments from inventory during the closure and increased production after restarting the plant to make up for lost production.

Kennecott Corp. closed its Greens Creek zinc-silver-lead mine in Alaska in April due to low metal prices. Development work and engineering studies continued, however, as the company plans to re-open the mine when economic conditions improve. The Greens Creek mine has a capacity of 10 000 t/y of lead in concentrate.

Equinox Resources Ltd. placed its Van Stone mine in Washington on a care and maintenance basis in late January due to weak market conditions. The mine, which has a capacity of 4000 t/y of lead in concentrate, had re-opened in August 1992 after being closed for similar reasons.

The U.S. Defense Logistics Agency (DLA) disposed of slightly over 20 000 t of lead from its strategic stockpile in fiscal year 1993 which ended

September 30. This amount was well below the 47 000 t authorized in the Annual Materials Plan. The agency was authorized to dispose of just under 32 000 t under the 1993/94 plan. The Market Impact Committee of the DLA has assured producers that it will not dispose of lead from its stockpile in a manner that would disrupt lead markets.

In Mexico, Industrial Minera Mexico S.A. closed its Monterrey lead refinery for over two weeks in July while government authorities investigated possible violations of environmental standards. No violations were discovered and the plant was allowed to resume operations. However, the company again closed the refinery as well as its Chihuahua lead smelter in November due to shortages of lead concentrates and low lead prices. The antiquated facilities each had a nominal capacity of 120 000 t/y of refined lead, but effective capacities were about 60 000 t/y.

Minera Real de Angeles, S.A. de C.V. closed its Real de Angeles silver-zinc-lead mine in April due to the falling price of silver. However, a recovery in silver prices later in the year resulted in the mine re-opening in September at a reduced rate. The mine produced 45 000 t of lead in concentrate in 1992.

Minera San Francisco del Oro S.A. de C.V. reached an agreement in February for the closure of its Frisco, Clarines and Mesa mines. The lower-cost Grenadena mine, employing more advanced mining techniques, was re-opened. Lead-in-concentrate production at the San Francisco de Oro operation was to fall by 6000 t/y to 8000 t/y of lead in concentrate.

Europe

Ente Nazionale Idrocarburi (ENI) subsidiary Nuova Samim, SpA closed its Porto Vesme lead smelter from July 10 to October 1 due to the world surplus of refined lead, poor demand and low lead prices. The closure of the 100 000-t/y Kivcet smelter was one of a number of closures in Europe. ENI also closed its Monteponi and Masua mines in Sardinia in February due to low prices. The closures were part of a plan by the Italian government to close all uneconomic mines in the region. Lost capacity from the two closures was 11 000 t/y of lead in concentrate.

In Germany, Metaleurop S.A. closed its 95 000-t/y Nordenham lead smelter for two months commencing June 15. The closure resulted in the loss of an estimated 17 000 t of refined lead. Metaleurop idled the plant due to a surplus of refined lead in Europe. The company closed its 110 000-t/y Noyelles-Godault smelter in France for the same period with an estimated loss of 20 000 t of refined lead. After re-opening, Metaleurop announced that it planned to eliminate 100 jobs at the Noyelles-Godault plant in an attempt to cut costs.

Metallgesellschaft experienced technical problems with its QSL lead smelter at Stolberg, Germany. The plant, with a capacity of 100 000 t/y of refined lead, was closed from mid-April to mid-June but was back to full capacity at the end of June.

In Spain, a prolonged drought closed Andaluza de Piritas S.A.'s Aznalcollar open-pit zinc-lead-copper mine in May. The mine remained closed throughout the year with a loss in capacity of 20 000 t/y of lead in concentrate. No date for re-opening has yet been given. The company plans to expand its operation, raising lead mine capacity by 30 000 t/y to 50 000 t/y of lead in concentrate by 1996. Also in Spain, Navan Resources Plc is seeking planning permission for its Mazarron lead-zinc project which would have a capacity of 5000 t/y of lead in concentrate.

Boliden AB reduced lead metal production at its Ronnskar smelter in Sweden by 7000 t from a planned 57 000 t for 1993. The Ronnskar smelter has a capacity of 65 000 t/y of refined lead and Boliden sources its concentrates from its own mines in Sweden.

The legal dispute over the Lisheen zinc-lead project in Ireland continued during the year. Lac Minerals Ltd. made a US$70 million bid for the 52.5% stake of Chevron Minerals Ltd. in the Lisheen project. However, junior partner Ivernia West Plc exercised its pre-emptive rights clause in its joint-venture agreement with Chevron to buy Chevron's stake. Lac Minerals has challenged Ivernia West's right to do so. The Lisheen deposit contains a proven reserve of 22 Mt grading 12.2% zinc, 2.2% lead and 31 g/t silver.

Also in Ireland, Arcon International Resources Plc received planning approval for its zinc-lead project in County Kilkenny. The proposed underground mine is expected to come on stream in late 1995 and to produce 4000 t/y of lead in concentrate.

Secondary Production/Recycling

Lead is one of the most recycled nonferrous metals in the world. Secondary production (from recycled materials) has risen steadily and surpassed primary output for the first time in 1989 (Figure 1). This growth reflects the favourable economic conditions associated with lead recycling and the fact that lead retains its physical and chemical properties when recycled. As lead is used worldwide, scrap lead has become a readily renewable resource to which countries without lead mines have access.

Cutbacks in North American secondary lead production took place earlier in 1993 than in Europe due to scrap lead prices falling at a slower rate than the LME price for lead. In Europe, although demand was also weak, the highly competitive nature of the secondary lead business and the greater availability of lead scrap resulted in many producers maintaining high output levels. By midyear, however, more production cuts were initiated in Europe.

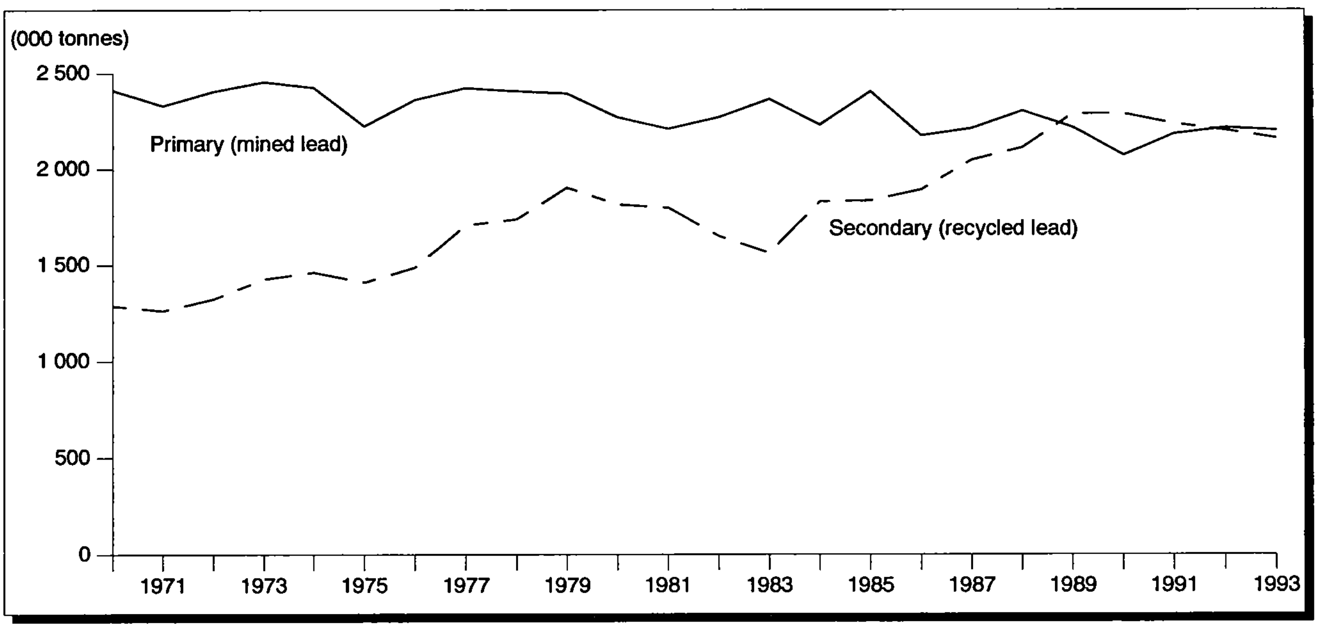
Production of secondary lead in the United States rose sharply in the latter part of the year as demand increased, particularly in the replacement battery market, and battery scrap was plentiful.

The U.S. secondary lead industry initiated several production cutbacks and temporary closures during the year. Schuylkill Metals Corp. announced in April that production at its two plants would be reduced to 70 000 t/y from 85 000 t/y of refined lead. However, with rising demand later in the year, Schuylkill increased production to more normal levels. Several indefinite plant closures occurred during the year including PBX Inc.'s Norwalk, Ohio smelter, Refined Metals Corporation's Beech Grove, Indiana plant, Ross Metals Inc.'s Rossville, Tennessee plant, and Tejas Resources' Terell, Texas smelter. Total lost capacity for these four plants was 72 000 t/y of refined lead.

In Europe, scrap supplies remained scarce throughout the latter half of the year. Metaleurop reduced production by about 10 000 t at its 70 000-t/y Oker secondary lead smelter in Germany. Britannia Refined Metals Ltd. closed the secondary lead furnaces at its Northfleet facility in England for the month of July with an estimated loss of 3000 t of refined lead production.

Billiton B.V. announced in August that it had agreed to sell its lead recycling operations in the United Kingdom and France to the parent of U.S. recycler RSR Corporation. Billiton's U.K. operations have a smelting capacity of 85 000 t/y and a refining capacity of 125 000 t/y of lead. The company's plant in France produces about 10 000 t/y of lead products. RSR is a major U.S. secondary lead producer with a total capacity at its three U.S. plants of 245 000 t/y of refined lead.

Figure 1
World Lead Metal Production,[1] 1970-93



Source: International Lead and Zinc Study Group.
[1] Excludes Eastern European and socialist countries.

TARIFFS

Item No.	Description	Canada			United States	EC	Japan[1]
		MFN	GPT	USA	Canada[1]	MFN	MFN
2607.00	Lead ores and concentrates	Free	Free	Free	.6¢/kg on Pb	Free	Free
78.01	Unwrought lead						
7801.10	Refined lead						
7801.10.10	Pig and block	Free	Free	Free	1.2% on Pb	3.5%	8 yen/kg
7801.10.90	Other	10.2%	Free	4.0%	1.2% on Pb	3.5%	8 yen/kg
7801.91	Containing by weight antimony as the principal other element						
7801.91.10	Lead-antimony-tin alloys	6.8%	Free	2.7%	1.2% on Pb	3.5%	6.5%
7801.91.90	Other	10.2%	Free	4.0%	1.2% on Pb	3.5%	6.5%
7801.99	Other						
7801.99.10	For refining, containing 0.02% or more by weight of silver (bullion lead)	10.2%	Free	4.0%	1.4% on Pb	Free	4.7%
7801.99.20	Lead alloys	10.2%	Free	4.0%	1.4% on Pb	3.5%	4.7%
7801.99.90	Other	10.2%	Free	4.0%	1.2% on Pb	3.5%	8 yen/kg
7802.00	Lead waste and scrap	Free	Free	Free	Free	Free	3.2%
7803.00	Lead bars, rods, profiles and wire						
7803.00.10	Bars and rods, not alloyed	4%	2.5%	1.6%	0.4%	8%	5.8%
7803.00.20	Bars and rods, of lead-antimony-tin alloys	6.8%	Free	2.7%	0.4%	8%	5.8%
7803.00.30	Bars and rods, of other alloys; profiles and wire	10.2%	Free	4.0%	0.4%	8%	5.8%
7804.20	Powders and flakes						
7804.20.10	Powders, not alloyed	4%	Free	1.6%	4.5%	2.2%	6.5%
7804.20.20	Alloyed powders; flakes	10.2%	Free	4.0%	4.5%	2.2%	6.5%

Sources: Customs Tariff, effective January 1994, Revenue Canada, Customs and Excise; Harmonized Tariff Schedule of the United States, 1994; The International Customs Journal, European Economic Community, 1992-93, No. 14, "Conventional" column; Customs Tariff Schedules of Japan, 1993.

[1] GATT rate is shown; lower tariff rates may apply circumstantially.

TABLE 1. CANADA, LEAD PRODUCTION AND TRADE, 1992 AND 1993, AND CONSUMPTION, 1991 AND 1992

Item No.		1992		1993p	
		(tonnes)	($000)	(tonnes)	($000)
SHIPMENTS					
	All forms[1]				
	Newfoundland	–	–	–	–
	Prince Edward Island	–	–	–	–
	Nova Scotia	834	612	–	–
	New Brunswick	78 137	57 352	73 076	37 488
	Quebec	–	–	–	–
	Ontario	–	–	–	–
	Manitoba	1 487	1 091	2 099	1 077
	Saskatchewan	–	–	–	–
	Alberta	–	–	–	–
	British Columbia	81 591	59 888	56 353	28 909
	Yukon	135 688	99 595	27 112	13 908
	Northwest Territories	39 141	28 729	28 914	14 833
	Total	336 878	247 268	187 554	96 215
	Mine output[2]	343 808	. .	183 730	. .
	Refined production				
	Primary	151 252	. .	162 000	. .
	Secondary	103 936	. .	70 000	. .
	Total	255 188	. .	232 000	. .
EXPORTS				(Jan.-Sept.)	
2607.00	Lead ores and concentrates				
	Germany	31 138	11 212	15 805	7 053
	Japan	41 301	18 265	15 220	3 504
	France	5 693	2 049	5 872	2 841
	Italy	41 385	17 220	8 252	2 484
	United States	5 842	5 479	708	2 480
	South Korea	29 802	11 314	5 794	1 325
	India	16 990	9 669	–	–
	Australia	8 834	3 481	–	–
	Other countries	2 290	1 141	520	254
	Total	183 275	79 830	52 170	19 941
2607.00.20	Lead content of lead ores and concentrates	180 362	55 545	52 144	13 909
2603.00	Copper ores and concentrates				
2603.00.20	Lead content	727	224	195	61
2608.00	Zinc ores and concentrates				
2608.00.20	Lead content	9 633	2 490	14 746	2 614
78.01	Unwrought lead				
7801.10	Refined lead				
	United States	93 272	64 947	72 976	40 171
	Singapore	4 297	2 155	4 459	2 256
	Switzerland	–	–	4 000	2 219
	Taiwan	1 547	976	1 477	848
	South Korea	8 794	6 823	1 713	844
	Thailand	3 577	2 262	1 528	820
	Italy	–	–	1 000	560
	Japan	2 632	1 655	735	358
	Germany	10 511	7 755	–	–
	Other countries	5 796	3 638	5 830	3 101
	Total	130 426	90 211	93 718	51 177
7801.91	Containing by weight antimony as the principal other element	8 579	6 047	7 955	5 143
7801.99	Other	33 468	24 391	20 529	14 650

TABLE 1 (cont'd)

Item No.		1992 (tonnes)	1992 ($000)	Jan.-Sept. 1993p (tonnes)	Jan.-Sept. 1993p ($000)
EXPORTS (cont'd)					
7802.00	Lead waste and scrap				
	United States	5 839	2 133	2 549	863
	Belgium	301	219	–	–
	People's Republic of China	234	97	–	–
	Japan	99	67	–	–
	Hong Kong	22	18	–	–
	South Korea	22	15	–	–
	Ireland	21	11	–	–
	Other countries	70	16	21	3
	Total	6 608	2 576	2 570	866
7803.00	Lead bars, rods, profiles and wire				
	United States	372	430	264	536
	Other countries	45	47	9	14
	Total	417	477	273	550
78.04	Lead plates, sheets, strip and foil; lead powders and flakes				
	Plates, sheets, strip and foil				
7804.11	Sheets, strip and foil of a thickness (excluding any backing) <0.2 mm	279	383	197	282
7804.19	Other	281	301	117	76
7804.20	Powders and flakes	4	31	4	27
7805.00	Lead tubes, pipes and tube or pipe fittings (i.e., couplings, elbows, sleeves)	14	27	39	159
7806.00	Other articles of lead				
	United States	. .	1 679	. .	1 878
	Other countries	. .	151	. .	161
	Total	. .	1 830	. .	2 039
IMPORTS					
2607.00	Lead ores and concentrates				
	United States	4 203	3 754	6 238	6 145
	Peru	1 180	1 587	3 952	4 099
	Australia	–	–	3 537	1 674
	Greece	3 477	2 103	–	–
	South Africa	3 901	1 469	–	–
	Honduras	162	389	–	–
	Total	12 923	9 304	13 726	11 918
2607.00.00.20	Lead content of lead ores and concentrates	12 655	6 736	10 610	5 407
2608.00	Zinc ores and concentrates				
2608.00.00.20	Lead content	8 276	8 189	2 911	1 818
78.01	Unwrought lead				
7801.10	Refined lead				
7801.10.10	Pig and block	7 486	5 863	5 456	3 399
7801.10.90	Other	. .	76	. .	132
7801.91	Containing by weight antimony as the principal other element	64	95	14	20
7801.99	Other	195	154	98	89
7802.00	Lead waste and scrap				
	United States	50 517	9 658	29 581	6 235
	Other countries	21	13	19	13
	Total	50 538	9 671	29 600	6 248

TABLE 1 (cont'd)

Item No.		1992 (tonnes)	1992 ($000)	Jan.-Sept. 1993p (tonnes)	Jan.-Sept. 1993p ($000)
IMPORTS (cont'd)					
7803.00	Lead bars, rods, profiles and wire				
	United States	129	202	166	188
	Other countries	26	38	37	54
	Total	155	240	203	242
78.04	Lead plates, sheets, strip and foil; lead powders and flakes				
	Plates, sheets, strip and foil				
7804.11	Sheets, strip and foil of a thickness (excluding any backing) <0.2 mm	128	218	170	330
7804.19	Other	376	465	264	366
7804.20	Powders and flakes	144	188	90	113
7805.00	Lead tubes, pipe and tube or pipe fittings (i.e., couplings, elbows, sleeves)	33	87	14	36
7806.00	Other articles of lead				
	United States	. .	2 459	. .	2 093
	Germany	. .	45	. .	35
	Japan	. .	52	. .	14
	United Kingdom	. .	59	. .	7
	Other countries	. .	13	. .	12
	Total	. .	2 628	. .	2 161

	1991[5] Primary	1991[5] Secondary[4]	1991[5] Total	1992 Primary	1992 Secondary[4]	1992 Total
	(tonnes)					
CONSUMPTION[3]						
Lead used for, or in the production of:						
Antimonial lead	x	x	28 170r	x	x	30 730
Batteries and battery oxides	20 871	7 267	28 138	23 599	12 993	36 593
Chemical uses; white lead, red lead, litharge, tetraethyl lead, etc.	x	x	9 618	x	x	13 175
Copper alloys; brass, bronze, etc.	128	17	145	146	2	148
Lead alloys:						
solders	491	584	1 075	1 012	170	1 182
others (including babbitt, type metals, etc.)	x	x	4 284	1 369	3 143	4 512
Semi-finished products:						
pipe, sheet, traps, bends, blocks for caulking, ammunition, etc.	1 754	1 096r	2 850r	797	790	1 587
Other lead products	4 553	723	5 276	2 099	1 694	3 793
Total, all categories	39 696	39 859r	79 555r	43 534	48 185	91 719

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available; p Preliminary; r Revised; x Confidential.
1 Production includes recoverable lead in ores and concentrates shipped, valued at the average Montréal price for the year. 2 Lead content of domestic ores and concentrates exported. 3 Available data, as reported by consumers. 4 Includes all remelt scrap lead used to make antimonial lead. 5 Increase in number of companies being surveyed.
Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, LEAD PRODUCTION, TRADE[1] AND CONSUMPTION, 1975, 1980, AND 1985-93

	Production				Exports[1]			Imports	Consumption[3]
		Refined							
	All Forms[2]	Primary	Secondary	Total	In Ores and Concentrates	Refined	Total	Refined	
	(tonnes)								
1975	349 133	171 516	. .	171 516	211 909	110 882	322 791	1 962[a]	89 192
1980	251 627	162 463	72 117	234 580	147 008	126 539	273 547	2 602[a]	106 836
1985	268 291	173 220	66 791	240 011	93 657	113 993	207 650	5 675[a]	104 447
1986	334 342	169 934	87 746	257 680	118 373	111 831	230 204	4 247[a]	94 680
1987	373 215	139 475	91 186	230 661	207 936	100 204	308 140	12 558[a]	97 281
1988	351 148	179 461	88 615	268 076	200 822	179 946	380 768	15 132	88 041
1989	268 887	157 330	85 515	242 845	170 568	121 444	292 012	11 708	87 715
1990	233 372	87 180	96 465	183 645	221 565	84 007	305 572	11 756	71 468
1991	248 102	106 420	105 946	212 366	175 150	86 631	261 781	7 495	79 555[r]
1992	336 878	151 252	103 936	255 188	190 722	131 407	322 129	8 289	91 719
1993[p]	187 554	162 000	70 000	232 000	67 085[b]	94 309[b]	161 394[b]	6 268[b]	. .

Sources: Natural Resources Canada; Statistics Canada.
. . Not available; [p] Preliminary; [r] Revised.
[a] Lead in pigs, blocks and shot. [b] January to September 1993.
[1] Beginning in 1988, Exports and Imports are based on the new Harmonized System and may not be in complete accordance with previous method of reporting. Ores and concentrates include HS classes 2603.00.20, 2607.00.20 and 2608.00.20. Refined exports include HS classes 7801.10, 7803.00, 7804.11, 7804.19 and 7804.20. Refined imports include HS classes 7801.10.10.00, 7801.10.90.00, 7803.00, 7804.11, 7804.19 and 7804.20. [2] Recoverable lead in ores and concentrates shipped. [3] Consumption of lead, primary and secondary in origin, as measured by a survey of consumers.

TABLE 3. CANADA, LEAD SMELTING CAPACITY, 1993

Company and Location	Annual Rated Capacity
	(000 t of refined lead)
Cominco Ltd.[2] Trail, British Columbia	135
Metalex Products Ltd.[1] Burnaby, British Columbia	6
Canada Metal Company[1] Winnipeg, Manitoba	10
Canada Metal Company[1] Toronto, Ontario	12
Tonolli Canada Ltd.[1] Mississauga, Ontario	50
Nova Lead Inc.[1] Ville Ste-Catherine, Quebec	60
Brunswick Mining and Smelting Corporation Limited[2] Belledune, New Brunswick	72
Total Canada	345

Source: Natural Resources Canada.
[1] Process lead-bearing scrap. [2] Process lead-bearing concentrate and scrap.

TABLE 4. AVERAGE ANNUAL LEAD PRICES, 1975-93

Year	London Metal Exchange			
	Settlement		Three Months	
	(£/t)	(US¢/lb)	(£/t)	(US¢/lb)
1975	185.63	18.755	186.78	18.821
1976	250.70	20.480	259.79	21.275
1977	354.11	28.022	359.12	28.433
1978	342.79	29.886	342.94	29.895
1979	567.66	54.574	542.66	52.161
1980	391.29	41.237	392.08	41.343
1981	363.37	33.327	370.93	34.025
1982	310.72	24.679	321.55	25.516
1083	279.97	19.290	290.62	19.983
1984	332.49	20.156	333.20	20.196
1985	304.01	17.876	304.03	17.877
1986	277.36	18.456	277.61	18.473
1987	363.66	27.098	346.40	25.736
1988	368.40	29.748	358.35	28.834
1989	412.39	30.669	406.41	29.908
1990	458.21	37.097	443.06	35.871
1991	315.23	25.303	325.84	25.805
1992	306.12	24.496	317.26	25.109
1993	274.40	18.128	274.87	18.728

Sources: London Metal Exchange; Metals Week.

TABLE 5. AVERAGE MONTHLY LEAD PRICES, 1992 AND 1993

	London Metal Exchange			
	Settlement		Three Months	
	(£/t)	(US¢/lb)	(£/t)	(US¢/lb)
1992				
January	284.39	23.34	295.47	23.91
February	283.79	22.89	295.18	23.45
March	302.14	23.60	312.86	24.44
April	303.09	24.15	315.24	24.72
May	287.28	23.58	299.63	24.21
June	295.19	24.84	306.54	25.41
July	326.08	28.36	337.09	28.89
August	336.48	29.66	345.56	29.90
September	336.06	28.15	345.67	28.77
October	324.82	24.35	336.78	25.29
November	301.28	20.85	313.16	21.71
December	306.12	24.50	317.26	25.11
1993				
January	284.84	19.80	294.86	20.48
February	287.60	18.78	297.31	19.41
March	277.67	18.41	287.15	19.04
April	272.31	19.08	281.53	19.74
May	263.07	18.47	272.39	19.14
June	261.19	17.87	271.02	18.56
July	259.54	17.61	268.23	18.22
August	260.37	17.62	268.98	18.19
September	246.46	17.04	255.11	17.65
October	255.70	17.43	264.63	18.03
November	270.30	18.16	279.54	18.77
December	309.60	20.92	317.92	21.51

Source: Metals Week.

TABLE 6. NON-SOCIALIST WORLD LEAD CONSUMPTION, 1989-92

	1989		1990		1991		1992	
	(000 t)	(%)	(000 t)	(%)	(000 t)	(%)	(000 t)	(%)
Batteries	2 492.4	61.5	2 543.3	63.2	2 569.1	64.0	2 591.6	64.8
Cable sheathing	196.0	4.8	182.1	4.5	164.0	4.1	149.5	3.7
Rolled and extruded products	320.6	7.9	310.6	7.7	285.0	7.1	278.7	7.0
Shot/ammunition	95.5	2.4	100.5	2.5	108.1	2.7	109.8	2.7
Alloys	139.6	3.5	132.7	3.3	122.5	3.0	127.3	3.2
Pigments and other compounds	556.9	13.8	517.0	12.8	535.9	13.4	531.5	13.3
Gasoline additives	98.2	2.4	86.9	2.2	74.0	1.8	58.3	1.5
Miscellaneous	151.3	3.7	153.2	3.8	158.1	3.9	152.9	3.8
Total	4 050.5	100.0	4 026.3	100.0	4 016.7	100.0	3 999.6	100.0

Source: International Lead and Zinc Study Group.
Note: Statistics are for Australia, Austria, Belgium, Brazil, Canada, Finland, France, Germany, India, Italy, Japan, the Republic of Korea, Mexico, the Netherlands, New Zealand, Scandinavia, South Africa, Southeast Asia, Spain and Switzerland, Thailand, the United Kingdom and the United States.

TABLE 7. REFINED LEAD CONSUMPTION BY COUNTRY, 1989-93

	1989	1990	1991	1992	1993P
			(000 t)		
AMERICAS					
Canada	94	83	78	91	73
United States	1 346	1 312	1 247	1 288	1 278
Mexico	146	119	133	164	137
Brazil	100	75	66	69	66
Other Americas	71	58	73	80	76
Total Americas	1 757	1 647	1 597	1 692	1 630
EUROPE					
United Kingdom	301	302	264	264	244
Germany	375	392	413	412	350
Italy	259	258	259	247	200
France	244	255	253	246	201
Spain	119	134	135	105	90
Other Europe	437	409	402	332	294
Total Europe	1 735	1 750	1 726	1 606	1 379
ASIA					
Japan	406	401	422	401	340
Korea, Republic of	155	149	164	164	138
Taiwan	65	70	83	109	100
India	80	75	75	60	64
Other Asia	200	201	230	251	255
Total Asia	906	911	974	985	897
OCEANIA					
Australia	61	53	56	59	62
New Zealand	9	6	6	4	4
Total Oceania	70	59	62	63	66
AFRICA					
South Africa	63	66	56	54	54
Egypt	8	13	16	10	13
Algeria	17	15	19	19	17
Other Africa	23	21	26	29	25
Total Africa	111	115	117	112	109
Total Western World	4 579	4 482	4 476	4 458	4 081
Other countries	1 020	930	743	657	. .
Total world	5 599	5 412	5 219	5 115	. .

Source: International Lead and Zinc Study Group.
. . Not available; P Preliminary (January-November).

TABLE 8. LEAD MINE PRODUCTION BY COUNTRY, 1989-93

	1989	1990	1991	1992	1993p
			(000 t)		
AMERICAS					
Canada	276	241	276	342	181
United States	420	497	477	403	363
Mexico	163	180	165	170	160
Peru	220	210	218	194	210
Other Americas	63	56	62	58	49
Total Americas	1 142	1 184	1 198	1 167	963
EUROPE					
Yugoslavia	86	83	85	40	30
Sweden	83	85	87	106	113
Spain	64	62	50	31	28
Ireland	32	35	40	43	45
Germany	9	8	7	2	0
Other Europe	74	68	55	52	38
Total Europe	348	341	324	274	254
ASIA					
Japan	19	19	18	19	16
Iran	10	11	15	14	14
Thailand	24	22	17	13	12
India	25	26	25	31	30
Other Asia	36	35	31	29	25
Total Asia	114	113	106	106	97
OCEANIA					
Australia	498	556	579	575	515
AFRICA					
South Africa	78	69	76	77	100
Morocco	63	65	70	72	78
Zambia	12	12	10	6	8
Other Africa	31	29	23	22	19
Total Africa	184	175	179	177	205
Total Western World	2 286	2 369	2 387	2 299	2 034
Other countries	824	743	737	690	. .
Total world	3 110	3 112	3 124	2 989	. .

Source: International Lead and Zinc Study Group.
. . Not available; p Preliminary.

TABLE 9. REFINED LEAD PRODUCTION BY COUNTRY, 1989-93

	1989	1990	1991	1992	1993p
			(000 t)		
AMERICAS					
Canada	243	184	212	255	222
United States	1 253	1 291	1 195	1 182	1 247
Mexico	249	238	236	289	240
Peru	75	70	75	83	85
Brazil	86	76	64	63	72
Other Americas	46	41	46	51	49
Total Americas	1 952	1 900	1 828	1 923	1 915
EUROPE					
United Kingdom	350	329	311	347	364
Germany	350	349	362	354	335
Belgium	93	92	99	99	108
Italy	181	171	208	186	188
France	268	260	283	284	259
Sweden	75	76	88	91	84
Spain	122	130	112	55	54
Yugoslavia	119	94	94	54	30
Other Europe	94	85	75	67	63
Total Europe	1 652	1 586	1 632	1 537	1 485
ASIA					
Japan	333	327	332	330	308
Republic of Korea	87	75	62	84	104
Taiwan	58	27	17	20	20
India	37	41	48	53	42
Other Asia	85	87	102	109	124
Total Asia	600	557	561	596	598
OCEANIA					
Australia	210	224	239	232	253
New Zealand	5	5	5	5	5
Total Oceania	215	229	244	237	258
AFRICA					
South Africa	37	31	32	29	32
Morocco	66	67	73	71	60
Namibia	44	35	33	32	31
Other Africa	15	18	17	17	18
Total Africa	162	151	155	149	141
Total Western World	4 581	4 423	4 420	4 442	4 397
Other countries	1 129	1 035	900	912	. .
Total world	5 710	5 458	5 320	5 354	. .

Source: International Lead and Zinc Study Group.
. . Not available; p Preliminary.

Lime

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"Lime" is a general term referring to burned or calcined limestone (burnt lime or quicklime) and its secondary products, including slaked lime and hydrated lime (or calcium hydroxide). In the calcining process, quicklime (CaO or CaO.MgO) begins to form when the dissociation temperature of the limestone occurs. (This occurs from 402°C for the $MgCO_3$ component to 898°C for the $CaCO_3$ portion.) Temperatures are maintained sufficiently long until there is a complete breakdown of the limestone and a release of the carbon dioxide content.

In 1993, shipments of all lime amounted to 2.4 Mt valued at $200.7 million, based on preliminary data. Quicklime accounted for 90% of the total volume, which remained essentially the same as in 1992; however, the total value of shipments increased nearly 5% in 1993. Production figures do not include some captive production from pulp and paper plants, which burn sludge to recover lime for re-use in the causticization process.

THE CANADIAN INDUSTRY

In 1993, the lime industry in Canada comprised 13 active companies operating 19 plants, of which 13 plants were in eastern Canada (Table 3). Total employment in the industry was approximately 770, about 12% less than in 1992. Calcining capacity to produce quicklime has not changed following expansions in the 1989-91 period in New Brunswick, Quebec, Ontario and western Canada. Effective capacity utilization was approximately 70% in 1993.

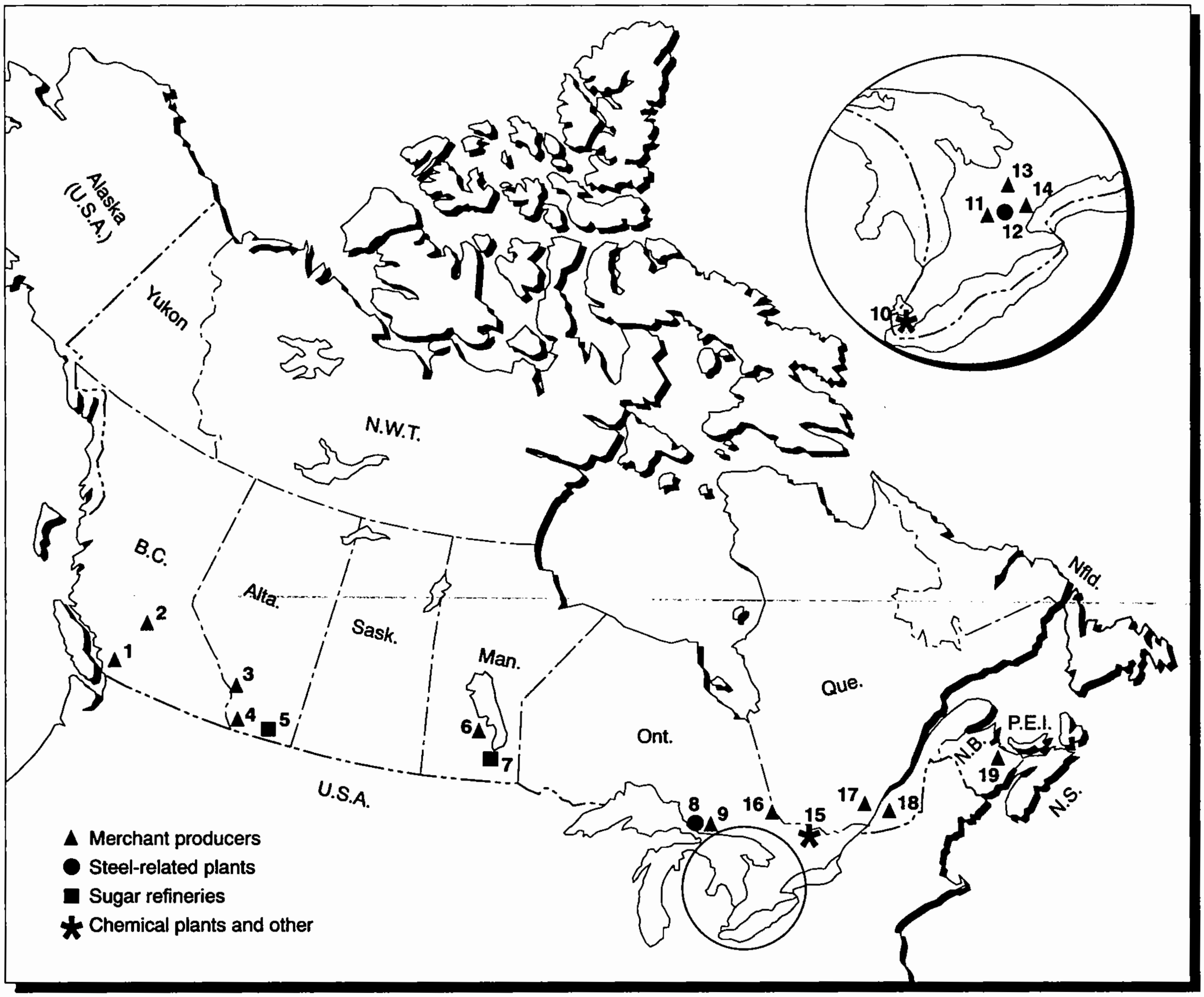
Lime is a high-bulk, comparatively low-cost commodity; however, it may be sold within a wide radius depending on transportation costs and supply and demand. Preferred locations are within close proximity to major lime markets and sources of high-quality limestones, with convenient access to low-priced energy.

High-calcium quicklime is commercially available in six forms: lump, crushed, pebble, ground, pulverized lime, and as briquettes or pellets. Slaked lime is produced from mixing quicklime and water, and may be purchased as a putty, dry powder or slurry. Hydrated lime is produced from slaked lime after drying and regrinding. The resulting hydrated lime products, which are categorized by their chemistry, include the following types: high-calcium lime, dolomitic lime, and magnesian or hydraulic lime. (The latter type contains siliceous, aluminous or ferrous compounds.) Aglime, or agricultural lime, refers to pulverized limestone used for soil neutralization, primarily during the fall and spring spreading seasons.

Several changes in ownership have occurred in the last two years. BeachviLime Limited of Ingersoll, Ontario, and owned by Dofasco Inc., was sold to Calcitherm Nederland BV of the Netherlands. The Chemical Lime Works, also of Ingersoll and owned by Stelco Inc., was sold to Global Stone Corp. of Vancouver, British Columbia. These divestitures by Canada's leading steel producers were apparently based on company strategies to place more emphasis on core business activities; however, both Dofasco and Stelco will continue to source their lime requirements from the respective plants. Calcitherm is a holding company for several major limestone- and lime-producing subsidiaries in Europe and the United States. Global Stone Corp. is a privately owned company that has a management group linked with the production of construction materials and lime in the United Kingdom. Redland plc acquired Steetley Quarry Products Inc. of Dundas, Ontario; this operation is now referred to as Redland Quarries Inc. – Dundas. At Spragge, Ontario, the operations of Reiss Lime Company of Canada were purchased by Koch Minerals of Canada Limited.

In British Columbia, Texada Lime (BP Resources Canada Limited, Mining Division) of Fort Langley, British Columbia, was sold in 1992 to Chemstar Lime Co., a member of the Chemical Lime Group (CLG), which is the largest lime producer in the United States. CLG, in turn, is controlled by business interests in the Netherlands and Belgium.

Figure 1
Lime Producers in Canada, 1993



Numbers refer to locations on map above.

Merchant Producers

1. Texada Lime, a division of Chemstar Lime Co., Fort Langley
2. Continental Lime Ltd., Pavilion Lake
3. Continental Lime Ltd., Exshaw
4. Summit Lime Works Limited, Hazell
6. Continental Lime Ltd., Faulkner
9. Koch Minerals of Canada Limited
11. Guelph DoLime Limited, Guelph
13. Redland Quarries Inc., Dundas
14. BeachviLime Limited, Ingersoll
16. Dymond Clay Products Limited, Haileybury
17. Graybec Calc Inc., Joliette
18. Graybec Calc Inc., Marbleton
19. Havelock Lime, a division of Dickenson Mines Limited, Havelock

Steel-Related Producers

8. The Algoma Steel Corporation, Limited, Sault Ste. Marie
12. Global Stone (Ingersoll) Ltd.

Sugar Refineries

5. The British Columbia Sugar Refining Company, Limited, Taber
7. The British Columbia Sugar Refining Company, Limited, Fort Garry

Chemical Plants and Other

10. General Chemical Canada Ltd., Amherstburg
15. Timminco Limited, Haley

CONSUMPTION

The consumption of lime produced in Canada consists of two basic categories: the captive market, which mainly includes lime produced internally by chemical plants, one steel producer and two sugar refineries; and the merchant market, which is served by the mainstream lime producers. In 1992, captive consumption, including relatively large quantities dedicated to specific established uses, was estimated to be 713 000 t, accounting for about 40% of total domestic sales. (Domestic sales are defined as output for captive use, plus all sales in the merchant market.)

Consumption of quicklime, based on sales in the merchant market, amounted to 1 711 279 t in 1992. The major end uses were steel-making (46%), environmental control (13%), pulp and paper (15%), chemicals (5.4%), and other industrial uses, including metal concentration (18%). Hydrated lime shipments in the merchant market amounted to 127 574 t in 1992, and were sold mainly for environmental control (51%), other industrial uses (18%), agricultural uses (7%), masonry (10%), metal concentration (5%), pulp and paper (1%), and other miscellaneous uses related mainly to road and soil stabilization and other construction (8%). Eastern Canada, comprising Ontario eastward, accounted for about three quarters of total merchant sales of quicklime in 1992.

Lime is used widely in the metallurgical, industrial (including environment), agricultural and construction sectors. In the metallurgical industry, consumption is mainly as a basic flux in steel furnaces allowing impurities, including silica, alumina, phosphorus and sulphur, to form a slag. Other fluxing agents may include limestone, dolomite and fluorspar. Limestone and dolomite (or dolostone) are used mainly in blast furnaces for making pig iron and in sinter plants at steel mills; limestone, lime and dolime are used in both basic oxygen and electric-arc steel furnaces. Electric-arc furnaces account for one third of steel production capacity in Canada, with basic oxygen furnaces accounting for the remainder.

Industrial markets mainly include the pulp and paper industry, the mining industry, chemicals manufacturing, and environmental control. The pulp and paper industry is one of the major consumers of lime, mainly for the preparation of digesting liquor for manufacturing kraft or sulphate paper, and for pulp bleaching during a primary stage of production. Most of the input lime is recovered by calcining dewatered calcium carbonate sludges; however, an important volume of lime is required as "make-up." The increasing use of precipitated calcium carbonate in coated and uncoated printing and writing papers in North America has led to major growth in the demand for lime.

In the mining sector, acidic effluents are treated with alkalis or related industrial products. These include lime, limestone, soda ash, and ammonium and magnesium hydroxide to raise pH levels (for neutralization) and to precipitate metals. In the uranium industry, lime controls hydrogen-ion concentration in the extraction process as well as in the recovery of sodium carbonate and for neutralization of waste sludges. Lime is also used for cyanidation and the neutralization in recovering gold and silver by flotation. Chemical manufacturers require lime to produce sodium carbonate (soda ash) and bicarbonate of soda, and also to produce chloralkali, calcium carbide, and calcium cyanimide.

Lime is increasingly needed for environmental control with the introduction of more stringent regulations. Major uses include the treatment of liquid wastes and industrial effluents; lime is also used in the clarification and softening of potable water. In addition, the neutralization of lakes has attracted much attention over the last two decades. In certain areas, these bodies of water have been acidified by precipitation of sulphur dioxide and nitrogen dioxide emissions. Effective interim actions include liming with limestone, calcite, quicklime, hydrated lime, dolomite, sodium bicarbonate, fly ash, and industrial slags. However, research conducted mainly in Ontario has shown that pure limestone (or calcite) was the most cost-effective method.

Air pollution control is a major developing market for lime and limestone in North America. Major coal-fired power stations are taking measures to reduce emissions from the burning of high-sulphur coal, oil and lignite. Several methods apply, including the use of Flue Gas Desulphurization (FGD) units, or scrubbers. There are several options for scrubbing, including the following: wet scrubbing with limestone or lime; dry scrubbing with lime; dry injection using sodium reagents (sodium bicarbonate and sodium sesquicarbonate), trona, or nahcolite; dry injection with limestone integrated with calcium oxide activation; and dry injection of hydrated lime. Wet scrubbing processes using limestone or lime now appear to be gaining importance. The choice of processes depends on many factors such as resource availability, solid waste disposal programs, equipment costs, maintenance and operational costs, flue gas characteristics, utility type and size, and the type of fuel consumed by the power station.

Agricultural uses apply mainly to neutralizing soil acidity. The current practice principally involves the use of pulverized limestone (or aglime). In the case of some sandy soils, dolomitic liming is carried out to help balance magnesium deficiencies.

Miscellaneous uses for lime relate to sugar refining (removal of acids from the crude sugar liquids), the control of storage conditions for fruit and vegetables, and petroleum refining (neutralization of sulphur compounds and sulphur dioxide emissions). Lime is also used in making plaster, mortar, leather and rubber, paint, glass, dolomitic refractories, and calcium-silicate bricks.

ENERGY AND TECHNOLOGY

Energy costs to produce quicklime account for nearly 40% of total production costs, one of the highest ratios in the manufacturing sector. Calcining takes place mainly in vertical (shaft-type) or rotary-type kilns, the latter technology being most common in North America. Preheater systems and computerized process control systems are now commonplace.

About 80% of the kilns in service use natural gas, 12% use coal, and less than 6% use electricity. Long rotary kiln systems consume an average of about 6.4 gigajoules per tonne (GJ/t) of calcined lime. New rotary kilns, with preheaters, consume less than 5.0 GJ/t, and short-shaft kilns consume about 4.2 GJ/t of calcined lime. Other types of kilns, of comparatively recent design, are the rotary hearth, travelling grate, fluo-solid, and the inclined vibratory kiln. Dust-collecting equipment to meet current environmental control regulations is required for all systems.

PRICES

Published prices for lime represent only a broad range. Actual prices vary according to marketing strategies and supply and demand. Average prices for high-calcium quicklime and high-calcium hydrated lime, f.o.b. plant, in Ontario, in bulk, were quoted at $70.80/t and $80.40/t, respectively.

INTERNATIONAL DEVELOPMENTS

In 1993, world lime production was an estimated 126.9 Mt, compared to 127.3 Mt in 1992, based on revised figures. The former Soviet Union, the largest producing area, accounted for 18%, followed by China (16%), the United States (13%), Germany (6%) and Japan (6%). Canada ranked thirteenth with a 2% share.

The United States produced 16.6 Mt of lime in 1993, compared to 16.2 Mt in 1992, according to preliminary figures. Apparent consumption in 1993 amounted to 16.7 Mt, compared to 16.3 Mt in 1992. During the period of economic expansion in the industry since 1986, higher consumption was mainly attributable to growing sales to the chemical and industrial sectors, accounting for about 90% of the market.

OUTLOOK

The production of lime in Canada in 1994 is expected to increase between 2% and 4% compared to the previous year. Sales to the steel industry will increase moderately as economic growth progresses; however, over the medium-to-long term, demand for lime as a flux in steel-making is forecast to decline because of several factors. These include: improved efficiencies in steel production and energy inputs, the use of larger amounts of scrap in basic oxygen furnaces, improved ore grades and more use of fluxed pellets, and growth of the mini-mills sector that makes steel from scrap iron in electric furnaces.

Demand for lime in the pulp and paper and chemical sectors is expected to improve in 1994 because of higher operating rates. Consumption in the environmental sector will expand in the short term with increased treatment of effluents in the industrial and mining sectors. Ontario Hydro is installing wet scrubbers using limestone at two of its coal-fired units at the Lambton Generating Station near Sarnia, Ontario. Similarly, limestone technology was installed for controlling sulphur dioxide emissions at major power installations in Nova Scotia and New Brunswick. In the United States, the extent of the choice between lime and limestone for wet scrubbing technology remains uncertain.

After some consolidation, restructuring and recent plant improvements, the lime industry has become more concentrated as fewer companies control more operations. These companies, or corporate groups (often diversified geographically and in product line), will be in a better position to meet future economic downturns. However, the current low rate of capacity utilization, along with ongoing plant modernization, will allow the lime industry to be well positioned in response to any major increases in demand.

Note: Information in this review was current as of Feburary 1, 1994.

TARIFFS

Item No.	Description	Canada MFN	Canada GPT	Canada USA	United States Canada
2522.10	Quicklime	Free	Free	Free	Free
2522.20	Slaked lime	Free	Free	Free	Free
2522.30	Hydraulic lime	Free	Free	Free	Free

Sources: Customs Tariff, effective January 1994, Revenue Canada, Customs and Excise; Harmonized Tariff Schedule of the United States, 1994.

TABLE 1. CANADA, LIME PRODUCTION AND TRADE, 1991-93

Item No.		1991		1992		1993p	
		(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
PRODUCTION[1]							
	By type						
	Quicklime	2 184 836	175 183	2 193 752	172 066	2 260 322	181 386
	Hydrated lime	190 424	18 358	190 592	19 246	186 304	19 277
	Total	2 375 260	193 541	2 384 344	191 313	2 446 626	200 663
	By province						
	New Brunswick	x	x	x	x	x	x
	Quebec	x	x	x	x	x	x
	Ontario	1 439 341	107 790	1 455 801	108 470	1 495 180	114 468
	Manitoba	x	9 382	x	x	x	x
	Alberta	217 946	20 407	191 399	18 463	206 977	20 362
	British Columbia	x	x	x	x	x	x
	Total	2 375 260	193 541	2 384 344	191 313	2 446 626	200 663
IMPORTS						(Jan.-Sept.)	
2522.10	Quicklime						
	United States	34 425	3 160	43 802	3 869	30 917	3 035
	Total	34 425	3 160	43 803	3 869	30 917	3 035
2522.20	Slaked lime						
	United States	1 913	343	2 727	491	3 753	677
	Belgium	17	7	64	28	34	15
	United Kingdom	–	–	6	2	–	–
	Total	1 930	351	2 797	522	3 787	692
2522.30	Hydraulic lime						
	United States	7 902	1 153	7 606	1 284	4 377	790
	Germany	755	390	1 500	334	–	–
	Total	8 657	1 543	9 106	1 618	4 377	790
EXPORTS							
2522.10	Quicklime						
	United States	94 445	8 512	135 734	12 348	114 467	10 293
	Bermuda	16	2	–	–	–	–
	Total	94 461	8 515	135 734	12 348	114 467	10 293
2522.20	Slaked lime						
	United States	20 408	2 117	18 858	2 161	17 328	1 963
	Bermuda	–	–	–	–	16	2
	Total	24 408	2 117	18 858	2 161	17 344	1 966
2522.30	Hydraulic lime						
	United States	19 520	1 781	18 659	1 747	16 878	1 566
	Bermuda	16	2	32	4	–	–
	Other countries	–	–	1	. . .	–	–
	Total	19 536	1 784	18 691	1 752	16 878	1 566

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . . Amount too small to be expressed; p Preliminary; x Confidential.
[1] Producers' shipments and quantities used by producers.
Notes: Numbers may not add to totals due to rounding. HS code 2522.30, as interpreted, applies mainly to hydrated lime.

TABLE 2. CANADA, LIME PRODUCTION, TRADE AND APPARENT CONSUMPTION, 1970, 1975, 1980, AND 1985-93

	Production[1]					Apparent
	Quick	Hydrated	Total	Imports	Exports	Consumption[2]
			(tonnes)			
1970	1 296 590	224 026	1 520 616	30 649	181 994	1 369 271
1975	1 533 944	199 195	1 733 139	30 099	234 034	1 529 204
1980	2 364 000	190 000	2 554 000	40 901	403 166	2 191 735
1985	2 054 294	157 286	2 211 580	23 056	194 097	2 040 539
1986	2 069 043	173 534	2 242 577	46 917	189 512	2 099 982
1987	2 140 793	189 278	2 330 071	44 290	163 767	2 210 594
1988[a]	2 306 831	211 151	2 517 982	32 543	122 900	2 427 625
1989	2 349 312	202 622	2 551 934	39 095	83 608	2 507 421
1990	2 137 996	202 741	2 340 737	43 715	138 409	2 246 043
1991	2 184 836	190 424	2 375 260	45 012	138 405	2 281 867
1992	2 193 752	190 592	2 384 344	55 706	173 283	2 265 759
1993p	2 260 322	186 304	2 446 626	52 690	190 068	2 309 248

Sources: Natural Resources Canada; Statistics Canada.
p Preliminary.
a Beginning in 1988, Exports and Imports are based on the new Harmonized System and may not be in complete accordance with previous method of reporting. Imports and Exports include HS classes 2522.10, 2522.20 and 2522.30.
1 Producers' shipments and quantities used by producers. 2 Production plus imports, less exports.

TABLE 3. CANADIAN LIME INDUSTRY, 1993

Company	Plant Location	Calcining Capacity	Market	Type of Quicklime and Other Products
		(000 t/y)		
NEW BRUNSWICK				
Havelock Lime, a division of Dickenson Mines Limited	Havelock	175	Merchant	High calcium[1]
QUEBEC				
Graybec Calc Inc.	Marbleton	300	Merchant	High calcium[1]
Graybec Calc Inc.	Joliette	282	Merchant/captive	High calcium[1]
ONTARIO				
Algoma Steel Inc.	Sault Ste. Marie	200	Captive	High calcium and dolomitic
BeachviLime Limited	Ingersoll	600	Merchant	High calcium[1]
Dymond Clay Products Limited	Haileybury	40	Merchant	High calcium
General Chemical Canada Ltd.	Amherstburg	292	Captive	High calcium
Guelph DoLime Limited	Guelph	122	Merchant	Dolomitic[1]
Koch Minerals of Canada Limited	Spragge	200	Merchant	High calcium
Redland Quarries Inc.	Dundas	345	Merchant	Dolomitic
Global Stone (Ingersoll) Ltd.	Ingersoll	215	Merchant/captive	High calcium
Timminco Limited	Haley	53	Captive	Dolomitic
MANITOBA				
The British Columbia Sugar Refining Company, Limited	Fort Garry	16	Captive	High calcium
Continental Lime Ltd.	Faulkner	117	Merchant	High calcium
ALBERTA				
The British Columbia Sugar Refining Company, Limited	Taber	66	Captive	High calcium
Continental Lime Ltd.	Exshaw	130	Merchant	High calcium[1]
Summit Lime Works Limited	Hazell	50	Merchant	High calcium and dolomitic[1]
BRITISH COLUMBIA				
Continental Lime Ltd.	Pavilion Lake	235	Merchant	High calcium
Texada Lime, division of Chemstar Lime Co.	Fort Langley	135	Merchant	High calcium[1]

Source: Natural Resources Canada.
1 Production of hydrated lime.

TABLE 4. CANADA, CONSUMPTION[1] OF DOMESTIC LIME, QUICK AND HYDRATED, 1990-92

End Uses	1990	1991	1992
		(tonnes)	
CHEMICAL AND INDUSTRIAL			
Steel-making	438 000	780 978	794 700
Water and sewage treatment	412 710	292 346	201 685
Water purification	42 329	71 212	71 589
Gas scrubbing	13 922	17 088	20 608
Metal concentration	59 248	70 856	163 777
Pulp and paper mills	234 917	220 735	264 223
Chemicals	119 587	116 939	92 609
Other industrial uses	88 531	90 401	175 410
CONSTRUCTION			
Road and soil stabilization	14 329	12 723	14 676
Mason and finishing lime	7 095	5 971	12 176
Other	21 230	11 079	17 784
AGRICULTURE	10 519	9 584	9 616
Total	1 462 417	1 699 912	1 838 853

Sources: Natural Resources Canada; producing companies' surveys, 1990-92.
[1] Includes merchant market; excludes companies that are completely captive producer/consumers.

TABLE 5. WORLD PRODUCTION OF QUICKLIME AND HYDRATED LIME, INCLUDING DEAD-BURNED DOLOMITE SOLD AND USED, 1988-93

	1988	1989	1990	1991	1992	1993p
			(000 tonnes)			
Former Soviet Union	30 110	30 020	27 996	26 036	23 043	22 700
China	12 970	15 960	16 964	18 507	19 051	20 000
United States	15 490	15 580	15 832	15 667	16 200	16 600
Japan[1]	7 725	7 890	8 528	8 954	8 528	8 000
Germany	10 680	10 745	10 197	9 317	7 711	7 700
Brazil	5 495	5 495	5 697	5 498	5 534	5 500
Poland	4 100	4 100	4 400	3 103	3 000	3 000
Mexico	6 000	5 995	5 996	6 505	6 505	6 500
Romania	3 535	3 265	3 202	3 003	2 540	2 500
France	3 090	3 080	2 994	2 994	2 994	3 000
United Kingdom	2 810	2 810	2 604	2 604	2 540	2 500
Italy	3 900	3 900	3 846	3 602	3 602	3 500
Canada	2 520	2 550	2 341	2 375	2 384	2 400
Belgium	1 890	1 905	1 796	2 005	1 099	1 100
South Africa	1 915	1 940	1 831	1 765	1 724	1 700
Other countries	20 485	20 175	27 799	20 634	20 865	20 200
Total	132 705	135 310	142 023	132 569	127 320	126 900

Sources: Natural Resources Canada; Statistics Canada; U.S. Bureau of Mines' Mineral Commodity Summaries, 1994.
p Preliminary.
[1] Quicklime only.

Magnesium

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According to the International Magnesium Association (IMA), Western World primary magnesium production reached 167 600 t by the end of the third quarter, compared to 168 400 t in 1992. Primary magnesium stocks continued to rise throughout the year and were expected to reach about 49 000 t by the end of 1993.

Primary magnesium exports to the West from the former Soviet Union (FSU) and the People's Republic of China are expected to have reached about 20% of the total Western World market share in 1993. Prior to the political break-up of the FSU in 1990, all primary magnesium production was consumed internally. Most of the magnesium imports from the FSU targeted the aluminum alloying, nodular iron, and desulphurization markets.

CANADIAN DEVELOPMENTS

The Canadian magnesium industry faced another difficult year in 1993. The Western World recession and trade action by the United States continued to affect total Canadian refinery magnesium production. In 1992, Canadian magnesium consumption increased by 1962 t to 17 707 t, mainly in response to increased consumption for castings and wrought products, which increased to 6500 t from 4600 t in 1991. Demand for magnesium used in aluminum alloys declined slightly to 9200 t.

Magnesium Corporation of America (Magcorp) filed an anti-dumping and countervailing petition in 1991 requesting the imposition of anti-dumping and countervailing duties on the imports of pure and alloy magnesium from Canada. In 1992, following investigations by the U.S. Department of Commerce, a 7.6% countervailing duty was imposed against pure and alloy magnesium produced by Norsk Hydro Canada Inc. Timminco Limited, the only other Canadian producer, was not subject to duties. In addition to the countervailing duties, the United States issued a 32.7% anti-dumping duty against pure magnesium from Norsk Hydro Canada. The dumping margin for Timminco was zero. Finally, the U.S. International Trade Commission confirmed the application of the countervailing and anti-dumping duties on magnesium exports to the United States.

The Government of Quebec and Norsk Hydro Canada filed requests for a panel review under the dispute settlement provisions of Chapter 19 of the Canada-U.S. Free Trade Agreement with respect to both the dumping and subsidy determinations. Three separate panels were established in 1993 to examine the cases for dumping, subsidy and material injury.

In October, the first panel's review on dumping maintained the anti-dumping duty on pure magnesium exports to the United States, but at a lower rate. The panel affirmed a determination of a 21% anti-dumping duty on pure magnesium from Norsk Hydro Canada and found that the Department of Commerce had correctly determined the company's cost.

In December, the second panel accepted the decision to impose a 7.6% countervailing duty against both pure and alloy magnesium exported to the United States. The Department of Commerce ruled that Norsk Hydro Canada received unfair subsidies from the Quebec government when the plant was built.

The third panel, set up to determine whether or not exports by Norsk Hydro Canada had caused material injury to U.S. producers, rendered its decision at the end of January 1994 and upheld the other two panels' decisions. The duties will remain at 7.6% countervail on pure and alloy magnesium and 21% anti-dumping on pure magnesium. An annual administrative review of the dumping duties is expected in 1994.

Norsk Hydro's magnesium plant at Bécancour, Quebec, started production in December 1989 and continued to produce at roughly 50% of the plant's that the three countries' combined European Community market share rose from 5% to 17%. The Commission can impose duties on imports if it deems them to be unfairly undercutting European industry prices.

Australia

In Australia, Queensland Metal Corp., MIM Holdings Ltd., Ube Industries Ltd., and the Commonwealth Scientific Industrial and Research Organization continued work on the joint-venture project to invest A$50 million to develop a magnesium production process. The three private companies will fund half the cost of the Magmetal project while the Australian government will provide A$20 million and the Queensland government A$5 million. The partners plan to build a 60 000-t/y magnesium metal plant next to Queensland Metal Corp.'s magnesite deposit in Kunwarara. Initially, the company expects to commission a 1000-t/y pilot plant by 1994 or 1995. The five-year program includes 18 months of laboratory work followed by testing at a plant to be built in Gladstone, 150 km south of Kunwarara. The joint-venture partners plan to start production in 1997 to meet the expected increase in Japanese magnesium demand.

Japan

Kawasaki Steel Corp. announced that it had begun tests involving magnesium for use in a desulphurization process. If implemented, Kawasaki would be the first Japanese steel manufacturer to use magnesium for desulphurization.

Ube Industries Ltd. reportedly signed a long-term agreement for the supply of dolomite feedstock from China. Previously, Ube was supplied with an estimated 90 000 t/y of dolomite under contract from suppliers in Korea and Taiwan. In December, Ube announced that it would cut production to between 6300 t/y and 7200 t/y from 8000 t/y.

Japan Metals and Chemicals Company Limited liquidated Nichiju M.A., its 5000-t/y magnesium-producing subsidiary. The company's only plant was closed in mid-1992 as a result of furnace problems and the fall in market prices with the introduction of magnesium from China and the FSU.

Middle East

In February, Israel Chemicals Ltd. approved a US$360 million investment by its Dead Sea Works subsidiary for its planned magnesium metal plant and co-generation power station. In June, Israel's Dead Sea Works announced that it had signed a US$9 million contract to purchase Russian electrolytic cell technology. Engineering firms reportedly began work for the planned 25 000-t/y magnesium plant located at Beer-Sheva. Construction of the new plant is scheduled to be completed in 1995.

The Gulf Organization for Industrial Consultancy, which includes Saudi Arabia, Bahrain, Kuwait, Oman, Qatar, and the United Arab Emirates, completed a study in April on a proposed 10 000-t/y magnesium plant for the region. Saudi Arabia was targeted as the preferred site; however, Oman and Qatar were also identified as possible sites. The report estimates that demand for magnesium in the Gulf States could rise from the current 3000 t/y to more than 10 000 t/y by the end of the decade.

Russia

The Solikamsk Magnesium Works in the Urals district of central Russia produced about 30 000 t in 1993, slightly less than in 1992. Solikamsk has reportedly started work on a reconstruction project that is scheduled for completion in 1998.

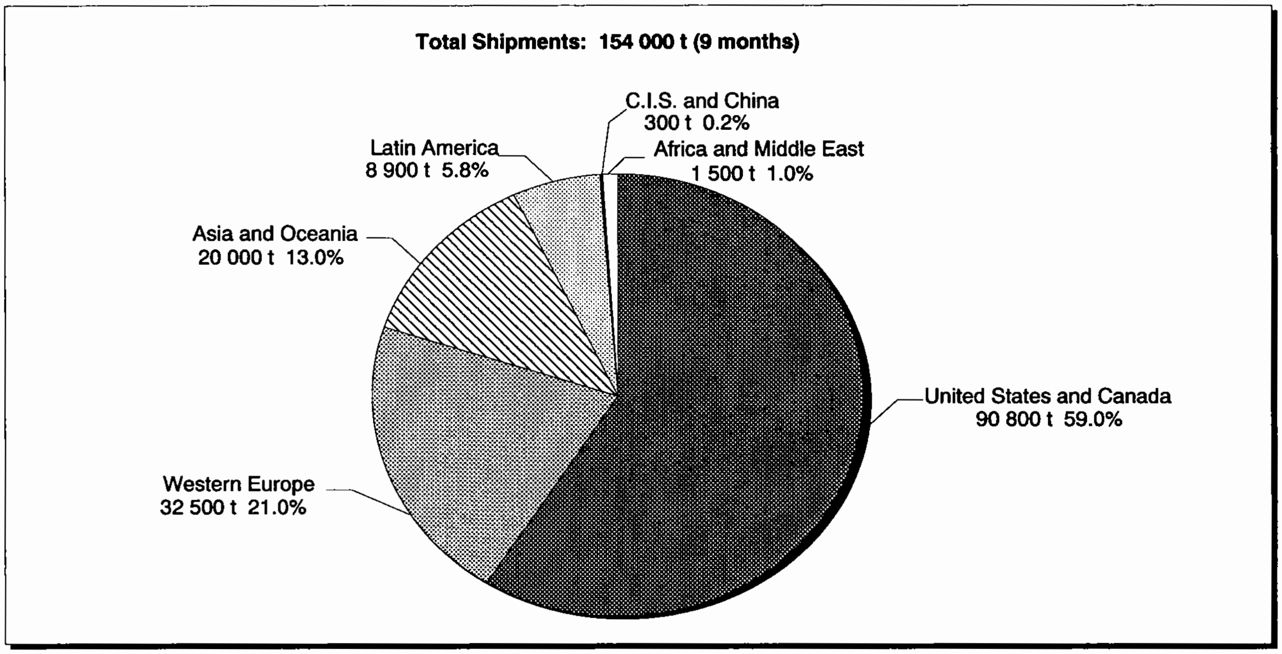
USES AND MARKETS

The main application of magnesium is as an alloying agent for aluminum, accounting for close to 57% of non-socialist consumption in 1992. According to the IMA, Western World magnesium shipments for this application reached 82 200 t in the first nine months of 1993. Magnesium consumption for this application is forecast to increase by 3%/y, despite increased recycling of cans and a reduction in their thickness.

The second largest use of magnesium is in structural applications, of which pressure die-cast products is the most important use. The IMA reported that shipments of magnesium in the first nine months of 1993 for die-cast applications totalled 27 800 t. Total consumption of magnesium for this application is expected to exceed 55 000 t/y within the next five years. During the next decade, pressure die-casting is expected to be the fastest growing sector, particularly in the United States and Japan.

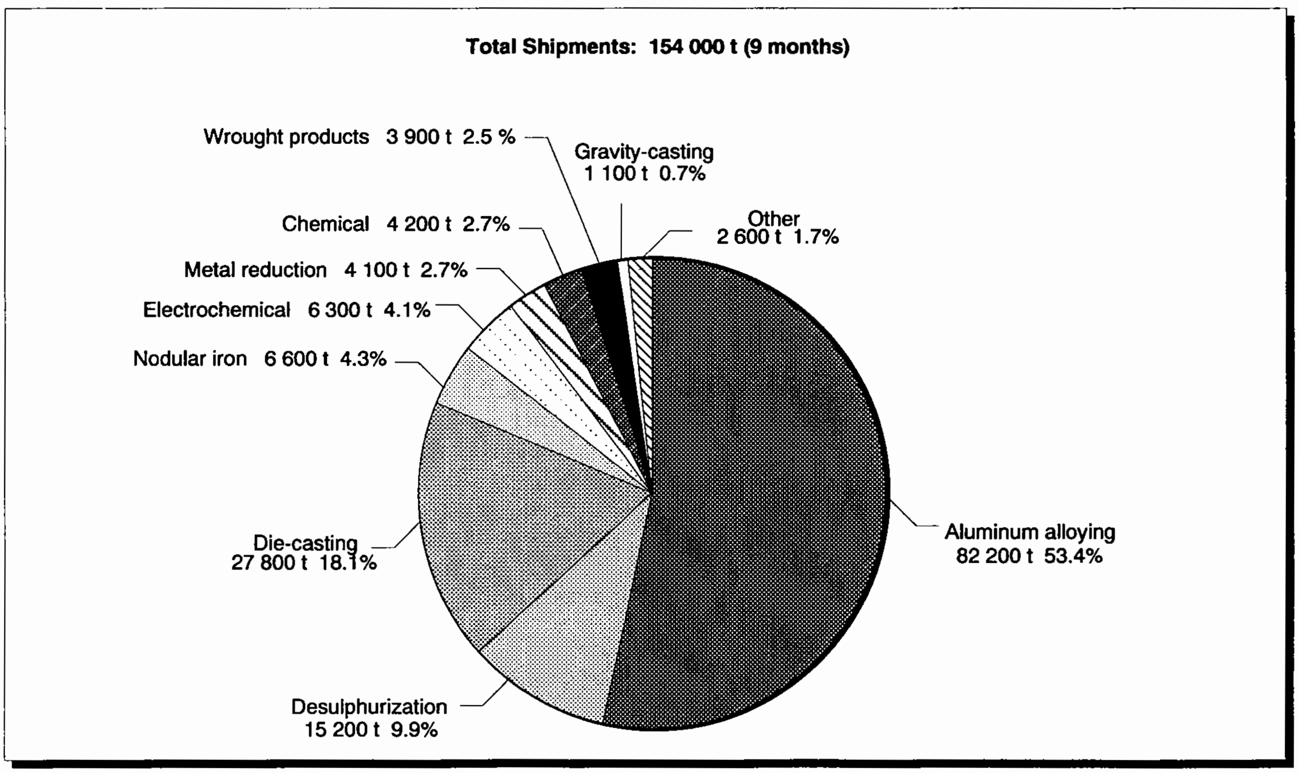
The increased interest in magnesium metal in the automotive market is largely due to weight savings of about 33% compared to the weight of aluminum. Magnesium also has good vibration-dampening characteristics. Its lower heat of solidification,

Figure 2
Percentage of Magnesium Metal Shipments by World Zone, First Nine Months of 1993



Source: International Magnesium Association.

Figure 3
Percentage of Magnesium Shipments by Use, First Nine Months of 1993



Source: International Magnesium Association.

which increases die-casting production capacity by 25%, results in major process energy savings. In addition, magnesium dies are reported to have twice the life of aluminum dies. Parts requiring several castings when made from aluminum can be produced with a single casting when produced from magnesium. Furthermore, die-casters note that even at a magnesium-aluminum price ratio of 1.7:1.0, some magnesium metal parts can be fabricated at the same cost as those made from aluminum.

The enforcement of stricter fuel efficiency and emissions standards is encouraging many auto manufacturers to reduce their vehicles' weight. Increased consumer demand for cars with added luxury items is also driving manufacturers to find ways to reduce automobile curb-weight. Many automobile manufacturers in both the United States and Japan are looking to magnesium to help reduce total vehicle weight without sacrificing the consumer demand for larger vehicles.

In an attempt to reduce air pollution, the Japanese government introduced nitrous oxide regulations requiring the average automobile weight to decrease by 35% over the next 10 years. The principal aim of the Japanese legislation, as with the U.S. Corporate Average Fuel Economy (CAFE) requirement, is to reduce both fuel consumption and automobile emissions of carbon dioxide, sulphur dioxide and nitrous oxide. The Japanese Automotive Manufacturers Association expects magnesium use per Japanese car to grow from 1 kg in 1989 to 5 kg in 1995 and to 40 kg by the year 2000. In anticipation of this market growth, Norsk Hydro has established a market development centre in Japan. Norsk Hydro and Dow currently operate such centres in the United States and Europe.

Several automobile manufacturers have announced plans to increase magnesium use beyond the average of 2-3 kg per American car in 1991. Chrysler Corp.'s Dodge Viper high-performance sports car, introduced in 1992, incorporates about 5 kg of magnesium components in its engine as well as magnesium castings in valve covers and accessory brackets. General Motors' North-Star V-8 Cadillac engine contains about 7 kg of magnesium. The GM Cadillac model will use magnesium in the induction system, valve covers, and oil filter adapters.

New applications in European luxury cars should also translate into further applications for magnesium. Mercedez Benz started to use an 8.5-kg magnesium one-piece seat frame on some of its models. Audi uses a 4.2-kg magnesium component in the dashboard bulkhead on its V-8 sedan. The company anticipates using this part on other models. Volvo is currently evaluating magnesium and aluminum doors for one of its models. Magnesium and aluminum doors can provide a weight reduction of around 13 kg. Such an application could also be used for electric cars in which weight limitations are very important.

Aside from automotive applications, die-cast magnesium products are widely used in the manufacture of portable tools and sporting goods. The use of magnesium in electronics equipment, particularly computer housings and components, has grown substantially. This trend is expected to continue. Magnesium's advantages for these applications are good strength-to-weight ratio, good heat dissipation, electro-magnetic field containment, and radio frequency interference dissipation.

The third largest use of magnesium is as a deoxidizing and desulphurizing agent in the ferrous industry. Magnesium shipments in the first nine months for desulphurization, as reported by the IMA, totalled 15 200 t. This sector, which has grown at an average rate of 15%/y in the late 1980s, should see a more moderate growth rate because of a major rationalization taking place in the steel industry. An increase in steel scrap recovery is also expected to create more markets for magnesium in this application.

Nodular iron production is used primarily for ductile iron pipes and die-cast parts for use in automobiles and farm equipment. Shipments in the first nine months of 1993 totalled 6600 t. This application is not expected to grow as plastics increasingly penetrate the water pipe market. Magnesium is also used as a reducing agent in the production of titanium, beryllium, zirconium, hafnium and uranium. Electrochemical applications account for about 4% of magnesium consumption for use in the manufacture of batteries and anodes for cathodic protection of gas pipelines and water heaters. As with nodular iron, plastics in the gas pipeline market continue to penetrate this market. Chemical applications include the manufacture of pharmaceutical products, perfumes and pyrotechnics. Wrought products mainly include extruded products except anodes, sheets and plates; gravity casting includes the production of complex or large parts by sand casting or with other materials.

RECYCLING

Anticipated growth of magnesium die-cast parts in the automotive sector should provide greater opportunities for magnesium recycling. Norsk Hydro Canada Inc. and the Dow Chemical Company will both collect magnesium scrap from their clients. This trend should continue as magnesium metal further penetrates the automobile market.

The International Magnesium Association unveiled a new magnesium recycling logo in 1992. The logo comprises the chemical symbol for magnesium (Mg) surrounded by a hexagonal-shaped mobius loop. It was designed to educate end users about a magnesium component's metal content and recyclability. Like aluminum, recycled magnesium only requires about 5% of the energy required to manufacture primary magnesium. Currently, the magnesium present in aluminum alloys, primarily beverage cans, accounts for approximately 75% of the magnesium recycled throughout the world. Recycling of magnesium is expected to increase with the expected growth in the use of magnesium die-cast automobile parts.

PRICES

According to the IMA, total magnesium stocks decreased from 55 100 t in December 1991 to 25 700 t in September 1992, and have subsequently risen through 1993 to 45 000 t by the end of the third quarter.

The increased availability of magnesium from the FSU and China, including oxidized metal offered at a discount, and the general weakness in the European and Japanese economies, have been cited as the main reasons for lower prices at the end of 1993.

In October, Norsk Hydro A/S announced it was cutting its European pure magnesium producer price to DM4.80/kg from DM5.30/kg (US$2.90/kg from $3.20/kg). The company cited continued price undercutting by FSU producers, which has resulted in a loss of market share and increasing inventories with the Western producers, as the main reason for the reduction.

In the United States, import prices were reportedly lower and declined throughout the year. Several aluminum customers reportedly entered into longer-term agreements for imported magnesium. Import prices traded between US$1.10 and US$1.20/lb throughout the year. U.S. prices were listed as relatively unchanged from 1992 in the $1.45/lb range.

OUTLOOK

The economic recovery in 1994, led by the United States, should result in increased magnesium consumption, particularly in the aluminum alloying and die-casting end uses.

Within five years, Western World magnesium consumption is expected to increase to more than 350 000 t/y, primarily because of the substantial increase expected in the die-casting of automobile parts. Magnesium die-casting consumption could exceed 55 000 t/y by 1997.

Increased production capacity, the slow economic recovery, and the increased availability of Russian and Chinese magnesium are expected to keep prices low. These relatively low prices (below US$1.20/lb) will continue to put pressure on older, high-cost producers to curtail production or to close. Prices in the longer term are expected to remain in the US$1.20-1.40/lb range as new, more efficient capacity comes on stream.

If growth in consumption is to be sustained, magnesium must remain competitively priced while facing stiff competition from aluminum and plastics in the automobile parts sector. A long-term magnesium-aluminum price ratio of 1.5:1.0 could lead to important breakthroughs for new applications.

Canada's comparative advantages in this industry include competitively priced energy and raw materials, a skilled work force, and proximity to major world markets.

Note: Information in this review was current as of February 1, 1994.

TARIFFS

Item No.	Description	Canada MFN	Canada GPT	Canada USA	United States Canada	EEC MFN	Japan[1] MFN
8104.11	Magnesium unwrought, containing by weight at least 99.8% of magnesium	4%	2.5%	1.6%	3.2%	5.3%	6.5%
8104.19	Magnesium unwrought, n.e.s.	4%	Free	1.6%	2.6%	5.3%	6.5%
8104.20	Magnesium waste and scrap	Free	Free	Free	Free	Free	3.2%
8104.30	Magnesium raspings, turnings and granules, graded according to size; powders						
8104.30.10.00	Raspings, turnings and granules; powders, alloyed	10.2%	6.5%	4%	2.6%	5.3%	7.2%
8104.30.20.00	Powders, not alloyed	4%	2.5%	1.6%	2.6%	5.3%	7.2%
8104.90	Other magnesium						
8104.90.10	Bars, rods, plates, sheets, strip, foil, tubes and pipes, alloyed	4%	Free	1.6%	a	5.3%	7.2%
8104.90.90	Other	10.2%	6.5%	4%	a	5.3%	7.2%

Sources: Customs Tariff, effective January 1994, Revenue Canada, Customs and Excise; Harmonized Tariff Schedule of the United States 1994; The International Customs Journal, European Economic Community, 1992-93, No. 14, "Conventional" column; Customs Tariff Schedules of Japan, 1993.
n.e.s. Not elsewhere specified.
[a] 5.9¢/kg on magnesium content plus 1.4%.
[1] GATT rate is shown; lower tariff rates may apply circumstantially.

TABLE 1. CANADA, MAGNESIUM EXPORTS AND IMPORTS BY COMMODITIES AND COUNTRIES, 1992 AND 1993

Item No.		1992		Jan.-Sept. 1993p	
		(tonnes)	($000)	(tonnes)	($000)
EXPORTS					
8104.11	Magnesium unwrought, containing by weight at least 99.8% of magnesium				
	United States	921	3 291	1 725	6 805
	Japan	1 349	4 033	1 558	5 546
	Netherlands	1 357	3 415	297	3 876
	Australia	185	844	548	1 485
	Norway	714	2 142	538	1 353
	United Kingdom	752	3 434	261	1 327
	Switzerland	463	1 583	282	1 151
	Other countries	1 701	4 713	517	1 510
	Total	7 442	23 455	5 726	23 053
8104.19	Magnesium unwrought, n.e.s.				
	United States	2 955	10 791	4 359	17 371
	Australia	223	1 281	204	1 128
	Netherlands	24	134	161	985
	Venezuela	46	119	114	558
	South Africa	–	–	76	485
	Mexico	20	106	58	343
	Other countries	183	949	116	494
	Total	3 451	13 380	5 088	21 364
8104.20	Magnesium waste and scrap				
	United States	1 049	902	359	661
	Venezuela	18	43	–	–
	Total	1 067	946	359	661
8104.30	Magnesium raspings, turnings or granules, graded according to size and powders				
	United States	571	3 182	265	1 423
	Ireland	180	1 108	105	649
	Germany	–	–	17	69
	Netherlands	1	4	11	44
	Other countries	70	256	–	–
	Total	822	4 550	398	2 186
8104.90	Magnesium and articles thereof, n.e.s.				
	United States	364	1 101	82	410
	Netherlands	12	19	16	129
	Australia	52	298	21	112
	Japan	40	186	1	18
	Other countries	105	342	3	16
	Total	573	1 946	123	685
	Total exports	13 355	44 277	11 694	47 949
IMPORTS					
8104.11	Magnesium unwrought, containing by weight at least 99.8% of magnesium				
	United States	4 028	11 418	4 007	13 766
	Russia	. .	. .	73	259
	France	–	–	40	160
	People's Republic of China	–	–	16	55
	Other countries	727	2 269	. . .	. . .
	Total	4 755	13 687	4 136	14 243
8104.19	Magnesium unwrought, n.e.s.				
	United States	920	2 716	748	2 809
	Norway	20	69	692	2 575
	United Kingdom	32	405	24	266
	France	–	–	20	72
	Total	972	3 191	1 485	5 724
8104.20	Magnesium waste and scrap				
	United States	2 108	5 565	1 554	4 339
	France	–	–	191	572
	Germany	51	107	79	180
	Total	2 159	5 672	1 824	5 093
8104.30	Magnesium raspings, turnings or granules, graded according to size and powders				
	United States	142	495	47	191
	Other countries	33	95	5	15
	Total	175	590	52	207
8104.90	Magnesium and articles thereof, n.e.s.				
	United States	829	4 531	608	3 250
	United Kingdom	3	102	–	–
	Total	832	4 633	608	3 250
	Total imports	8 893	27 773	8 105	28 517

Source: Statistics Canada.
– Nil; . . Not available; . . . Amount too small to be expressed; n.e.s. Not elsewhere specified; p Preliminary.
Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, CONSUMPTION[1] OF MAGNESIUM, 1986-92

	1986[a]	1987	1988[a]	1989[a]	1990	1991[a]	1992[p]
				(tonnes)			
Castings and wrought products[2]	2 628	3 837	5 067	5 661	5 849	4 604	6 499
Aluminum alloys	4 907	4 508	7 810	7 761	7 672	9 215	9 203
Other uses[3]	1 191	1 124	1 189	1 985	1 604	1 926[r]	2 005
Total	8 726	9 469	14 066	15 407	15 125	15 745[r]	17 707

Source: Natural Resources Canada.
[p] Preliminary; [r] Revised.
[a] Increase in number of companies being surveyed.
[1] Available data as reported by consumers. [2] Die, permanent mould and sand castings, structural shapes, tubings, forgings, sheet and plate. [3] Cathodic protection, reducing agents, deoxidizers and other alloys.

TABLE 3. WORLD PRIMARY MAGNESIUM PRODUCTION, 1988-92

	1988	1989	1990	1991	1992
			(tonnes)		
Brazil	5 865	6 200	6 500	7 800	7 300
Canada	7 600	7 200	26 726	34 512	26 500
China	3 200	3 600	5 800	6 000	6 500
France	13 776	14 600	14 600	14 000	12 000
Italy	5 436	5 469	5 725[r]	5 115[r]	3 000
Japan	9 012	8 381	12 843	11 559	7 768
Kazakhstan	n.a.	n.a.	n.a.	n.a.	20 000[e]
Norway	50 317[r]	49 827	48 222	44 322	30 404
Russia	n.a.	n.a.	n.a.	n.a.	40 000[e]
Serbia	n.a.	n.a.	n.a.	n.a.	4 000
Ukraine	n.a.	n.a.	n.a.	n.a.	10 000[e]
U.S.S.R.	91 000[e]	91 000[e]	88 000[e]	80 000[e]	n.a.
United States	141 983	152 066	139 333	131 288	136 947
Yugoslavia	6 176	6 105	5 788	4 000	n.a.
Total	334 365	344 448	353 537	338 596	304 419

Sources: Natural Resources Canada; U.S. Bureau of Mines.
[e] Estimated; n.a. Not applicable; [r] Revised.

TABLE 4. PRIMARY MAGNESIUM PRODUCTION BY WORLD ZONE,[1] 1981-93

Period	Area 1 United States and Canada	Area 2 Latin America	Area 3 Western Europe	Area 5 Asia and Oceania	Total
			(000 tonnes)		
1981	138.4	–	64.4	5.7	208.5
1982	97.8	–	52.8	5.8	156.4
1983	109.0	–	51.0	6.0	166.0
1984	152.8	1.0	71.6	6.7	232.1
1985	142.9	2.0	80.8	8.2	233.9
1986	130.7	3.7	81.4	8.1	233.9
1987	133.2	5.2	84.0	7.9	230.3
1988	149.6	5.8	76.2	9.6	241.2
1989	159.3	6.2	76.5	11.4	253.4
1990	164.6	8.7	74.6	12.9	260.8
1991	166.8	7.8	68.7	11.5	254.8
1992	162.7	7.3	53.1	7.0	230.1
1993[a]	129.1	7.3	30.4	5.8	172.6

Source: International Magnesium Association.
– Nil.
[a] First nine months.
[1] There is no production in Area 4 (Africa and the Middle East).

TABLE 5. PRIMARY MAGNESIUM SHIPMENTS BY WORLD ZONE, 1983-93

Period	Area 1 United States and Canada	Area 2 Latin America	Area 3 Western Europe	Area 4 Africa and Middle East	Area 5 Asia and Oceania	Area 6 COMECON C.I.S. & PRC	Total
				(000 tonnes)			
1983	98.6	9.6	60.4	2.4	33.4	–	204.4
1984	110.1	8.0	66.8	1.6	29.5	–	216.0
1985	102.4	9.4	72.2	2.4	38.4	–	224.8
1986	103.3	11.3	73.6	3.2	35.0	–	226.4
1987	113.7	8.3	66.9	5.2	28.7	13.2	236.0
1988	125.0	11.7	70.6	3.8	33.8	6.2	251.2
1989	127.9	9.4	69.5	2.6	33.7	4.1	246.2
1990	127.3	11.6	68.7	4.0	37.6	2.8	252.0
1991	121.3	10.3	66.6	4.5	40.1	0.7	243.5
1992	139.5	10.3	67.9	3.8	35.0	0.8	257.3
1993	143.1	12.3	58.1	3.6	35.0	–	252.1

Source: International Magnesium Association.
– Nil.

TABLE 6. PRIMARY MAGNESIUM SHIPMENTS BY WORLD ZONE AND CATEGORY, 1993

Use	Area 1 United States and Canada	Area 2 Latin America	Area 3 Western Europe	Area 4 Africa and Middle East	Area 5 Asia and Oceania	Area 6 Other	Total
				(000 tonnes)			
Aluminum alloying	64.7	2.7	30.1	2.7	25.8	–	126.0
Desulphurization	29.3	–	10.6	0.7	–	–	40.6
Die casting	22.7	7.7	6.8	–	1.4	–	38.6
Nodular iron	7.4	0.3	2.8	0.2	2.7	–	13.4
Electrochemical applications	6.3	1.3	1.0	–	0.8	–	9.4
Chemical applications	1.3	–	3.3	–	1.9	–	6.5
Wrought products	5.1	–	0.7	–	–	–	5.8
Metal reduction	3.9	–	1.2	–	–	–	5.1
Gravity casting	0.7	–	0.8	–	–	–	1.5
Other	1.7	0.3	0.8	–	2.4	–	5.2
Total	143.1	12.3	58.1	3.6	35.0	–	252.1

Source: International Magnesium Association.
– Nil.

TABLE 7. PRIMARY MAGNESIUM SHIPMENTS BY CATEGORY, 1984-93

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
					(000 tonnes)					
Aluminum alloying	113.5	121.0	122.1	122.1	134.3	130.8	130.6	137.9	133.8	126.0
Desulphurization	17.4	19.1	20.3	21.9	28.6	32.3	28.0	28.1	36.6	40.6
Die casting	30.4	29.7	26.8	26.6	28.5	28.6	36.3	30.7	34.5	38.6
Nodular iron	9.8	11.3	12.3	14.2	15.8	16.9	14.4	13.7	13.3	13.4
Electrochemical applications	7.7	9.1	8.3	8.0	8.0	8.1	9.6	9.2	9.5	9.4
Chemical applications	7.8	8.0	8.0	7.2	8.1	5.5	7.1	7.1	7.3	6.5
Wrought products	6.6	4.8	5.4	8.4	7.4	6.2	6.7	5.7	6.8	5.8
Metal reduction	12.2	10.3	9.6	8.8	10.2	9.4	8.8	5.6	7.4	5.1
Gravity casting	1.3	1.2	1.6	1.8	2.1	2.5	3.3	2.2	2.6	1.5
Other	9.3	10.3	10.0	17.0	8.2	6.9	7.2	3.3	5.5	5.2
Total	216.0	224.8	226.4	236.0	251.2	247.2	252.0	243.5	257.3	252.1

Source: International Magnesium Association.

Mineral Aggregates

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Total shipments of mineral aggregates (mainly crushed stone and sand and gravel), decreased 6% to about 295 Mt in 1993, when comparing recent preliminary statistics with final figures for 1992. In contrast, total annual shipments were in excess of 350 Mt/y during the pre-recessionary period from 1987 to 1990.

Related unit values have generally increased in pace with average annual inflation rates, with selling prices varying considerably depending on proximity to consumers. Housing starts, a broad indicator of demand for most primary construction materials, were 156 000 in 1991, 168 000 in 1992, and 155 000 in 1993. Total construction expenditures in 1993 were about $94.4 billion (Table 13).

CANADIAN DEVELOPMENTS

Mineral aggregates play an essential role in the economic competitiveness of Canada's urban areas; their importance in this regard is currently gaining growing recognition. The demand for these resources has been steadily increasing since World War II and all jurisdictions have become more aware of the need for planning in the context of land use, rehabilitation, and the environment. In the case of Ontario, the province's new *Aggregate Resources Act*, which in 1990 replaced two related acts and the applicable part of the province's *Mining Act*, is probably the most comprehensive document of its kind in Canada. As a general trend in many jurisdictions, planning and legislative measures designed to protect the environment are increasingly being complemented by efforts to ensure that the impacts of loss of access to valuable non-renewable resources are considered.

Numerous constraints to increasing the reserves of aggregates persist; property owners now generally oppose the opening of nearby quarries or pits. The need for aggregates resources planning is particularly important in southern Ontario, as described in a study of the issues, "Aggregate Resources of Southern Ontario – A State of the Resource Study." This report, commissioned by the Ontario Ministry of Natural Resources, includes a comprehensive review of supply/demand factors, costs, questions concerning legislation and planning, and issues on recycling and re-use.

Demand for mineral aggregates is mainly local or regional, reflecting trends in domestic construction. However, in some populated regions, market areas are not self-sufficient, as evidenced by their reliance on imports from other areas. In addition, international bulk shipping has become more important in some areas.

Sand and Gravel

Sand and gravel deposits are widespread and large producers have established plants as conveniently as possible to major consuming centres. These large aggregate operations are usually associated with other activities such as ready-mix or asphalt plants and are complemented by many small producers who serve local markets seasonally or only on demand. Some relatively large operations may operate intermittently, serving as suppliers to heavy construction companies when required. Provincial highways departments operate regional or divisional quarries for supplying roadbed material for new and repair work.

This activity by a wide range of entities has been an obstacle to capturing complete production and consumption data. Ontario, the largest producing province, is a case in point; some estimates suggest that the total production of aggregates from all sources is 25%-30% higher than official statistics indicate. Included in the all-source estimates are designated areas, wayside sources, Ministry of Transportation sites, Crown lands, and private lands.

As existing land-based sources are depleted, there is potential for extensive dredging of sand and gravel in Canada. (In Ontario, there are three long-standing operations recovering alluvial material from lake embayments or rivers.) Offshore sand and gravel resources in Canada have been utilized to meet special job requirements in the Beaufort Sea, the Prince Rupert area, and at the Roberts Bank port facility near Vancouver. On the east coast, it has been established that there is a good possibility of defining sufficient quantities of sand and gravel for marine dredging.

Crushed Stone

Many operations producing crushed stone are part-time or seasonal; others are operated as subsidiaries of construction or manufacturing establishments not classified with the stone industry. In addition, some are operated by municipal or provincial government departments producing stone only for their own use. Quarries removing rock by drilling, blasting and crushing are generally associated with work by large construction companies, and not with the smaller, more local needs often associated with gravel pits. Depending on costs and availability, crushed stone competes with gravel and crushed gravel as an aggregate in concrete and asphalt, and as railway ballast and road-base aggregates (road metal). In these applications, it is subject to the same physical and chemical-testing procedures as gravel and sand aggregates.

In **Atlantic Canada**, construction continued at Bull Arm, Trinity Bay, Newfoundland, on the $5.2 billion Hibernia offshore oilfield project. It is expected that work on the concrete gravity-based system for supporting the drilling and production platform will be completed in 1996, with drilling scheduled to begin the following year. The Newfoundland Resources and Mining Company (NRMC), owned by a subsidiary of Explaura Holdings plc., has been evaluating a high-purity limestone deposit near its established operation. It plans to produce special products in conjunction with its new aggregates operation at Lower Cove, on the Port au Port Peninsula, in Newfoundland. NRMC's new $30 million plant and handling facility is designed mainly for long-distance bulk shipping; approximately 500 000 t can be stockpiled and about 4.3 Mt/y can be produced.

Aguathuna Mining Inc. continued its efforts to develop high-purity limestone and dolomite at Aguathuna on the Port au Port Peninsula. Initiatives have focused on securing sales contracts in markets including iron ore pelletizing, combustion desulphurization, and the pulp and paper industry.

The Province of Prince Edward Island signed an agreement with Strait Crossing, a Calgary-based consortium, to begin preliminary work on an $840 million, 13.5-km-long fixed transportation link between Prince Edward Island and New Brunswick. It is anticipated that discussions on financial arrangements will be completed in 1994; construction is expected to take five years.

Granite aggregate from the Porcupine Mountain quarry at Auld's Cove, near Port Hawkesbury, Nova Scotia, has been transported to markets throughout the region. In recent years when favourable backhaul arrangements could be made, 50 000-60 000-t loads were shipped as far as Houston, Texas.

Atlantic Industrial Minerals began supplying limestone from its Glen Morrison deposit in Cape Breton to Nova Scotia Power Corporation's Point Aconi thermal-electric station, which uses circulating fluid bed technology.

Plans by Kelly Rock Limited and an associate to develop a major coastal marine quarry for construction aggregates remained on hold pending an environmental review. The company plans to develop a site on deep water at Kelly's Mountain, about 40 km north of Sydney.

In **Quebec**, Marconi Quarries Ltd., situated on the north shore of the St. Lawrence River at Pointe Noire near Sept-Îles, continued to produce a wide range of construction aggregates for widespread distribution. Reserves of anorthositic gabbro are said to be very large.

In **Ontario**, Dufferin Aggregates (a subsidiary of St. Lawrence Cement Inc.) operating near Milton, with a capacity to produce about 7 Mt/y, remains the largest quarrier in Canada. Following a growing pattern in the industry, the progressive and ongoing rehabilitation of the company's sites has become a major priority in recent years.

Manitoulin Dolomite, owned by Standard Aggregates Inc., is situated on Manitoulin Island in Lake Huron. Approximately 2.2 Mt/y of white-to-grey, fine-grained dolomite is shipped for construction, chemical and metallurgical markets in Canada and the United States.

3M Canada Inc. continued to produce from its modernized basalt quarrying/processing operation at Havelock, Ontario. Recent capital expenditures were mainly related to increasing the output of crushed aggregates, particularly a fine-grained dense rock having superior physical properties for use in asphalt surfacing.

In **western Canada**, large-volume ocean transportation facilities have been used for many years in British Columbia to supply high-quality aggregates or high-calcium limestone. For example, limestone producers on Texada Island, situated about 100 km northwest of Vancouver in the Strait of Georgia, supply raw material to cement and lime producers on the lower mainland and in the state of Washington. Holnam West Materials Ltd., formerly Ideal Basic Industries Limited, has been shipping from Texada since 1957. Road-base material and riprap for use in the lower mainland are also important products; special orders for related materials may be for destinations extending as far away as Alaska or northern California. Imasco Minerals Inc. (formerly International Marble & Stone Co. Ltd.), now owned by Sacks Industrial Group, continued to produce a wide range of minerals for filler and other applications.

RECYCLING

The recycling of concrete and other construction materials is expected to increase because of limitations on the use of landfill sites as well as growing expertise in materials management within the construction industry. Again looking at Ontario as an example, more than 90 of about 145 asphalt plants in the province are now producing some recycled hot-mix asphalt material, according to a recent study. In the future, the recycling of old pavement is expected to increase.

There has been more emphasis in Ontario on developing more sources of relatively durable igneous and metamorphic rocks since the Ontario Ministry of Transportation stopped the use of crushed blast furnace slag and steel slag as aggregates in premium quality hot-mix pavements.

WORLD DEVELOPMENTS

Large-scale coastal marine quarrying of aggregates for international markets continues to attract considerable attention. In the United Kingdom, environmental and land use pressures are expected to result in relatively less production from inland quarries and more from large coastal super-quarries. In Ireland, a new coastal marine quarry, known as the Wimpey Fleming Adrigole Quarry, started production. (This is a joint venture between John Fleming Construction of County Cork and the Minerals Division of the U.K.-based Wimpey Group.) Annual production is expected to rise from 500 000 t in 1992/93 to 1.2 Mt in 1995 and to 2.0 Mt/y by the end of the decade. The rock, situated in a remote area, is described as a superior-quality quartzitic sandstone expected to meet new European standards for aggregates. The project is only the second large-scale operation of its kind in Europe; it is expected that markets in the United Kingdom and continental Europe will be convenient for backhaul cargo. This scale of aggregates operation was first pioneered in 1986 by Foster Yeoman Ltd. at its Glensanda quarry on the west coast of Scotland. The quarry mainly serves aggregates markets in the United Kingdom, but also increasingly serves the European continent as far as the Baltic coast of Germany. The Glensanda operation has been followed by the Vulcan Materials Co. joint venture on Mexico's Yucatan Peninsula, as well as by NRMC's large project as described earlier.

Tarmac plc is establishing a 5-Mt/y coastal quarry at Jossingfjord in Norway, while Schweden Splitt AB has been established to produce aggregate close to the south coast of Sweden, primarily for the Berlin and German Baltic coast markets. Redland Aggregates Ltd. plans to develop a 10-Mt/y coastal super-quarry on South Harris in Scotland's Western Isles. The initial cost of the project is expected to be about US$36 million, with plans to produce over a 70-year life, leaving the site open for a new tidal inlet.

International investments in North American aggregates production slowed, apparently because of recessionary conditions and opportunities elsewhere. Major companies involved in recent years include Tarmac plc, RMC Group plc, Redland plc, C.H. Beazer, English China Clays plc, Alfred McAlpine, Blue Circle Industries Ltd., BTR Ltd., Hanson PLC, Consolidated Gold Fields PLC, and Wimpey Construction Ltd.

Seabed mining of aggregates is currently the principal ocean-mining activity related to hard minerals. In Japan, seabed sands account for about 40% of total domestic production of fine aggregates needed for concrete. As a general trend, more consideration is being given to the need for offshore dredging for aggregates because of growing demand and environmental and zoning constraints associated with developments inland. This is particularly true in the United States, although several factors have contributed to difficulties in drafting a seabed mining law that would alleviate major industry and environmental concerns.

LIGHTWEIGHT AGGREGATES

The classification of lightweight aggregates is based on source, processing methods, and end uses. Source rocks include pumice, scoria, volcanic cinders, and tuff. Manufactured lightweight aggregates are bloated or expanded products commonly obtained by heating certain clays, shales and slates. Ultra-lightweights, produced mainly from perlite and vermiculite, are expanded or exfoliated by heating. Fly ash (produced mainly as a by-product of combustion of coal and coke in thermal power plants), ground pelletized slag (resulting from metallurgical processes), and condensed silica fume (a by-product of the smelting process used to produce silicon metal and ferrosilicon alloys) are generally classified as supplementary cementing materials because of their pozzolanic characteristics.

Perlite

Perlite is a glassy volcanic rock containing 2%-5% of combined water; after crushing and rapid heating to 760°-1100°C, perlite expands its volume from 4 to 20 times. Through attention to preblending of kiln feed and retention time in the kiln, expanded material weighing as little as 30-60 kg/m^3 can be produced.

Imported perlite is expanded at numerous locations for use mainly in horticultural peat mixes as well as in lightweight and fire-resistant construction products. Other uses relate to loose insulation and insulating media in concrete products. Imports of crude perlite are mainly from New Mexico and Colorado, with production from companies such as Grefco, Inc., Manville Corporation, USG Corporation, and United Perlite Corp. Perlite has not been produced in Canada since Aurun Mines Ltd. closed its processing plant in Surrey, British Columbia, in 1990. With improved markets over a wider range of grades, there is a possibility that local occurrences may be developed in the future.

Pumice

Numerous concrete product manufacturers, mainly including block producers, use pumice imported from Greece or the northwestern United States. In Canada, a major potential use for this durable and angular material is in highway asphalt overlay as a highly skid-resistant ingredient.

Vermiculite

Vermiculite refers to a small group of minerals, physically resembling the lamellar structure of the micas, which expand or exfoliate greatly when heated rapidly. Canadian consumption is mainly for horticultural uses, with lesser amounts for insulation and other products.

The United States is the world's leading producer of vermiculite, with W.R. Grace and Company being the major supplier from the Enoree region of South Carolina. Canada also imports crude vermiculite from the Republic of South Africa, where Palabora Mining Co. Ltd. (PMC) is the major producer. Vermiculite occurrences have been reported in British Columbia, and deposits near both Perth and Peterborough in Ontario have attracted attention in the past.

Clay, Shale and Slag

Common clays and shale are used throughout Canada for manufacturing lightweight aggregates. Although the Canadian industry began in the 1920s in Ontario, it did not evolve significantly until the 1950s. Raw clay materials, usually quarried adjacent to plant sites, receive little beneficiation other than drying before going to the kiln where they are expanded. Shales are crushed and screened before burning. Slag, a porous, glassy, nonmetallic by-product resulting from controlled cooling conditions at the end of the steel-making process, may be crushed and sized for many construction-related applications.

Ongoing research, sponsored through the Canada Centre for Mineral and Energy Technology (CANMET), relating to supplementary cementing materials led to the successful use of ground granulated blast furnace slag for use as a cementitious material in concrete. Koch Minerals of Canada Limited (formerly Reiss Lime Company of Canada, Limited) produces this material, commonly referred to as "slag cement," at a grinding plant at Spragge, Ontario. The granulated slag is from a plant owned by Algoma Steel Inc. at Sault Ste. Marie. Plant capacity is 200 000 t/y of slag cement for complete or partial replacement of Portland cement, depending on requirements. The primary use at present is in mine backfill; however, construction-related uses are also being investigated.

PRICES

In addition to supply/demand factors, prices of the various aggregates are determined locally or regionally on the basis of production and transportation costs, the degree of processing prior to final use, and by site-specific volume requirements.

USES

The principal uses for sand and gravel are for highway construction and concrete and asphalt aggregates. Based on a recent study by the Ontario Ministry of Natural Resources, the construction of single-family homes triggers an overall demand of about 300 t of aggregate per unit, while apartment construction requires about 50 t per unit.

More than 90% of the total stone output used by the construction industry is for crushed material as an aggregate in concrete and asphalt for highway and railway construction, and as heavy riprap for wharf facings and breakwaters. Specifications vary greatly depending on intended uses, and many tests are required to determine the acceptability of aggregates for certain applications. Particle size distribution, as assessed by grading tests or sieve analysis, affects the uniformity and workability of concrete, the strength of the final product, the density and strength of an asphalt material, as well as the durability, strength and stability of aggregates compacted as fill or base-course material. Also of importance are tests concerning organic impurities or other deleterious material; resistance of the aggregate to abrasion and to freeze-thaw cycles; the effects of thermal expansion, porosity and absorption; reactivity with associated materials; and surface texture.

Lightweight concrete used in commercial and institutional projects has facilitated the construction of taller buildings and the use of longer clear spans in bridges and buildings. Other advantages of using lightweight aggregates relate to their thermal and acoustical properties, fire resistance, freeze-thaw properties, and low water-absorption characteristics.

As yet, there are no Canadian Standards Association (CSA) specifications for lightweight aggregates. Production and application are based on the American Society for Testing and Materials (ASTM) designations as follows: ASTM C 332-91, Lightweight Aggregates for Insulating Concrete; C 330-89, Lightweight Aggregates for Structural Concrete; and C 331-89, Lightweight Aggregates for Concrete Masonry Units.

OUTLOOK

Shipments of aggregates in 1994 are expected to increase about 5%, based on a moderate recovery in residential and engineering construction. Engineering-related construction will benefit from a new two-year, federal-led $6 billion cost-shared program for infrastructure renewal involving the cooperative efforts of all three levels of government. A recovery in non-residential building construction is expected to be slower, given relatively high office and industrial vacancy rates.

In Atlantic Canada, the Hibernia offshore oil project and the planned fixed crossing between Prince Edward Island and New Brunswick, respectively, may reach their maximum needs for primary construction materials in 1995 and 1996.

The demand for aggregates in the United States is forecast to increase about 7% in 1994, largely based on increases in construction expenditures related to single-family housing, institutional facilities, and public works in some areas. In addition, the outlook for office and industrial building is expected to improve.

Urban expansion has greatly increased the demand for aggregates in support of major construction. Paradoxically, urban spread has not only tended to overrun operating pits and quarries, but has also extended into areas containing potentially valuable reserves and resources. In this context, and in view of advancements in rehabilitation techniques, municipal and regional zoning can be expected to become more coordinated and balanced concerning land planning and management.

Sand and gravel will continue to be competitive with crushed stone in many areas and, in some applications, with lightweight aggregates. New reserves are expected to be located and assessed as part of the community planning or regional zoning process. Prices for aggregates will continue to rise with increasing land values, more sophisticated operating techniques and equipment, the depletion of more accessible reserves, and added rehabilitation expenditures.

Estimates suggest that available sand and gravel supplies in some regions will be depleted during the 1990s, resulting in a need to develop outlying deposits. Predicted shortages could encourage the exploitation of offshore deposits and even underground mining in some regions.

Note: Information in this review was current as of February 1, 1994.

TABLE 1. CANADA, TOTAL PRODUCTION OF STONE, 1991-93

	1991		1992		1993p	
	(000 t)	($000)	(000 t)	($000)	(000 t)	($000)
BY PROVINCE[1]						
Newfoundland	1 251r	7 606r	1 000	4 758	2 367	9 508
Nova Scotia	4 632	24 810	4 705	24 910	4 671	26 499
New Brunswick	2 591	15 851	2 784	15 799	2 694	14 556
Quebec	34 801	208 805	36 524	207 500	29 044	176 822
Ontario	38 704	238 446	37 666	219 388	33 451	193 811
Manitoba	1 725	11 023	1 549	7 770	1 967	9 878
Alberta	321	3 556	316	3 600	300	4 137
British Columbia	2 779	24 685	3 910	30 113	4 247	32 134
Northwest Territories and Yukon	1 003	4 788	884	2 679	467	2 205
Total	87 807r	539 569r	89 338	516 518	79 209	469 550
BY USE[2]						
Dimensional stone						
Rough	195	22 898	. .	. .	. .	. .
Monumental and ornamental stone (n.f.)	42	7 340	. .	. .	. .	. .
Other (flagstone, curbstone, paving blocks, etc.)	50	4 500	. .	. .	. .	. .
Lining open-hearth furnaces	. . .	5	. .	. .	. .	. .
Chemical and metallurgical						
Cement plants, Canada	9 719	31 181	. .	. .	. .	. .
Cement plants, foreign	779	2 932	. .	. .	. .	. .
Flux in iron and steel furnaces	491	2 632	. .	. .	. .	. .
Flux in nonferrous smelters	162	667	. .	. .	. .	. .
Clay plants, Canada	501	1 466	. .	. .	. .	. .
Glass factories	169	2 927	. .	. .	. .	. .
Lime plants, Canada	2 354	17 032	. .	. .	. .	. .
Lime plants, foreign	156	1 100	. .	. .	. .	. .
Pulp and paper mills	220	1 857	. .	. .	. .	. .
Sugar refineries	23	122	. .	. .	. .	. .
Other chemical uses	964	5 456	. .	. .	. .	. .
Pulverized stone						
Whiting	50	3 760	. .	. .	. .	. .
Asphalt filler	139	924	. .	. .	. .	. .
Dusting coal mines	3	98	. .	. .	. .	. .
Agricultural purposes and fertilizer plants	905	12 783	. .	. .	. .	. .
Other uses	356	13 542	. .	. .	. .	. .
Miscellaneous stone						
Manufacture of artificial stone	38	478	. .	. .	. .	. .
Roofing granules	303	6 381	. .	. .	. .	. .
Poultry grit	53	1 019	. .	. .	. .	. .
Stucco dash	12	1 998	. .	. .	. .	. .
Terrazzo chips	4	215	. .	. .	. .	. .
Rock wool	18	443	. .	. .	. .	. .
Rubble and riprap	1 043	9 042	. .	. .	. .	. .
Other uses	1 860	10 142	. .	. .	. .	. .
Crushed stone for						
Concrete aggregate	9 197	57 250	. .	. .	. .	. .
Asphalt aggregate	8 947	49 201	. .	. .	. .	. .
Road metal	35 264	177 388	. .	. .	. .	. .
Railroad ballast	1 117	10 039	. .	. .	. .	. .
Other uses	25 247	132 430	. .	. .	. .	. .
Total	100 380	589 248	. .	. .	. .	. .

Sources: Natural Resources Canada; Statistics Canada.
. . Not available; . . . Amount too small to be expressed; n.f. Not finished or dressed; p Preliminary; r Revised.
[1] Data exclude stone used in the Canadian cement and lime industries. [2] Data include stone used in the Canadian cement and lime industries.
Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, PRODUCTION OF SAND AND GRAVEL[1] BY PROVINCE, 1991-93

	1991		1992		1993p	
	(000 t)	($000)	(000 t)	($000)	(000 t)	($000)
Newfoundland	2 535	11 396	3 537	17 610	3 551	17 477
Prince Edward Island	1 123	3 261	444	1 699	448	1 700
Nova Scotia	5 526	21 667	5 976	20 462	5 629	19 906
New Brunswick	7 400	13 483	6 552	13 161	6 684	14 041
Quebec	32 804	113 299	37 307	116 968	30 445	104 961
Ontario	65 317	233 239	87 647	266 368	90 000	265 305
Manitoba	8 000	28 355	9 591	35 239	8 766	31 871
Saskatchewan	9 871	41 513	6 236	17 841	6 147	17 835
Alberta	38 401	127 307	38 094	125 277	34 003	118 402
British Columbia	42 023	135 852	39 923	128 624	39 431	127 134
Yukon and Northwest Territories	3 265	11 953	5 309	17 119	4 837	17 846
Total	216 264	741 326	240 616	760 367	229 940	736 479

Sources: Natural Resources Canada; Statistics Canada.
p Preliminary.
1 Production values for silica have been included in sand and gravel.
Note: Numbers may not add to totals due to rounding.

TABLE 3. AVAILABLE DATA ON CONSUMPTION OF SAND AND GRAVEL,[1] BY PROVINCE, 1990 AND 1991

		Atlantic Provinces	Quebec	Ontario	Western Provinces[2]	Canada
				(000 tonnes)		
Road bed, surface	1990	13 897	14 964	40 899	77 431	147 193
	1991	11 738	17 082	33 969	60 054	122 843
Roads, ice control	1990	798	975	2 248	961	4 981
	1991	795	845	1 803	9 100	12 542
Concrete aggregate	1990	1 591	4 812	13 580	12 670	32 652
	1991	1 493	3 865	9 896	11 138	26 391
Asphalt aggregate	1990	1 673	3 109	4 960	7 339	17 080
	1991	1 299	3 431	3 973	6 593	15 298
Railroad ballast	1990	20	57	599	817	1 493
	1991	5	138	237	297	676
Mortar sand	1990	83	554	1 403	282	2 321
	1991	61	292	942	738	2 033
Backfill for mines	1990	9	53	524	682	1 268
	1991	–	204	410	132	746
Fill	1990	925	2 797	11 049	8 016	22 787
	1991	769	2 874	8 868	7 115	19 626
Other special uses[3]	1990	52	705	404	543	1 704
	1991	52	641	369	306	1 366
Other purposes	1990	456	1 932	4 306	6 239	12 932
	1991	459	3 492	4 850	5 402	14 203
Total	1990	19 502	29 959	79 970	114 978	244 410
	1991	16 671	32 865	65 317	100 871	215 724

Sources: Natural Resources Canada; Statistics Canada.
– Nil.
1 Data include natural silica sand, silica sand manufactured from quartz or silica rock, and silica used in Canadian cement plants. 2 The western provinces include the Yukon and Northwest Territories. 3 Includes glass manufacture, ferrosilicon carbide manufacture, silica brick manufacture, chemical manufacture, smelter flux, sand blasting, and moulding and core sands.
Note: Numbers may not add to totals due to rounding.

TABLE 4. CANADA, EXPORTS AND IMPORTS OF SAND AND GRAVEL AND CRUSHED STONE, 1991-93

Item No.		1991		1992		Jan.-Sept. 1993p	
		(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
EXPORTS							
2505.90	Natural sands n.e.s., excluding metal-bearing sands						
	St. Helena	–	–	–	–	69 544	722
	United States	35 614	342	113 347	912	81 864	718
	Bermuda	7 026	70	31 451	299	7 397	72
	France	16	3	97	22	32	8
	St. Vincent Grenada	–	–	11 688	250	–	–
	Bahamas	34 923	652	7 628	143	–	–
	Saint Lucia	67 959	1 331	6 621	124	–	–
	United Kingdom	–	–	66	18	–	–
	Other countries	4 051	87	3	4	–	–
	Total	149 589	2 485	170 901	1 772	158 837	1 522
2517.10	Pebbles, gravel, broken or crushed stone used for aggregates, etc.						
	United States	1 315 763	7 527	1 877 413	10 968	1 462 344	10 383
	Bermuda	21 534	197	25 395	215	15 296	138
	Taiwan	192	21	–	–	79	8
	St. Vincent Grenada	–	–	25 867	512	–	–
	Bahamas	20 575	383	27 312	397	–	–
	Saint Lucia	58 718	1 136	12 814	265	–	–
	Barbados	26 202	484	–	–	–	–
	Other countries	–	–	184	50	–	–
	Total	1 442 984	9 749	1 968 985	12 407	1 477 719	10 530
2517.41	Marble granules, chippings and powder of 25.14 or 25.16 heat-treated or not						
	United States	325	61	5 632	712	190	34
	Total	325	61	5 632	712	190	34
2517.49	Granules, chippings and powder, n.e.s., of 25.15 or 25.16 heat-treated or not						
	United States	706	21	21	7	27 505	168
	Costa Rica	8	1	36	4	28	3
	Panama	–	–	–	–	4	. .
	Saint Lucia	9 000	167	–	–	–	–
	Belgium	35	5	–	–	–	–
	Total	9 749	195	57	12	27 537	172
2518.10	Dolomite, not calcined						
	United States	219 832	970	92 727	455	208 782	1 074
	Total	219 832	970	92 727	455	208 782	1 074
2518.20	Calcined dolomite						
	United States	27 261	4 233	23 610	4 185	25 717	3 779
	Trinidad-Tobago	–	–	–	–	17 465	235
	Japan	–	–	–	–	20	2
	Total	27 261	4 233	23 610	4 185	43 202	4 017
2518.30	Agglomerated dolomite (including tarred dolomite)						
	Trinidad-Tobago	–	–	–	–	36 597	553
	Total	–	–	–	–	36 597	553
2521.00	Limestone flux; limestone and other calcareous stone used for lime or cement						
	United States	1 134 223	6 120	1 528 530	8 137	1 446 771	7 848
	Total	1 134 223	6 120	1 528 530	8 137	1 446 771	7 848
IMPORTS							
2505.90	Natural sands n.e.s., excluding metal-bearing sands						
	United States	125 018	2 868	239 904	3 454	256 344	3 032
	Japan	375	55	292	42	938	172
	United Kingdom	84	15	103	15	191	37
	Philippines	116	7	4	. .	31	5
	France	282	56	4	. .	19	3
	Germany	22	4	37	7	3	. .
	Other countries	305	62	28	8	–	–
	Total	126 202	3 067	240 372	3 526	257 526	3 251

TABLE 4 (cont'd)

Item No.		1991		1992		Jan.-Sept. 1993p	
		(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
IMPORTS (cont'd)							
2517.10	Pebbles, gravel, broken or crushed stone used for aggregates, etc.						
	United States	1 019 089	6 113	905 995	6 829	707 089	5 652
	Germany	386	5	379	5	560	8
	France	1 026	14	433	6	312	4
	Belgium	422	4	363	5	193	2
	Italy	361	5	–	–	20	2
	Other countries	127	3	965	15	1	2
	Total	1 021 411	6 144	908 135	6 860	708 175	5 670
2517.20	Macadam of slag, dross or similar industrial waste, etc.						
	United States	24 791	65	2 165	32	672	10
	Total	24 791	65	2 165	32	672	10
2517.30	Tarred macadam						
	United States	51	3	80	5	181	8
	Total	51	3	80	5	181	8
2517.41	Marble granules, chippings and powder of 25.15 or 25.16 heat-treated or not						
	United States	51 806	6 290	71 935	8 222	40 046	5 334
	France	673	109	330	65	570	65
	Italy	384	65	463	82	63	9
	Total	52 863	6 464	72 728	8 369	40 679	5 408
2517.49	Granules, chippings and powder, n.e.s., of 25.15 or 25.16 heat-treated or not						
	United States	108 858	1 237	99 151	1 586	87 246	1 441
	France	–	–	68	8	233	28
	South Africa	3	. .	6	. .	–	–
	New Zealand	2	. .	4	. .	–	–
	Total	108 863	1 237	99 229	1 595	87 479	1 470
2518.10	Dolomite, not calcined						
	United States	2 752	536	6 460	1 288	7 397	1 440
	United Kingdom	5	1	8	2	19	6
	Total	2 757	538	6 468	1 290	7 416	1 446
2518.20	Calcined dolomite						
	United States	4 876	489	6 312	552	3 668	327
	Total	4 876	489	6 312	552	3 668	327
2518.30	Agglomerated dolomite (including tarred dolomite)						
	United States	624	184	194	79	54	28
	Total	624	184	194	79	54	28
2521.00	Limestone flux; limestone and other calcareous stone used for lime or cement						
	United States	2 696 021	11 119	3 334 509	14 119	2 704 823	11 778
	Thailand	919	5	388	2	109	. .
	Total	2 696 940	11 124	3 334 897	14 121	2 704 932	11 778

Source: Statistics Canada.
– Nil; . . Not available; n.e.s. Not elsewhere specified; p Preliminary.
Note: Numbers may not add to totals due to rounding.

TABLE 5. LIGHTWEIGHT AGGREGATE PRODUCERS IN CANADA, 1992

Company	Location	Commodity	Remarks
ATLANTIC PROVINCES			
Annapolis Valley Peat Moss Company Limited	Berwick, N.S.	Vermiculite	Processed for use in horticulture.
Avon Aggregates Ltd.	Minto, N.B.	Expanded shale	Processed for concrete products industry.
Fafard Peat Moss Company Ltd.	Shippagan, N.B.	Perlite, vermiculite	Processed for use in horticulture.
Sun Gro Horticulture Inc.	Maisonnette, N.B.	Perlite	Processed for use in horticulture.
QUEBEC			
Armstrong World Industries Canada Ltd.	Gatineau	Perlite	Processed for use in ceiling tile manufacture.
Miron Inc.	Ville St-Laurent	Pumice	Purchased for concrete block manufacture.
Premier Peat Moss Ltd.	Rivière du Loup	Perlite, vermiculite	Processed for use in horticulture.
Vermi-lite Inc.	Baie-du-Febvre	Perlite	Processed for use in horticulture, insulation and concrete products.
ONTARIO			
CGC Inc.	Hagersville	Perlite	Processed for use in gypsum plaster.
National Slag Limited	Hamilton	Slag	Used in concrete products industry and as slag cement.
V.I.L. Vermiculite Inc.	Woodbridge	Vermiculite	Processed for use in loose insulation, horticulture and concrete products.
W.R. Grace & Co. of Canada Ltd.	St. Thomas	Vermiculite	Vermiculite processed for use in horticulture and as loose insulation.
	Ajax	Vermiculite, perlite	Perlite processed for use in gypsum plaster, horticulture, refractories, as loose insulation, in friction materials and in fire-proofing.
PRAIRIE PROVINCES			
Cindercrete Products Limited	Saskatoon, Sask.	Expanded clay	Processed for concrete block manufacture.
	Regina, Sask.	Expanded clay	Processed for concrete block manufacture.
Consolidated Concrete Limited	Calgary, Alta.	Expanded shale	Processed for concrete products industry and for loose insulation.
	Edmonton, Alta.	Expanded clay	Processed for concrete block manufacture.
CBR Cement Canada Limited	St. Albert, Alta.	Expanded clay	Processed for concrete products industry and for loose insulation.
Kildonan Concrete Ltd.	Winnipeg, Man.	Expanded clay	Processed for concrete products industry.
Sun Gro Horticulture Inc.	Elma, Man.	Perlite	Processed for use in horticulture.
Sun Gro Horticulture Inc.	Seba Beach, Alta.	Perlite	Processed for use in horticulture.
W.R. Grace & Co. of Canada Ltd.	Winnipeg, Man.	Vermiculite, perlite	Perlite processed for use in gypsum plaster and in horticulture.
	Edmonton, Alta.	Vermiculite, perlite	Vermiculite processed for use in horticulture and as loose insulation.
BRITISH COLUMBIA			
Ocean Construction Supplies Limited	Vancouver	Pumice	Purchased for concrete products industry.
W.R. Grace & Co. of Canada Ltd.	Vancouver	Vermiculite, perlite	Mainly for horticulture.

Source: Natural Resources Canada, reported from EMR survey "Production of Lightweight Aggregates in Canada."

TABLE 6. CANADA, IMPORTS OF VERMICULITE, PERLITE AND PUMICE, 1991-93

Item No.		1991		1992		Jan.-Sept. 1993p	
		(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
2513.11	Pumice stone, crude or in irregular pieces, including crushed pumice						
	United States	4 891	712	4 540	563	5 659	550
	Turkey	3 886	1 124	3 054	567	2 533	472
	Greece	–	–	4 500	73	197	32
	France	9	3	–	–	1	. .
	United Kingdom	110	38	47	8	–	–
	Total	8 896	1 878	12 141	1 211	8 390	1 055
2513.19	Pumice stone, other						
	United States	5 592	796	3 479	701	3 221	594
	United Kingdom	27	9	25	8	295	103
	Ecuador	180	52	155	50	216	67
	Germany	102	35	247	83	112	39
	Taiwan	30	10	48	16	7	2
	Other countries	46	18	10	6	4	3
	Total	5 977	920	3 964	864	3 855	808
2530.10.10.10	Vermiculite, unexpanded						
	South Africa	5 971	835	8 608	1 539	6 148	1 158
	United States	10 410	1 551	8 320	1 256	5 790	791
	Greece	–	–	–	–	79	7
	People's Republic of China	400	42	–	–	–	–
	Total	16 781	2 429	16 929	2 796	12 018	1 957
2530.10.10.20	Perlite, unexpanded						
	United States	28 018	3 288	26 709	3 295	15 325	2 477
	Greece	6 331	454	6 796	547	6 351	504
	Mexico	–	–	–	–	19	3
	Total	34 348	3 743	33 505	3 842	21 695	2 985
3802.90.20	Activated perlite, excluding expanded perlite ground to be employed in filtering						
	United States	1 779	788	101	42	131	79
	Total	1 779	788	101	42	131	79
6806.20.00.10	Exfoliated (expanded) vermiculite						
	United States	313	755	321	689	224	475
	Total	313	755	321	689	224	475
6806.20.00.20	Expanded perlite						
	United States	3 353	1 555	4 281	2 130	3 294	1 836
	Mexico	42	35	–	–	–	–
	Total	3 395	1 590	4 281	2 130	3 294	1 836

Source: Statistics Canada.
– Nil; . . Not available; p Preliminary.
Note: Numbers may not add to totals due to rounding.

TABLE 7. CANADA, LIGHTWEIGHT AGGREGATES PRODUCED, SOLD AND USED, 1991 AND 1992

	1991				1992			
	Produced		Sold and Used		Produced		Sold and Used	
	(m^3)	($)	(m^3)	($)	(m^3)	($)	(m^3)	($)
From domestic and/or imported raw materials								
Expanded clay, shale and slag[1]	350 685	9 006 372	340 848	8 688 139	195 306	5 863 743	187 778	5 576 372
From imported crude materials								
Expanded perlite and exfoliated vermiculite[1]	450 209	24 008 711	473 544	25 358 011	492 054	26 191 487	493 524	26 261 137
Total	800 894	33 015 083	814 392	34 046 150	687 360	32 055 230	681 302	31 837 509

Source: Natural Resources Canada, reported from EMR survey "Production of Lightweight Aggregates in Canada." See Table 5 for list of establishments surveyed.
[1] Combined to avoid disclosing confidential company data.

TABLE 8. CANADA, SALES OF EXPANDED SLAG, PERCENTAGE BY END USE, 1990-92

Use	1990	1991	1992
Concrete block manufacture	90.0	60.0	90.0
Ready-mix concrete	10.0	20.0	10.0
Miscellaneous uses	–	20.0	–

Source: Natural Resources Canada, reported from EMR survey "Production of Lightweight Aggregates in Canada."
– Nil.
Notes: See Table 5 for list of establishments surveyed. Sales also imply quantities consumed for own use.

TABLE 9. CANADA, SALES OF EXPANDED CLAY AND SHALE, PERCENTAGE BY END USE, 1990-92

Use	1990	1991	1992
Loose insulation	25.5	33.1	49.5
Concrete block manufacture	67.7	49.4	38.6
Precast concrete manufacture	2.8	13.9	10.2
Ready-mix concrete	3.1	3.0	1.0
Horticulture and miscellaneous uses	0.9	0.6	0.7

Source: Natural Resources Canada, reported from EMR survey "Production of Lightweight Aggregates in Canada."
Notes: See Table 5 for list of establishments surveyed. Sales also imply quantities consumed for own use.

TABLE 10. CANADA, SALES OF EXPANDED PERLITE, PERCENTAGE BY END USE, 1990-92

Use	1990	1991	1992
Horticulture and agriculture	67.0	70.3r	69.7
Insulation			
in gypsum products	0.8	0.2r	0.2
in other construction materials	24.0	23.0	25.3
Loose insulation and miscellaneous uses	8.2	6.5	4.8

Source: Natural Resources Canada, reported from EMR survey "Production of Lightweight Aggregates in Canada."
r Revised.
Notes: See Table 5 for list of establishments surveyed. Sales also imply quantities consumed for own use.

TABLE 11. CANADA, SALES OF EXPANDED VERMICULITE, PERCENTAGE BY END USE, 1990-92

Use	1990	1991	1992
Horticulture	68.1	72.8	82.8
Loose insulation	9.9	9.0	2.9
Miscellaneous uses	22.0	18.2	14.3

Source: Natural Resources Canada, reported from EMR survey "Production of Lightweight Aggregates in Canada."
Notes: See Table 5 for list of establishments surveyed. Sales also imply quantities consumed for own use.

TABLE 12. CANADA, VALUE OF CONSTRUCTION BY TYPE,[1] 1991-93

	1991	1992	1993
		($ millions)	
BUILDING CONSTRUCTION[2]			
Residential	34 768	37 315	38 432
Industrial	3 642	2 777	2 594
Commercial	13 436	11 185	11 146
Institutional	5 845	5 964	6 205
Other building	3 210	2 707	2 937
Subtotal	60 901	59 948	61 315
ENGINEERING CONSTRUCTION[2]			
Marine	553	556	576
Highways, airport runways	6 334	6 374	6 800
Waterworks, sewage systems	2 660	2 701	3 026
Dams, irrigation	399	306	334
Electric power	6 859	7 867	7 645
Railway, telephones	3 135	3 053	3 070
Gas and oil facilities	9 629	7 790	8 081
Other engineering	3 686	3 267	3 565
Subtotal	33 254	31 913	33 096
Total construction	94 155	91 861	94 411

Source: Statistics Canada.
[1] Actual expenditures 1991, preliminary 1992, intentions 1993. [2] Includes total value of new and repair work purchased.
Note: Numbers may not add to totals due to rounding.

TABLE 13. CANADA, VALUE OF CONSTRUCTION BY PROVINCE,[1] 1991-93

	1991			1992			1993		
	Building Construction[2]	Engineering Construction[2]	Total	Building Construction[2]	Engineering Construction[2]	Total	Building Construction[2]	Engineering Construction[2]	Total
					($ millions)				
Newfoundland	906	871	1 777	824	1 048	1 873	836	1 438	2 275
Nova Scotia	1 544	955	2 499	1 460	696	2 157	1 526	602	2 129
New Brunswick	1 150	837	1 987	1 160	1 057	2 217	1 120	712	1 832
Prince Edward Island	257	99	356	242	106	348	227	98	326
Quebec	14 032	6 369	20 401	13 106	7 027	20 133	13 261	7 323	20 584
Ontario	24 980	8 978	33 958	23 132	8 941	32 074	23 473	9 502	32 974
Manitoba	1 500	1 226	2 725	1 517	1 200	2 717	1 578	1 135	2 713
Saskatchewan	1 269	2 254	3 523	1 306	1 754	3 060	1 286	1 449	2 735
Alberta	5 577	7 170	12 747	6 204	5 995	12 199	6 030	6 348	12 378
British Columbia, Yukon and Northwest Territories	9 684	4 497	14 182	10 995	4 088	15 083	11 978	4 488	16 465
Total Canada	60 901	33 254	94 155	59 948	31 913	91 861	61 315	33 096	94 411

Source: Statistics Canada.
[1] Actual expenditures 1991, preliminary 1992, intentions 1993. [2] Includes total value of new and repair work purchased.
Note: Numbers may not add to totals due to rounding.

Nickel

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Western World demand for nickel in 1993 increased by an estimated 4.5% to 654 600 t compared to 1992's six-year low of 626 800 t. This was largely due to an increase in stainless steel production and a decrease in the availability of secondary materials. Despite lower Western World production and a decrease in exports from Russia, the build-up of nickel stocks continued. London Metal Exchange (LME) stocks increased by nearly 58% and reached 124 104 t at the end of 1993. The price of nickel consequently declined to an average LME price of US$2.40/lb, a record low in real terms, and much lower than the 1992 average of US$3.18/lb.

Russian exports of nickel to the Western World decreased in 1993 to close to 110 000 t from the 1992 level of 133 000 t. Problems with supplies and technical difficulties were the principal causes of decreased Russian production and exports. Also, government officials were able to decrease the amount of "back-door" nickel leaving the country due to better border control, new export taxes and higher domestic nickel prices.

Canadian Developments

Canadian nickel mine production increased to 188 400 t from 186 400 t in 1992. This is the first increase since 1988 when Canada produced 216 600 t.

Inco Limited closed its Canadian operations for seven weeks in 1993: three weeks at the beginning of the year and four weeks during its annual summer shut-down. Together with shut-downs at its foreign operations, the company decreased its production from 182 000 t in 1992 to 167 000 t in 1993.

Inco completed its Sudbury sulphur dioxide abatement program in August 1993 at a total cost of $612 million. Inco began working on the project in February 1989 as part of its commitment to reduce sulphur dioxide emissions to 265 000 t/y, as required by the government of Ontario starting on January 1, 1994. The $540 million smelter portion of the program utilized Inco's flash smelting technology. Two flash furnaces were built to replace the existing reverberatory furnaces, along with a sulphuric acid plant. The first flash furnace was completed in October 1991. The second flash furnace commenced operation in August 1993 with the smelting of bulk copper-nickel concentrate occurring on November 1. The $72 million mill rationalization program included the installation of a pyrrhotite rejection phase at Inco's Clarabelle mill. Inco now captures 90% of the sulphur contained in its Sudbury ores, compared to 70% previously, along with reducing the quantity of nitrogen oxides and carbon dioxide produced.

In early 1993, Inco commenced production from its Lower Coleman mine. The Lower Coleman is Inco's newest mine in the Sudbury region, equipped with the latest in equipment and technology. Full production of 8000 t/y is scheduled for 1994. Also in 1993, Inco re-opened its Garson mine in Sudbury at a cost of $40 million. The Garson mine was closed in 1986 due to poor ground conditions which had caused a serious rockfall. Production of 2000 t/d of nickel ore is scheduled for 1995. Proven ore reserves total 13.3 Mt grading 1.58% nickel and 1.09% copper. Mining was suspended in 1993 at Inco's Levack mine, which was the company's highest-cost mine in the Sudbury region. Nearly 65 Mt of nickel-copper ore has been produced from Levack since its beginning in 1929.

Engineering work continued on Inco's new McCreedy East mine. Development of the mine was suspended in September 1992 in order to re-evaluate the development costs and to incorporate into the project another orebody which had been discovered 1 km away. The capital costs for phase one of the project are now estimated at $205 million. With suitable market conditions, the McCreedy East mine will operate at 3000 t/d for 330 days per year to yield 12 500 t of nickel and

18 000 t of copper. Reserves stand at 32 Mt grading 1.58% nickel and 2.27% copper.

Shaft sinking was nearly completed in 1993 at the Manitoba Division's 1-D extension. The $222 million extension is providing some ore, but full production of nearly 17 000 t/y of nickel is not anticipated until 1998. The average anticipated grade is estimated at 2.51% copper-nickel over 14 years.

A clay seal was placed on the bottom of the mined-out Thompson Open-Pit to allow mining of the crown pillar from underground at the Thompson mine. Meanwhile, the Birchtree shaft extension remains on hold until 1996. The $143 million Birchtree extension would add more than 10 years' life to the mine at a production rate of 15 000 t/y of nickel and an average grade of 2.02% copper-nickel.

A new three-year labour contract for Thompson was ratified. The contract will expire in September 1996.

In October, Inco announced plans to reduce its 1994 production by 27 000 t, the majority of which would take place in the first quarter of 1994 through an eight-week shut-down at its Ontario Division and a combination of a four-week shut-down and a four-week-on/one-week-off rotation at the Manitoba Division. In addition, the company will close its Canadian operations for its annual four-week summer shut-down. Inco's production plans will depend on market conditions.

Inco continued programs to increase productivity. Over the past three years, productivity increased by 18% due mainly to workforce reductions and improvements in mining and processing technologies.

Mining grades of nickel decreased at both the Ontario and Manitoba divisions in 1993. The Ontario Division's average ore grade decreased from 1.28% nickel in 1992 to 1.23% nickel in 1993. The Manitoba Division's average ore grade was 2.43% nickel, down from 2.62% in 1992.

Inco's average realized nickel price for primary nickel in 1993 was US$2.72/lb, down from US$3.38/lb in 1992. Despite the low nickel prices, Inco reported a net profit of US$28 million for 1993 due mainly to the sale of its 62% interest in TVX Gold Inc., which generated US$127.9 million in after-tax income. A loss of US$18 million was incurred in 1992. Inco's capital expenditures decreased to US$186 million in 1993 from US$234 million in 1992.

Inco is proposing a $60 million underground exploration program on its Victor deposit located at the northeast rim of the Sudbury basin. The deposit has an estimated resource of between 20 and 40 Mt, with the richest mineralization occurring between 8000 and 8800 feet below the surface.

Falconbridge Limited closed its Canadian operations for six weeks ending January 31, 1993, and reduced its previously planned summer shut-down from ten weeks to two weeks. Its Canadian operations were also closed for the last week of December. Despite these shut-downs, Falconbridge increased its Canadian nickel production by 8% to 38 300 t, from 35 400 t of nickel in matte produced in 1992. Falconbridge also reduced its workforce by 200 employees and contractors in 1993. About one half of the reductions were through voluntary retirements and one half were through layoffs.

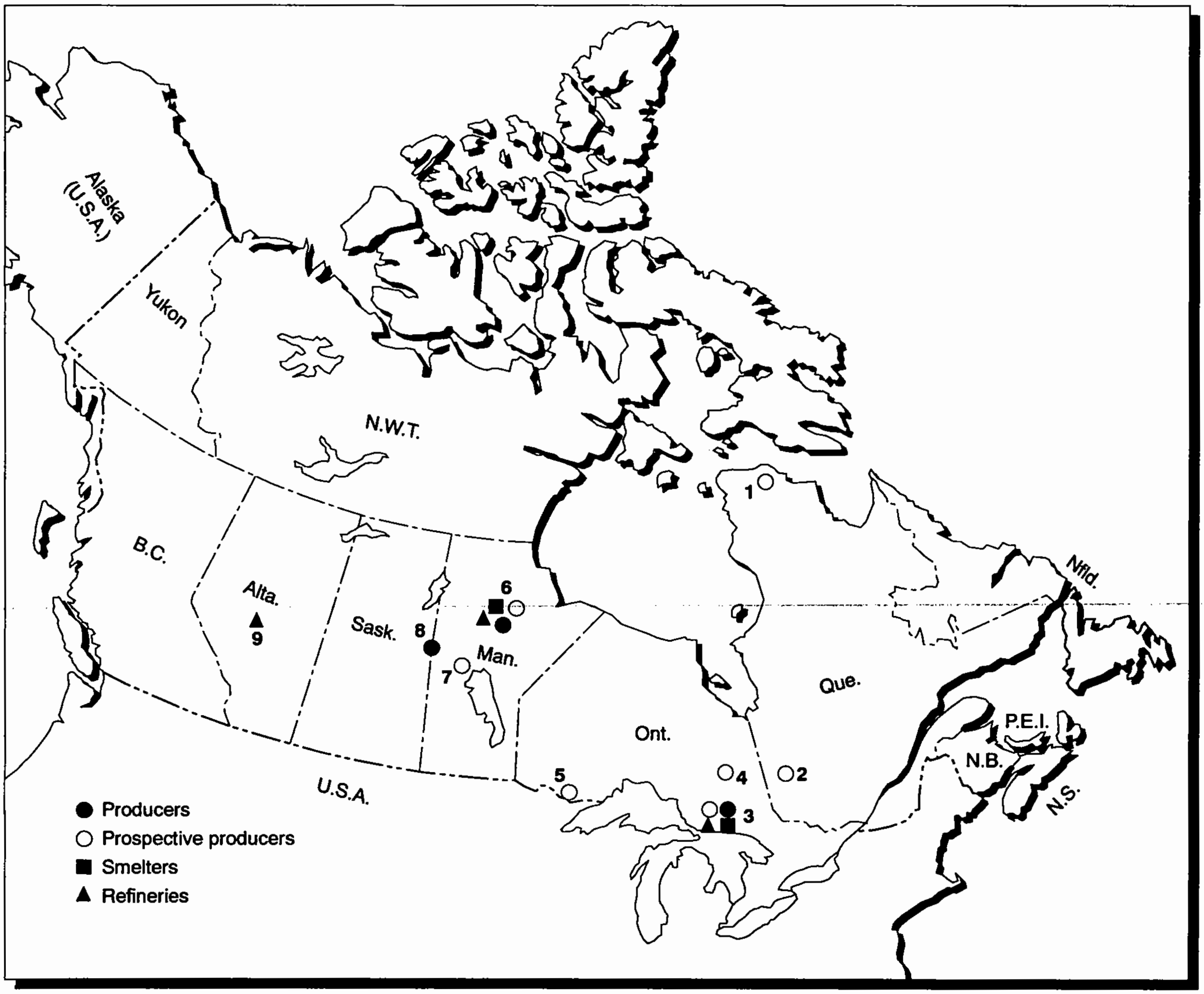
Falconbridge also mined higher-grade ore in 1993. The mill head grade in its Sudbury operations increased to 1.7% nickel in 1993 from 1.36% in 1989. Productivity increases and higher grades allowed Falconbridge to reduce operating costs to less than US$2.00/lb at Sudbury. This makes it one of the world's lowest-cost producers of nickel. However, Falconbridge lost $95 million in 1993 compared to earnings of $29 million in 1992, due principally to low nickel prices. The company spent $86 million on capital expenditures and $24 million on exploration in 1993 compared to capital expenditures of $158 million and exploration spending of $51 million in 1992.

The $25 million-$30 million shaft-sinking project at Falconbridge's Craig mine remained on hold. Production from the mine commenced in 1991 and reached 50% capacity by 1992, then increased to 70% capacity and will remain at that level until completion of the Craig shaft. Once in full production, it will produce over half of Falconbridge's nickel from Sudbury.

In 1993, Falconbridge also intersected what appears to be the down-dip extension of Inco's Victor deposit in Sudbury with reported grades of 5% nickel, 27% copper and 11 g/t platinum and palladium. Falconbridge is continuing its surface exploration work in the area.

The $30 million feasibility study of Falconbridge's Raglan nickel deposit in northern Quebec was completed in 1993. The study concluded that the project would be economic with nickel prices above US$4.25/lb. The capital cost of the project is estimated at $400 million and development would

Figure 1
Nickel in Canada, 1993



Numbers refer to locations on map above.

Producers

3. Falconbridge Limited (Craig, Fraser, Lockerby, Onaping, Strathcona)
   Inco Limited (Copper Cliff North, Copper Cliff South, Crean Hill, Creighton, Frood, Levack, Little Stobie, Coleman, McCreedy West, Stobie)
6. Inco Limited (Thompson, Birchtree, Thompson Open Pit)
8. Hudson Bay Mining and Smelting Co., Limited (Namew Lake)

Prospective Producers

1. Falconbridge Limited (New Quebec Raglan)
2. Timmins Nickel Inc. (Dumont)
3. Inco Limited (Garson, Murray, Totten, McCreedy East, Victor)
   Falconbridge Limited (Lindsley, Whistle)
4. Teck Corporation (Moncalm Township)
   Timmins Nickel Inc. (Redstone, Langmuir)
5. Inco Limited (Shebandowan)
6. Inco Limited (Soab North, Soab South, Pipe No. 1, Pipe No. 2)
7. Black Hawk Mining Inc. (Minago)

Smelters

3. Falconbridge Limited (Falconbridge)
   Inco Limited (Copper Cliff, Sudbury)
6. Inco Limited (Thompson)

Refineries

3. Inco Limited (Sudbury)
6. Inco Limited (Thompson)
9. Sherritt Gordon Limited (Fort Saskatchewan)

take three years. An estimated 20 000 t/y of nickel in concentrate would be produced from the operation. Falconbridge has budgeted $3.7 million in 1994 for surface exploration around the Raglan deposit. The Raglan deposit is now estimated to contain 18.1 Mt grading 3.13% nickel, 0.88% copper and 0.05% cobalt, plus precious metals.

Sherritt Inc., formerly Sherritt Gordon Limited, lost $41.5 million in 1993, compared to earnings of $2.3 million in 1992. The company increased its nickel production in 1993 to over 18 000 t, from 16 600 t in 1992. This increase was due in part to the completion of a nickel and cobalt expansion project. The project allows Sherritt to process nickel feeds with higher cobalt content, which Sherritt obtains from Union del Niquel of Cuba. Sherritt expects to operate in 1994 at close to its full capacity of 25 000 t/y of nickel and 2000 t/y of cobalt. Sherritt's long-term feed contract with Union del Niquel was expanded past the year 2000, which will ensure continued high levels of production.

The Namew Lake mine owned jointly by Hudson Bay Mining and Smelting Co. Limited and Outokumpu Canada was mined out and closed on November 5, 1993. The mine, which began production in September 1989, employed 176 and produced 8000 t/y of nickel.

WORLD DEVELOPMENTS

The world's two largest producers, Norilsk Nikel and Inco, each produced less in 1993 than in 1992. Japanese ferronickel producers also reduced production in 1993 which in turn sparked production cuts with most lateritic producers. There were two new operations that came on stream in 1993: Outokumpu's Forrestania project in Western Australia, and Potgietersrust Platinum's open-pit mine in South Africa. Expansion projects completed in 1993 include: Western Mining Corporation's (WMC) Kalgoorlie smelter and Kwinana refinery expansion, Tokyo Nickel's new roaster construction, Niquel Tocantin's refinery upgrade, and Jinchuan Nonferrous Corporation's new flash smelter. Cominco's Glenbrook Nickel project in Riddle, Oregon, along with the Feronikel Kosova plant in Serbia and the Macedonian ferronickel producer Fenimak, closed completely in 1993.

Australia

Australia's 1993 mine production was estimated to be 66 300 t. Western Mining Corporation Holdings Limited (WMC) reportedly produced 55 000 t, of which 29 000 t were refined at its Kwinana refinery, and the remaining was exported as matte. Outokumpu Aust. Pty. Ltd.'s Forrestania operation produced around 7000 t of contained nickel in concentrate. Queensland Nickel Joint Venture refined close to 27 000 t of nickel at its Yabulu refinery, mostly from ore imported from New Caledonia and Indonesia.

Outokumpu's Forrestania nickel project officially opened in January 1993. The total capital cost is expected to be $90 million, of which $55 million had been spent by year-end. When in full production, it will process 500 000 t/y of ore at an average grade of between 1.7% and 2.3% nickel to produce 11 000 t of nickel in concentrate. The concentrate is shipped through the port of Esperance to Outokumpu's Harjavalta smelter in Finland. Ore reserves at Forrestania are 4.4 Mt grading 2.1% nickel.

In November, WMC completed the expansion of its Kalgoorlie nickel smelter at a cost of $60 million. The project included $40 million to rebuild the furnaces and $20 million for a new oxygen plant. The capacity of the smelter was increased to 80 000 t from 55 000 t. The net result of the expansion will be lower unit operating costs. WMC's Kwinana refinery was also shut down in October and November to increase its capacity from 30 000 t to 42 000 t. The upgrades are part of WMC's $700 million project to expand its nickel operations in Western Australia.

WMC gained full control over the Mount Keith property in February 1993 as Outokumpu sold its interest in order to concentrate on its new Forrestania operation. But Outokumpu will still process concentrate from Mount Keith, having agreed to purchase half of Mount Keith's output for the first 10 years of the mine's life, a total of 140 000 t of nickel in concentrate. Mount Keith is one of the world's largest low-grade nickel sulphide deposits. Once completed in 1995, the mill will treat 6 Mt/y of ore and produce 28 000 t/y of nickel in concentrate. The project is estimated to cost $395 million.

Also included in WMC's $700 million project was the $115 million expansion of the Leinster mill to 2 Mt/y, which increased output at Leinster to 30 000 t/y of contained nickel in concentrate. WMC's Kambalda operations will be refurbished at a cost of close to $90 million.

As Queensland Nickel continued to lose money, the operation reduced staff by 64 people (10% of employees) at its Yabulu treatment plant and cut salaries for directors and staff by 7.5%. Output was 27 000 t in 1993.

With continued lower nickel prices, Dominion Mining Limited's $410 million Yakabindie nickel project in Western Australia remained on hold. The large low-grade open-pit mine was to have started at the end of 1992 to produce 21 000 t/y of nickel in concentrate, but development was deferred due to weak nickel market conditions.

Brazil

Cia de Niquel Tocantins invested US$25 million to increase output at its San Miguel Paulista refinery from 5000 to 10 000 t/y. Production in 1993 was expected to increase to 7200 t from the 6000 t produced in 1992. The target for 1994 is 10 000 t, of which 70% will be exported. Elsewhere in Brazil, RTZ decided to proceed with a feasibility study on the Fortaleza de Minal nickel deposit in Minas Gerais state.

Burundi

RTZ Corp. PLC signed a nickel exploration agreement with the government. The agreement covers the southern half of a 300-km prospective nickel belt crossing Burundi from northeast to south. Exploration ceased, however, pending the resolution of regional difficulties.

China

China's refined nickel production in 1993 was close to 30 000 t, of which the Jinchuan Nonferrous Metals Corporation produced over 80%. Jinchuan successfully commissioned its new flash smelter in 1993 but, as of September, it had yet to complete the sulphuric acid plant. The expansion will increase Jinchuan's smelter capacity to 40 000 t by 1995, but the mine may not be able to supply the additional feed required.

Colombia

Cerro Matoso S.A. announced in January 1993 that it would postpone plans for a US$600 million expansion of its 20 000-t/y ferronickel plant. The plans included building a second furnace at its plant. The company cited low nickel prices, rising production costs and a new government proposal to increase royalties as reasons for the postponement. Cerro Matoso is 52% owned by the Royal Dutch Shell Group.

Cuba

Cuban production fell in 1993 to 29 000 t from 32 000 t in 1992. The decreased production resulted primarily from maintenance problems and an energy shortage. The government sought to revitalize the sector by giving producers greater autonomy and encouraging foreign investment.

Union del Niquel was granted more autonomy over its affairs, including an agreement that the company could keep 50% of the profits. This permitted Union del Niquel to attract foreign investment for much-needed maintenance and upgrading of its operations. Increased energy efficiency was one of the goals.

Davy International was commissioned to begin a technical study of the Punta Gorda nickel smelter which produced 4000 t in 1993, only 13% of its capacity.

Dominican Republic

Falconbridge Dominicana, C. por A., a subsidiary of Falconbridge, closed its ferronickel plant for three months beginning December 26, 1992. Consequently, production in 1993 decreased by 3500 t to 24 000 t of ferronickel. The company planned to carry out maintenance, repairs and a general clean-up of the operation during the shutdown.

Finland

Outokumpu Harjavalta Metals Oy announced that it will expand its Harjavalta smelting and refining facilities from 18 000 t/y to 32 000 t/y of refined nickel. The project is expected to cost US$327 million and should be completed by 1996. The additional nickel feed for the expansion will come from Australia. Both its Forrestania nickel mine in Western Australia and WMC's Mount Keith property, under a long-term contract, will supply the feed material. Outokumpu Finnmines Oy plans to close its Enonkoske mine in Finland in February 1994 due to low prices.

Greece

General Mining & Metallurgical Co. S.A. LARCO operated at about 50% of its 25 000-t/y capacity due to the prevailing weak market conditions. LARCO's production costs are reportedly close to US$3.50/lb. The decision to privatize the operation was deferred until market conditions improve.

Indonesia

P.T. International Nickel Indonesia's (P.T. Inco) output decreased slightly in 1993 to 34 000 t of contained nickel. The 2000-t decrease from 1992 was due to transformer problems affecting one of P.T. Inco's three furnaces. Production for 1994 is expected to reach 45 000 t, or 100% of rated capacity. The higher production will result from the completion of a five-year expansion program.

P.T. Aneka Tambang plans to commission its new 5500-t/y ferronickel smelter on Sulawesi Island in 1994. This will increase the company's total capacity to 11 000 t/y of contained nickel. Contracts for the additional ferronickel were signed with Japan.

Ivory Coast

Falconbridge signed an agreement with the Société d'Etat pour le Développement Minier de la Côte d'Ivoire (SODEMI) and the Canadian junior company Trillion Resources. The partners will explore for nickel deposits in the Biankouma area of western Ivory Coast. Falconbridge had conducted extensive exploration in that same region 10 years ago, delineating the Sipala sulphide deposit with a grade of between 1.7% and 2.0% nickel. Current exploration will take place just east of that deposit.

Japan

Japanese nickel production decreased to 98 500 t in 1993 from 107 000 t in 1992 and 114 200 t in 1991. The decrease reflected the weak demand from the domestic economy and decreased exports of stainless steel. The strong yen continues to hurt Japanese competitiveness.

Tokyo Nickel Company Ltd. completed construction of its new US$41 million roaster at its Matsuzaka plant. The roaster, completed in March, did not begin producing until July due to poor market conditions. The new roaster replaced one which had been installed 25 years earlier.

Sumitomo Metal Mining Co. Ltd. announced steps to reduce costs at its nickel operations. It intends to cut 400 jobs from its present workforce of 4400 people between April 1994 and March 1997. The reductions will be achieved through attrition, early retirement and hiring restraints.

Total nickel production in 1994 is expected to be similar to 1993. An increase in nickel oxide sinter production, due to increased supplies from P.T. Inco and WMC, will be offset by a decrease in ferronickel production. Ferronickel production is expected to fall by approximately 6% to 48 000 t due to declining stainless steel production.

Malaysia

Australia's Malaysian Nickel Management discussed the possibility of building a US$300 million ferronickel smelter at Bintulu, Sarawak in east Malaysia. The ferronickel smelter would produce 16 000 t/y of contained nickel. Ore for the project would be sourced from within the region, more specifically from Indonesia, the Philippines or elsewhere in the Pacific Rim.

New Caledonia

Société Métallurgique le Nickel (SLN) produced 36 000 t of nickel in ferronickel and 11 000 t of electrolytic nickel refined at its facilities in France in 1993. This was an increase of 20% from SLN's 1992 production of 32 000 t of nickel in ferronickel and 7000 t of electrolytic nickel, which had been lower than normal due to smelter maintenance at the Doniambo plant.

SLN worked on two mine projects in 1993. A small extension of the Mea mine was near completion, and development work commenced on the Népoui mine on the west coast of the island. Népoui is scheduled to begin operating by 1995.

Goro Nickel S.A. was incorporated in New Caledonia in 1993. Inco owns 85% and the Bureau de Recherches Géologiques et Minières, an agency of the French government, owns the remaining 15%. Goro was formed to develop an economic process to treat its lateritic deposits which are located in New Caledonia.

Norway

Falconbridge's Nikelverk refinery was shut down for four weeks as a result of Falconbridge's Canadian operations' extended winter shut-down. Despite the shut-down, Nikelverk's production increased by 1100 t of refined nickel to 56 800 t in 1993.

Russia

According to the International Nickel Study Group, nickel production in Russia fell in 1993 to 190 000 t from 243 000 t in 1992. This in turn led to a 17% decrease in Russian exports to the West to 110 000 t in 1993 from close to 133 000 t in 1992.

Norilsk Nikel is reported to have had difficulties obtaining equipment and supplies. These problems, together with decreased ore grades and increased energy costs, have increased Norilsk's production costs to US$3.50/lb, according to a senior representative of the Norilsk Nikel Concern. A fire at the smelter complex on October 14 reduced its production. Norilsk's production is estimated at 90 000 t in 1993, down from an estimated 119 000 t in 1992. Serveronikel, which received less feed from Norilsk, was reportedly searching for feed from foreign sources. Serveronikel's production is estimated at 70 000 t in 1993 (half of its rated capacity), down from 107 000 t in 1992.

Russian nickel exports in 1993 decreased to an estimated 110 000 t from 133 000 t in 1992, not only as a result of lower production, but also due to a decrease in the quantity of "back-door" nickel leaving the county. The Russian government adopted a number of measures to control exports. The government granted Norilsk the sole licence for nickel exports, and also brought in an export tax of 1200 European Currency Units per tonne (ECU/t) on refined nickel, which brought the export price of nickel up to US$1.70/lb (October 1993) compared to an LME cash nickel price of US$2.02/lb in October. The domestic price of nickel also increased. Exports of Russian nickel are expected to be about 90 000-100 000 t in 1994.

A new tender to renovate Norilsk's Pechenganikel nickel smelter was offered in 1993. The previous tender to reduce the sulphur dioxide emissions at Pechenga had been awarded to Outokumpu, but the US$640 million deal fell through due to a lack of financing. The tender was awarded to a consortium of Norway's Elkem Technology, Kvarner Engineering, and Sweden's Boliden Contech; however, no deal was signed and the Russians have told the consortium that the project plans must be changed to cut costs. Under the tender guidelines, sulphur dioxide emissions must be reduced from 248 000 t/y to 40 000 t/y. The consortium drew up two reconstruction projects, each costing US$297 million.

It is planned that Norilsk will be privatized in 1995. The state is expected to hold 38% of the shares; 25% of the shares would be issued at no charge to the 250 000 employees and 10% would be sold to employees at a preferential rate of 90% of par value. Norilsk would reserve 10% of the stock for future employees and sell 5% to management. The remaining 12% could be offered on the free market.

Serbia and Macedonia

The 4500-t/y Feronikel Kosovo plant in Serbia reportedly stopped production in May 1993. Fenimak, the Macedonian ferronickel producer which closed in September for two weeks for repairs, remained shut through year-end. Earlier in the year Fenimak had gone from a two-line to a one-line operation, decreasing its output to 8500 t/y from 17 500 t/y of contained nickel.

South Africa

In 1993, South Africa produced around 28 000 t of nickel as a by-product of platinum, of which 11 000 t was consumed domestically. Nickel production is expected to increase to 36 000 t by 1998, of which 27 000 t would be consumed domestically by Columbus Steel. Columbus Steel is in the process of expanding its current operation, which will make it the world's largest single-site producer of stainless steel. Rustenburg Platinum Mines Ltd., Impala Platinum Ltd. and Western Platinum Ltd. held negotiations with Columbus to supply the additional nickel.

Rustenburg Platinum produced 16 000 t of nickel in 1993 and is expected to produce 21 000 t in 1994 due to the opening in 1993 of Potgietersrust Platinum's (a joint venture between Rustenburg and Lebowa) open-pit mine. The new mine will add 4000-5000 t of nickel to Rustenburg's annual production. Of Rustenburg's 1994 production, about 13 000 t could be supplied to Columbus. Impala Platinum, which produced about 8500 t in 1993, exported about 6500 t. However, Impala could divert all of its nickel production to Columbus and utilize more of its 11 000-t/y capacity. Western Platinum produces around 2500 t/y of contained nickel, which is shipped to both Bindura and Impala Platinum. Northam Platinum Ltd. produced around 500 t of contained nickel in 1993, which is also sent to Impala for processing. Northam plans to triple its production in 1994.

Anglovaal approved an 80 million Rand feasibility study of a nickel mine in the Eastern Transvaal. The complex mineralized orebody contains nickel, cobalt, copper and platinum group metals. Anglovaal recommended sinking a pilot shaft and construction of a pilot plant. The study will be completed in three years.

Taiwan

Taiwan Nickel Refining Corp. suspended production for six weeks at the start of 1993 due to low nickel prices. This reduced the company's output by 1200 t to an estimated 8000 t of nickel in utility nickel in 1993. Inco continued a study of expanding refining capacity at Taiwan Nickel, in which it has a 49.9% equity interest. The increased capacity would service the expanding domestic stainless steel industry. All of the present output is consumed within Taiwan.

Tanzania

Exploration continued in 1993 on the Kabanga deposit by Sutton Resources Ltd. and its partner BHP Minerals. To date, reserves are estimated at 25.5 Mt grading 1.19% nickel, 0.20% copper and 0.10% cobalt. A 24 000-t/y smelter is being considered for the deposit at a cost of $210 million.

United Kingdom

Production at Inco's United Kingdom nickel and precious metals refineries were reduced due to lower shipments of intermediate feed from Canada. As a result, Inco's nickel refinery at Clydach, Wales, switched from two lines to one line. The Clydach refinery shut down for six weeks in the summer of 1993 and will also shut down for six weeks in the summer of 1994. To reduce costs, Inco had cut employment at Clydach by 22% in 1992.

United States

Cominco Resources' Glenbrook Nickel Corporation closed its operation in Riddle, Oregon, on July 31 due to low nickel prices. The operation had resumed on March 1 after being closed since December 20, 1992, due to low prices. Glenbrook produced 9000 t of ferronickel in 1992 and production was about 5000 t in 1993.

Black Hawk Mining Inc. plans to develop its Knox nickel-copper-cobalt deposit in Maine when market conditions improve. The US$35 million project is projected to have cash costs of between US$1.70 and $1.80/lb. When prices recover above US$3.00/lb, Black Hawk is expected to resume working on obtaining the necessary environmental permits, which could take two years.

The Defense Logistics Agency sold 1300 t of nickel in fiscal year 1993 (October 1, 1992 to September 31, 1993), although 9072 t were allocated for sale. The allocation for sale in fiscal year 1994 is 9072 t. The United States has indicated that it plans, over the next few years, to sell all of its inventory, which stood at 32 120 t in October 1993.

Venezuela

Anglo American Corporation acquired the right to buy 70% of Jordex Resources' 50% stake in the Venezuelan company Cofeminas. Cofeminas owns the Loma de Heirro nickel deposit. The deposit, discovered in the 1940s, has estimated reserves of 25 Mt grading 1.8% nickel. Preliminary capital costs are estimated at between US$300 million and $350 million for a mine and smelter which would produce 16 000-20 000 t of ferronickel.

Vietnam

Vietnam's Ban Phuc nickel-copper deposit was reported to be under development, with completion of the project planned for 1995 or 1996. The deposit is located in the province of Son La and has reserves of 981 000 t grading 3.38% copper and 1.24 % nickel. The US$18.3 million project could produce 5000 t/y of copper concentrate and 23 500 t/y (gross weight) of nickel concentrates.

Zimbabwe

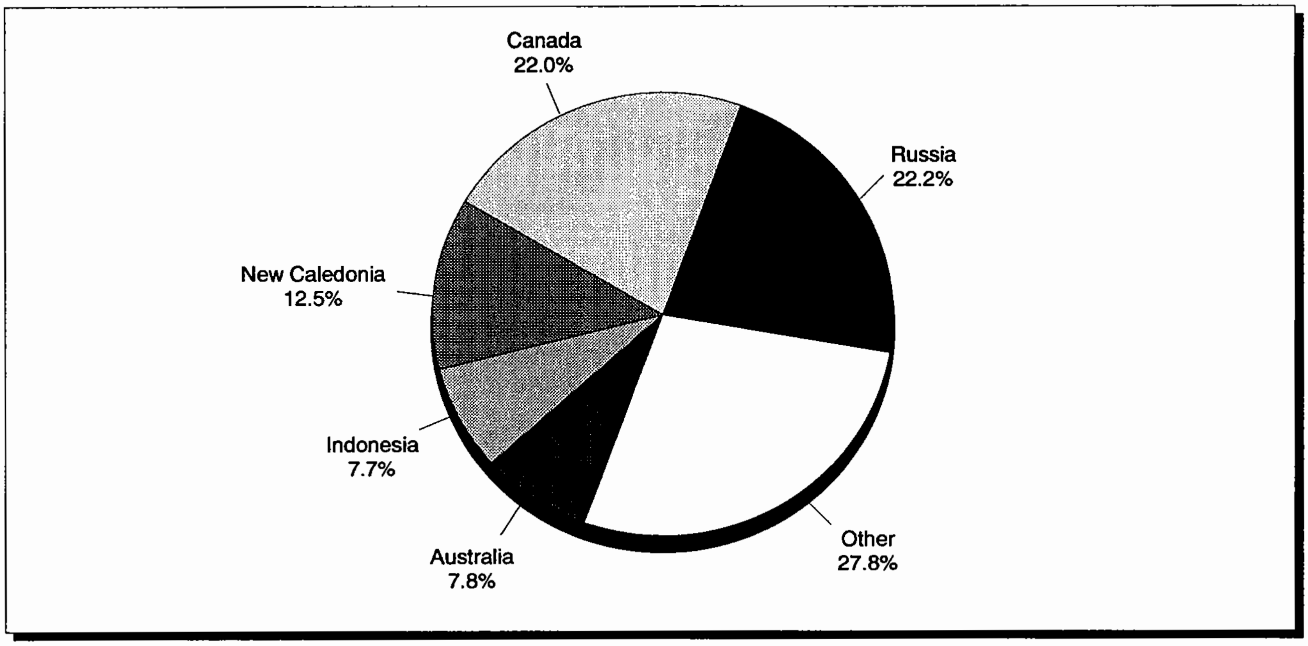
Rio Tinto Zimbabwe Ltd. continued to face problems in securing feed material to permit an increase in the capacity of the Empress nickel refinery in Eiffel Flats. The planned increase would increase capacity from 6000 t/y to 10 000 t/y. Design work continued, but the final decision was deferred due to cancellation of plans to develop the Phoenix mine in Botswana. Tati Nickel Mining Company shelved its development plans due to low nickel prices. The project needs a price of at least US$3.00/lb of nickel before development can be considered.

Bindura Nickel Corporation Ltd. produced 12 000 t in 1993, up slightly from 1992's production of 10 300 t. Bindura operated at full capacity of 14 000 t/y through the latter half of 1993, after completing a US$15 million smelter relining project. This project was part of a US$169 million capital project to install new technology that is to be completed in 1995. Bindura is expected to operate at its full capacity of 14 000 t/y in 1994 as its unit costs are lower at full capacity. Bindura undertook an extensive exploration program in Zimbabwe to seek further reserves.

HEALTH AND THE ENVIRONMENT

Under a 1985 Ontario government regulation, Inco and Falconbridge are required to reduce their emissions of sulphur dioxide to 265 000 t and 100 000 t, respectively, by 1994. In 1985, the limit had been set at 685 000 t for Inco and 154 000 t for Falconbridge. To meet the regulations, Inco embarked on a $612 million sulphur dioxide emission abatement project at its Sudbury operations, which was completed in 1993. Falconbridge spent $40 million between 1988 and 1993 to reduce its sulphur dioxide emissions.

Figure 2
Nickel, Production by Country, 1993



Sources: Natural Resources Canada; International Nickel Study Group.

The ores at Sudbury contain eight pounds of sulphur for every pound of nickel. To deal with the complex problem of reducing sulphur dioxide emissions, Inco developed new production techniques to process a single bulk copper-nickel concentrate. New milling technology at the Clarabelle mill eliminates much of the pyrrhotite from the concentrate; thus, much of the sulphur does not enter the smelter. This process reduced sulphur dioxide emissions by about 100 000 t/y. In addition, new fluid bed driers, two new oxygen flash furnaces, a new oxygen flash-smelting reactor, a sulphuric acid plant and an oxygen plant were installed to modernize and reduce sulphur dioxide emissions. With the introduction of this technology, Inco will no longer burn fossil fuels in the smelting process, thereby reducing carbon dioxide production as well. As an additional benefit, the intensive use of pure oxygen reduces the production of nitrogen oxides. Inco's Sudbury operations now capture 90% of the sulphur contained in its Sudbury ores, compared to 70% in 1987.

Falconbridge spent an estimated $40 million between 1988 and 1993 on research, development and capital projects towards reducing the amount of sulphur dioxide emitted from its smelter. The focus of its research was on increasing the quantity of pyrrhotite rejected before its concentrate enters the smelter. The modifications allow Falconbridge to operate its smelter at 100% capacity and not exceed the 100 000-t sulphur dioxide limit.

In Europe, the European Commission announced plans to introduce a Council Directive restricting the marketing and use of certain substances and preparations. The draft directive will restrict the marketing of products containing nickel and its alloys that can be used in direct and prolonged contact with the skin. If adopted, the directive would ban the use of nickel in a variety of jewellery, buttons, spectacle frames, tighteners and zippers if the rate of nickel release from the parts in direct and prolonged contact exceeds 0.5 $\mu g/cm^2$/week.

Characteristics and Uses

Nickel is a hard, tough, greyish-white metallic element that ranks 24th in the abundance of metals found in the earth's crust. Its many desirable properties, particularly its resistance to corrosion in both acidic and basic environments, its high strength over a wide temperature range and its pleasing appearance, have resulted in its wide application in both the alloyed and unalloyed state.

Along with chromium, nickel is alloyed with iron to produce stainless steels which account for over 60%, or 390 000 t, of primary nickel consumed by the Western World in 1993. As well, considerable quantities of secondary material are used directly in the production of stainless steels. These steels are used in a wide variety of applications, primarily for their resistance to corrosion, strength and ease of cleaning. They are used in chemical and food processing equipment, petroleum refining equipment, tanks for road, rail and sea transportation of various liquids, household goods and surgical equipment, along with building facings and trim, to name a few.

Stainless steels can contain varying quantities of nickel, but must have at least 10% chromium. The addition of large quantities of nickel, usually between 7% and 12%, changes the crystal structure of the steel to austenitic, making the steel non-magnetic. This type of stainless steel is thus called austenitic stainless steel and is widely referred to as 18/8, due to the most common content of chromium (18%) and nickel (8%). Austenitic stainless steel is readily fabricated and welded, and accounts for three quarters of all stainless steel produced.

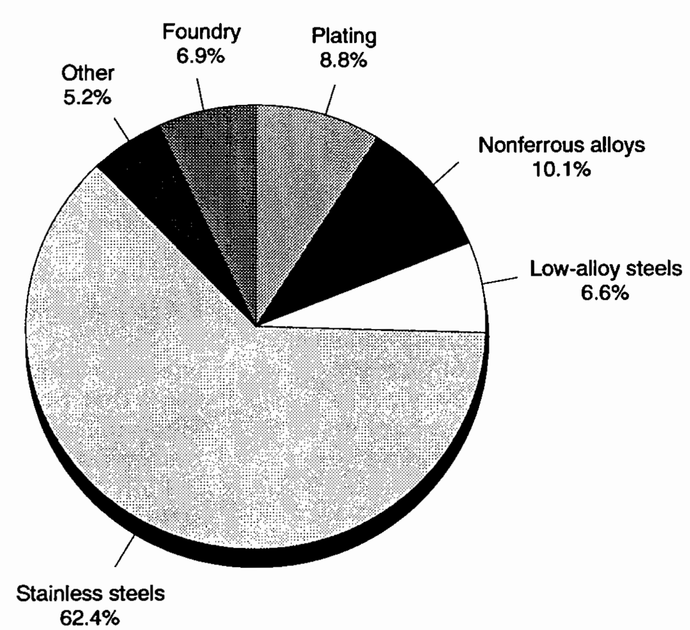
Nickel is used as an alloying agent and is a component in some 3000 different alloys which are used in more than 250 000 end-use applications. When nickel is alloyed with other metals such as chromium, its high-temperature performance makes it indispensable to the aerospace industry, specifically in the design of gas turbine aircraft engines. When alloyed with metals such as molybdenum or copper, its resistance to corrosion makes it essential in aggressive chemical processes, the petroleum industry and nuclear power plants. These high corrosion-resistant nickel alloys have been the overwhelming choice in environmental equipment such as flue-gas desulphurization scrubbers.

In an unalloyed state, nickel is used for plating of automotive products and household appliances. The use of zinc-nickel coatings can provide five to six times more resistance to road salt corrosion than ordinary galvanized steel.

The chemical properties of nickel enable it, and some of its salts, to be used as catalysts in the chemical industry. It is also used in the production of batteries and fuel cells, in carbide and hard-facing materials, and in ceramics to form a bond between the enamel and metal, as well as in the manufacturing of colours and pigments.

At present, Japan, the United States and Western Europe account for close to 90% of the demand for nickel in the Western World. But the newly

Figure 3
Nickel, Western World First-Use Consumption, 1993



Source: CRU International Ltd.
Note: Does not include the C.I.S., China, and former Comecon countries.

industrialized countries, particularly in the Pacific Rim, are gradually increasing their share of the market and are expected to continue this trend in the future. Russia is also a major consuming nation of primary nickel, ranked third behind Japan and the United States. China, which currently consumes an estimated 45 000 t/y of primary nickel, is anticipated to be one of the largest growth areas for nickel and, according to some analysts, could consume 90 000 t by the year 2000.

Nickel stainless steels and new high-performance alloys will be the major growth areas for nickel.

MARKETS AND PRICES

Demand for nickel in the Western World increased to an estimated 654 600 t in 1993 compared to 1992's six-year low of 626 800 t. This was due in part to a decrease in the substitution of secondary materials for primary nickel and an increase in stainless steel production. Western World production of primary nickel decreased in 1993 to an estimated 561 600 t from 575 800 t produced in 1992. This was due, for the most part, to production cuts by Inco and the Japanese ferronickel producers, along with technical problems at SLN. The decrease in Russian production was the major factor in Russian exports decreasing to around 110 000 t from an estimated 133 000 t in 1992.

Despite the decrease in Western World production and Russian exports, and an increase in primary nickel consumption, the build-up of nickel stocks continued. LME stocks increased by nearly 58% and reached 124 104 t at the end of 1993. The price of nickel consequently declined to an average LME price of US$2.40/lb, a record low in real terms, compared to the 1992 average of US$3.18/lb. The price started out the year at an average of US$2.69/lb in January and steadily decreased to a monthly average of US$1.98/lb in September. But, in October, with Inco's announced cutbacks in 1994 and news from Norilsk that production was lower, the price gradually started to increase, despite the growing LME stocks. By the end of the year the average price of nickel had risen to US$2.32/lb, due mostly to technical buying as very little physical nickel was actually being purchased.

OUTLOOK

Western World primary nickel consumption is expected to increase in 1994 to around 680 000 t from the estimated 654 600 t consumed in 1993, due to general strengthening of the world economy, led by the United States. Consumption is expected to reach close to 700 000 t/y by the year 2000 with the increase being largely due to increased stainless steel production, which should grow at over 3%/y.

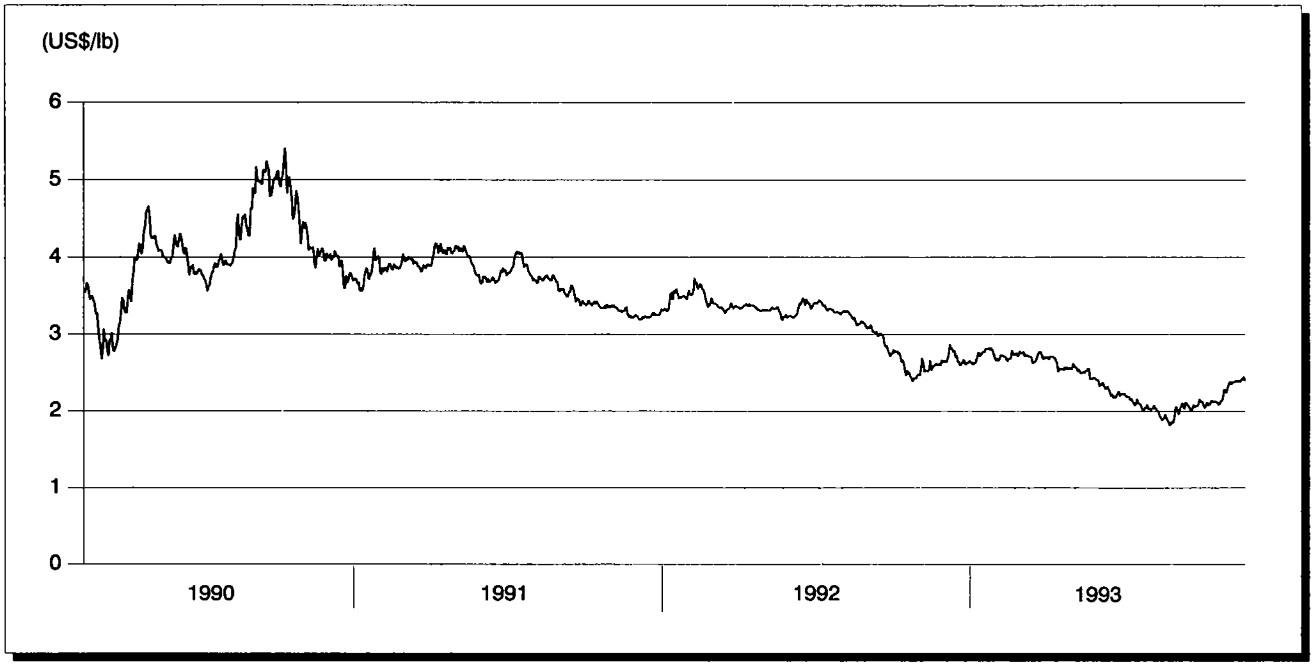
Canada's nickel production will decrease to an estimated 158 000 t in 1994 compared to 188 400 t in 1993. This will be primarily due to cutbacks by Inco and the closure of the Namew Lake mine. Canadian production is expected to rebound in 1995 to 190 000 t, and to 195 000 t by the year 2000. If New Quebec Raglan were to be brought into production, Canadian output would increase by an additional 20 000 t/y.

Despite Inco's announced cutbacks, Western World production of primary nickel is expected to increase in 1994. The increase will be primarily due to production increases at Western Mining Corporation's Australian facilities, Rustenburg Platinum's South African operation, and Sherritt's Canadian operation, along with production returning to normal levels at Falconbridge's Dominicana operation and its Kristiansand refinery in Norway. Production from Russia is expected to remain at close to 190 000 t, resulting in exports to the West of between 90 000 and 100 000 t in 1994.

The price of nickel is forecast to average around US$2.65/lb in 1994 as the supply/demand balance for nickel slowly starts to improve. LME stocks should start to decrease late in 1994, supporting higher nickel prices for 1995. Over the longer term, prices should vary within the range of US$3.75/lb to $4.25/lb in constant 1993 dollars.

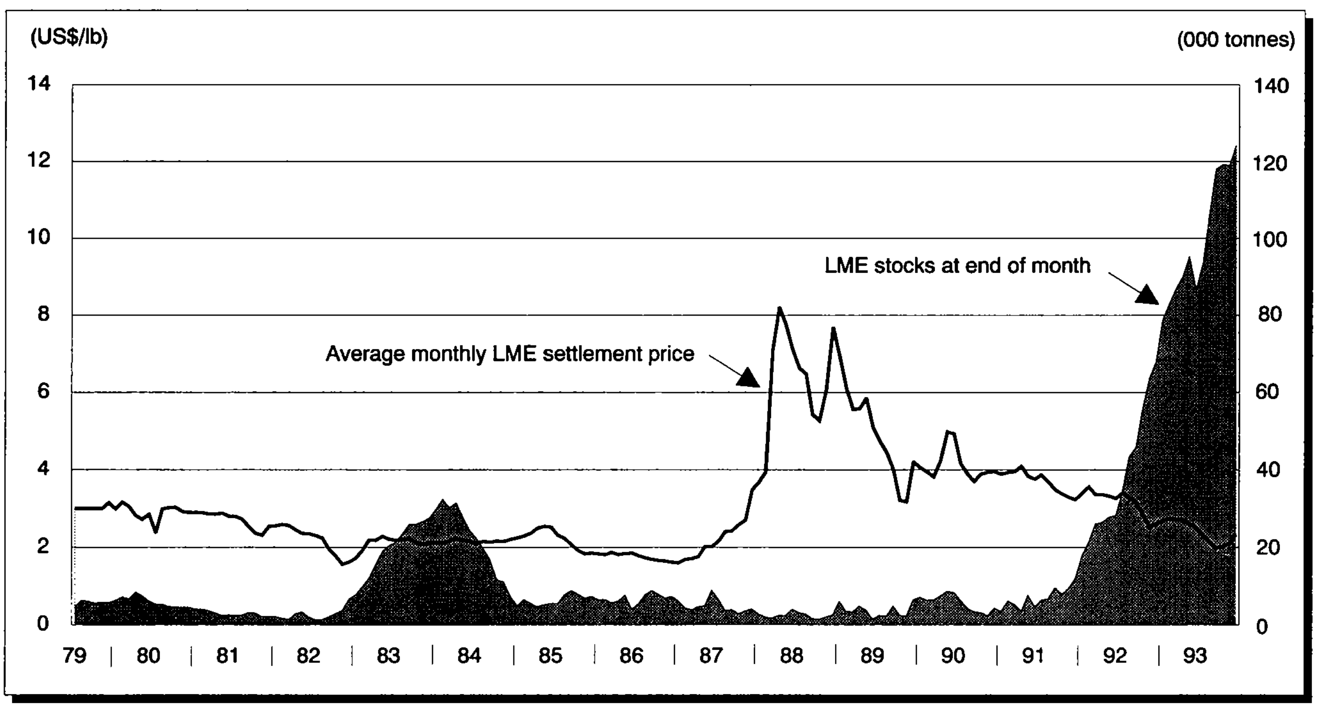
Note: Information in this review was current as of January 14, 1994.

Figure 4
London Metal Exchange Nickel Settlement Prices, 1990-93



Source: Natural Resources Canada.

Figure 5
Nickel, LME Monthly Settlement Price and LME Stocks, 1979-93



Source: Natural Resources Canada.

TARIFFS

Item No.	Description	Canada MFN	Canada GPT	Canada USA	United States Canada	EC MFN	Japan[1] MFN
2604.00	Nickel ores and concentrates	Free	Free	Free	Free	Free	Free
7501.10	Nickel mattes	Free	Free	Free	Free	Free	Free
7501.20	Nickel oxide sinters and other intermediate products of nickel metallurgy	Free	Free	Free	Free	Free	Free-81 yen/kg[2]
7502.10	Unwrought nickel, not alloyed	Free	Free	Free	Free	Free	81 yen/kg
7502.20	Unwrought nickel alloys	Free	Free	Free	Free	Free	Free-9%[3]
7503.00	Nickel waste and scrap	Free	Free	Free	Free	Free	Free
7504.00.10	Nickel powders containing by weight 60% or more nickel	Free	Free	Free	Free	0.5%	Free
7504.00.20	Nickel powders containing by weight less than 60% of nickel; flakes	10.2%	6 .5%	Free	Free	0.5%	65 yen/kg-6%
7505.11	Bars, rods and profiles of nickel, not alloyed	Free-10.2%	Free-6.5%	Free	Free	4.4%	7.2%
7505.12	Bars, rods and profiles of nickel alloy	Free-10.2%	Free-6.5%	Free	Free	4.4%	5.8%
7505.21	Nickel wire, not alloyed	Free-10.2%	Free-6.5%	Free	Free	4.4%	7.2%
7505.22	Wire, nickel alloy	Free-10.2%	Free-6.5%	Free	Free	4.4%	5.8%
7506.00	Nickel plates, sheets, strip and foil	Free-10.2%	Free-6.5%	Free	Free	4.9%	Free-7.2%
7507.00	Nickel tubes, pipes and tube or pipe fittings	Free-10.2%	Free-6.5%	Free	Free	5.3%	6.5%-7.2%
7508.00	Other articles of nickel	Free-11%	Free-7%	Free-4.4%	1.8%-2.2%	4.6%	5.8%

Sources: Customs Tariff, effective January 1994, Revenue Canada, Customs and Excise; Harmonized Tariff Schedule of the United States, 1994; The International Customs Journal, European Economic Community, 1992-93, No. 14, "Conventional" column; Customs Tariff Schedules of Japan, 1993.

[1] GATT rate is shown; lower tariff rates may apply circumstantially. [2] Free except for nickel oxide sinters containing by weight not less than 88% nickel which is 81 yen/kg, and nickel oxide containing by weight not more than 1.5% copper which is 7.2%. [3] Tariff rate of 9% applies to nickel alloys other than those containing by weight less than 50% of nickel and not less than 10% of cobalt.

TABLE 1. CANADA, NICKEL PRODUCTION AND TRADE, 1992 AND 1993

Item No.		1992		1993p	
		(tonnes)	($000)	(tonnes)	($000)
PRODUCTION[1,2]					
	All forms				
	Ontario	118 860	1 005 556	125 824	846 418
	Manitoba	58 695	496 556	52 696	354 486
	Total	177 555	1 502 112	178 520[a]	1 200 904
EXPORTS				**(Jan.-Sept.)**	
2604.00	Nickel ores and concentrates, nickel content				
	Finland	94	93	–	–
	United States	3	15	–	–
	Total	97	109	–	–
7501.10	Nickel mattes				
	Norway	33 763	312 590	15 541	252 334
	United Kingdom	29 157	206 578	22 866	149 822
	Total	62 920	519 169	38 407	402 156
7501.20	Nickel oxide sinters and other intermediate products of nickel metallurgy				
	Belgium	640	6 196	1 780	16 713
	South Korea	8 549	73 433	2 762	16 589
	Taiwan	1 992	15 971	1 264	7 576
	Singapore	845	7 832	503	3 246
	United States	530	3 841	310	2 070
	Other countries	134	1 858	100	1 292
	Total	12 690	109 131	6 719	47 486
7502.10	Nickel unwrought, not alloyed				
	United States	52 847	456 375	37 410	279 913
	Belgium	21 514	187 704	13 232	99 776
	Taiwan	5 124	43 306	4 975	35 676
	Netherlands	5 475	47 228	4 875	34 544
	Japan	6 542	60 178	2 858	20 305
	United Kingdom	3 221	27 437	1 952	14 988
	Other countries	8 237	70 783	5 880	43 750
	Total	102 960	893 011	71 182	528 952
7502.20	Nickel unwrought, alloyed				
	United States	1 094	10 057	871	6 909
	Belgium	617	6 614	837	6 027
	Japan	–	–	289	2 274
	South Korea	89	913	62	595
	Other countries	43	441	97	657
	Total	1 843	18 025	2 156	16 462
7503.00	Nickel waste and scrap				
	United States	3 591	13 727	1 172	5 460
	Netherlands	215	787	554	1 958
	Japan	49	105	60	461
	United Kingdom	85	463	78	184
	Other countries	42	326	–	–
	Total	3 982	15 408	1 864	8 064
7504.00	Nickel powders and flakes				
	United States	5 698	70 683	4 602	58 039
	Japan	2 324	26 223	1 924	14 600
	People's Republic of China	112	1 475	298	3 081
	Netherlands	198	2 113	391	2 692
	Singapore	63	847	182	1 885
	Hong Kong	259	3 367	106	1 523
	Other countries	311	4 628	248	3 125
	Total	8 965	109 336	7 751	84 945
7505.11	Bars, rods and profiles of nickel, not alloyed	3	28	8	47
7505.12	Bars, rods and profiles of nickel alloy				
	Poland	...	1	...	1
	United States	...	10	–	–
	Total	...	11	...	1
7505.21	Nickel wire, not alloyed	24	144	–	–

TABLE 1 (cont'd)

Item No.		1992		Jan.-Sept. 1993p	
		(tonnes)	($000)	(tonnes)	($000)
EXPORTS (cont'd)					
7505.22	Wire, nickel alloy	36	589	25	292
7506.00	Nickel plates, sheets, strip and foil	48	956	159	3 044
7507.00	Nickel tubes, pipes and tube or pipe fittings	. .	3 086	. .	1 173
7508.00	Other articles of nickel				
	Netherlands	. .	830	. .	1 294
	Former Czechoslovakia	–	–	. .	1 253
	United States	. .	259	. .	359
	Finland	. .	3	. .	338
	Other countries	. .	647	. .	532
	Total	. .	1 739	. .	3 776
IMPORTS[3]					
2604.00.00.20	Nickel ores and concentrates, nickel content				
	United States	281	1 486	460	2 603
	Total	281	1 486	460	2 603
7501.00	Nickel mattes, nickel oxide sinters and other intermediate products of nickel metallurgy				
	Cuba	19 957	123 355	16 841	89 442
	United States	4 429	6 752	3 816	5 655
	United Kingdom	827	3 267	1 042	3 021
	Belgium	3 275	4 613	2 224	2 746
	Australia	556	4 221	497	2 669
	C.I.S. (former U.S.S.R.)	2 994	19 280	. .	. .
	Other countries	1 862	2 799	1 725	1 914
	Total	33 900	164 287	26 145	105 447
7502.10	Nickel unwrought, not alloyed				
	Russia	. .	. .	4 042	29 755
	Norway	1 037	5 619	1 270	8 459
	United States	153	967	310	2 054
	United Kingdom	606	5 107	238	1 762
	C.I.S. (former U.S.S.R.)	878	7 617	. .	. .
	Other countries	432	3 787	172	1 278
	Total	3 106	23 097	6 032	43 308
7502.20	Nickel unwrought, alloyed				
	United States	445	2 244	299	1 634
	Russia	. .	. .	162	1 148
	United Kingdom	62	731	3	50
	C.I.S. (former U.S.S.R.)	157	1 031	. .	. .
	Other countries	20	270	1	14
	Total	684	4 276	465	2 848
7503.00	Nickel waste and scrap				
	United States	15 571	24 784	11 490	16 324
	United Kingdom	896	5 052	329	1 566
	Netherlands	773	2 618	393	1 026
	Germany	195	1 041	440	917
	New Zealand	–	–	198	430
	C.I.S. (former U.S.S.R.)	163	1 035	. .	. .
	Other countries	640	1 273	520	476
	Total	18 238	35 803	13 370	20 739
7504.00	Nickel powder and flakes				
	United States	74	1 286	93	1 328
	United Kingdom	30	388	67	971
	Australia	59	462	91	805
	Singapore	–	–	21	160
	Other countries	5	80	4	66
	Total	168	2 218	276	3 330
7502.11	Bars, rods and profiles of nickel, not alloyed	11	172	7	125
7505.12	Bars, rods and profiles of nickel alloy				
	United States	177	3 237	128	2 613
	Other countries	9	194	16	355
	Total	186	3 431	144	2 968

TABLE 1 (cont'd)

Item No.		1992		Jan.-Sept. 1993p	
		(tonnes)	($000)	(tonnes)	($000)
IMPORTS (cont'd)					
7505.21	Nickel wire, not alloyed	38	362	8	111
7505.22	Wire, nickel alloy	324	5 600	234	4 161
7506.00	Nickel plates, sheets, strip and foil	723	11 912	814	14 703
7507.00	Nickel tubes, pipes and tube or pipe fittings	. .	13 712	. .	14 624
7508.00	Other articles of nickel	. .	3 606	. .	2 880

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available or not applicable; . . . Amount too small to be expressed; p Preliminary.
a This number represents the 12-month cumulative.
1 Recoverable nickel in ores and concentrates shipped. 2 1992 preliminary production estimate was overstated by approximately 6%.
3 Imports from "other countries" may include re-imports from Canada.
Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, NICKEL PRODUCTION AND CONSUMPTION, 1970, 1975, AND 1980-93

	Production[1]	Consumption[2]
	(tonnes)	
1970	277 490	10 699
1975	242 180	11 308
1980	184 802	9 676
1981	160 247	8 603
1982	88 581	6 723
1983	125 022	5 010
1984	173 725	7 502
1985	169 971	7 206
1986	163 640	8 865
1987	193 391	9 732
1988	216 589	9 250
1989	200 899	10 423
1990	196 225	7 970r
1991	192 259	9 978r,a
1992	186 384	12 118
1993p,3	188 378	. .

Source: Natural Resources Canada.
. . Not available; p Preliminary; r Revised.
a Increase in number of companies being surveyed.
1 Refined nickel and nickel in oxides and salts produced, plus recoverable nickel in matte and concentrates exported. Data for 1987-93 are nickel contained in concentrates produced.
2 Consumption of metallic nickel, all forms (refined metal, and in ferronickel oxides and salts) as reported by consumers on the Natural Resources Canada survey "Consumption of Nickel." 3 This number represents the 12-month cumulative.

TABLE 3. CANADIAN PROCESSING CAPACITY, 1993

	Inco Limited		Falconbridge Limited	Sherritt Gordon Limited
	Sudbury	Thompson	Sudbury	Fort Saskatchewan
			(t/y of contained nickel)	
Smelter	110 000[a]	81 600	45 000	n.a.
Refinery	56 700	49 900	n.a.	25 000

n.a. Not applicable.
[a] Capacity is constrained to this level by the Ontario government regulation on SO_2 emission limits.

TABLE 4. WORLD MINE PRODUCTION OF NICKEL, 1991-93

	1991	1992	1993
		(tonnes)	
Russia	260 000	243 000	190 000
Canada	192 300	186 400	188 400
New Caledonia	99 600	100 500	106 600
Australia	69 000	57 700	66 300
Indonesia	70 400	78 100	65 800
People's Republic of China	33 000	35 000	35 700
South Africa	27 700	28 400	28 900
Cuba	33 300	32 200	28 800
Brazil	20 000	22 000	22 700
Dominican Republic	29 100	27 500	23 900
Colombia	23 000	23 300	22 800
Botswana	20 400	20 800	21 500
Greece	19 300	18 700	12 700
Other	52 000	48 400	41 800
Total	949 100	922 000	855 900

Sources: Natural Resources Canada; International Nickel Study Group.

TABLE 5. WORLD CONSUMPTION OF NICKEL, 1991-93

	1991	1992	1993
		(tonnes)	
Japan	180 100	148 100	154 700
United States	125 200	119 300	122 000
Russia	150 000	123 000	62 000
Germany	77 000	73 000	75 000
People's Republic of China	40 000	41 000	43 800
France	36 800	35 000	34 000
Italy	31 500	30 000	30 000
United Kingdom	29 500	28 500	29 000
Republic of Korea	23 200	26 500	27 000
Belgium/Luxembourg	19 600	21 400	22 000
Other	153 900	153 500	164 000
Total	866 800	799 300	764 900

Sources: Natural Resources Canada; International Nickel Study Group.

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Australia	69 000	57 700	66 300
Indonesia	70 400	78 100	65 800
People's Republic of China	33 000	35 000	35 700
South Africa	27 700	28 400	28 900
Cuba	33 300	32 200	28 800
Brazil	20 000	22 000	22 700
Dominican Republic	29 100	27 500	23 900
Colombia	23 000	23 300	22 800
Botswana	20 400	20 800	21 500
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Other	52 000	48 400	41 800
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Russia	150 000	123 000	62 000
Germany	77 000	73 000	75 000
People's Republic of China	40 000	41 000	43 800
France	36 800	35 000	34 000
Italy	31 500	30 000	30 000
United Kingdom	29 500	28 500	29 000
Republic of Korea	23 200	26 500	27 000
Belgium/Luxembourg	19 600	21 400	22 000
Other	153 900	153 500	164 000
Total	866 800	799 300	764 900

Sources: Natural Resources Canada; International Nickel Study Group.

TABLE 6. AVERAGE ANNUAL NICKEL PRICES, 1983-93

	London Metal Exchange – Settlement Price
	(US$/lb)
1983	2.12
1984	2.16
1985	2.22
1986	1.76
1987	2.19
1988	6.25
1989	6.04
1990	4.03
1991	3.70
1992	3.18
1993	2.40

Source: Natural Resources Canada.

TABLE 7. AVERAGE MONTHLY NICKEL PRICES, 1991-93

	London Metal Exchange – Settlement Price		
	1991	1992	1993
		(US$/lb)	
January	3.89	3.41	2.69
February	3.94	3.57	2.74
March	3.95	3.37	2.71
April	4.10	3.37	2.71
May	3.84	3.32	2.62
June	3.76	3.26	2.51
July	3.88	3.40	2.29
August	3.83	3.30	2.14
September	3.48	3.14	1.98
October	3.38	2.86	2.02
November	3.29	2.52	2.10
December	3.23	2.60	2.32

Source: Natural Resources Canada.

TABLE 8. LME MONTHLY STOCKS, 1991-93

	1991	1992	1993
		(tonnes)	
January	3 462	17 916	78 804
February	6 186	21 432	83 028
March	5 238	26 028	86 910
April	3 570	26 478	89 910
May	7 728	27 792	95 280
June	4 656	28 296	86 646
July	6 420	34 560	101 568
August	6 732	43 302	106 260
September	9 624	45 750	117 930
October	7 890	56 040	119 196
November	9 426	63 726	118 944
December	11 922	67 914	124 104

Source: Natural Resources Canada.

Peat

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Peat is an accumulation of organic residues obtained from the partial decomposition of plant debris under very high humidity and anaerobic conditions. In its raw material form, it is ligneous, fibrous, and elastic. It has a pH of 2.8-4.0 and an ash content of 0.5%-2.5%. Peat is found in bogs, swamps, and marshes. Its main properties are its high water-retaining capacity, low density, high resistance to decomposition, low heat conductivity, and high porosity. It can hold up to 20 times its weight in liquids and gas. Peat is divided into two principal types: horticultural peat and fuel peat. Horticultural peat is characterized by a low decomposition corresponding to a von Post value of H1-H5. It has a high fibre content, is light yellowish brown in colour, and contains few colloid residues. Fuel peat is highly decomposed, with a von Post value of H6-H10. It is blackish in colour and contains colloid residues.

The total area of peatlands in Canada is estimated at 111 328 000 ha, covering close to 12% of the country's land surface. Approximately 1.5% of Canada's peatland has been used for agriculture, 0.8% for urban development, and 0.022% for forestry. Peat harvesting currently accounts for 0.014% of that total area. In 1984, Agriculture Canada estimated Canadian peat resources at 3 004 996 million m^3, a volume which is equivalent to 338 003 Mt of oven-dry peat.

Canada mainly produces sphagnum peat, which is used in horticulture and agriculture. It is harvested from May to September, primarily in the eastern and southeastern parts of the province of Quebec, in the eastern and northeastern parts of the province of New Brunswick, and in the western provinces near Edmonton, Alberta; Carrot River, Saskatchewan; and Giroux and Elma, Manitoba. Some peat production is also found in the provinces of Nova Scotia, Prince Edward Island, and Newfoundland.

CANADIAN STATISTICS

Canadian peat production in 1993 was estimated by Natural Resources Canada (NRCan) at 830 000 t. This estimate represents a 12% increase from the revised 1992 production of 739 920 t. The data collected show significant increases for Quebec (from 194 536 t to 292 000 t, or 50%) and Nova Scotia and Prince Edward Island combined (100%[1]), a decrease for New Brunswick (from 294 151 t to 256 000 t, or 13%), a small drop for Newfoundland (from 2182 t to 2000 t, or 8%) and Saskatchewan (7%), a small increase for Alberta (4%), and almost unchanged figures for Manitoba (–0.1%). As in 1992, peat was not harvested in British Columbia and Ontario in 1993.

Peat shipments in 1993 were estimated at 776 000 t valued at $112.9 million. This estimate represents a 6.3% drop in volume and a 3.4% decrease in value over the revised 1992 shipments. Shipments from New Brunswick and Quebec, the two major producing provinces, respectively accounted for 35% and 32% of total 1993 shipments. The balance of shipments originated largely from Alberta and Manitoba. These two provinces accounted for 26% of total 1993 shipments. Bearing in mind that very little peat is imported into Canada, the 1992 shipment and export data were used to calculate the apparent Canadian consumption. In 1992, Canada consumed 13.4% of its total shipments, or 111 000 t. That tonnage is significantly lower than that of the previous four years, during which an average of 212 000 t/y (accounting for 26.9% of shipments) were consumed in Canada. In Atlantic Canada, shipments calculated from 1992 revised data and the 1993 estimate decreased from 344 968 t to 310 000 t, while in western Canada shipments increased from 211 551 t to 219 000 t. In Quebec, a compilation carried out by the province for the first nine months of 1993 suggests that total shipments for 1993 declined from 271 000 t to 248 000 t, or by approximately 9%. The reader

[1] Production figures are confidential for the provinces of Nova Scotia, Alberta, Manitoba and Saskatchewan.

will note that this tonnage and, consequently, the tonnage representing total Canadian shipments are lower than the ones derived from earlier estimates and reported in Table 2.

Peat stocks in January 1993 were 2.68 million and 3.59 million bales of 0.17 m^3 in Quebec and New Brunswick respectively. When compared to the stock levels of January 1992, these stocks represent a drop of 2 million bales in Quebec and 0.7 million bales in New Brunswick. During the first six months of 1993, stocks were almost depleted reaching, at the end of June, record lows of 282 000 bales in Quebec and 300 000 bales in New Brunswick. These stock levels were substantially lower than those of 1.89 million and 1.99 million bales reported for Quebec and New Brunswick at the same time in 1992. A good 1993 harvesting season in Quebec and a reasonably good one in New Brunswick helped to replenish peat stocks and, by the end of September, levels were at 4.8 million and 4.0 million bales respectively. At the end of 1993, stocks were estimated at 3.7 million bales for Quebec and 2.0 million bales for New Brunswick.

Exports in 1992 increased 11% to 717 672 t valued at $163 million. Canadian producers exported to 32 countries, with the United States again being by far Canada's major customer accounting for 88.8% of total peat exports. Japan ranked second with 10.0%, and the remaining 30 countries accounted for the balance of 1.2%. Peat exports to the United States increased 11.4% over 1991, while those to Japan increased 8.9%. Exports to countries other than the United States and Japan increased from 7205 t to 8721 t, or 21.0%, after registering declines for three consecutive years. When peat exports for the first nine months of 1992 and 1993 are compared, an overall tonnage decrease of 3.9%, or 21 906 t, is observed. This drop can be attributed mainly to a 3.7% decrease in sales in the United States and 8.2% in Japan.

In the United States, aggressive promotion by the Canadian Sphagnum Peat Moss Association (CSPMA) and individual producers in the last few years continues to have a positive impact on sales to that country. Since 1989, sales to the United States have increased 43% to reach 637 142 t in 1992. Central and Atlantic Canada accounted for 73% of these exports while western Canada accounted for 27%.

With respect to Japan, data from Statistics Canada show that 71 809 t of peat were exported to Japan in 1992. As in 1991, 87% of these exports originated from Atlantic Canada, mainly from New Brunswick. Central and western Canada accounted for 9% and 4% respectively of 1992 exports to Japan.

In other markets, exports of peat to European countries decreased for the third consecutive year from 438 t in 1991 to 334 t in 1992. The Netherlands is the only European country worth mentioning, with Canadian peat imports of 243 t. Within the Pacific Rim, the Canadian industry was particularly successful in increasing its sales to Taiwan and South Korea. Overall, sales in Pacific Rim countries increased from 2254 t to 3727 t, or 65%. The Canadian peat industry continued to be successful in Australia, with sales of 3188 t representing a 120% increase in two years.

Small quantities of peat were again imported from the United States in 1992. Statistics Canada shows that peat valued at $216 648 was imported mostly into Ontario. Fifty percent of this peat originated in California.

CANADIAN ACTIVITIES AND NEW DEVELOPMENTS

In Canada, 73 operations harvested and/or processed sphagnum peat in 1992. NRCan's 1992 census shows that 1448 direct jobs were provided by the peat industry when calculated on an annual basis. (Data on employment in operations that mainly process peat into finished products are gathered by Statistics Canada and are not included in the above compilation. This latter industry sector probably represents an additional 100 to 200 jobs.)

In 1993, weather conditions were good in Quebec along the south shore of the Saint Lawrence River enabling major producers in the Rivière-du-Loup area to enjoy a good harvesting season. However, producers located on the north shore of the Saint Lawrence as well as those located in the Lac-St-Jean area and the Gaspé Peninsula were not as fortunate. These producers were affected by frequent rainfalls and were able to meet only 50%-70% of their production targets. Overall, the 1993 harvesting season in Quebec can be qualified as normal and definitely much better than the disastrous 1992 season. However, since an important part of the peat sold on the professional market comes from those areas that were affected by bad weather, it is possible that Quebec may face some shortage of that type of peat early in 1994. That possibility is reinforced by the fact that New Brunswick, a major Canadian producer of professional peat, had, as indicated below, a difficult

1993 harvesting season, a situation which may translate into a higher-than-normal demand for Quebec professional peat.

In New Brunswick, weather conditions were bad in the northeastern part (Acadian Peninsula) but reasonably good in the southern part of the province. Overall, the province, which is by far the major peat-producing province in Atlantic Canada, harvested about 15% less than normal. Newfoundland, the host of an important international conference on peat in 1993, experienced, as indicated earlier, an 8% drop in production. Nova Scotia and Prince Edward Island together recorded a 100% increase in production mainly because of the opening of new bogs in Prince Edward Island.

In Ontario, there was little change from 1992 with no significant production reported in 1993. During the year, Lakeland Peat Moss Ltd. of Alberta purchased from North Peat Inc. an operation at Iroquois Falls which had been shut for a few years. The bog and the plant at that locality were revamped for production in 1994. The recently renovated operation will bear the name of Lakeland Peat Moss (Ontario) Ltd.

In western Canada, weather conditions varied significantly from province to province. Alberta enjoyed sunny weather, while Manitoba was hit by record precipitation in July and August. Saskatchewan had a close-to-normal harvesting season. In Manitoba, sun-dried peat was baled directly together with peat left over from the 1992 harvesting season. Producers did not use plastic tubes to store peat for future processing. Since the harvest of professional peat has been difficult in Quebec and Atlantic Canada, part of the eastern Canadian and U.S. professional peat markets are expected to be served by western producers in the spring of 1994. However, that situation may last only a few weeks if favourable weather conditions allow peat producers to go into the fields early in 1994.

Premier CDN Enterprises Ltd. of Rivière-du-Loup continued its efforts to modernize its operations in Quebec as well as in other Canadian provinces. The company is confident that, by 1994, all of its peat will be palletized to reduce handling costs to a minimum. In research and development, Premier's major themes remain horticulture and environmental protection. The company hopes to soon be able to introduce better-performing and more environmentally oriented peat products. In 1993, Premier received recognition from the Association de construction et de l'habitation du Québec for a biofilter developed by its Research and Development Division. Premier Tech, a subsidiary of Premier CDN Enterprises Ltd., continues to develop equipment related to the handling of large volumes of peat or any other fibrous materials, and to design equipment that permits the linkage of different plant operations.

Fafard et Frères Ltd. suffered fire damage at Saint-Luger-de-Milot, Quebec. The bagging operation at that locality was completely destroyed in April 1993. The company utilized plastic tubes to store its sun-dried peat while a new bagging plant was being built. Fafard's peat production level at Sainte-Marguerite was about the same as in 1992. The peat from that operation is used by Johnson and Johnson Inc. in the manufacture of sanitary napkins. In 1993, the latter company increased its napkin production significantly; however, it was achieved through a better utilization of the peat originating from the Sainte-Marguerite operation.

Berger Peat Moss introduced in 1993 a new concept in packaging bulk peat and bulk peat mixes. Monoblocks of compressed mixes referred to as "skyscrapers" are now available in dimensions of 40 x 48 x 92-98 inches (1 x 1.2 x 2.3-2.5 metres). This new concept has advantages in handling, storage and stacking, and significantly reduces the amount of plastic to be discarded.

Lameque Quality Group Ltd. of Lamèque, New Brunswick, suffered very serious fire damage last December to its newly inaugurated plant. Buildings were partly saved but the equipment was completely destroyed. At the time of writing, no decision had been taken by the company to reconstruct the plant.

An important international conference on peat was held in September at Corner Brook, Newfoundland. Twenty-five papers covering every facet of the peat industry were presented at the three-day conference by speakers from Canada, Finland, Ireland, Russia, and the United States. The event was an excellent opportunity to showcase the peat industry in Newfoundland.

Several research projects related to the restoration and reclamation of peat bogs continued to be of great interest to both the industry and government. With the support of the industry, the Department of Botany of the University of Alberta, the Department of Phytology of Laval University, Le Centre Québécois de Valorisation de la Biomasse (CQVB), the New Brunswick Peat Research and Development Centre (PRDC), and the Quebec and New Brunswick provincial governments have been involved in several projects. The main objectives of these projects are to improve our and fertilizers to depleted soils. Peat is also used as a horse, cattle and poultry litter to absorb liquids and odours. Peat is used in the production of artificial mixtures such as potting soil, seed carriers, peat-perlite and peat-vermiculite mixes, fertilizers, and composts. It is also used in the production of peat pots for sprouting plants.

Peat has several industrial applications. It can be used in the production of paper towels, chemical products, metallurgical coke, and activated carbons. Peat is also used to treat industrial and domestic effluents. Its cellular structure, absorbing properties and high capacity for ionic exchange form the basis for its use as a natural filter. Peat can reduce the acidity of drainage from old mines and remove iron oxides from waste and drainage water. Peat has also been used as an oil spill absorbent and in certain medical applications.

Fuel peat is recognized as an alternate source of energy. This form of biomass is widely used as a fuel in several European countries such as Ireland, Finland and the C.I.S. Fuel peat has a high degree of humification, a high bulk density, a high calorific value, a low ash content, and a low percentage of pollutants such as sulphur and mercury. Canadian peat possesses a calorific value of about 4700-5100 kcal/kg. In comparison, the value for coal is 4800-5800 kcal/kg, and for oil, 9900-10 000 kcal/kg. Fuel peat is fired in furnaces to produce the steam needed to drive turbines, which in turn generate electricity. It can also be processed to produce coke, synthetic natural gas, and methanol.

OPPORTUNITIES

In order to consolidate its share of the Japanese market, Canadian peat exporters need to maintain a close contact with Japanese importers and encourage exchanges between the Canadian Sphagnum Peat Moss Association and the Japanese Peat Moss Importers Association in order to further promote Canadian peat products.

The success of the Canadian peat industry in acquiring an 85% share of the Japanese market may be a model upon which efforts can be extended to other Asian countries and Australia. Canada's peat exports to these countries, particularly Australia, South Korea and Taiwan, have increased rapidly in the last two to three years. In 1992, close to 7000 t of peat were sold in that part of the world and preliminary export data show that sales could exceed 8000 t in 1993.

Growth opportunities still lie in new applications such as the use of peat to manufacture extra-thin super-absorbent sanitary napkins. The potential for utilizing peat in the treatment of domestic and industrial effluents also remains. Experimental work presently carried out in Canada in these areas may lead to the development of new peat markets.

The development and manufacture of field and plant equipment is continuing to progress rapidly in Canada. A vast experience in peat harvesting and processing is being put to use to design equipment that will allow operating costs to be maintained at a competitive level. New engineering products that can be used to handle large volumes of peat or other fibrous materials are currently marketed worldwide. This area continues to represent an interesting diversification and market opportunity for the Canadian peat industry.

Note: Information in this review was current as of February 1, 1994.

PRICES[1] IN THE UNITED STATES, BY TYPE OF PEAT, 1992

Type	Domestic			Imported[2]
	Bulk	Packaged or Bales	Average	Total
	(U.S. dollars per short ton)			
Sphagnum moss	27.45	102.48	80.94	157.31
Hypnum moss	24.00	68.62	51.89	n.a.
Reed-Sedge	17.31	21.05	19.63	n.a.
Humus	17.31	9.77	14.68	n.a.

Source: U.S. Bureau of Mines, "Peat," 1992.
n.a. Not applicable.
[1] Prices are f.o.b. plant. [2] Average customs values.

TARIFFS

Item No.	Description	Canada			United States
		MFN	GPT	USA	Canada
2703.00	Peat (including peat litter) whether or not agglomerated	10.2%	6.5%	Free	Free
6815.20	Articles of peat	6.8%	4.5%	2.7%	Free

Sources: Customs Tariff, effective January 1994, Revenue Canada, Customs and Excise; Harmonized Tariff Schedule of the United States, 1994.

TABLE 1. WORLD PRODUCTION OF PEAT, BY COUNTRY, 1988-92

Country	1988	1989	1990	1991	1992p
			(000 tonnes)		
AGRICULTURAL USE					
U.S.S.R.e	163 260	163 260	149 655	140 600	119 800
Germany, Republic of	2 670r	2 840r	3 000r	2 880r	2 900
Canada	736	812	715	856	740
United States	765	690	690	632	600
Netherlandse	300	300	300	300	300
Irelandr	300	265	230	248	300
Finland	325	450	325	220	355
Swedenr	230	230	255	260	260
Francee	200	200	200	200	200
Polande	200	200	200	200	200
Denmark	50	50	110r	100	100
Spain	75	75	70	70	70
Hungarye	70	70	70	60	60
Norway	30	30	30	30	30
Other	20	55	55	55	55
Subtotal	169 231	169 527	155 942	146 721	125 970
FUEL USE					
U.S.S.R.e	17 500	16 800	14 965	10 000	9 100
Irelandr	4 055	7 760	6 400	4 800	6 200
Finlandr	3 720	4 600	4 500	2 300	5 100
West Germanyr	232	232	232	230	210
Subtotal	25 507	29 392	26 097	17 330	20 610
Total world	194 738	198 919	182 039	164 051	146 580

Sources: Natural Resources Canada; U.S. Bureau of Mines, "Peat," 1992.
e Estimated; p Preliminary; r Revised.

TABLE 2. CANADA, PEAT SHIPMENTS BY PROVINCE, 1991-93

Province	1991		1992		1993p	
	Quantity	Value	Quantity	Value	Quantity	Value
	(000 t)	($000)	(000 t)	($000)	(000 t)	($000)
Newfoundland	3	141	5	725	2	259
Prince Edward Island	–	–	–	–	–	–
Nova Scotia	x	x	x	x	x	x
New Brunswick	263	28 510	323	38 053	274	33 224
Quebec	350	40 221	271	36 944	292	41 250
Ontario	–	–	–	–	x	x
Manitoba	x	x	x	x	x	x
Saskatchewan	x	x	x	x	x	x
Alberta	102	15 639	94	20 500	94	21 034
British Columbia	–	–	–	–	–	–
Total	833	100 133	828	116 869	820	119 174

Sources: Natural Resources Canada; Statistics Canada.
– Nil; p Preliminary; x Confidential.
Note: Numbers may not add to totals due to rounding.

TABLE 3. CANADIAN DOMESTIC EXPORTS OF PEAT, BY COUNTRY, 1989-93

Country	1989		1990		1991		1992		Jan.-Sept. 1993p	
	Tonnage	Value	Tonnage	Value	Tonnage	Value	Tonnage	Value	Tonnage	Value
		($000)		($000)		($000)		($000)		($000)
American Samoa	–	–	–	–	–	–	–	–	36	8
Angola	7	6	–	–	–	–	–	–	–	–
Anguilla	30	21	18	3	–	–	–	–	–	–
Australia	1 938	645	1 464	366	2 490	445	3 188	700	3 469	737
Barbados	5	5	15	6	38	28	15	7	23	18
Belgium	32	20	179	33	57	19	28	10	–	–
Belize	–	–	–	–	–	–	–	–	28	15
Bermuda	56	11	20	7	31	7	47	8	–	–
Brazil	–	–	–	–	–	–	–	–	6	4
British Virgin Islands	–	–	–	–	–	–	–	–	6	2
Chile	–	–	–	–	36	4	4	10	–	–
China, People's Republic of	24	6	90	20	16	6	54	23	50	19
Denmark	75	145	129	385	68	154	–	–	52	105
Dominican Republic	68	11	54	10	–	–	107	100	9	4
Ecuador	–	–	–	–	–	–	15	17	8	20
Egypt	–	–	–	–	–	–	44	14	–	–
France	24	62	117	50	8	10	–	–	15	3
Germany	79	14	7	11	23	32	7	22	8	13
Guadeloupe	13	6	–	–	–	–	–	–	–	–
Haiti	76	67	135	143	22	13	–	–	–	–
Hong Kong	86	18	37	19	96	28	102	33	318	175
Iceland	50	9	9	2	9	2	9	2	9	2
India	27	16	–	–	–	–	–	–	–	–
Indonesia	–	–	–	–	–	–	114	179	4	5
Ireland	–	–	–	–	18	2	–	–	–	–
Israel	167	39	475	87	134	35	28	5	91	21
Italy	16	47	250	26	–	–	–	–	–	–
Japan	56 226	12 640	65 765	16 522	66 196	14 654	71 809	16 143	54 060	13 197
Jordan	243	115	199	84	148	73	65	48	–	–
Korea, North	–	–	–	–	–	–	96	21	–	–
Korea, South	269	88	1 051	202	594	160	1 283	261	632	257
Kuwait	62	29	–	–	–	–	57	20	263	78
Lebanon	–	–	–	–	3	4	–	–	–	–
Malaysia	–	–	–	–	219	38	313	57	–	–
Mexico	16	5	36	15	215	61	76	39	60	9
Netherlands	4 571	149	719	140	247	48	243	73	144	35
Netherland Antilles	17	4	–	–	–	–	–	–	–	–
New Caledonia	2	3	–	–	–	–	–	–	–	–
Nigeria	–	–	–	–	–	–	24	11	–	–
Puerto Rico	2 672	489	–	–	–	–	–	–	–	–
St. Lucia	5	2	–	–	–	–	–	–	–	–
St. Pierre and Miquelon	–	–	1	. . .	–	–	31	7	69	6
Saudi Arabia	1 975	579	41	11	–	–	–	–	533	204
Singapore	–	–	12	1	539	100	16	3	39	11
South Africa	709	252	2 300	607	1 382	323	883	190	814	167
Spain	50	14	4	6	–	–	16	27	–	–
Switzerland	8	23	7	13	–	–	16	40	7	20
Taiwan	135	40	424	206	783	331	1 803	843	1 788	726
Thailand	–	–	–	–	23	4	–	–	–	–
Trinidad and Tobago	32	28	82	61	46	15	22	20	17	12
United Kingdom	7	10	79	41	8	17	15	5	17	47
United States	460 606	90 669	542 431	110 816	576 675	119 505	637 142	144 537	496 289	122 051
Uruguay	–	–	8	4	–	–	–	–	–	–
Vietnam	–	–	–	–	–	–	–	–	9	8
Total	530 378	106 303	616 158	129 914	650 124	136 132	717 672	163 488	558 873	137 996

Source: Statistics Canada.
– Nil; . . . Amount too small to be expressed; p Preliminary.
Note: Numbers may not add to totals due to rounding.

European consumption of potash decreased by 3% to 4.0 Mt K_2O. In Latin America, demand for potash in Brazil recovered from the weak consumption level of 1991 and reached 1.5 Mt K_2O, up from 1.34 Mt in 1992. Globally, the nitrogen-to-potash ratio has gradually declined since 1991 from 1:0.34 to 1:0.27 in 1993, reflecting lower potash application, reduced potash accessibility, and higher unbalanced fertilization.

In the United States, potash fertilizer demand was relatively stable in 1993, despite a higher Acreage Reduction Program rate of 10% for corn, and unfavourable weather during the year resulting in flooding. In the spring, heavy rainfalls during April delayed the planting season in the Corn Belt; however, in May, improved weather conditions stimulated fertilizer application and led to monthly record shipments of potash. In late June and July, rainfalls and flooding of the Mississippi basin resulted in crop losses in Iowa, Missouri and Illinois. Floods disrupted transportation, and potash shipments slowed in late summer. Limited barge traffic resumed in early September in the northern Mississippi area. In the fall, weather conditions were uneven and normal levels of potash consumption were reported.

CANADIAN INDUSTRY

The potash industry in Canada is composed of six companies that employ more than 3800 workers. Production occurs in eight underground mines and two solution-mining operations in Saskatchewan, and in two underground mines in New Brunswick, the latter accounting for 15% of Canadian capacity. The potash industry in Canada was first developed in the early 1960s with the opening of potassium chloride mines in Saskatchewan. As a result of a series of expansions in the 1970s and 80s, the Canadian potash industry now ranks as the world's largest producer and exporter of potash.

Major Developments

In 1993, Canadian mine production decreased 6% from 7.27 Mt to 6.85 Mt K_2O; declines in potash output were registered both in Saskatchewan and in New Brunswick, with the latter accounting for 15% of total Canadian production. Canadian potash shipments declined to 7.0 Mt K_2O due to reduced levels of shipment to offshore markets; potash sales to China, where the level of potash purchases from Canada was close to 0.9 Mt in 1991, remained fairly low at 0.3 Mt for a second consecutive year due to reduced domestic demand and fierce competition from the FSU with low-priced potash. Canada's total potash sales in 1993 were estimated at $901 million, compared to $981 million in 1992. Canadian inventories decreased by about 0. 15 Mt to 1.64 Mt K_2O.

At the end of 1993, Canadian potash productive capacity was estimated at 12 Mt/y K_2O, a level that could sustain an operating rate of 95% on an annual basis. Of this capacity, close to 1.2 Mt/y K_2O could be considered dormant with idle milling units at the Cory and Lanigan operations. It is believed that such facilities could be reactivated in a relatively short period of time. Of the total Canadian capacity, New Brunswick accounts for 1.28 Mt/y K_2O.

In 1993, mine shut-downs amounted to 142 mine-weeks, a 20% increase over last year (118 mine-weeks). Most of these shut-downs (92%) occurred in Saskatchewan; Potash Corporation of Saskatchewan Inc. accounted for 58% of these temporary closures. Compared to 1992, shut-downs were extended in February, summer shut-downs were moved back to the July-August period, while fall shut-downs were prolonged because of weaker sales prospects in Asia for the second half of 1993.

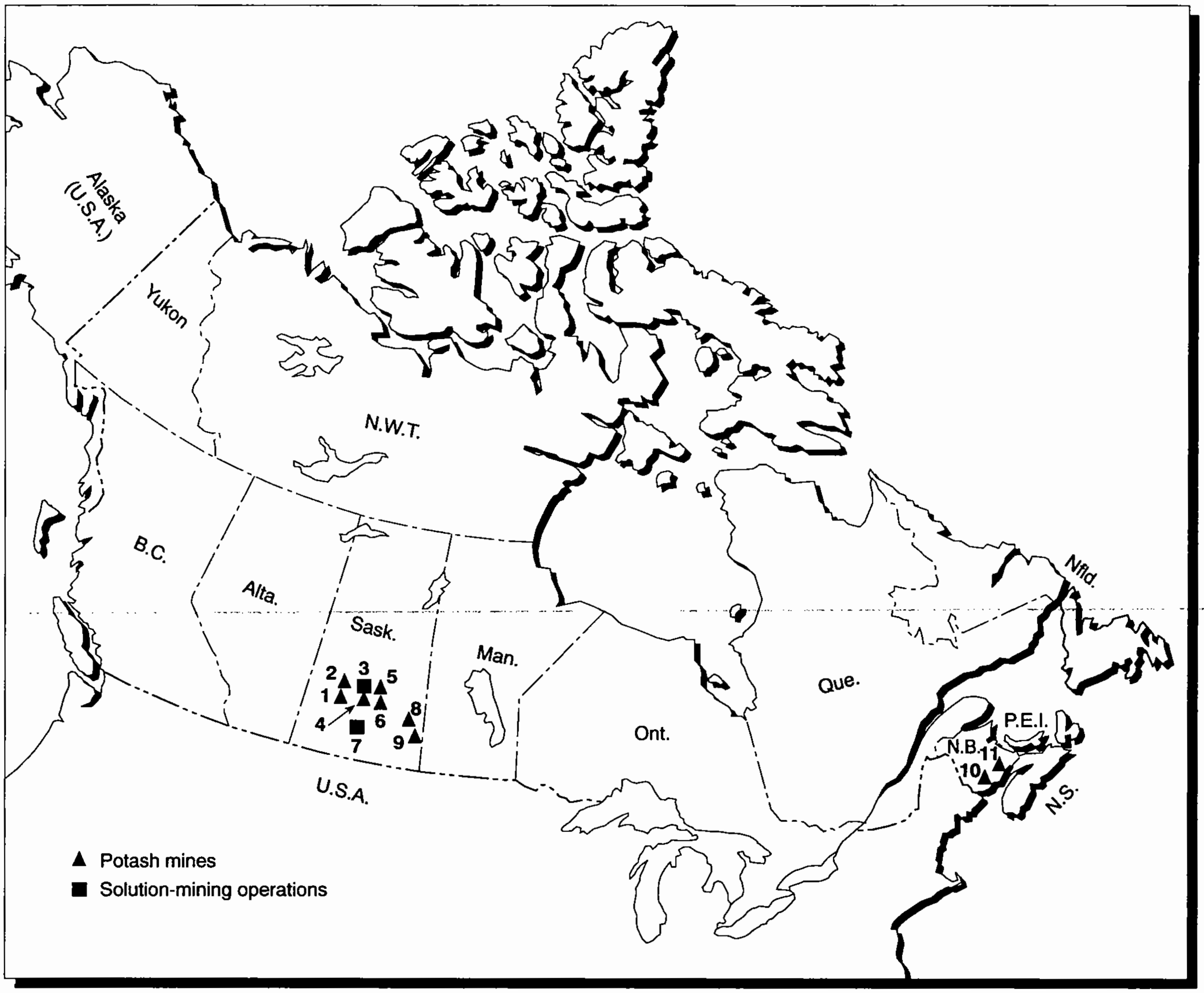
In 1993, the average unit value of potash shipped by Canadian producers was computed at C$79/t KCl (f.o.b. mines), a C$6/t decline from last year. For the first nine months of 1993, the average unit value of exports on the basis of port of exit (e.g., Vancouver or Saint John, or a border crossing to the United States) was C$119.88/t KCl; for the same period in 1992, that value was $112.51/t. The decrease in the value of the Canadian dollar during 1993 was the main factor for this increase. For the first nine months of 1993, potash exports totalled 7.68 Mt KCl valued at C$922 million.

According to the Canadian Fertilizer Institute, the Canadian potash industry (except for one producer) reported a net profit, after taxes and interest, of $128.3 million in 1992 compared to $137.1 million in 1991. Sales rose 13% between 1992 and 1991. Profits in 1993 were expected to be slightly lower due to reduced export and domestic sales, longer shut-downs, and a stagnation in offshore and U.S. prices.

In January 1993, the five-year suspension agreement between U.S. and Canadian potash producers was due for termination; in 1988, the agreement suspended anti-dumping investigations against Canadian producers. Early in 1993, several U.S. potash producers filed objections against termination to the International Trade Administration of the U.S. Department of Commerce, who notified in March that the agreement was extended for another year.

Figure 1

Location of Potash Mines and Operations in Canada, 1993



Numbers refer to locations on map above.

Potash Mines

1. Cominco Fertilizer Ltd.; Vanscoy, Saskatchewan
2. Potash Corporation of Saskatchewan Inc., Cory Division; Saskatoon, Saskatchewan
4. Potash Corporation of Saskatchewan Inc., Allan Division; Allan, Saskatchewan
5. Noranda Minerals Inc., Central Canada Potash Division; Colonsay, Saskatchewan
6. Potash Corporation of Saskatchewan Inc., Lanigan Division; Lanigan, Saskatchewan
8. International Minerals & Chemical Corporation (Canada) Limited; Esterhazy, Saskatchewan
9. Potash Corporation of Saskatchewan Inc., Rocanville Division; Rocanville, Saskatchewan
10. Potacan Mining Company; Sussex, New Brunswick
11. Potash Corporation of Saskatchewan Inc. (formerly Potash Company of America, a Division of Rio Algom Limited); Sussex, New Brunswick

Solution-Mining Operations

3. Potash Corporation of Saskatchewan Inc. (formerly Potash Company of America, a Division of Rio Algom Limited); Patience Lake, Saskatchewan
7. Kalium Canada, Ltd.; Belle-Plaine, Saskatchewan

In the spring, allegations of price-fixing in North America by several U.S. and Canadian potash exporters since 1987 emerged and resulted in a series of class-action lawsuits in several states. Complaints filed in Minnesota, New York, Illinois, Virginia and California were consolidated in Saint Paul (Minnesota). In December, legal counsels for the plaintiffs were disqualified from the case on legal grounds in a U.S. District Court ruling. Also in December, several U.S. and Canadian potash producers were subpoenaed by a U.S. Grand Jury to provide information related to price-fixing. This action, prompted by the U.S. Attorney General, is to hear evidence of alleged criminal activities.

Saskatchewan

Saskatchewan produced about 85% of Canada's potash in 1993. During the year, several temporary shut-downs were called by mine operators in Saskatchewan for maintenance, vacation and, mostly, for inventory control.

Potash Corporation of Saskatchewan Inc. (PCS Inc.) is the largest publicly held potash producer in the world. In 1993, PCS Inc. operated four mines in Saskatchewan. Potash production from all of PCS Inc.'s operations, including tonnage on PCS Inc.'s account from International Minerals & Chemical Corporation (Canada) Limited, was estimated at 3.7 Mt KCl, a 4% decrease over 1992. PCS Inc.'s operating rate fell to 39%, down from 41% in 1992. Throughout 1992, PCS Inc. continued to pursue its policy of strict inventory control with intermittent shut-downs at all of its operations. In January, all of its mines were partially shut except for Cory, which remained in operation for most of the year due to its ability to produce white crystallized potash products; in March, the Rocanville mine shut down temporarily for four weeks, and in April the Lanigan operation was shut down, also for four weeks. As a countermeasure to weak sales prospects to offshore markets in the second half, operations at Rocanville and Allan ceased from the end of June until late August. Late in the fall of 1993, PCS Inc. announced shut-downs at all of its operations for December; Rocanville and Lanigan shut-downs began in November.

PCS Inc. completed the purchase of all the potash assets of Potash Company of America (PCA) from Toronto-based Rio Algom for C$160 million plus $30 million in working capital. The newly acquired facilities will be known as PCS Patience Lake (Saskatchewan) and PCS New Brunswick. Products from Patience Lake will be marketed offshore by Canpotex Ltd., while potash products from PCS New Brunswick will be handled by PCS Sales, the Chicago-based subsidiary of PCS Inc. With the acquisition of PCA's operations, PCS Inc.'s production capacity rose by 16% to reach 6.54 Mt/y K_2O, equating to 55% of Canada's total potash capacity. In September, PCS Inc. issued four million common shares at $25.75 each, raising C$103 million to help finance the acquisition. In December, the Province of Saskatchewan sold its last remaining 579 000 shares of PCS Inc. During the year, PCS Inc. extended for another year its offshore marketing agreements with several U.S. potash producers in New Mexico, including Mississippi Chemical Corp., New Mexico Potash Corp., and Eddy Potash Inc.

International Minerals & Chemical Corporation (Canada) Limited (IMC Canada), which is wholly owned by IMC Fertilizer Group Inc., extracted potash ore from two interconnected underground mines, K1 and K2, at Esterhazy in southeastern Saskatchewan. In 1993, IMC Canada produced about 2.5 Mt KCl, of which close to 0.5 Mt was for PCS Inc.'s account. Throughout 1993, both K1 and K2 operated on a 10/4 (working 10 days out of 14) schedule; maintenance and vacation shut-downs in the summer and winter equated to 8 mine-weeks, compared to 6.5 mine-weeks in the previous year. In April, in a move to reduce costs, IMC Canada laid off 48 permanent workers, equating to 5% of its workforce.

During 1993, the K2 mine continued to experience water inflow problems; in early January 1993, increases in water inflows were lowered to more acceptable levels. Chemical grouting with calcium chloride in the "B block" mining panel was carried out. During the year, inflow rates fluctuated at around 4000 gallons per minute (gpm), while pumping capacity was maintained at above 7000 gpm. In the summer of 1993, IMC Canada reached an out-of-court settlement worth C$130.4 million with its insurers for flood damage incurred since late 1985 at the K2 underground mine. Close to $27.3 million of the total insurance amount was paid to PCS Inc. by reason of its share of the Esterhazy operation. Expansion plans for a 4.2-Mt/y replacement mine near Esterhazy are reported to remain on hold.

Kalium Canada, Ltd. operates a large solution mine at Belle-Plaine, west of Regina. During 1993, the company produced 1.75 Mt KCl, a 2% decrease over the previous year. Sales were slightly higher. The plant shut down for two-week periods during both January and February, and for two weeks in the summer. The plant is designed to run continuously, 24 hours per day, 365 days per year. At

Kalium, by-product salt brine is shipped to the nearby salt evaporation plant, operated by Canadian Salt Co. Ltd., and some volumes of salt waste are dissolved and re-injected underground. In 1993, Kalium announced expansion plans of its product lines through a five-year C$45 million investment for the production of industrial-grade potash products. This investment is not expected to increase Kalium's production capacity but, rather, to increase its output of specialty products by up to 20%.

Central Canada Potash (CCP), a division of Noranda Minerals Inc., produced 0.9 Mt KCl in 1993, a 1% decrease over last year. Potash is mined from its underground mine at Viscount, east of Colonsay. Shipments were slightly lower than those of last year and inventories were reduced. The operation shut down for two weeks in February and for nine weeks in the summer. CCP pursued its Miner Automated Network project, dubbed Miner Autonet, to be fully implemented in 1994. The project includes full automation of continuous miners, establishment of an underground radio communication network, and a monitoring system for operating equipment and storage areas.

Cominco Ltd. produced 0.9 Mt KCl in 1993 at its Vanscoy mine, a 4% reduction over 1992. The operation ran on a seven-day-per-week schedule throughout the year except for five weeks in the summer. Nu Salt Corp. recovered some salt from the tailings to sell as a de-icer in local markets. During 1993, Cominco Fertilizers Ltd. (CFL) completed the purchase of the fertilizer assets of Cominco Ltd. and Alberta Energy Company Ltd. (AEC), and became a publicly traded listing on the Toronto Stock Exchange. Cominco Ltd. now owns 17.8% of CFL, while AEC sold its 10.2% share.

Potash Company of America (PCA), a division of Rio Algom Limited, extracted potash by solution from its old underground mine that flooded in 1987. The potash extraction process involves the pumping of diluted brine down into the mine for dissolving in-situ potash ore and the recovery of concentrated brine into surface cooling ponds that cover more than 130 acres. During periods of cold temperature, potash in the brine precipitates at the bottom of the ponds where it is dredged; the potash material is then processed by crystallization and compaction to produce crystalline standard and coarse grades. In 1993, the mine produced about 250 000 t of KCl. Also during 1993, the company had its summer shut-down, which lasted from mid-June until the end of October.

Big Quill Resources Inc. produced potassium sulphate from sodium sulphate brine from Big Quill Lake and from potash supplied by Potash Corporation of Saskatchewan Inc. The plant, located in Wynyard, was expanded in 1992 from 3500 t/y to 7000 t/y K_2SO_4. In 1993, Big Quill announced another expansion to double the current capacity to reach 12 000 t/y by mid-1994. Potassium sulphate products were used in the chemical and wallboard sectors.

New Brunswick

In New Brunswick, potash was mined at two underground operations located in the Sussex area in Kings County. Potash products for export are hauled 60-80 km from the Sussex area to the Barrack Point potash terminal in Saint John. The terminal, which is operated by Furncan Marine under contract with PCA, has a storage capacity of 165 000 t of potash. The shipping port, equipped with a 2700-t/h shiploading facility, can accommodate cargo sizes between 3000 and 50 000 t.

Potash Company of America (PCA), a division of Rio Algom Limited, operated the Penobsquis underground mine, also referred to as the Plumweseep mine, about 5 km east of Sussex. In 1993, production was about 630 000 t of KCl, a 6% decrease over 1992. The mine operated throughout the year at high capacity but was shut down for 3.5 weeks in July and 1.5 weeks in late December. It operates on a seven-day-per-week schedule. Common salt is also co-produced at an annual rate of 400 000 t and is sold commercially through a sales agent as de-icing material on North American markets. Improvements in compaction circuits were carried out to enhance the quality of granular potash products.

Potacan Mining Company (PMC) produced 1.0 Mt of KCl in 1993, a 10% decrease over 1992. The company extracts potash at the Cloverhill mine located 20 km southeast of Sussex. Since 1991, PMC has been owned by Potash Company of Canada Limited, which in turn is owned jointly by Entreprise Minière et Chimique (EMC) of France, and Kali und Salz AG (K&S) of Germany. For inventory control, the operation was shut down in 1993 for one week in both January and December.

Manitoba

In 1993, the Manitoba Potash Corporation, held 51% by EMC of France and 49% by the Government of Manitoba, continued its evaluation of a proposed 1.2-Mt/y K_2O potash mine near Russell at the Manitoba-Saskatchewan border. Potamine Mining of Canada Inc., a new subsidiary of EMC, is managing its share of the project. During 1993, three-dimensional seismic work was carried out, with results to be interpreted in early 1994. A decision to proceed is expected in the near future, with possible completion after the year 2000.

CANADIAN POTASH TRADE

Canada is the world's largest potash exporter with a 40% share of international trade. Germany is the second largest, followed by the FSU. Canada exports potash to more than 35 countries, although only 6 countries account for close to 80% of Canada's total potash exports.

In 1993, Canadian potash was shipped mostly to the United States (62%) and Asia (24%), with the remainder being sent to Latin America (7%), Oceania (5%) and Western Europe (1%). Exports to Latin America originated mostly from New Brunswick (88%), while shipments to Africa and Western Europe came equally from both Saskatchewan and New Brunswick. Saskatchewan accounted for 95%, 93% and 88% respectively of Canada's exports to Asia, the United States and Oceania.

On a nine-month basis in 1993, data compiled by Statistics Canada indicated that potash exports were valued at C$921 million, with tonnages totalling 7.9 Mt KCl, a 5% decrease compared to the same period in the previous year. The United States remained the dominant destination with 4.9 Mt KCl, a 3% decrease over last year. In the offshore markets, sales to Asia were down 15%, mostly due to much reduced sales to India, while sales to China were steady. Exports to South Korea, Japan, Malaysia and Indonesia registered marginal gains. Canada's exports to Asia accounted for 24% for the first nine months of 1992 compared to 26% for the same period in 1991. Shipments to Latin America rose sharply by 30% with higher sales notably to Brazil, Mexico and Colombia. Sales to Western Europe decreased by half as much lower exports were reported to Belgium during the year. Exports to Africa doubled compared to last year, with additional tonnage to South Africa. Shipments to Oceania rose 28% with higher sales to Australia.

INTERNATIONAL DEVELOPMENTS

World production of potash in 1993 continued to decline for the fifth consecutive year to an estimated 21.5 Mt K_2O, compared to 24 Mt in 1992. Most of the 10% decrease between 1992 and 1993 occurred in the FSU. North America was the major producing region with a 39% share of world potash output, a 2% increase over last year. Canada contributed 32% to world production in 1993. The FSU was second with a 26% share, compared to 29% in 1992. Western Europe accounted for 24%, the same level as in 1992. The Middle East accounted for close to 10%, compared to 9% in 1992.

Americas

Argentina

Potasio Rio Colorado S.A. continued its development work for a new sylvinite-based, 150 000-t/y K_2O solution mine near Marlague in the southern Mendoza Province, 960 km south of Buenos Aires. In 1993, further injection tests were carried out to complete the feasibility study.

Brazil

Companhia Vale do Rio Doce (CVRD), a state-owned mining company, produced 173 000 t K_2O, a 100% increase over last year. The 300 000-t/y K_2O mine is located at Rosario do Catete, 47 km from Aracagu, the capital of the Sergipe District. During 1993, Unidade Operacional Taquari Vassouras (UOTV), a branch of CVRD, purchased new mining equipment to meet its plans to increase potash production to 240 000 t K_2O by 1994 and to reach 300 000 t K_2O in 1995.

Chile

Late in 1992, Sociedad Quimica y Minera de Chile S.A. (SQM) acquired the 63.75% interest of AMAX Inc. of the United States in the Minsal project for extracting potash and other salts from brines in the Atacama desert in northern Chile. SQM now has a 75% share in Minsal Ltda, with the remaining 25% being held by Corporacion de Fomento de la Produccion. SQM's plans include a 180 000-t/y K_2O potash operation and some lithium recovery due for completion in 1996. Close to US$85.2 million is to be invested between 1993 and 1997. Minsal's potash production is expected to fulfill SQM's needs, replacing potash imports for the manufacture of potassium nitrate.

United States

Production in the United States in 1993 decreased by 10% to 1.5 Mt K_2O as a result of the closure of one potash mine in New Mexico. The value of production of marketable potash was about US$280 million. Potassium sulphate and potassium-magnesium sulphate together accounted for 25% of U.S. potash production, the remainder being potassium chloride. Apparent consumption was estimated at close to 5.2 Mt K_2O, of which 4.0 Mt were imported. Inventories at year-end dropped 11% to 253 000 t K_2O. Based on a revised production capacity of 1.62 Mt/y K_2O, the U.S. potash industry ran at 92% of its capacity, compared to 84% in 1992.

In the United States, potash was extracted in four states, of which New Mexico accounts for more than 85% of total U.S. potash production. In New Mexico, potassium chloride was mined by conventional underground mining methods at Eddy Potash Inc., Horizon Potash, IMC Fertilizers Inc., Mississippi Chemicals Corp., and New Mexico Potash Corp.; Western Ag-Minerals Co. mined langbeinite ore to produce magnesium-potassium sulphate. In Utah, Moab Salt Inc. extracted potassium chloride from brines, Great Salt Lake Minerals and Chemicals Corp. (GSL) exploited brines from the Great Salt Lake to produce potassium sulphate, and Reilly Industries Inc. extracted potassium chloride from near-surface brines. In California, North American Chemical Corp. produced potassium sulphate and potassium chloride at Searles Lake. In Michigan, Kalium Chemical Ltd. operated a pilot solution mining plant near Hershey to recover potassium chloride.

In 1993, a petition by several U.S. potash producers was filed to the U.S. Trade Representative under Section 406(d) of the *1974 Trade Act*, requesting the President of the United States to discuss with FSU governments the alleged disruption in the U.S. potash market caused by low-priced FSU shipments. Late in the year, the U.S. government indicated it would seek further information and consult with Russian and Belarussian governments in order to eliminate market disruption.

In the fall, GSL at Odgen (Utah) commissioned a new 34-km underwater brine-transporting trench which would expand the company's production of potassium sulphate to 0.36 Mt/y K_2O; the Behrens Trench links the Great Salt Lake to a new pond system (7100 hectares), doubling the original pond surface (7700 hectares). Following a corporate restructuring, GSL is now a subsidiary of the newly formed Harris Chemical Group Inc., a holding company for D. George Harris & Associates Inc. In April 1993, Horizon Potash ceased to operate its 320 000-t/y K_2O potash mine in Carlsbad, New Mexico; mining and compaction equipment went for liquidation late in the fall. Mississippi Chemical formed a new operating subsidiary to oversee its potash operations in Carlsbad called Mississippi Potash Inc. In addition, the company announced plans to expand by 33% its capability to produce granular potash with the installation of new compacting equipment. Vicksburg Chemical Co., a subsidiary of Cedar Chemical Corp., is to complete the construction of a new 25 000-t/y potassium carbonate plant near its existing potassium nitrate facility in Vicksburg, Mississippi, in 1994.

Europe

In 1993 at year-end, the Commission of the European Communities (CEC) reviewed and approved the proposed merger of Kali und Salz A.G. and Mitteldeutsche Kali A.G. in Germany. The CEC also re-evaluated the imposed anti-dumping duties on potash imports from Russia, Belarus and Ukraine. Current duties, in the form of minimum prices, would be replaced by a fixed duty in combination with minimum pricing levels.

Former Soviet Union

Following the break-up of the U.S.S.R. in 1991, the former Soviet potash industry is now spread mostly among two republics. In Russia, potash is produced at the Joint Stock Company Uralkali complex (4.0-Mt/y K_2O capacity) and at the Silvinit complex (2.4-Mt/y K_2O capacity). In Belarus, potash is produced at The Joint Stock Association Byeloruski, which manages the four Soligorsk operations (5.3-Mt/y K_2O capacity). Low-grade potash ores are also mined in Ukraine at Kalush. In 1993, total potash production in the FSU was estimated at close to 5.6 Mt K_2O, a 20% decline compared to 1992. The utilization rate of potash production capacity dropped to below 50%. The decline in production was mainly in response to a depressed demand for potash in both the domestic and central European markets. During 1993, in a drive to earn hard currency, FSU potash remained highly available for export despite cutbacks in production. Major gains in sales were registered in Asia, Brazil and the United States. Also during 1993, some controls on fertilizer exports were enforced in the early summer and late fall to limit potash sales outside official channels; in December, both Belarus and Russia issued new export regulations allocating export quotas.

In 1993, development work was carried out on port facilities at Vostochnyy, Murmansk, Yuzhny, Riga, Illichevsk, and in the Gulf of Finland at Luzhskaya Guga. Increased operating costs were reported in the FSU as a result of higher energy, transportation and labour costs. In Russia at the Uralkali 4 complex, the first 0.6-Mt/y K_2O phase of the new application has yet to recover fully from very low levels. In Asia, both China and India have yet to absorb the radical agricultural reforms implemented since 1992; further shifts in policies and fluctuations of currencies will inhibit any strong growth in the short term.

In the United States, potash consumption is set to increase by 4%-6% as higher planted acreages for soybean and corn are projected following the poor corn harvest in 1992/93. The 1992/93 Acreage Reduction Program rates for corn and soybean have been lowered to 0% from 10%. The subsequent increase in plant acreages and a refurnishing of nutrients washed away by the 1993 heavy rains and floods will result in a stronger demand for potash and a higher application rate per hectare, with U.S. consumption of fertilizer potash reaching 5.0 Mt in 1994.

Total world demand for potash in 1994 is projected at 23 Mt K_2O. Potash usage is mostly in fertilizers with a 95.4% share of total potash consumption, with the remainder being used in industrial chemicals.

The sharp decline in potash demand over the last five years was mostly in reaction to drastic economic and agricultural reforms with consequent structural changes affecting potash consumption. However, the fundamental elements for growth in potash demand have remained and will persist in order to meet world requirements for food. As agricultural reforms and structural changes are absorbed, fertilizer potash demand is expected to recover gradually and grow at an annual rate of 3% to reach 24.4 Mt by 2000; most of this increase will occur in Asia and the FSU. In terms of annual growth rates, the highest will prevail in Central Europe (12%), India (8%), China (8%) and the FSU (6%). World demand for industrial potash is forecast to reach 1.25 Mt/y in 2000, a 9% overall increase from the 1993 level. There is limited trade for industrial potash as its consumption is mostly centred in developed countries, including the United States, which accounts for more than 60% of the world's total industrial potash demand. Taking into account industrial uses and distribution losses, total world demand for potash is projected at close to 27 Mt/y by the end of this decade.

In Latin America, a major increase in consumption of fertilizer potash is anticipated (4.5%/y). In Brazil, farmers will continue to increase planted areas with profitable, exportable crops in which fertilizers are applied at larger rates. Future Brazilian potash consumption is forecast to grow at an annual rate of 3.5% to reach 1.8 Mt/y by 2000, as a result of incentives for higher crop productivity, expansion of arable lands in the Cerrado region, higher usage of fertilizer per hectare of arable lands, especially for basic food crops, and a higher potash ratio.

In Asia, medium-term potash consumption is expected to grow both in India and China. Indian potash consumption is expected to increase at an annual rate of 3% from its current low level to reach 1.4 Mt/y by the year 2000. Since the extent of harvested areas has reached an optimum level since the mid-1970s, increases in potash consumption will mainly be a result of improvements in the rates of application of fertilizers per hectare and in the balance of nutrients, especially phosphate and potash. With progressive reforms and healthy economical stability, this level could ultimately reach 1.8 Mt/y. In China, the recent fundamental changes have negatively affected potash demand in the short term, but medium- to long-term projections indicate that Chinese potash consumption is forecast to grow at an annual rate of 3% to reach 2.7 Mt/y by the year 2000. With diminishing acreage of cultivated lands, increases in crop production will result mostly from higher application rates and rising potash ratios.

In North America, long-term potash consumption is expected to remain relatively flat due to the very high efficiency of the U.S. agricultural sector. Potash demand in the United States for fertilizers is considered mature and will continue to fluctuate slightly as a function of annual crop production and the resulting annual determination of the Acreage Reduction Program rates, shifts to more profitable crops, and weather conditions. In the medium to long term, potash consumption in the United States is forecast to fluctuate marginally around 4.8 Mt/y.

In the FSU and Central Europe, potash consumption in the FSU is expected to recover slowly, assuming a smooth transition to market-driven economies. Future potash consumption in the FSU is forecast to grow gradually at first, at an annual rate of 2% between 1995 and 1998, to 3.2 Mt/y, but then to grow at a higher rate of 12% for the rest of the decade, to reach 4.0 Mt/y by 2000. In Central Europe, potash consumption will reach 1.1 Mt/y by the year 2000 as farmers decide on application of inputs on the basis of cost considerations and optimum application rates. Land usage being optimized, increases in potash consumption will come from higher application rates for fertilizers in Russia and Ukraine as well as in Central Europe, while the formerly high nitrogen-to-potash ratio will have to be readjusted.

In Western Europe, the full implementation of the major reform of the Common Agricultural Policy will impact negatively on potash consumption, which is expected to decrease gradually to 3.8 Mt/y by the year 2000 as crop areas are reduced and support prices lowered.

On the supply side, over the next seven years, several changes are likely to occur in the world potash industry. Capacity will be curtailed due to ore depletion, rationalization or obsolete facilities; at the same time, additions will also occur at established or emerging producers.

In Western Europe, the closure of two mines in France will reduce French potash capacity from 1.5 Mt/y to nil. In Germany, capacity will decline by 1.0 Mt to 3.6 Mt by 1997 as four mines are shut down. In Spain, one mine is expected to close, reducing Spanish capacity by 0.2 Mt to 0.7 Mt/y. In total, Western European potash capacity is expected to decline by 25% (or 1.7 Mt/y) to 6.2 Mt/y between 1993 and 2000, or by 2.7 Mt/y to 5.2 Mt/y between 1993 and 2003.

In the FSU, poor market conditions and some rationalization will have its toll on FSU potash producers: three operations are expected to reduce their capacity, namely Soligorsk 1 and 2 in Belarus, and Uralkali 1 in Russia. Increases are planned at the efficient Soligorsk 3 mine in Belarus and at the new plant of Uralkali 4 in Russia. Given these developments, by the year 2000, the FSU's potash capacity is projected to decrease by 13% (or 1.5 Mt/y) to 10.5 Mt/y. In the longer term, several old operations will be under review for potential closure; these would include Solikamsk 1 and Uralkali 2 in Russia, and Soligorsk 2 and Soligorsk 4 in Belarus.

In North America, the Eddy Potash mine in New Mexico is expected to face ore depletion and shut down, while a small expansion at North American Chemical in Utah is expected to be completed by 1995. North American potash capacity is forecast to decline by 0.3 Mt/y to reach 13.3 Mt/y in the year 2000, with no change anticipated in Canada at 12 Mt/y. Other projects may be developed after the year 2000 in Manitoba by Potamine Mining Company of Canada and in Michigan by Kalium Chemical.

In Latin America, the development of the potash project in Chile is expected to be completed by 1998, while Argentina's new solution mining could be successfully developed by 2000. Latin American potash capacity will likely increase by 0.2 Mt to reach 0.55 Mt/y, with Brazil's capacity remaining stable at 0.3 Mt/y.

In the Middle East, several expansions are projected in Israel by the year 2000, and in Jordan in 1994 and 1998. Capacity in the Middle East will increase by 0.65 Mt to reach 2.9 Mt/y by the year 2000.

In Asia, only one project is expected to be completed by 1996/97: the phase-three expansion of the Qinghai potash operation, while the Asean Potash Mining Co. in Thailand may commission its new mine at Bamnet Narong after the year 2000. In the medium term, Asia's potash capacity is forecast to increase by 0.5 Mt to reach 0.65 Mt/y.

For the period from 1993 to 2000, world potash capacity is forecast to decrease by 2.2 Mt/y to 34 Mt/y. Most of this decline will occur in Western Europe and the FSU. However, if all potential changes are realized by 2003 (while setting aside probable closures in the FSU), world potash capacity would then reach 35 Mt/y. This latter level still represents a 3% decrease compared to today's capacity.

Current world potash capability is more than adequate to cover forecast growing demand. However, planned as well as unexpected shut-downs in the next 10 years will offset additions to capacity, resulting in a net 1.2-Mt reduction in world capacity. Between 1993 and 2000, the world potash demand/supply balance will continue to face a lagging but gradually declining surplus. Based on capacity projections and demand forecasts, this surplus is expected to decline from 13 Mt/y K_2O in 1993 to 7 Mt/y by the year 2000, or to 21% of world capacity, compared to 36% in 1993.

Note: Information in this review was current as of February 1, 1994.

TARIFFS

Item No.	Description	Canada MFN	Canada GPT	Canada USA	United States Canada
3104.20	Potassium chloride	Free	Free	Free	Free
3104.30	Potassium sulphate	Free	Free	Free	Free
3104.90.00.10	Magnesium-potassium sulphate	Free	Free	Free	Free
3104.90.00.90	Other potassic fertilizer	Free	Free	Free	Free

Sources: Customs Tariff, effective January 1994, Revenue Canada, Customs and Excise; Harmonized Tariff Schedule of the United States, 1994.

TABLE 1. CANADA, POTASH PRODUCTION, SHIPMENTS AND TRADE, 1992 AND 1993

Item No.		1992		1993p	
		(tonnes)	($000)	(tonnes)	($000)
PRODUCTION, Potassium Chloride					
Gross weight		11 889 292	. .	11 202 252	. .
K_2O equivalent		7 269 583	. .	6 841 406	. .
SHIPMENTS					
K_2O equivalent		7 039 590	980 855	6 969 758	901 539
IMPORTS, Fertilizer Potash				**(Jan.-Sept.)**	
3104.20	Potassium chloride, in packages weighing more than 10 kg				
	United States	8 837	1 099	3 258	386
	Germany	3	. . .	11	1
	United Kingdom	4	. . .	–	–
	Total	8 844	1 100	3 269	388
3104.30	Potassium sulphate, in packages weighing more than 10 kg				
	United States	10 920	3 435	7 611	2 195
	Germany	–	–	36	60
	United Kingdom	4	8	1	3
	Total	10 924	3 444	7 648	2 259
3104.90.00.10	Magnesium potassium sulphate				
	United States	73 401	12 302	42 669	7 389
	Germany	–	–	27	5
	Total	73 401	12 302	42 696	7 395
3104.90.00.90	Other potassic fertilizer				
	United States	3 741	1 367	1 307	627
	Israel	39	16	–	–
	Total	3 780	1 384	1 307	627
	Potash Chemicals				
2815.20	Potassium hydroxide (caustic potash)	9 817	4 496	7 517	3 671
2834.21	Potassium nitrate	5 603	2 931	4 560	2 599
2835.24	Potassium phosphates	684	794	649	736
2836.40	Potassium carbonates	1 957	1 395	1 488	1 043
2839.20	Potassium silicates	726	537	513	439
	Total potash chemicals	18 787	10 155	14 727	8 490

TABLE 1 (cont'd)

Item No.		1992 (tonnes)	1992 ($000)	Jan.-Sept. 1993p (tonnes)	Jan.-Sept. 1993p ($000)
EXPORTS, Fertilizer Potash[1]					
3104.20	Potassium chloride, in packages weighing more than 10 kg				
	United States	6 389 198	710 037	4 902 167	556 590
	People's Republic of China	641 035	82 361	557 580	69 084
	Japan	513 026	70 593	349 016	46 838
	Malaysia	388 263	47 505	321 344	39 150
	South Korea	338 869	43 067	292 928	34 855
	Australia	217 517	27 756	272 558	34 267
	Brazil	293 373	32 794	283 455	30 801
	New Zealand	129 084	15 257	116 176	15 401
	Taiwan	172 567	23 842	102 276	14 304
	Indonesia	103 705	13 006	97 125	11 904
	Chile	99 283	13 542	75 267	9 985
	India	462 105	55 333	54 454	7 255
	Colombia	29 957	3 377	61 820	6 666
	Mexico	–	–	54 387	5 746
	Thailand	26 480	3 344	42 007	5 634
	Philippines	22 008	2 844	39 300	4 303
	Venezuela	14 963	1 559	34 912	3 576
	Jamaica	19 546	3 104	19 197	3 407
	France	15 750	1 740	25 636	3 391
	Netherlands	35 864	4 019	19 318	2 389
	Italy	–	–	17 688	2 321
	South Africa	–	–	15 650	2 054
	Costa Rica	–	–	21 004	1 983
	Nigeria	20 000	1 901	17 500	1 881
	Norway	16 000	1 804	16 000	1 631
	Cuba	20 000	2 013	12 565	1 257
	Guatemala	6 000	584	10 375	1 085
	Denmark	30 856	3 391	13 830	1 071
	Singapore	13 850	1 306	6 000	783
	Dominican Republic	5 800	602	6 008	674
	Ecuador	–	–	6 000	571
	El Salvador	–	–	2 625	279
	Guyana	2 625	557	1 050	168
	Honduras	9 000	907	1 050	104
	United Kingdom	144	79	72	43
	Pakistan	–	–	36	23
	Trinidad and Tobago	9	1	–	–
	Martinique	10 027	930	–	–
	Bangladesh	53 320	4 968	–	–
	Hungary	5 000	504	–	–
	Belgium	94 047	11 515	–	–
	Vietnam	3	1	–	–
	Total	10 199 272	1 186 159	7 868 375	921 494
3104.30	Potassium sulphate, in packages weighing more than 10 kg				
	United States	1 064	664	1 902	1 025
	France	–	–	740	445
	Mexico	–	–	2	1
	Netherlands	–	–	1	. . .
	Australia	6	4	–	–
	Total	1 070	668	2 645	1 472

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available or not applicable; . . . Amount too small to be expressed; p Preliminary.
[1] Countries are ranked in descending order of value, based on nine-month 1993 data.
Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, POTASH PRODUCTION AND TRADE, FERTILIZER YEARS ENDED JUNE 30, 1977-93

	Production[2]	Imports[1,2]	Exports[1]
	(tonnes K_2O equivalent)		
1977	4 803 015	24 289	4 175 473
1978	6 206 542	26 095	5 828 548
1979	6 386 617	21 819	6 256 216
1980	7 062 996	20 620	6 432 124
1981	7 336 973	35 135	6 933 162
1982	6 042 623	25 437	5 400 662
1983	5 378 842	21 846	4 864 219
1984	7 155 599	17 934	6 730 733
1985	7 283 509	17 396	6 784 178
1986	6 519 777	12 837	6 479 678
1987	7 031 586	12 122	7 100 135
1988	7 839 625	14 486	7 315 318
1989	8 088 748	18 604	7 075 122
1990	6 773 019	20 714	6 387 857
1991	7 520 235	23 714	6 727 678
1992	7 011 915	22 437	6 464 897
1993	7 281 726	27 302	6 384 389

Sources: Potash and Phosphate Institute; Canadian Fertilizer Institute.
[1] Includes potassium chloride, potassium sulphate, potassium-magnesium sulphate, except that contained in mixed fertilizers. [2] Change of data source; prior to 1978, figures were obtained from Statistics Canada.

TABLE 3. CANADA, POTASH PRODUCTION AND SALES IN 1992 AND BY QUARTERS, 1993

	Total 1992	1993				
		1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Total
	(000 tonnes, K_2O equivalent)					
Production	7 245.4	1 717.9	2 088.6	1 179.0	1 823.3	6 808.6
Sales						
North America	4 313.2	1 121.0	1 504.3	880.1	898.5	4 404.2
Offshore	2 712.6	720.4	738.1	537.7	462.7	2 458.9
Total	7 025.8	1 841.4	2 242.4	1 418.4	1 361.2	6 863.1
Ending Inventories						
Mine site	957.1	766.7	796.2	710.3	917.8	n.a.
Off site	827.5	902.2	746.0	564.4	808.7	n.a.
Total	1 784.6	1 668.9	1 542.2	1 274.7	1 726.5	n.a.

Source: Potash and Phosphate Institute.
n.a. Not applicable.

TABLE 4. CANADA, POTASH SALES BY PRODUCT AND AREA, 1991 AND 1992

		Agricultural					Industrial			Total
		Standard	Coarse	Granular	Soluble	Total	Standard	Soluble	Total	Sales
		(tonnes, K_2O equivalent)								
British Columbia	1991	53	67	6 054	44	6 218	–	–	–	6 218
	1992	62	79	5 774	38	5 953	–	–	–	5 953
Alberta	1991	296	650	30 206	1 426	32 578	1 850	366	2 216	34 794
	1992	172	26	34 847	1 899	36 944	1 469	117	1 586	38 530
Saskatchewan	1991	77	602	8 293	331	9 303	2 324	992	3 316	12 619
	1992	51	2 425	11 494	303	14 273	4 943	623	5 566	19 839
Manitoba	1991	–	1 837	19 367	2 052	23 256	–	–	–	23 256
	1992	–	1 705	24 076	1 490	27 271	63	–	63	27 334
Ontario	1991	825	82 132	72 666	427	156 051	5 669	411	6 080	162 131
	1992	27	85 316	58 156	1 291	144 790	7 473	282	7 755	152 545
Quebec	1991	18	7 772	72 209	54	80 053	1 051	226	1 277	81 330
	1992	–	1 541	82 228	332	84 101	1 040	–	1 040	85 141
New Brunswick	1991	48	6 470	6 103	–	12 621	–	–	–	12 621
	1992	648	9 485	3 391	–	13 524	–	–	–	13 524
Nova Scotia	1991	–	3 488	1 295	–	4 783	–	14	14	4 797
	1992	–	3 920	1 779	–	5 699	–	–	–	5 699
Prince Edward Island	1991	351	–	12 414	24	12 789	3	241	244	13 033
	1992	1 624	–	12 999	–	14 623	–	–	–	14 623
Newfoundland	1991	–	–	782	–	782	–	–	–	782
	1992	–	–	–	–	–	–	–	–	–
Total	1991	1 668	103 018	229 389	4 358	338 433	10 897	2 250	13 147	351 580
	1992	2 584	104 497	234 744	5 353	347 178	14 988	1 022	16 010	363 188

Source: Potash and Phosphate Institute.
– Nil.

TABLE 8. CANADA, POTASH MINES, CAPACITY PROJECTIONS, 1985-95

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
						(000 tonnes K_2O equivalent)					
Potash Corporation of Saskatchewan Inc.											
Allan[1]	575	575	575	575	575	960	960	960	960	960	960
Cory	830	830	830	830	830	830	830	830	830	830	830
Esterhazy (25% of IMC)	580	580	580	580	580	580	580	580	580	580	580
Lanigan	690	1 240	1 740	2 090	2 090	2 090	2 090	2 090	2 090	2 090	2 090
Rocanville	1 160	1 160	1 160	1 160	1 160	1 160	1 160	1 160	1 160	1 160	1 160
Patience Lake[2]	–	–	–	–	–	–	–	–	400	400	400
Subtotal	3 835	4 385	4 885	5 235	5 235	5 620	5 620	5 620	6 020	6 020	6 020
Central Canada Potash	815	815	815	815	815	815	815	830	830	830	830
Cominco Ltd.	815	815	815	815	815	815	815	830	830	830	830
International Minerals & Chemical Corporation (75%)	1 745	1 745	1 745	1 745	1 745	1 745	1 745	1 745	1 745	1 745	1 745
Kalium Canada, Ltd.	1 055	1 055	1 245	1 245	1 245	1 245	1 245	1 245	1 245	1 245	1 245
Potash Company of America, Inc.[2]	630	630	100	30	150	400	400	400	–	–	–
Saskaterra Fertilizers Ltd. (Allan)[1]	385	385	385	385	385	–	–	–	–	–	–
Subtotal	5 445	5 445	5 105	5 035	5 155	5 020	5 020	5 000	4 650	4 650	4 650
Total Saskatchewan	9 280	9 830	9 990	10 270	10 390	10 640	10 640	10 670	10 670	10 670	10 670
Potash Mining of Canada	200	450	650	780	780	780	780	810	810	810	810
Potash Company of America, Inc.[3]	300	300	380	380	380	380	380	470	–	–	–
Potash Corp. of Saskatchewan[3]	–	–	–	–	–	–	–	–	470	470	470
Total New Brunswick	500	750	1 030	1 160	1 160	1 160	1 160	1 280	1 280	1 280	1 280
Total Canada	9 780	10 580	11 020	11 430	11 550	11 800	11 800	11 950	11 950	11 950	11 950

– Nil.
[1] Potash Corporation of Saskatchewan Inc. increased its share of Allan mine from 60% to 100% in mid-1990. [2] Patience Lake PCS operation acquired by PCS Inc. in 1993. [3] New Brunswick PCS operation acquired by PCS Inc. in 1993.
Note: Capacity means "rated" capacity; under normal conditions, Canadian mines can operate comfortably at about 95% of rated capacity.

Primary Iron

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Primary iron is defined to include blast furnace iron, direct reduced iron (DRI) and, in Canada, electric smelted iron. It is the main raw material used to make steel and other iron products such as castings.

There are two technologies used to produce steel: basic oxygen furnaces, which are charged with blast furnace iron and ferrous scrap at the integrated steel mills; and electric furnaces, which are charged with scrap and/or direct reduced iron (DRI) at the mini-mill plants. Approximately 50% of iron units used to make steel in Canada come from scrap.

CANADIAN DEVELOPMENTS

Since almost all of the primary iron produced in Canada is used in the production of steel, trends in steel production and in demand for steel mill products influence the production of primary iron. Therefore, this review will frequently refer to developments in the steel industry.

Steel

The economy improved slightly in 1993; however, the steel industry continued to face a very competitive and difficult pricing environment. Although production increased, prices continued to be relatively low. Prices tend to increase in periods of economic recovery and, while prices have increased, the magnitude of these increases was lower than expected. Most of the companies in the industry returned to profitability in 1993.

Even under the Canada-U.S. Free Trade Agreement (FTA), bilateral steel trade was an area of considerable conflict during the year. However, shipments remained high even with the threat of trade actions by both countries. U.S. exports to Canada declined by 4.2% in the first nine months of 1993, while Canadian exports to the United States increased by 10.4% in the same period. Total Canadian exports of steel mill products to all countries increased 4.9% to 4 161 000 t, and total imports increased by 12.5% to 1 976 000 t. Of these tonnages, 88% of Canadian exports went to the United States while 63% of Canadian imports were of U.S. origin. These figures emphasize the importance of bilateral steel trade to the industries of both Canada and the United States.

Canadian steel shipments in the first nine months of 1993 increased 13.6% to 11 290 t. This increase was attributed to an improvement in the North American economy. Sales of North American-made cars improved significantly, and expenditures on capital goods were strong.

Blast Furnace Iron

Canadian production of pig iron in the first nine months of 1993 increased to 6.59 Mt, compared to 6.43 Mt in the same period of 1992. This increase was due to higher steel production at integrated producers.

The Canadian steel industry has eight operating blast furnaces with a total capacity of 9.26 Mt/y. Associated with these furnaces are 780 coke ovens with a total capacity of 4.8 Mt/y.

Electric Smelted Iron

Another source of primary iron are the nine electric furnaces at the ilmenite smelting facility operated by QIT-Fer et Titane Inc. at Tracy, Quebec. These furnaces have the capacity to produce 900 000 t/y of iron as a co-product with titanium dioxide. The iron is used to produce three products: a range of specialty pig iron grades, which are sold mainly to the foundry industry; iron powder used by the powder metallurgy industry; and continuous cast steel billets, which are sold to the steel industry for re-rolling. This facility continued to operate at capacity during 1993.

Direct Reduced Iron (DRI)

DRI is a semi-metallic product made by reducing iron ore in its solid state to approximately 95% metallics. Sidbec-Dosco Inc. has one operating Midrex DRI plant at Contrecoeur, Quebec. This plant, with a capacity to produce 750 000 t/y, operated at capacity during 1993. DRI, together with scrap, is used to produce steel at the company's electric furnace steel mill.

INTERNATIONAL DEVELOPMENTS

Primary Iron and Steel

World steel production, as calculated by the International Iron and Steel Institute, increased 1.8% in the first nine months of 1993 relative to the same period in the previous year. This slight increase in production was concentrated in North America. Production increased 5.5% in Canada and 3.7% in the United States. The increase was attributed to the North American economy recovering from the recession. North American demand increased for both capital equipment and consumer durables, especially automobiles. Other economies where steel production also improved include Japan at 4.4%, Turkey at 14.6%, Australia at 10.8%, and several South American countries. In Eastern Europe and the former U.S.S.R., the massive changes involved in the break-up of the U.S.S.R. and efforts to establish market economies continued to devastate the economy.

On the trade front, the year was characterized by multiple trade actions from the U.S. government, which resulted from a series of investigations for dumping and subsidization started in the previous year. The Canadian government was also involved in a number of trade actions. By year-end, a number of countervail and anti-dumping duties had been imposed by both the Canadian and U.S. governments against many of their trading partners.

Direct Reduced Iron (DRI)

Midrex plants accounted for about 64% of world DRI and hot briquetted iron (HBI) production, with the HYL-1 and HYL-111 plants the second most important. Total DRI production, as calculated by the Midrex Corporation, was 20.7 Mt in 1992, an 8% increase over the 1991 level of 19.41 Mt, or about 3% of world crude steel.

DRI has generally been considered to be an alternative to ferrous scrap in the electric furnace-based steel industry where its inherent advantages of high-purity and controlled chemistry have always been valued. This situation has become particularly true in recent years as electric furnace mills have moved into the market for such products as high-quality wire rod and special-quality forging grade bar. Another important factor is the technical success of the thin slab casting technology that allows electric furnace mills to produce flat products at very competitive prices, and where the chemistry of the steel is critical.

An increasingly important market for DRI is for use in blast furnaces. Charging DRI to a blast furnace dramatically increases the hot metal yield from the furnace while reducing the coke rate. When the DRI is melted in the furnace, any gangue it contains is slagged off and any unreduced metallics are reduced. In addition, the carbon that becomes dissolved in the molten iron is of value in increasing the energy available to melt ferrous scrap in the basic oxygen furnaces used to produce steel in integrated plants. Thus, trade in DRI and HBI continues to increase.

The areas in the world with the best potential to increase production of DRI and HBI are the Middle East, where large quantities of natural gas associated with oil production are available, and in Venezuela. This potential is attracting new investment in DRI plants and a continuing modest growth in production is expected.

OUTLOOK

Canada and the United States

In North America an economic recovery is under way, but it is a slow one with the manufacturing sector lagging behind the rest of the economy. The auto industry is an exception, and sales will likely continue to increase significantly, especially for North American-made cars and light trucks. New home construction is expected to grow as lower interest rates improve access to credit. Another consideration is the need to rebuild American towns and infrastructure that were destroyed in natural disasters, i.e., by floods in the U.S. midwest, hurricanes in Florida, and earthquakes in California.

In the primary iron and steel industry, structural change, driven by the availability of new technologies, will continue at a healthy pace. Costs, both of production and for capital equipment, will continue to decline significantly. The old oligopolistic structure, where price changes were more a factor of changes in input costs rather than supply and demand, is gone. Today the customer is king. In terms of world competitiveness, North American producers are quite low-cost and international competitiveness is likely to improve even further in the near future. Steel prices will continue to go down in comparison with substitute materials. These lower prices and improved performance will likely result in maintenance of steel's share of the market. On a cost-performance basis, steel is a very competitive material. In the medium term, annual growth of 2%-4% is expected in North America. This forecast assumes a considerable reduction in offshore imports to North America.

Although the Canadian steel industry is well placed to benefit from a period of economic growth, additional improvements in productivity will be necessary to maintain a competitive position with the greatly improved U.S. steel industry.

In the medium term (three to five years), Canadian producers should see a period of slightly increasing sales at profitable prices as the economy enters a period of growth. Steel producers would therefore benefit from improved productivity and product quality. In the longer term (five to ten years), trade under the North American Free Trade Agreement (NAFTA) should stabilize in North America, and the Canadian industry should find its place in the North American market. Assuming that the intent of existing and proposed free trade agreements becomes reality, barriers to trade that exist in the form of various trade laws will become less restrictive. Because Mexico is not self-sufficient in steel, both Canadian and U.S. steel producers will have an opportunity to increase export sales to Mexico. Canada can benefit from both direct shipments to Mexico and indirectly in the form of increased sales to the United States as American steel from the southern states is sold in Mexico.

Changes in the relative exchange rates between the currencies of Canada and its trading partners dramatically influence trade patterns and, consequently, Canadian production. The above forecast assumes that the Canadian dollar will also remain relatively low vis-à-vis the U.S. dollar and that the Canadian steel-consuming secondary manufacturing industry will create new business capable of competing in North American, if not world, markets.

International Factors

The difference in the cost of producing steel anywhere in the world continues to narrow; therefore, the relative value of currencies and the cost of shipping are becoming more important factors in steel trade. The North American steel industry, of which Canada is an integral part, will continue to rationalize and improve its competitiveness. A very important factor is that North America does not have excess domestic supply. Furthermore, over the next ten years, North American prices will not be significantly higher than world prices. Therefore, North American producers will have an opportunity to maintain relatively high levels of capacity utilization. Capacity utilization is a key factor in profitability and the ability to maintain the capital expenditures necessary to maintain or improve competitiveness. However, it is important to note that continuing high levels of capital spending will be required. The rate of technological change is not likely to slow but, rather, to accelerate as new processes, such as thin slab and near net shape casting, become the industry standard. Traditional steel-making will have to be competitive, or it will be replaced by direct smelting or direct steel-making processes. The impact of technological change should not be under-estimated as it is an exceptionally important factor forming the nature of tomorrow's steel industry. All of the recently proven and advanced technologies have the significant characteristic of reducing barriers to entry into the steel industry, and dramatically decreasing both the capital and operating costs of steel production.

U.S. steel production is expected to increase 5%-6% in 1994 and to increase an average 2%-3% per year in the medium term. Much of this growth will be in the form of exports and the substitution of imports with domestic production. Prices in 1994 will likely continue to increase.

In European countries, production of iron and steel should increase slightly by year-end 1994. A large restructuring of the European steel industry, especially that of Eastern Europe, is required. Until this restructuring occurs, European competitiveness will not keep pace with that in North America, South America and the newly developed Asian countries.

It is likely that European producers will lose a portion of their U.S. market. In the medium term, growth in steel production should decline by an average of 2%-3%/y. In the longer term, the European economy will likely be stimulated by the rebuilding of the economies of Eastern Europe with a great potential demand for consumer-durables and the availability of relatively low-cost labour.

Japanese production is forecast to decrease in the short term as export markets, especially to China, are lost to domestic production or to lower-cost producers.

Steel production in the newly industrialized nations is expected to increase at over 2%/y throughout the decade.

Note: Information in this review was current as of February 1, 1994.

Figure 1
Production of Steel in Canada, by Furnace Type, 1981-93

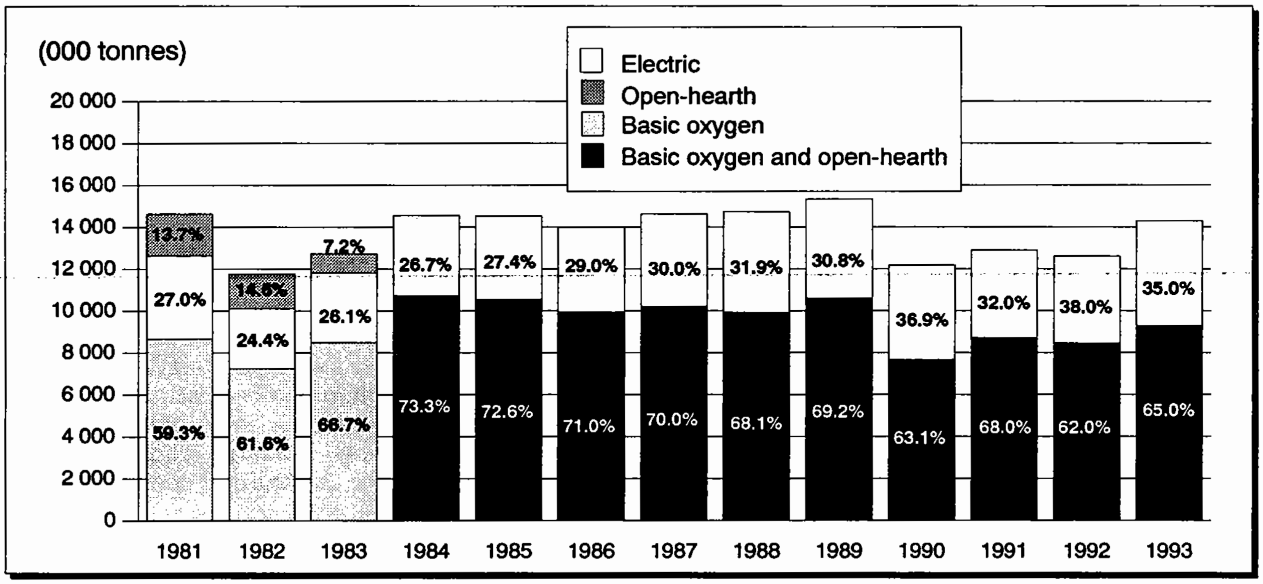
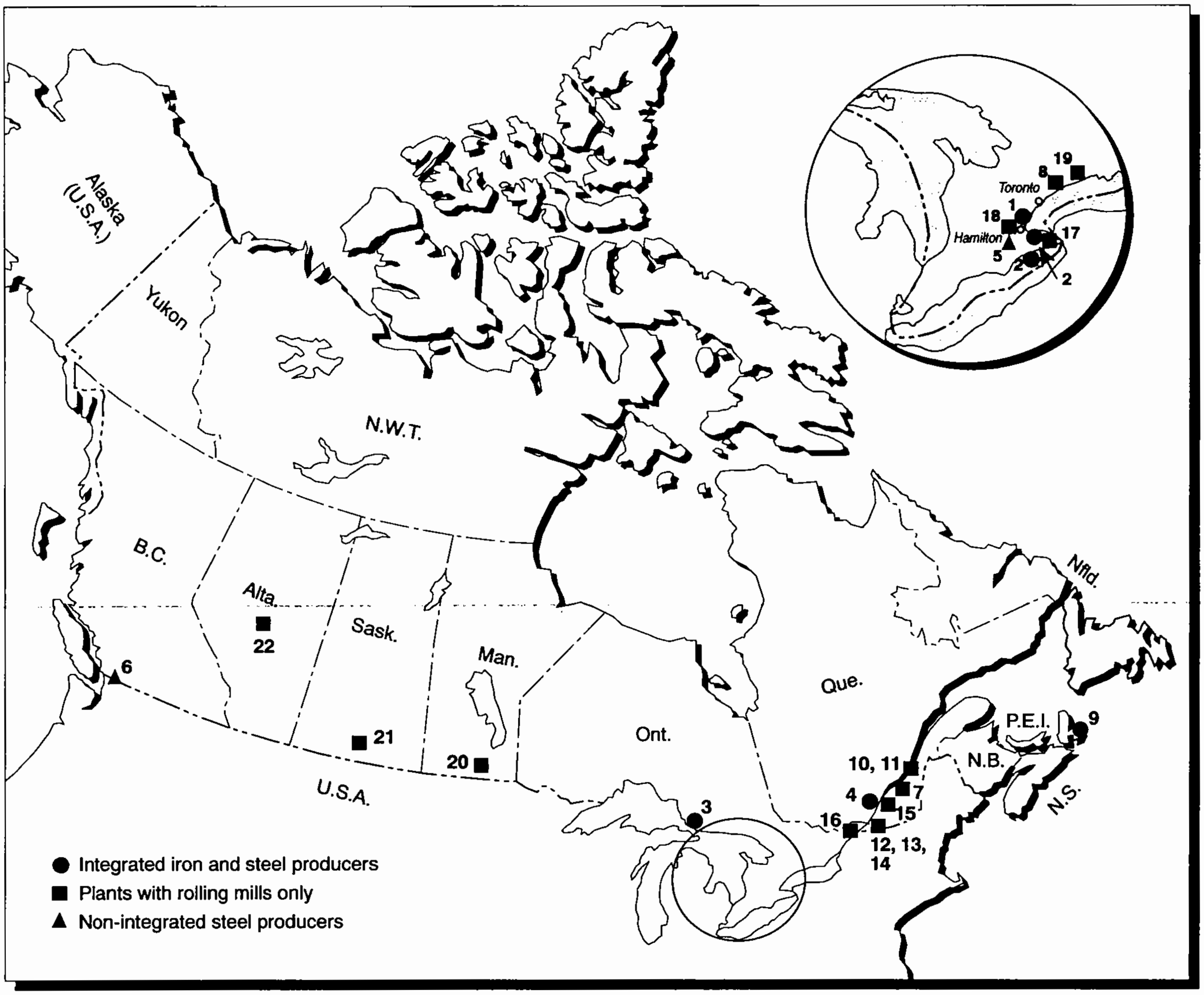


Figure 2
Iron and Steel in Canada, 1993



Numbers refer to locations on map above.

Integrated Iron and Steel Producers

1. Dofasco Inc. (Hamilton)
2. Stelco Inc. (Hamilton and Nanticoke)
3. Algoma Steel Ltd. (Sault Ste. Marie)
4. Sidbec-Dosco Inc. (Contrecœur)

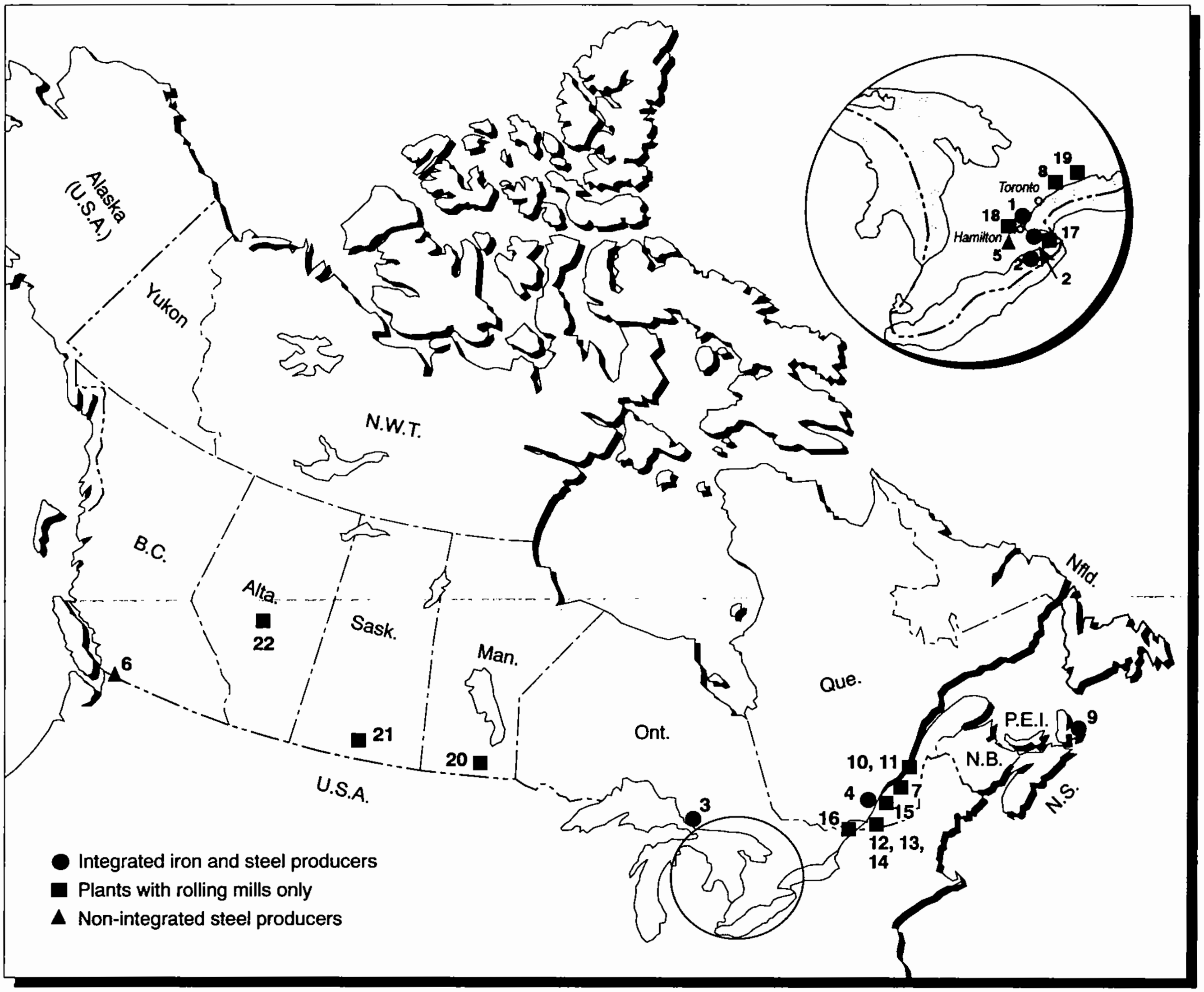
Plants with Rolling Mills Only

5. Stanley Strip Steel, division of Stanley Canada Inc. (Hamilton)
6. Pacific Continuous Steel Limited (Delta)

Non-Integrated Steel Producers

7. QIT-Fer et Titane Inc. (Sorel)
8. Courtice Steel Inc. (Cambridge)
9. Sydney Steel Corporation (Sydney)
10. Stelco Inc. (Contrecœur)
11. Atlas Stainless Steels, division of Sammi Atlas Inc. (Tracy)
12. Sorel Forge, division of Slater Industries Inc.
13. Canadian Steel Foundries, division of Hawker Siddeley Canada Inc. (Montréal)
14. Canadian Steel Wheel Limited (Montréal)
15. Sidbec-Dosco Inc. (Montréal and Longueuil)
16. Ivaco Inc. (L'Orignal)
17. Atlas Specialty Steels, division of Sammi Atlas Inc. (Welland)
18. Hamilton Specialty Bar, division of Slater Industries Inc. (Hamilton)
19. Co-Steel Inc. (Whitby)
20. Manitoba Rolling Mills, subsidiary of The Canam Manac Group Inc.
21. IPSCO Inc. (Regina)
22. Stelco Inc. (Edmonton)

Figure 2
Iron and Steel in Canada, 1993



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20. Manitoba Rolling Mills, subsidiary of The Canam Manac Group Inc.
21. IPSCO Inc. (Regina)
22. Stelco Inc. (Edmonton)

TABLE 4. WORLD STEEL PRODUCTION FORECAST, 1992 AND 1993

	1992	1993e
	(million tonnes)	
WESTERN EUROPE		
EEC		
Belgium-Luxembourg	13.4	13.5
Germany[1]	39.8	37.6
France	18.0	17.1
Italy	24.8	25.9
United Kingdom	16.1	16.7
Spain	12.6	13.0
Netherlands	5.4	5.9
Other EEC	2.5	3.7
Scandinavia	8.1	8.4
Turkey	10.2	11.4
Other	6.6	5.8
Subtotal	157.4	158.1
NORTH AMERICA		
United States	83.2	87.0
Canada	13.9	14.4
Subtotal	97.1	101.4
OTHER ADVANCED		
Japan	98.1	99.6
South Africa	9.2	8.6
Australia/New Zealand	7.6	8.6
Subtotal	114.9	116.8
Total, developed regions	369.4	376.3
LATIN AMERICA		
Brazil	23.9	25.1
Mexico	8.4	9.0
Other	8.8	9.2
Subtotal	41.1	43.3
DEVELOPING ASIA		
South Korea	27.8	33.4
India	18.1	18.5
Other	19.2	19.8
Subtotal	65.1	71.7
AFRICA-MIDDLE EAST		
Africa	5.1	5.8
Middle East	5.6	6.8
Subtotal	10.7	12.6
Total, developing regions	116.9	127.6
Total, market economies	486.3	503.9
EASTERN EUROPE/CPEs		
Former U.S.S.R.	111.2	95.7
Eastern Europe[2]	29.1	29.7
China	80.2	88.7
Other CPEs	7.2	7.0
Subtotal	227.7	221.1
Total, world	714.0	725.3
% Change	−2.8	+0.4

Source: International Iron and Steel Institute.
CPE Centrally Planned Economies.
e Estimated.
[1] Includes East Germany beginning in 1990. [2] Excludes East Germany beginning in 1990.

TABLE 5. PIG IRON PRODUCTION, 1991-93

	1991	1992	1993[e]
		(000 tonnes)	
EUROPEAN UNION			
Belgium	9 353	8 524	8 245
France	13 646	13 051	12 626
Germany, Federal Republic of[1]	30 946	28 548	26 967
Italy	10 857	10 451	11 066
Luxembourg	2 463	2 255	2 412
Netherlands	4 696	4 649	5 410[a]
Portugal	251	402	397
Spain	5 404	5 076	5 399
United Kingdom	11 883	11 351	11 563
Subtotal	89 542	84 507	84 085
OTHER WESTERN EUROPE			
Austria	3 441	3 074	3 075
Croatia	–	82	40[e]
Finland	2 331	2 452	2 535
Norway	61	60	60[e]
Sweden	2 812	2 735	2 845
Switzerland	70	70	70[e]
Turkey	4 594	4 489	4 353
Yugoslavia	1 266	905	105[a]
Yugoslavia, Federal Republic of	–	824	65[a]
Subtotal	14 575	11 815	11 902
Total, Western Europe	104 118	96 322	95 987
EASTERN EUROPE			
Albania	10	–	–[e]
Bulgaria	960	848	950[c]
Czechoslovakia	8 479	8 039	7 890
Czech Republic	–	5 082	4 640[b]
German Democratic Republic	–	–	–
Hungary	1 311	1 176	1 431[a]
Poland	6 355	6 359	6 120[a]
Romania	4 525	3 135	3 190[b]
Slovak Republic	–	2 952	3 250[b]
Total, Eastern Europe	21 640	19 557	19 581
Total, Europe	125 758	115 579	115 568
C.I.S.			
Kazakhstan	–	4 659	3 544
Russia	48 890	45 824	40 599
Ukraine	–	34 663	25 999
Subtotal	–	85 146	71 142
Georgia	–	274	88
Total, former Soviet Union	90 953	85 420	71 230
NORTH AMERICA			
Canada	8 268	8 621	8 600[a]
United States	44 123	47 378	47 873[a]
Total, North America	52 391	85 999	56 473

TABLE 5 (cont'd)

	1991	1992	1993[e]
		(000 tonnes)	
LATIN AMERICA			
Argentina	1 437	971	1 000[a]
Brazil	22 695	23 152	23 887
Chile	726	873	920[a]
Colombia	304	298	240 [a]
Mexico	3 039	3 404	3 400[a]
Paraguay	69	89	85[a]
Peru	200	158	–
Venezuela	–	–	–
Total, Latin America	28 470	28 945	29 532
Algeria	1 320	1 300[e]	1 300[e]
AFRICA			
Egypt	1 204	1 062	1 180[e]
South Africa	8 968	6 498	6 070[a]
Tunisia	172	157	154
Zimbabwe	525	507	211
Other Africa[e]	20	20[e]	20[e]
Total, Africa	10 219	9 544	8 935
ASIA			
Iran	1 952	2 053	1 961
China, People's Republic of	67 850	75 893	87 302
India	14 176	15 126	15 574
Japan	79 985	73 144	73 739
North Korea[e]	6 000	6 000[e]	6 000[e]
South Korea	18 510	19 323	21 776
Malaysia[e]	120	120	120[e]
Pakistan[e]	910	800[e]	800[e]
Taiwan	5 634	5 292	6 190[b]
Thailand	10	10	10[e]
Total, Asia	193 195	195 708	211 611
Australia	5 633	6 384	6 769
Total world	506 571	499 932	502 079
of which			
Total industrial countries	249 094	238 347	239 038
Total developing countries	71 081	72 662	76 967
Total Western World	320 176	311 009	315 005
Total CPEs	185 395	188 933	186 074

Source: International Iron and Steel Institute.
CPE: Centrally Planned Economies.
– Nil; [e] Estimated.
[a] Estimate based on 12 months; [b] Estimate based on 10 months; [c] Estimate based on 6 months.
[1] Former German Democratic Republic included in Federal Republic of Germany in 1991 and 1992.

Salt

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Domestic Production and Developments[1]

In 1993, Canadian salt production was estimated at 10.84 Mt, which represents a 3% decrease over 1992. Most of this decline was due to reduced production in the brining industry. Estimated Canadian shipments of all types of salt in 1993 were 11.04 Mt, a slight decrease over 1992 shipments of 11.09 Mt. In 1993, shipments from Ontario accounted for 60% of all shipments, a share comparable to that of 1992. Rock salt shipments accounted for 73% of total shipments, followed by salt in brines (20%) and evaporated salt (7%). The average unit value of salt shipments was estimated at $25.33/t, a 5.4% increase over 1992. Salt production capacity in Canada decreased slightly to 13.22 Mt, of which rock salt accounted for 72%, followed by captive brines (20%) and evaporated salt (8%). In 1993, rock salt mines operated at 84% of capacity; captive brining plants and evaporated salt facilities operated at 83% and 76%, respectively. Salt operations overall ran at an average of 83% of capacity, compared to 82% in 1992. Sales of salt products for de-icing purposes were soft in the prairies in 1993, mostly due to a cold winter with limited precipitation.

The chloralkali sector is still under significant pressure, mainly for environmental reasons. The major Dow Chemical chloralkali complex in Sarnia, Ontario, closed down, as announced, in June 1993. The Canadian pulp and paper industry, which is one of the largest end users for chloralkali, had a marginally higher output in 1993 than in 1992. Pulp mills operated at 86% of capacity in 1993; a higher rate is forecast for 1994. Canadian production of wood pulp rose 1% to 23 105 000 t in 1993, while pulp exports increased only 2.7% over 1992.

Chlorine continued to be under scrutiny with respect to its use in solvents (chlorofluorocarbons), in drinking water disinfection, and in pulp bleaching. Some of the Canadian pulp and paper producers are being required to abandon the use of chlorine if they wish to retain some of their markets. In North America, by 1995, caustic soda is forecast to represent 49.0% of bleaching chemical usage; chlorine will be reduced to 22.5% and sodium chlorate will account for 20.9%. The imbalance between chlorine and caustic soda, two co-products from the same electrolysis process, seemed to turn around; in the second half of 1993, demand for chlorine was on the rise. In 1993, spot prices for caustic soda in the United States plunged to below US$50/t, while chlorine prices showed marked improvement and reached US$225/t. Producers of natural soda ash are also penetrating the caustic soda market, which may in the end reverse the imbalance between chlorine and caustic soda. The Canadian market for PVC (polyvinyl chloride) and its feedstocks (ethylene dichloride-EDC and vinyl chloride monomer-VCM) was still affected by the recession due to the weakness of the construction sector; however, PVC output grew by about 10% due to increased foreign demand.

Sodium chlorate is considered to be the primary substitute for chlorine bleaching in pulp mills as it is the feedstock for the production of chlorine dioxide. In comparison with the previous year, no new sodium chlorate plants came on stream in 1993, mainly because of the situation in the pulp and paper industry. In 1993, Canadian production of sodium chlorate was up by about 13% over the previous year and is expected to experience a similar growth in 1994 as a result of the forecast improved performance of the pulp and paper industry.

Atlantic Region

Salt production in the Atlantic provinces was from an underground rock salt mine at Pugwash, Nova Scotia; an underground potash and salt mine at Sussex, New Brunswick; and a brining operation near Nappan, Nova Scotia.

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[1] Numbers used in the text may vary from numbers provided in the tables as the most recent information available was used for calculations.

In Nova Scotia, The Canadian Salt Company Limited operates an underground rock salt mine at Pugwash in Cumberland County, with a rated capacity of approximately 1.2 Mt/y. Most of the salt from this mine is used for snow and ice control. At the evaporated salt plant, saturated brine is fed to a quadruple effect vacuum pan, rated at 13 t/h, where brine solution is evaporated to produce high-quality salt crystals for use in the chemical and food industries. Development work on the 300-m level is now complete. The bagging operation bought in 1989 by The Canadian Salt Company Limited from Avalon Salt of Newfoundland, and located at Shelbourne and North Sydney, is used at capacity for the bagging of solar salt supplied from the company's facility in the Bahamas.

In New Brunswick, Potash Corporation of Saskatchewan Inc. – New Brunswick Division (formerly Potash Company of America) produced potash and salt at its underground mine near Sussex. Salt is extracted at a rate of 400 000-500 000 t/y and is sold mainly to the eastern United States and eastern Canada under a sales contract with Akzo Salt Limited. Reserves are estimated to be large enough to operate for as long as potash is extracted, which is for at least 20 years. In 1993, about 95% of production was used in road de-icing and the remainder was for chemical use. In October 1993, Rio Algom Limited sold the Potash Company of America assets to the Potash Corporation of Saskatchewan Inc. Operations in New Brunswick will now be known as PCS – New Brunswick Division.

The mine is now using the integrated method of utilizing salt tailings underground as fill to support the salt and potash mining operation. Approximately 1.5 Mt of processed salt tailings and rock-salt screen rejects are sent directly to active cut-and-fill potash stopes to be used as backfill. Clay slimes and excess brine slurries from the processing plant are also piped underground to be discharged into large cavities created by the extraction of rock salt. After the solids have settled out, the clear brine solution is re-pumped to the surface for re-use. The entire operation results in a closed circuit or "zero effluent" system.

Sifto Canada Inc., a division of North American Salt Co., has a brining operation at Nappan in Cumberland County, Nova Scotia. Evaporated salt products are sold for table salt, fisheries, and water conditioning.

Quebec

There is only one operating producer in Quebec, Seleine Mines Inc., located on the Magdelen Islands. The 173-m level is almost mined out and is expected to last until mid-1994; development work continued on the 255-m and 268-m levels. Each level contains reserves of about 8 Mt, which are sufficient to last about five years. Optimization of the crushing circuit is now complete, which resulted in an increase of about 5% in the recovery. Seleine Mines Inc. is owned by The Canadian Salt Company Limited.

Ontario

In 1993, salt was produced from two underground rock salt mines, Goderich and Ojibway, and from brining operations at Goderich, Sarnia, Windsor and Amherstburg. Salt is extracted from the Salina formation.

At Goderich, Sifto Canada Inc. operated an underground rock salt mine. Mining is currently conducted approximately 537 m below surface, 2.5 km offshore Lake Huron. Reserves are estimated to be 240 Mt and the mine has an annual capacity of 3.3 Mt of salt products. The mine is currently converting to the bench mining technique; the conversion is expected to be completed by the fall of 1994. Sifto's salt is marketed mainly for ice control and is sold primarily in eastern Canada, the north-central United States (Great Lakes Basin), and regions accessible through the Mississippi River system. Salt produced at Goderich is also used by the chemical and water treatment industries. Evaporated salt is produced at the Sifto brining operation located near Goderich and is used mainly for the water-softening market.

The Canadian Salt Company Limited produced both rock salt from the Ojibway underground mine and vacuum salt products from brine wells near Windsor. The mine capacity is 2.5 Mt/y and current estimated reserves are 100 Mt. Rock salt is extracted using room-and-pillar mining methods from a 7.5-m unit of the Salina formation about 297 m below surface. Brine is pumped from the 427-m and 457-m levels. Production is now taking place in the southwest portion of the 297-m level, within about 600 m of the shaft. Salt products include de-icing road salt (accounting for two thirds of production) and water softening, agricultural and chemical fine salt. The main markets are Canada and the midwest United States for all salt products except chemical fine salt, which is marketed in Quebec for the manufacture of caustic soda and chlorine. The company reports that it has acquired the mineral rights to Fighting Island in the Detroit River; therefore, it now has sufficient reserves for at least 40 years.

In the vicinity of Amherstburg, General Chemical Canada Ltd. has operated a brining operation for the manufacture of sodium carbonate and by-product calcium chloride. At Sarnia, Dow Chemical Canada Inc. has extracted brines from wells for the production of caustic soda and chlorine. Dow Chemical Canada Inc. closed its last chloralkali unit at the end of June 1993 due to market conditions.

Prairie Provinces

In Saskatchewan, four companies produced salt from the Middle Devonian Prairies formation. International Minerals & Chemical Corporation (Canada) Limited (IMCC) supplied by-product rock salt from its potash operation at Esterhazy. Its salt is distributed locally for road de-icing. Sifto Canada Inc. operated a brining operation near Unity for the production of fine vacuum pan salt. Since the closure of its fused salt plant, the company has adopted the compaction method to produce water-softener salt. Other uses of its salt include agriculture and food processing. Due to strong competition, Sifto closed its operation at Patience Lake where salt was recovered by processing waste salt from the nearby Potash Company of America potash operation. The Canadian Salt Company Limited at Belle-Plaine produced evaporated salt from by-product brines sourced from an adjacent potash solution mine operated by Kalium Chemicals, a division of Kalium Canada, Ltd. Most of the production goes towards water softening; other uses include agriculture, food processing, and ice control. Saskatoon Chemicals, a division of Weyerhaeuser Canada Ltd., produced brines from wells near Saskatoon for the manufacture of caustic soda and chlorine to be used internally in its pulp and paper operations.

Nusalt Corporation processed salt-rich potash tailings from Potash Corporation of Saskatchewan's Rocanville operation. The potash tailings are dried and bulk delivered to local distributors for road de-icing. Other markets, such as the United States, are being investigated.

Central Canada Potash Limited began salt production in September 1992. Salt is recovered from its potash tailings and the reported capacity increased to 300 000 t/y from the original 100 000 t/y. The main product is de-icing salt, which accounts for 90% of production; 5% is for domestic salt and 5% is agricultural grade. Products are mostly sold locally. The company is now moving to the commercial market where its products can be found under the trade mark "Sabre."

In Alberta, four producers operated brining operations. At Fort Saskatchewan near Edmonton, Dow Chemical Canada Inc. extracted salt brines for the manufacture of chloralkali and, at Lindberg, The Canadian Salt Company Limited produced fine vacuum pan salt. Near Bruderheim, two companies, Canadian Oxy Ltd. and Albchem Industries, operated solution mines to produce sodium chlorate used mostly for pulp bleaching in the prairies and western Canada.

British Columbia

There was no production of salt in this province where three companies operated four chloralkali plants. These operations used solar salt imported from Mexico, the United States and Chile.

CONSUMPTION

In Canada, the apparent consumption of salt has averaged 9.0 Mt/y since the mid-1980s, a 30% increase compared to the early 1980s. In 1992, the apparent consumption of salt in Canada was estimated at 9.5 Mt, a 7.6% decrease over 1991. In 1992, imports, mainly in British Columbia, Ontario and Quebec, accounted for about 11% of total domestic consumption. Due to the 1992 closure of several chloralkali plants, imports of salt in British Columbia decreased by about 35%. Chemical and de-icing uses accounted for between 90% and 95% of Canadian consumption, with the remainder being used for water conditioning, food processing, fisheries, and other industrial uses. Most of the salt used as a de-icing agent is consumed in Ontario, Quebec and Atlantic Canada. Average yearly consumption of salt in Canada for ice and snow control ranges between 3.2 and 4.5 Mt.

Some 60% of world salt consumption is as a chemical raw material, followed by table salt (20%) and road de-icing salt (10%); the remaining 10% is used in animal feed and water treatment. The consumption pattern differs in North America where the chemical industry consumes about 56% of total production, followed by highway usage (24%) and the food industry (7%).

Chloralkali and Related Uses

The industrial chemicals industry consumes salt for the manufacture of chloralkali such as caustic soda (sodium hydroxide), chlorine, and sodium chlorate. Salt for four caustic soda and chlorine plants in Canada is obtained from on-site brining and natural brines; other plants use mined rock salt or imported solar or evaporated salt. Other industrial chemicals that require significant quantities of salt include sodium bicarbonate, sodium chlorite, sodium hypochlorite, sodium carbonate (soda ash), and calcium chloride.

Chlorine, which is a major market for salt, is the principal pulp-bleaching agent responsible for the presence of traces of dioxin (2, 3, 7, 8,-TCDD (tetrachlorodibenzo-p-dioxin)) and furan (2, 3, 7, 8,-TCDF (tetrachlorodibenzo-p-furan)) in certain pulp and paper mill effluents in North America. These chlorinated compounds have been identified as carcinogenic to some animals; however, their effect in small dosages on humans is the focus of controversy.

By 1994, the release of furans and dioxins will be banned in pulp mill effluents in Canada. This is further to an announcement by the government in February 1991 requiring compliance by pulp and paper mills with new amendments to regulations under the *Fisheries Act*. These amendments establish new procedures for effluent measurement and, for the first time, make **all** mills in Canada, new and old, subject to regulations governing the discharge of suspended solids and oxygen-depleting substances. To obtain an extension beyond the December 31, 1993, deadline, a company will have to demonstrate that it made all reasonable efforts to comply with these regulations. An extension will be subject to public consultation and ministerial approval. No extensions will be granted after December 31, 1995. Several mills have asked for extensions.

The degree to which dioxins present a toxicity hazard is currently the focus of debate in the United States and Canada. In this regard, the U.S. Environmental Protection Agency and the Centers for Disease Control in Atlanta have stated that there is new evidence suggesting that dioxin is not as potent a carcinogen as originally believed. In Canada, a new study by the National Water Research Institute in Burlington found that there is no link between chronic biological changes in fish and effluents from all types of kraft mills, whether using chlorine as a bleaching agent or not. However, these findings are unlikely to change policies in Canada on dioxin as another study by Environment Canada found that pulp mill effluents are toxic and will endanger human life as long as chlorine is used, even if all dioxins were to be removed.

In early 1992, the province of British Columbia issued a regulation calling for the elimination of chlorine-compound pollution from pulp mills by the year 2002. Under this regulation, absorbable organic halides (AOX) should be reduced to 1.5 kg/t by 1995 and to zero by 2002. In 1993, the province of Ontario issued new rules for the pulp and paper industry. Under these rules, discharges of AOX should drop 40% from the current 2.5 kg/t by the end of 1995 and by a total of 68% by the end of 1999, bringing total discharge of AOX to 0.8 kg/t. However, the Ontario regulation does not go as far as the British Columbia initiative as it does not call for total elimination of AOX by the year 2002. Final decisions on this issue may take until the end of the decade. Currently, eight Ontario mills are still using chlorine.

Many mills in North America have continued the conversion of their bleaching process away from chlorine technology. A limit of 2.0 kg/t for absorbable organic halides (AOX), which include furans and dioxins, could be readily achieved; however, a cap could be legislated at 1.5 kg/t and would require a substitution level of up to 80%-90% in older mills, and up to 60%-70% in more recent mills.

Most mills in Canada have carried out extensive process modifications and improvements in effluent treatment. Several have opted to reduce chlorine usage by installing other bleaching processes such as extended lignification, oxygen delignification, sodium chlorate bleaching, integrated chlorine dioxide with hydrochloric acid recycling, and ozone and hydrogen peroxide bleaching processes. Although environmentalists consider sodium chlorate as a step in the right direction in the move away from chlorine, they still would like the pulp and paper industry to adopt dioxin-free bleaches, such as oxygen and hydrogen peroxide. It is estimated that the use of chlorine in Canadian pulp and paper mills has decreased by 65% in the last decade.

In late 1993, the Canadian and U.S. governments did not adopt a total ban of chlorinated chemicals as proposed in 1992 by the Canada-U.S. International Joint Commission which monitors the Great Lakes' water quality. In addition, a study sponsored by the chloralkali industry to assess the economic impact of such a ban concluded that such a regulation would cost US$102 billion in both countries and lead to the closure of 25 chlorine plants and 153 polyvinyl chloride facilities. These closures would result in the loss of 220 000 direct and indirect jobs. The replacement of chlorine compounds by alternative chemicals would take 10 to 20 years and would require investments of $67 billion in the construction of new facilities.

In the United States, the Environmental Protection Agency proposed a new rule to cut toxic air and water pollutants from about 350 pulp and paper mills. Under the proposed new rule, all dioxin discharges in water would be virtually eliminated. This new rule is due to take effect in 1998.

De-Icing

Sodium chloride, or salt, remains the primary de-icing agent. Different de-icers are used in accordance with site requirements. On streets and highways, rock salt, calcium chloride-salt mixtures, salt brines, and mechanical measures (plowing and blowing) are mostly used. On bridges, salt, sand-salt mixtures, and salt alternative methods are used; pavement heating and non-corrosive chemicals with corrosion inhibitors are under investigation. On runways and airways, non-corrosive compounds are used and comprise urea, formamide, and glycols. In residential and commercial areas, rock salt, potassium chloride (potash), calcium chloride, and various combinations of these materials with abrasives are regularly used. Calcium chloride is the second most used de-icer, being effective at temperatures ranging between –10° and –20°C; this chemical is usually mixed with salt at a 2%-4% rate. The use of abrasives is mostly limited to highways and residential areas; a mixture of coarse sand and small crushed stone is spread to improve the skid resistance of slippery roads.

Growing concerns over respecting the environment and the corrosion of infrastructure, such as bridge decks and parking lots, have led to numerous experiments with de-icing salt substitutes. Research on alternatives has focused on abrasive mixes, magnesium chloride, ammonium compounds, tetrapotassium pyrophosphates, calcium magnesium acetate (CMA), sodium formate, isopropyl alcohol, ethylene glycol, and technical urea. Studies have also been conducted on non-chemical treatments, including a series of measures that are mainly used in Europe such as ice-retardant pavement surfacing and roadway heating. The effects of salt-spreading on the environment depend on a variety of factors such as weather conditions, road characteristics, traffic loads, winter maintenance methods, and local topography. Environmental effects may include adverse impacts on plant growth and crop productivity in the immediate vicinity of highways, as well as higher salinity levels in streams and groundwater systems. For many years, provincial and regional agencies in charge of road maintenance have pursued the objective of optimizing the use and selection of ice and snow control methods. Cost, operational reliability, public safety, and environmental considerations have all resulted in improvements to existing methods and better road safety and rideability.

Other Uses

Tests by the Ontario Ministry of Transportation indicate that CMA is only effective at temperatures around –6° and –7°C. Although CMA has proven to be effective and environmentally safe, its temperature limitation and its price, which is about 30 times that of salt, will continue to limit its application. In 1991, the Research and Development Branch of the Ontario Ministry of Transportation published a paper presenting results of research on highway de-icers. Several de-icers were compared; salt was still acknowledged as the most efficient and the least expensive de-icer for use in the province of Ontario.

Other sectors that consume salt include water softening, food processing, and the fisheries industry, which together account for close to 5% of total consumption in Canada. Salt consumption in Canada for water softening is estimated at 150 000-200 000 t/y. All Canadian production is consumed in the domestic market; trade in conditioning salt is estimated to be small. Typical annual consumption per household in Canada ranged between 350 and 450 kg/y of salt. The bulk of the water-softening market is reported to be located in suburban and rural areas where hard water is seldom treated on a large-scale basis. Some major municipalities in western Canada, such as Regina and Calgary, use water softeners extensively as the local water carries high calcium and magnesium concentrations. In 1993, the water treatment market in Canada was evaluated at $700 million, essentially the same level as in 1992. The residential water-softening market remained stable at $60 million. Salt sales in this market segment remained flat at $20 million. The bottled water market was $203 million in 1993. Fused salt, which was a popular product for water softening, has been replaced by compacted salt pellets, nuggets and crystals; in some instances, coarse salt is used. Growth in this market is tied to housing starts and local water characteristics. New water treatment devices that do not use salt, such as electromagnetic equipment and catalytic units, have not yet been approved in Canada. As Canada moves out of the current recession, the water-softening market should show a marginal growth in 1994.

TRADE

Imports of salt in 1992 were 1.04 Mt valued at $28.8 million, which represented a decrease of

TABLE 4. CANADIAN SALIENT STATISTICS ON SALT

Company	Location/ Initial Production	Employment 1991	Employment 1992	Annual Production Capacity 1989	1990	1991	1992	1993	Remarks
				(000 t/y)					
Albchem Industries Ltd.	Bruderheim, Alta./1991	10[a]	10[a]	–	–	29	29	29	Brining to produce sodium chlorate.
Canadian Occidental Petroleum Ltd.	Bruderheim, Alta./1991	5[a]	5[a]	–	–	26	26	28	Brining to produce sodium chlorate.
Canadian Salt Company Limited, The	Pugwash, N.S./1959	214[b]	204[b]	1 200	1 200	1 200	1 200	1 200	Rock salt mining to a depth of 305 m.
	Pugwash, N.S./1962			110	110	110	110	110	Dissolving rock salt fines for vacuum pan evaporation.
	Îles-de-la-Madeleine, Que./1982	177	174	1 500	1 500	1 500	1 500	1 500	Rock salt mining to a depth of up to 273 m.
	Ojibway, Ont./1955	239	231	2 500	2 500	2 500	2 500	2 500	Rock salt mining at a depth of 300 m.
	Windsor, Ont./1892	108	116	150	150	150	150	170	Brining, vacuum pan evaporation.
	Belle-Plaine, Sask./1969	28	28	170	170	170	170	170	Producing fine salt from by-product brine from nearby potash operation.
	Lindbergh, Alta./1968	65	62	140	140	140	140	140	Brining, vacuum pan evaporation.
Subtotal		831	815						
Central Canada Potash Ltd.	Colonsay, Sask./1992	–	9	–	–	–	100	300	By-product rock salt from potash operation.
Dow Chemical Canada Inc.	Sarnia, Ont./1950	4[a]	4[a]	900	900	900	900	375[c]	Brining to produce caustic soda and chlorine. Closed in June 1993.
	Fort Sask., Alta./1968	3[a]	3[a]	1 400	1 400	1 400	1 400	1 400	Brining to produce caustic soda and chlorine.
Subtotal		7[a]	7[a]						
General Chemical Canada Ltd.	Amherstburg, Ont./1919	6[a]	6[a]	690	690	690	690	690	Brining to produce sodium carbonate.
International Minerals & Chemical Corporation (Canada) Limited	Esterhazy, Sask./1962	3	3	120	120	120	120	120	By-product rock salt from potash mine for use in snow and ice control.
Nusalt	Rocanville, Sask./1990	12	12	–	100	100	140	140	By-product rock salt from potash tailings.
Potash Corporation of Saskatchewan – New Brunswick Division	Sussex, N.B./1980	27	27	450	450	500	500	550	Rock salt produced in association with potash for use in snow and ice control.

Saskatoon Chemicals – a division of Weyerhaeuser Canada Ltd.	Saskatoon, Sask./1968	5[a]	5[a]	70	70	70	70	75	Brining to produce caustic soda, chlorine and sodium chlorate.
Sifto Canada Inc.	Nappan, N.S./1947	76	72	100	100	100	100	100	Brining for vacuum pan evaporation.
	Goderich, Ont./1959	339	318	2 800	3 300	3 300	3 300	3 300	Rock salt mining at a depth of 536 m.
	Goderich, Ont./1880	65	65	120	120	120	120	120	Brining for vacuum pan evaporation.
	Unity, Sask./1949	77	72	180	180	180	180	180	Brining vacuum pan evaporation. Fusion plant closed in 1991.
	Patience Lake, Sask./ 1987	5	5	–	–	100	100	75[c]	By-product rock salt from potash mine. Closed in fall of 1993.
Subtotal		562	532						
Total		1 468	1 431	12 600	13 200	13 405	13 545	13 272	

Sources: Natural Resources Canada, 1993; company surveys.
– Nil.
[a] Employment part of chemical complex. [b] Includes employment in brining operations at Pugwash. [c] Production capacity pro-rated to time of closure.

TABLE 5. CANADIAN CHEMICAL PLANTS USING SALT AS A MAJOR RAW MATERIAL, DEVELOPMENTS AND PROJECTS IN 1993

Company	Location	Parent Company	Plant Location	Type of Cells	Products	Annual Capacity[r]	Remarks
						(tonnes)	
Albchem Industries Ltd.	Bruderheim, Alberta	Sherritt Gordon Limited, Vencap Equities Alberta Ltd., Alberta	Bruderheim, Alberta	Metal	Sodium chlorate	55 000	Captive production.
B.C. Chemicals Ltd.	Prince George, British Columbia	B.C. Chemicals Ltd., Prince George, B.C.	Prince George, British Columbia	Metal	Sodium chlorate	77 000	
Canadian Occidental Petroleum Ltd.	Calgary, Alberta	Occidental Petroleum Corporation, Los Angeles, CA, U.S.A.	Amherstburg, Ontario	Metal	Sodium chlorate	50 000	
			Brandon, Manitoba	Metal	Sodium chlorate	85 000	
			Bruderheim, Alberta	Metal	Sodium chlorate	50 000	Captive production.
			Nanaimo, British Columbia	Metal	Sodium chlorate	16 000	
			North Vancouver, British Columbia	Diaphragm	Caustic soda Chlorine	155 000 141 000	
Domtar Inc.			Lebel-sur-Quévillon, Quebec		Sodium chlorate	. .	
Dow Chemical Canada Inc.	Sarnia, Ontario	The Dow Chemical Company, Michigan, U.S.A.	Fort Saskatchewan, Alberta	Diaphragm	Caustic soda Chlorine	524 000 476 000	
			Sarnia, Ontario	Diaphragm	Caustic soda Chlorine	401 000 365 000	Closed in 1993.
Eka Nobel Canada Inc.	Magog, Quebec	Nobel Industries AB, Sweden	Magog, Quebec	Metal	Sodium chlorate	122 000	
	Valleyfield, Quebec		Valleyfield, Quebec	Metal	Sodium chlorate	105 000	
General Chemical Canada Ltd.	Amherstburg, Ontario	General Chemical Corporation, Morristown, New Jersey, U.S.A.	Amherstburg, Ontario	Metal	Calcium chloride Sodium carbonate	450 000 400 000	
Great Lakes Forest Products Limited	Thunder Bay, Ontario	Canadian Pacific Securities Limited, Montréal, Quebec	Dryden, Ontario	Membrane	Caustic soda Chlorine	16 000 14 500	
ICI Canada Inc.	Montréal, Quebec	Imperial Chemical Industries plc (ICI), England	Bécancour, Quebec	Diaphragm	Caustic soda Chlorine	325 000 295 000	
			Cornwall, Ontario	Mercury	Caustic soda Chlorine	38 500 35 000	
			Dalhousie, New Brunswick	Metal	Sodium chlorate	22 000	
				Mercury	Caustic soda Chlorine	31 000 28 000	
PPG Canada Inc. Industrial Chemical Division	Beauharnois, Quebec	PPG Industries, Inc., Pittsburgh, Penn., U.S.A.	Beauharnois, Quebec	Metal	Sodium chlorate	40 000	
				Membrane	Caustic soda Chlorine	80 000 73 000	

St. Anne Chemicals Company Ltd.	Nackawic, New Brunswick	Parsons & Whittemore, Inc., New York, U.S.A.	Nackawic, New Brunswick	Metal	Sodium chlorate	12 500	Captive production.
				Membrane	Caustic soda Chlorine	10 000 9 000	Captive production.
Saskatoon Chemicals	Saskatoon, Saskatchewan	Weyerhaeuser Canada Ltd., Kamloops, B.C.	Saskatoon, Saskatchewan	Metal	Sodium chlorate	44 000	
				Membrane	Caustic soda Chlorine	36 000 33 000	
Sterling Pulp Chemicals	Islington, Ontario	Sterling Chemical Inc., Texas, U.S.A.	Buckingham, Quebec	Metal	Sodium chlorate	132 000	
			Grande Prairie, Alberta	Metal	Sodium chlorate	45 000	
			Thunder Bay, Ontario	Metal	Sodium chlorate	53 000	
			North Vancouver, British Columbia	Metal	Sodium chlorate	92 000	

Sources: Natural Resources Canada, December 1993; Chemicals Directorate and Investments, Industry, Science and Technology Canada, December 1993.
. . Not available; r Revised.

Ontario

Unimin Canada Ltd. is also the largest producer of silica in Ontario, with a reported total capacity of about 550 000 t/y. Lump quartzite from Badgeley Island (150 000-t/y capacity), in northern Georgian Bay, is shipped by lake boat to Canadian destinations for the manufacture of ferrosilicon. The finer material, produced by crushing, is shipped to Unimin's plant at Midland (400 000-t/y capacity), south of Georgian Bay, where it is further processed to a glass-grade silica sand and silica flour for ceramic and other uses.

Hutcheson Sand & Gravel Ltd. mines an unconsolidated silica sand in the Muskoka area. The sand is used mainly as golf course sand.

Manitoba

Marine Transport Limited of Selkirk permanently ceased production of high-purity silica sand from a quarry on Black Island on Lake Winnipeg, some 130 km north of Selkirk. Because of poor sales, the quarry had been inactive for the past few years.

Saskatchewan

Hudson Bay Mining and Smelting Co., Limited (HBMS) produces silica sand from two pits in the Amisk Lake area of northern Saskatchewan. The silica is used by HBMS as a smelting flux at its copper-zinc smelter in Flin Flon, Manitoba.

Red Deer Silica Inc. produces a small amount of silica northeast of the village of Hudson Bay, Saskatchewan. The main market is for golf course bunkers.

Alberta

Sil Silica, a wholly owned subsidiary of The Warren Paving and Materials Group Ltd., produces silica sand from local sand dunes in the Bruderheim area. The silica is sold mainly for the manufacture of fibreglass and as sandblasting material. It is also sold as foundry sand, filtration sand, fracturing sand, and railway traction sand.

British Columbia

Mountain Minerals Co. Ltd. mines a high-purity, friable sandstone deposit near Golden. At a plant near Golden, the ore is crushed, screened, washed, dried and separated into several sizes. These different sizes are sold mainly as glass sand, but also as sandblasting sand, foundry sand, filter media sand, and golf course sand.

Bert Miller Inc. mines the Nicholson silica deposit, which is located about 11 km from Golden. The property is owned by Silicon Metaltech Inc., a producer of silicon metal with a plant at Wenatchee, Washington. The ore consists of a massive quartzite and is sold as lump material.

TRADE

Most silica sand imported into Canada comes from loosely consolidated and easily processed sandstones or lake sand deposits located near the Great Lakes region. Major U.S. operations are located in the states of Illinois, Wisconsin, Michigan and Indiana. The imported silica sand is used mainly by iron and steel foundries and by the glass industry of Ontario and Quebec. In 1992, imports of silica sand for use in foundries were 315 191 t valued at $5.89 million, in 1991 they were 445 963 t valued at $6.87 million, and in 1990 they were 589 162 t valued at $8.99 million. In 1992, imports of silica sand for use in glass-making were 101 230 t valued at $0.995 million, in 1991 they were 136 327 t valued at $1.30 million, and in 1990 they were 152 028 t valued at $1.49 million.

CANADA, SILICA CONSUMPTION,[1] 1991 AND 1992

	1991r	1992p
	(tonnes)	
Lump	898 148	1 061 561
Sand	1 280 333	1 277 780
Flour	48 885	62 643
Total	2 227 366	2 401 984

Source: Natural Resources Canada.
p Preliminary; r Revised.
1 Available data, as reported by consumers.

OUTLOOK

Not much improvement is expected in 1994 in most silica markets in Canada. In the longer term, environmental concerns and the disposal problems posed by plastic containers should encourage greater use of glass containers, which are easier to recycle. However, at the same time, the glass container industry is under growing pressure to increase recycling, which will likely mean a reduction in its consumption of silica and other industrial minerals used in glass-making. Markets for flat glass and fibreglass are not expected to improve as long as the economy remains weak. Producers of silicon carbide and silicon metal will continue to suffer from strong overseas competition.

In the long term, competition from U.S. producers of silica for glass and foundry sand will remain strong in Ontario and Quebec because of the proximity of these provinces to the low-cost producers of the Great Lakes region. Also, due to reduced North American car production and the recycling of silica sand at foundries, no growth can be expected in the foundry sand industry in Canada. Competition from substitutes for glass containers, such as paper, plastics and aluminum, will continue. Sandblasting will continue to decline as a result of tighter environmental controls and substitution from minerals such as garnet, olivine, staurolite and feldspar. The filler market is still small, but its growth will continue to be strong. On balance, silica producers will continue to suffer from low capacity utilization and low prices.

OPPORTUNITIES

Higher-value silica products could be produced in Canada because of the low cost of electricity in certain parts of the country. Such products include:

- cultured quartz in western Canada for the production of oscillators used in electronics, in optical instruments and other applications;

- fused amorphous silica or quartz (minimum 99.8% SiO_2) in the form of ingots, rods, tubes and powder for the chemical and electronic industries;

- cristobalite for use as a filler in paints, plastics, glues, and ceramics;

- microgrits/powders of refined (cleaned, surface coated, etc.) silicon carbide for advanced ceramics and composites;

- monocrystalline silicon for the production of silicon chips;

- high-purity ground silica (minimum 99.5% SiO_2, 2 to 20 microns) for use as an abrasive for metal polishes and cleansers, and fillers in plastics and rubber;

- chemical-grade silicon metal for the production of silicones in western Canada; and

- an integrated silicon carbide plant in western Canada, based on local raw materials and inexpensive electricity.

With the exception of a recently built cultured quartz plant in Quebec, none of these products is currently produced in Canada.

In addition, there are opportunities for:

- a new reinforcement fibreglass plant (in Canada there is only one plant in Ontario);

- the production of silicones[1] by reacting silicon metal powder with methyl chloride;

- the production of fumed amorphous silica[1] from the hydrolysis of silicon tetrachloride[2] in a flame of hydrogen and oxygen for use in rubbers, as a thickening agent in inks, paints, cosmetics, etc., polyester, and specialty coatings such as powder coatings; and

- precipitated silica and silica gel[1] by reacting sodium silicate[3] with sulphuric acid. (These products are used for reinforcing rubber, in toothpastes, as extenders in paints, fillers in inks, and as thickener in batteries.)

REFERENCES

[1] No production facility yet exists in Canada, although most raw materials are available.

[2] Produced through the chlorination of silicon metal or silica.

[3] Produced by reacting high-purity silica with sodium carbonate or with caustic soda.

Note: Information in this review was current as of February 1, 1994.

TABLE 1. CANADA, SILICA PRODUCTION AND TRADE, 1992 AND 1993

Item No.		1992		1993p	
		(tonnes)	($000)	(tonnes)	($000)
PRODUCTION (shipments)					
	By province				
	Newfoundland	–	–	. .	. .
	Prince Edward Island	–	–	. .	. .
	Nova Scotia	x	x	. .	. .
	New Brunswick	x	x	. .	. .
	Quebec	568 834	13 927	. .	. .
	Ontario	647 273	10 568	. .	. .
	Manitoba	–	–	. .	. .
	Saskatchewan	x	x	. .	. .
	Alberta	174 861	1 878	. .	. .
	British Columbia	x	x	. .	. .
	Total	1 753 894	32 508	. .	. .
IMPORTS[1]				**(Jan.-Sept.)**	
2505.10	Silica sands and quartz sands				
	United States	689 278	14 570	746 728	15 295
	South Africa	40	12	3 174	320
	Germany	43	36	93	60
	United Kingdom	–	–	20	5
	Japan	4	2	6	5
	U.S. Minor Outlying Islands	–	–	38	1
	Italy	–	–	1	1
	Norway	3 198	274	–	–
	Total	692 563	14 895	750 060	15 690
2506.10	Quartz (other than natural sands)				
	Spain	–	–	36 304	1 404
	United States	2 077	139	2 316	161
	Brazil	704	45	228	15
	Japan	107	7	105	7
	South Africa	1	. . .	–	–
	Total	2 889	193	38 953	1 589
2506.21	Quartzite crude or roughly trimmed				
	United States	2 005	198	1 161	133
	Total	2 005	198	1 161	133
2506.29	Quartzite n.e.s.				
	United States	1 274	140	1 411	204
	Brazil	16	2	98	14
	Total	1 290	142	1 509	218
2811.22	Silicon dioxide				
	United States	10 918	19 807	9 434	16 436
	Germany	1 067	2 664	1 121	2 743
	France	568	762	958	1 195
	United Kingdom	14	77	22	89
	Japan	7	51	3	27
	Switzerland	1	8	1	10
	Netherlands	. . .	. . .	. . .	2
	Ireland	–	–	. . .	1
	Sweden	3	31	–	–
	Total	12 579	23 404	11 540	20 508
EXPORTS					
2505.10	Silica sands and quartz sands				
	United States	181 653	820	132 017	718
	South Korea	–	–	97	22
	France	82	19	80	20
	South Africa	29	11	35	12
	Philippines	24	4	10	2
	Other countries	241	96	–	–
	Total	182 029	952	132 239	774

TABLE 1 (cont'd)

Item No.		1992		Jan.-Sept. 1993p	
		(tonnes)	($000)	(tonnes)	($000)
EXPORTS (cont'd)					
2506.10	Quartz (other than natural sands)				
	United States	65	26	5	24
	Total	65	26	5	24
2506.21	Quartzite crude or roughly trimmed				
	United States	66	11	65 614	1 071
	Total	66	11	65 614	1 071
2506.29	Quartzite n.e.s.				
	United States	–	–	7	5
	Total	–	–	7	5
2811.22	Silicon dioxide				
	United States	28	24	22	27
	Venezuela	134	64	–	–
	Belgium	. . .	. . .	–	–
	Total	163	89	22	27

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available; . . . Amount too small to be expressed; n.e.s. Not elsewhere specified; p Preliminary; x Confidential.
1 Includes sand for use in foundries and glass manufacturing, ground and flour sand, and volatized and silica flue dust.
Note: Numbers may not add to totals due to rounding.

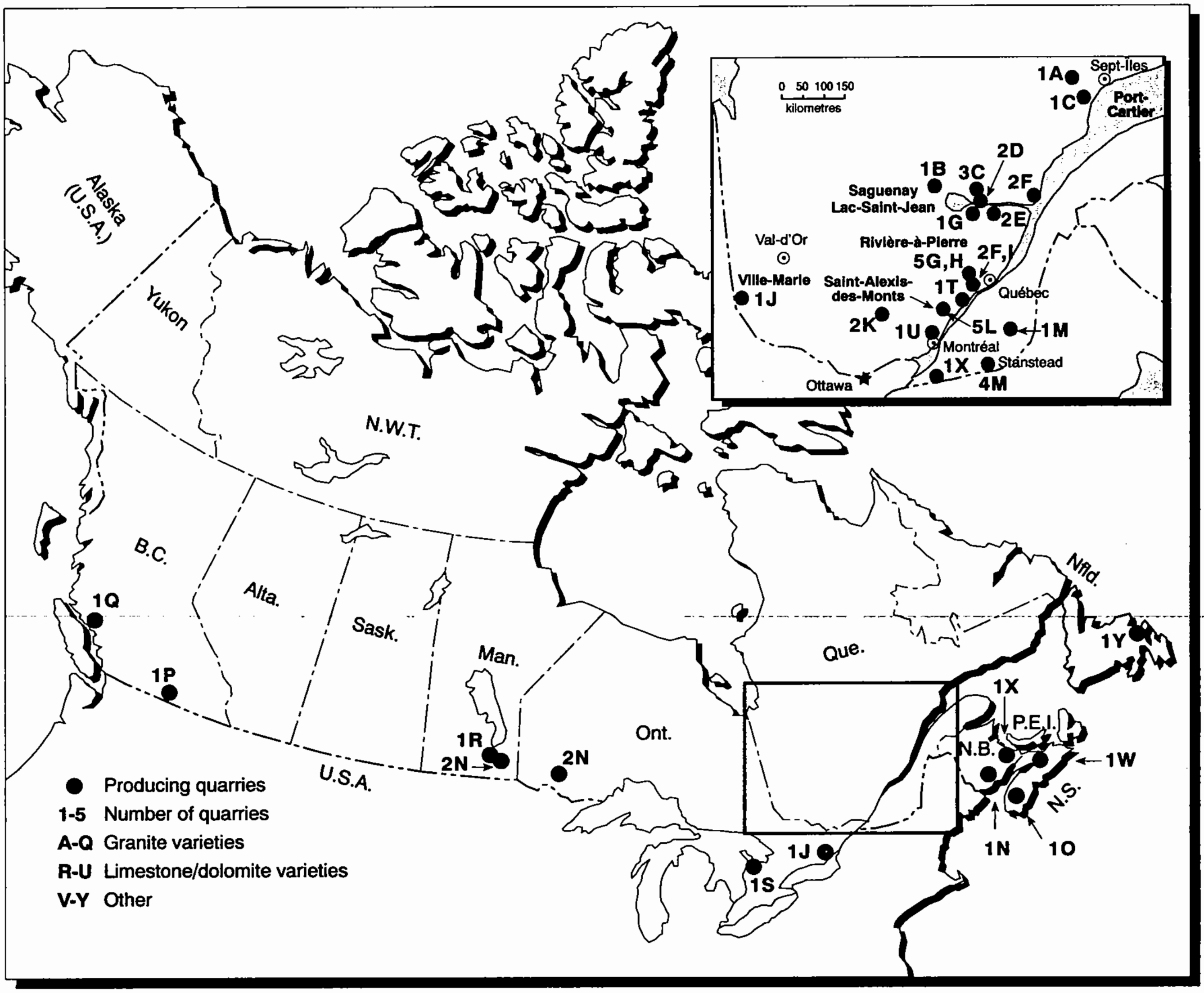
TABLE 2. IMPORTS OF SILICA SAND (FROM THE UNITED STATES) BY PROVINCE AND BY USE, 1992

	Foundry		Glass Manufacturing	
	(tonnes)	($000)	(tonnes)	($000)
Newfoundland	–	–	–	–
Prince Edward Island	–	–	–	–
Nova Scotia	935	8	–	–
New Brunswick	–	–	–	–
Quebec	28 326	476	8 961	95
Ontario	167 119	3 600	92 223	896
Manitoba	1 117	111	5	2
Saskatchewan	229	53	–	–
Alberta	142	16	–	–
British Columbia	117 323	1 628	41	1
Total	315 191	5 896	101 230	995

Source: Statistics Canada.
– Nil.
Note: Numbers may not add to totals due to rounding.

Figure 1

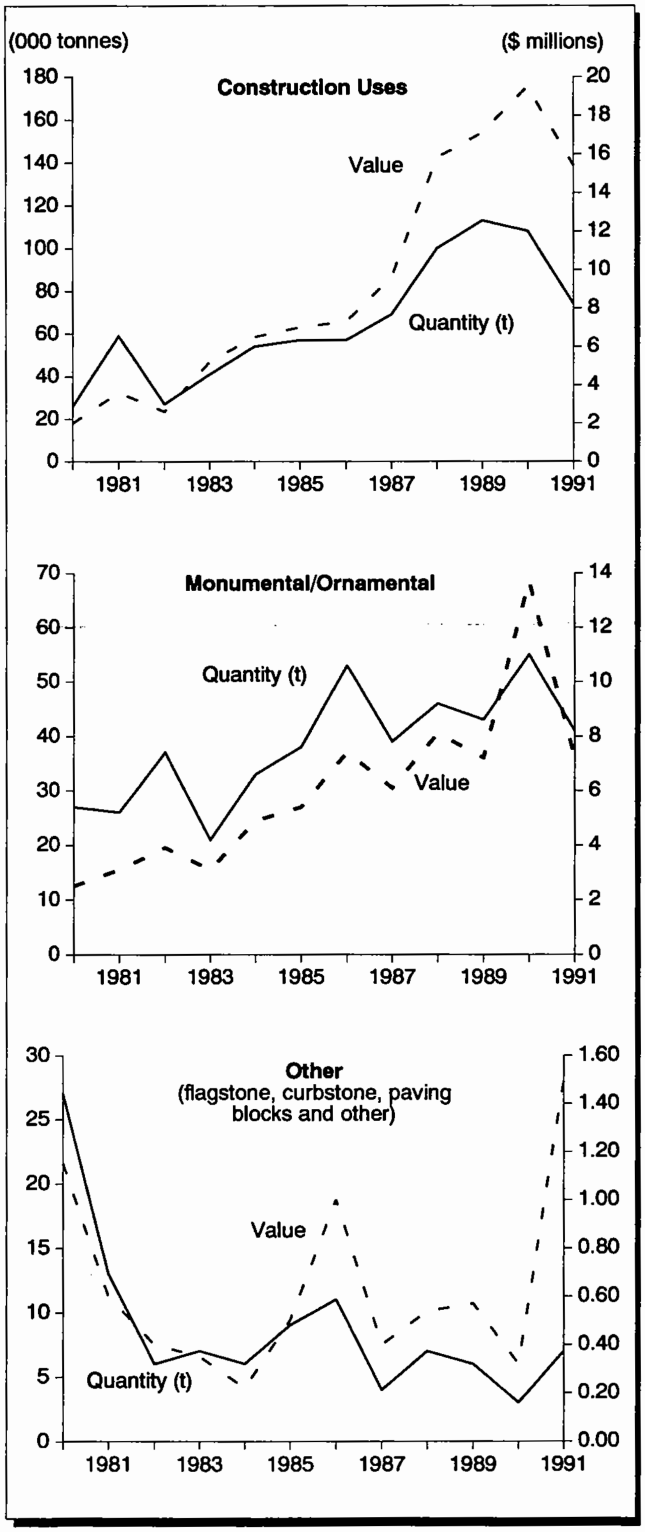
Canada, Architectural and Monumental/Ornamental Stone-Producing Centres, 1992



A Fine-grained pinkish-grey banded gneiss
B Medium-grained mahogany granite
C Coarse-grained black anorthosite
D Medium-grained black gabbroic anorthosite
E Medium-grained pinkish-grey quartz monzonite
F Fine-grained pink granitic gneiss
G Coarse-grained green charnockite
H Coarse-grained pink-grey or brown-grey granite
I Medium-grained grey dioritic gneiss
J Medium-grained red granite
K Fine-grained pink aplite
L Coarse-grained brown or red quartz monzonite
M Medium-grained grey granite
N Medium-grained pink granite
O Fine-grained blue-grey granite
P Coarse coral pink granite
Q Medium-grained blue-grey granite
R Light-coloured mottled dolomitic limestone (Tyndall)
S Fine-medium crystalline blue-grey to buff marble/dolostone (Arriscraft)
T Medium-grained light brownish-grey limestone (Deschambault)
U Medium-grained blue-grey limestone (Chazy)
V Medium-grained olive sandstone
W Fine-medium-grained olive-brown and blue-grey sandstone
X Fine-medium-grained white to buff sandstone (Potsdam)
Y Very fine-grained varicoloured slate

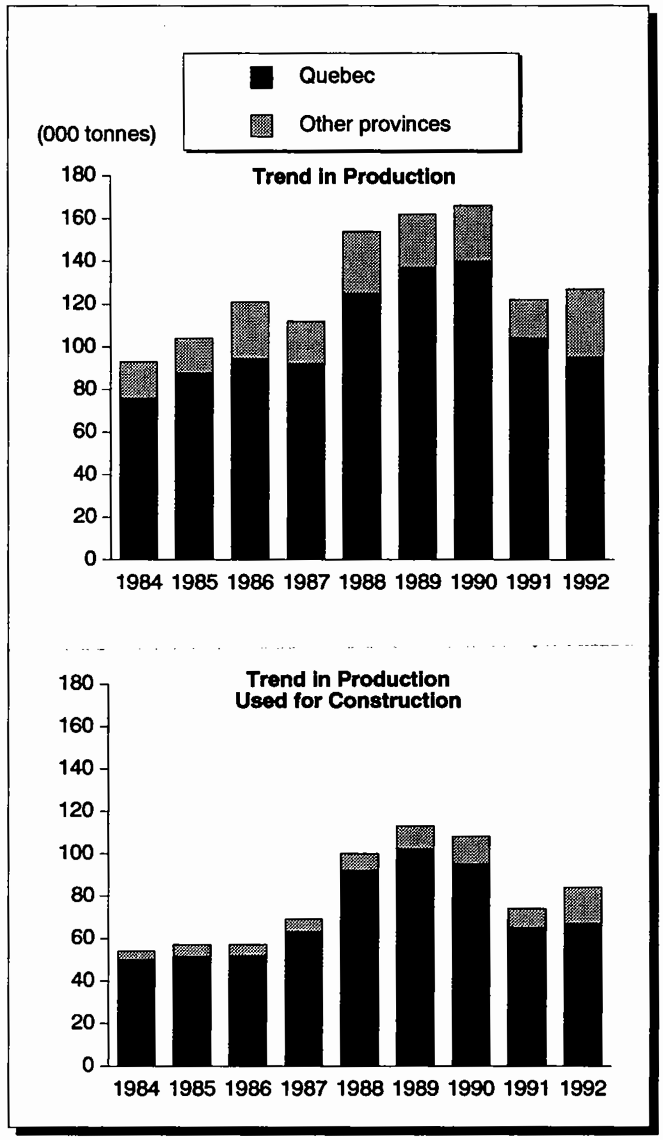
Source: Mainly provincial departments of Mines and Energy.

Figure 2
Canada, Production of Rough Granite (Sold and Used by Producers), 1980-91



Sources: Natural Resources Canada; Statistics Canada.

Figure 3
Canada, Trends in Production of Rough Granite, 1984-92



Sources: Natural Resources Canada; Quebec Ministry of Energy and Resources.

The Canada Centre for Mineral and Energy Technology (CANMET) completed the final report in a series of summary reports on industrial minerals entitled *Summary Report No. 20: Limestone, Calcite and Lime.*[4] Processing and analytical data for the subject rocks and minerals, and to a lesser extent lime, from several provinces is reported in tabular format; detailed assessments of individual testwork are presented in an appendix.

Atlantic Provinces

Limestone

Occurrences of limestone in the Atlantic provinces are common and have been systematically catalogued in the past.[5,6,7] Deposits of commercial importance are being worked in three of the four provinces.

In Newfoundland, outside of requirements for aggregate for highways, the most important operation is the manufacture of cement by North Star Cement Limited at Corner Brook.[8] Recently, the Iron Ore Company of Canada (IOC) in western Labrador brought into production a dolomitic marble for use in self-fluxing "dolomitic-type" iron ore pellets.[9] Newfoundland Resources & Mining Company Limited, as mentioned in the *Mineral Aggregates* chapter, made several shipments of crushed limestone from its tidewater property on the Port-au-Port Peninsula. A comprehensive major study entitled "Newfoudland Limestone/ Dolomite Market Study" was completed in 1993. The objective was to review present markets and related potential markets over the next 20 years and to identify influencing factors. The study is available from the Government of Newfoundland and Labrador (Department of Mines and Energy, St. John's). In Nova Scotia, limestone for numerous uses is quarried in the central and eastern parts of the province. Atlantic Industrial Minerals began supplying limestone from its Glen Morrison, Cape Breton deposit to Nova Scotia Power Corporation's Point Aconi thermal-electric station. In New Brunswick, quarries operate at three locations: Brookville, Elm Tree, and Havelock.

Granite and Marble

Occurrences of granite in the Atlantic region have been described by Carr.[10] In Nova Scotia, a blue-grey granite produced near Nictaux is used mainly in the monument industry. Activity relating to granite, as well as to other types of stone, has been summarized in two publications.[11,12] Construction Aggregates Ltd., owned by Lone Star Industries, Inc. of Greenwich, Connecticut, continued shipping high-quality granite aggregate from the company's Porcupine Mountain quarry on the Strait of Canso. Plans to develop a granite aggregates quarry at Kelly's Mountain on Cape Breton Island remained on hold pending an environmental review.

Granite is quarried intermittently for uses that include building stone and monumental stone at a number of sites in New Brunswick.[13] A red, fine-to-medium-grained granite is available near St. Stephen, and fine-grained pink, grey and blue-grey granites are available in the Hampstead (Spoon Island) district. Other stone available on demand includes: a brown-to-grey, coarse-grained granite in the Bathurst area; a salmon-coloured, medium-grained granite near Antinouri Lake; and a black ferro-magnesian rock in the Bocabec River area. Finally, quarries in the St. George district, characterized by a red granite, are potential candidates for reactivation.

The exploration and assessment of a wide variety of granite and marble continued in Newfoundland and Labrador. On the northern Labrador coast, work concentrated on a large complex that hosts a uniform medium-grained, light-grey anorthosite containing up to 20% labradorite crystals exhibiting flashes of blue chatoyance on cut surfaces.[8] Rough blocks were shipped from a deposit being developed by the Labrador Inuit Development Corporation (LIDC). This company has a 10% interest in an Italian-German partnership responsible for quarrying and shipping the stone to Italy for processing and marketing under the name "Reflect Blue."

In Newfoundland, work continued on several types of granite. These include: Borney Lake granite, a fine-to-medium-grained, black-to-grey gabbroic rock described as being similar to some South African "black granites"; Lumsden, a coarse-grained, megacrystic granite that has been used in a university building in St. John's; Dunamagon, an orange-pink granite characterized by a weak biotite-quartz foliation pattern; Petites, a medium-grained pink granite that has been used in the past in buildings in St. John's; and Seal Cove, a medium-grained rose granite that has a related red phase described as being comparable to Indian red granites. In western Newfoundland, efforts were directed toward developing the Goose Arm Road marble deposit.

Sandstone and Slate

In 1992, Newfoundland Slate Inc. opened a new slate production plant at Nut Cove, Trinity Bay, Newfoundland. More than $9 million was invested to bring the former Newfoundland Slate Quarries site into production. Ardoisières d'Angers, a major French company and a leading European marketer of roofing slates, provided up-to-date technology and is the primary distributor. Distribution networks in Canada and the United States were established in 1993.

In Nova Scotia, a medium-grained buff sandstone known as "Wallace sandstone" is quarried for use as heavy riprap and for dimension stone. This stone enjoyed widespread architectural use in the past in central and Atlantic Canada and, as a result, is seeing growing use for renovation and restoration work.

In New Brunswick, a red fine-to-medium-grained sandstone has been quarried in Sackville for use in construction. Deposits are exploited on demand throughout Kent and Westmoreland counties. Sandstone has been quarried in the past in Prince Edward Island and used locally.

Quebec

Limestone

Limestone occurs in the St. Lawrence and Ottawa River valleys and in the Eastern Townships. The century-old Deschambault quarry at St. Marc-des-Carrières is one of the few locations where blocks and other shapes are produced from time to time. Marble has been produced in the Eastern Townships and the Lac St-Jean areas.

Granite

Development mainly associated with granite has increased substantially during the last five years.[14,15] Quarries have been opened from near Rouyn-Noranda in the west to Magpie, about 100 km east of Sept-Îles. About 20 companies quarry granite, mainly in the Rivière-à-Pierre, Lac St-Jean, St. Lawrence North Shore, the Eastern Townships, and Appalachian regions. These companies now account for about 55 quarries classified as producers of granite for construction, monuments and/or furniture. Also in the province, there are 46 fabricating plants involved in processing granite for monumental and construction uses, according to a recent poster map and listing by the Quebec Ministry of Energy and Resources.[16]

Granicor Inc./Columbia Granite Inc. quarries numerous types of rough granite for its fabricating plants as well as for export markets. In 1993, Granicor introduced a new black granite to the market and established Tulinor USA as the company's distributor in the Atlantic states. In 1993, members of the Association des Producteurs de Granite du Québec (including Groupe Polycor Inc., A. Lacroix Ltée, and Granilac Inc.) merged with the Canadian Granite Association to create a single organization representing a very broad range of quarriers, processors and distributors in both domestic and international markets.

In 1992, Groupe Polycor purchased Dumas & Voyer, a quarrier of Caledonia granite since 1885 and a major fabricator of curbstones. Groupe Polycor's other quarrying divisions include Société Minière Polycor Inc. and also Carrières Norgranit Inc., which is owned jointly with Rock of Ages. In addition to Dumas & Voyer Ltée, the Groupe's manufacturing division includes Granite Bussière Inc.

Ancor Granite Tile Inc. operates a modern fabricating plant in Lachine. A wide range of thin-cut granite tiles serve the domestic and international markets; two new stones were introduced to the market in 1993.

Sandstone

Les Carrières Ducharme Inc., in Hemmingford, Huntingdon County, produces flagstone and construction blocks. This operation is the only company in Quebec producing this type of dimensional stone.

Ontario

Limestone

Major production is from Ordovician, Silurian and Devonian deposits; however, limestones in Ontario range in age from Precambrian through Devonian. A three-volume study entitled *Limestone Industries of Ontario* is a thorough assessment of the geological resources, economic factors and related industries associated with limestone, dolostone and marble.[17]

Arriscraft Corporation quarries a blue-grey to buff-coloured dolostone from the Wiarton/Colpoy Bay member of the middle Silurian Amabel formation near Wiarton. Sold under the name of Adair marble, this attractive stone has increasingly been used for up-scale construction projects, including the Canadian Chancery in Washington, D.C. Also in Washington, Adair marble was chosen as one of the types of stone used for the National Law Enforcement Officers Memorial.

Marble

In the past, only a few uses for local construction-quality marble have been reported.[18]

Jarvis Resources Ltd., a Canadian-controlled public company, opened its new $2 million marble slab and tile manufacturing plant near Sudbury in 1993. The plant is designed to produce a total of about 400 m^2 per day of material (two shifts per day). Rough blocks of multi-coloured marble are quarried approximately 35 km north of Sudbury where extensive reserves have been defined.

In the Bruce Peninsula region, Owen Sound Ledgerock Limited, as well as Ebel Quarries Limited, produces polished marble products on demand from rough stone as part of their quarrying and cutting operations. Other products produced by these and other companies in the region mainly relate to flagstone, landscaping stone and masonry stone using light-to-dark-brown-coloured dolostone from the Eramosa Member of the Amabel formation, locally referred to as Wiarton Dolostone. In 1992, Owen Sound added new equipment for cutting and finishing complex shapes for architectural and sculptural markets.

Two Island Marble Corporation operated intermittently during the past three years. The company started its small-scale quarrying and cutting operation in 1990 in the Renfrew area of eastern Ontario.

Granite

Granite occurs in northern, northwestern and southeastern Ontario.[19,20,21,22,23,24,25] In northwestern Ontario, Nelson Granite Limited continued to expand access to granite to complement its needs, mainly for the manufacture of monuments by affiliates in Ontario and New Brunswick. The company operates near Vermilion Bay, where there are exceptionally large reserves of pink granite. Canital Granite Ltd. of Winnipeg has quarried granite north of Kenora in northwestern Ontario. Current exploration and development work carried out by an associated group, Manex Granit Inc. of Winnipeg, extends into adjacent regions of Manitoba and also throughout the Sudbury area. Palin Granite (Canada) Inc., owned by the largest private stone producer in Finland, began production at a new quarry about 35 km northeast of Kenora. Plans are to produce rough block for both the domestic and export markets. Several other companies are active in Ontario and quarry mainly on demand. These include Vior Inc.; Positano Granite, a division of Poscan Ltd.; Granite Quarriers (G.Q.I.) Inc.; Granimar Quarries Ltd.; Belmont Rose Granite Corp.; and Les Granites Gibson. Detailed activity throughout the province has been highlighted in a directory published by the Ontario Ministry of Northern Development and Mines.[26] A program by the same Ministry to assess the economic potential of building stone and industrial minerals continued in the districts of Nipissing and Parry Sound.

Sandstone

Sandstone quarried near Toronto, Ottawa and Kingston has been widely used in Ontario as building stone.[27] Medina sandstone is fine-to-medium-grained and varies from grey, through buff and brown to red, with some mottled units. Potsdam stone is medium-grained and varies from grey-white through salmon-red to purple, and is mottled. Current uses are as rough building stone, mill blocks from which sawn pieces are obtained, ashlar, flagstone, and as a source of silica for ferrosilicon and glass.

Western Provinces

Limestone

From east to west through the southern half of Manitoba, rocks of Precambrian, Ordovician, Silurian, Devonian and Cretaceous ages occur. Limestones of commercial importance occur in the three middle periods and range from magnesian limestone through dolomite to high-calcium limestones.[3,28] A provincial publication reports on limestone as well as on other types of stone.[29]

Tyndall Stone, a mottled dolomitic limestone often referred to as "tapestry" stone, is the best known Manitoba limestone. It is quarried by Gillis Quarries, Limited at Garson, about 50 km northeast of Winnipeg. More than 25 000 m^2 were used on the Canadian Museum of Civilization very attractively situated on the Ottawa River in Hull, Quebec. Limestone from Moosehorn, 160 km northwest of Winnipeg, and from Mafeking, 40 km east of the Saskatchewan border and 160 km south of The Pas, is transported to Manitoba and Saskatchewan centres for use in the metallurgical, chemical, agricultural and construction industries.

The eastern ranges of the Rocky Mountains contain Cambrian to Triassic limestones. Major occurrences are characterized by a wide variety of types of limestone included within Devonian and Carboniferous rocks. Their development is based on accessibility and quarriability, and extensive work has been conducted on Alberta limestones in selected areas.[30] Most recently, focus has been on the potential use of the limestone for precipitated calcium carbonate (PCC). In southwestern Alberta, high-calcium limestone is mined at Exshaw, Kananaskis and Crowsnest, chiefly for the production of cement and lime, for metallurgical and chemical uses, and for use as crushed stone. Similar uses are made of limestone quarried at Cadomin, near Jasper.

In British Columbia, large volumes of limestone are mined each year for cement and lime manufacture, for use by the pulp and paper industry, and for various construction applications. Quarries on Texada Island, British Columbia, have for many years provided limestone to markets in Vancouver and in Washington State by virtue of their quality and position relative to tidewater shipping facilities. Other operations at Terrace, Clinton, Westwold, Popkum, Dahl Lake, Doeye River and Cobble Hill have produced stone for construction and for filler use.[31]

Granite

In Manitoba, several companies quarry pink-to-reddish granite. Canital Granite Ltd., along with associate Manex Granit Inc., obtains granite from several sites to serve Canital's large tile manufacturing plant in Winnipeg. Two new stones were introduced by the company to the market in 1993. Exports of manufactured products vary considerably depending on construction activity, with the United States accounting for most of the demand. Cold Spring Granite (Canada) Limited, situated 14 km south of Lac du Bonnet, continues to produce about five "colours" of granite, mainly as large blocks for cutting and polishing in the United States. Some local block is quarried in the Medika, Manitoba area, as documented in a provincial report published in 1990.[32] Recent investigations in the province, mainly related to granite, are included in the reports of activities for 1991 and 1992 by the Geological Services Branch of the Manitoba Department of Energy and Mines.

In Saskatchewan and Alberta, granite is not quarried on a regular basis. Some detailed work to evaluate potential reserves in Saskatchewan has been undertaken by the Saskatchewan Geological Survey.[33,34,35]

In British Columbia, there is growing interest in dimension stone. Quarry Pacific Industries Ltd., along with Margranite Industries Ltd. and C&S Ceramic Tile Distributors, the related processing and distribution companies respectively, continued to produce a range of granite tile at a new manufacturing plant in Burnaby. West Coast Granite Manufacturing Inc., of Delta (formerly Pacific Granistone Mfg. Inc.), started up in 1993 and operates a fully equipped plant to produce granite slabs. Also, a new company, Panorama Natural Stone Ltd., of Port Hardy, British Columbia, identified marble and granite properties with a view toward establishing a dimension stone industry on Vancouver Island. (A detailed publication by the British Columbia Ministry of Energy, Mines and Petroleum Resources highlights past quarrying activity in the province, along with uses relating to granite, marble, flagstone, jade, and rhodonite.)[36]

Sandstone

Sandstone for building and ornamental uses quarried near Banff, Alberta, is hard, fine-grained, medium-grey, and is referred to as "Rundle Stone." This stone is very popular locally and is best known for its use in the Banff Springs Hotel. Two companies are active: Thunderstone Quarries Ltd. and Rundle Rock Building Stone (1980) Ltd., both situated outside of the park near Canmore.

Yukon and Northwest Territories

Sidco Explorations Ltd., a Whitehorse-based processor of architectural stone, has evaluated several sites to produce granite for construction uses. Preliminary work concentrated on grey-white and beige-coloured granites that are expected to attract outside interest given the favourable back-haul rates to Vancouver and Edmonton.

A large unique occurrence of limestone has been recognized in the Arctic at Bear Island, about 12 km south of the community of Coral Harbour. This limestone has been described as fine grained, whitish beige to grey in colour, attractively veined, and relatively hard. Preliminary work suggests that it will be an excellent stone for sculptural and architectural uses, and possibly for some ornamental uses. A permit to quarry at the site is held by the Keewatin Inuit Association for the community of Coral Harbour.

Specifications

Several test methods apply to dimension stone, but generally begin with compressive strength (ASTM C170) and absorption (ASTM C97). The compressive strength is defined as the maximum load per unit area that can be applied before the rock fails, reported in pounds per square inch (psi) and in megapascals (MPa). Absorption is defined as the percentage of water by weight that is absorbed over a 48-hour period.

Consumption and Markets

Most dimension stone, including granite, limestone, marble, sandstone and slate, is used in construction-oriented projects. Limestone also has chemical-related uses, along with its large-scale use in the cement, lime, glass and metal-smelting industries.

Granite, as a dimension stone, is processed mainly for interior and exterior floor- and wall-cladding, modular block panelling, and monuments. Increasingly, a broader range of colour and texture is being sought by developers and architects. Detailed consumption data for rough and finished granite, as well as for other types of stone, are not available. However, trends can be established based on production, imports, and less well-defined export data. During the 1980-90 period, Canada's production of rough granite approximately doubled and imports of roughly trimmed and cut granite block (codes 2516.11 and 2516.12) more than doubled (Table 9). Exports of rough granite have increased about eightfold in terms of volume since 1986 in response to demand in Japan, the United States and Italy. Total exports of granite monumental or building stone – as represented by codes 6802.23, 6802.93 and 6802.99 relating to a range of cut, sawn or worked products – were valued at $28.1 million in 1992 (Table 1). The United States accounted for about 95% of this market. In 1993, however, total exports of the equivalent products declined to about $24 million, based on preliminary figures.

Some specific uses for stone in the chemical field are: the neutralization of acid waste liquors; the extraction of aluminum oxide from bauxite; the manufacture of soda ash, calcium carbide, calcium nitrate, and carbon dioxide; in pharmaceuticals; as a disinfectant; in the manufacture of dyes, rayons, paper, sugar and glass; and in the treatment of water. Agricultural limestone is used to control soil acidity and to add calcium and magnesium to the soil. Limestone and lime are used as soil stabilizers, particularly in highway construction projects.

Dolomite is the source of magnesium metal produced by Haley Industries Limited at Haley, Ontario; the company also uses a high-calcium lime from southeastern Ontario in the production of calcium metal. Dead-burned dolomitic limestone for use as a refractory is produced at Dundas, Ontario, by Redland Quarries Inc. A magnesite deposit at Eon Mountain in British Columbia has been quarried by Baymag Mines Co. Limited since 1982. A range of final products is produced, including fused magnesia.

WORLD TRENDS, TRADE AND TARIFFS

World annual production of raw dimension stone is estimated to be about 27 Mt (about 10 million m^3), with Europe accounting for about two thirds of total output. About 50% of world production comes from six leading countries: Italy, Spain, Greece, the United States, France and China. Italy has traditionally been the world's leading producer, accounting for about 7 Mt in 1990. Italy's dominance in production (accounting for about 50% of European output) also extends by the same proportion to exports, imports and re-exports. There is a trend toward larger companies as bigger firms buy smaller companies and smaller companies amalgamate. In addition to lateral integration, there is more and more vertical integration where quarries are being bought by manufacturing companies and dealers.

India, Brazil and China have quite recently become important producers of granite and are expanding production rapidly. These countries, in addition to the Republic of South Africa, Spain and the Scandinavian countries, account for approximately 70% of the world's exports of granite. The worldwide interest in developing stone resources and technology is partially indicated by several relatively new international stone exhibitions which include: 1) the International Granite, Marble and Ornamental Stones Fair, held in Sao Paulo, Brazil in March 1993; 2) Kostone '93, the Third Korea International Stone and Machine Industry Exhibition, held in Seoul, Korea in December 1993; and 3) Chinastone '94, the First International Stone & Machinery Industry Technical Exhibition, to be held in Beijing in late 1994. In the former Soviet Union, some Western companies have investigated the possibility of joint ventures. However, political uncertainties, lack of equipment, difficulties in obtaining representative samples, and transportation problems have discouraged progress.

Japan continued to be Canada's major customer for rough granite in 1993, accounting (by value) for about 65% of total exports. In the case of processed products (represented as granite monumental or building stone, as described), the United States is by far the leading customer. Tariffs between Canada and the United States relating to other types of worked stone, simply cut or sawn, as well as to tiles and similar articles, were phased out in 1993. Tariffs on all square or rectangular block or slab, along with tariffs relating to articles of granite, simply cut or sawn, were phased out in 1989. Some natural stone products classified as millstones or grindstones are subject to a later phase-out in 1998.

OUTLOOK

The demand for structural stone products in the commercial building market in North America is expected to improve in 1994/95. This is based on industry forecasts of processing equipment purchases and on economic forecasts that predict a 9% increase in new construction in the United States. Also, it is expected that there will be renewed demand for natural stone materials for aesthetic reasons as new markets develop. Although the most rapid expansion has been associated with new quarries and fabricating plants in Quebec, modernization by several producers across Canada has increased the availability of high-quality finished products at competitive prices. Producers continue to emphasize import replacement and the penetration of non-U.S. markets. The relatively large Japanese market for high-quality rough blocks is expected to remain firm and, in the case of producers active in both quarrying and processing, wider distribution in the sales of rough stone is expected to improve the awareness of all related products. Within the next two to three years, it is expected that annual shipments of fabricated construction-related granite products will be maintained at $100 million, the level reached in 1991/92. In general, the Canadian dimension stone industry will remain competitive because of its advanced quarrying, processing and installation technology, and should continue to improve cost-competitiveness vis-à-vis substitutes, including aluminum, concrete, glass and ceramics.

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TABLE 3. CANADA, PRODUCTION OF LIMESTONE, 1990-92

	1990		1991		1992	
	(000 t)	($000)	(000 t)	($000)	(000 t)	($000)
BY PROVINCE[1]						
Newfoundland	800	4 595	987	5 329	858	3 695
Nova Scotia	185	2 044	122	1 975	127	2 076
New Brunswick	509	6 229	469	5 658	480	5 511
Quebec	30 801	154 493	24 821	126 419	23 810	121 367
Ontario	48 252	266 557	36 528	206 615	35 529	188 678
Manitoba	2 951	12 208	1 347	5 922	1 400	6 243
Alberta	243	2 527	263	3 020	265	2 959
British Columbia	1 810	14 573	1 735	14 470	2 830	20 243
Northwest Territories and Yukon	967	7 424	200	998	224	1 326
Total	86 519	470 649	66 471	370 406	65 522	352 099
BY USE[2]						
Dimensional stone						
Rough	98	3 683	59	3 641	. .	. .
Monumental and ornamental stone (n.f.)	4	233	1	89	. .	. .
Other (flagstone, curbstone, paving blocks, etc.)	34	1 888	29	2 345	. .	. .
Lining, open-hearth furnaces	. . .	2	–	–	. .	. .
Chemical and metallurgical					. .	. .
Cement plants, Canada	11 846	25 414	9 478	30 487	. .	. .
Cement plants, foreign	1 126	4 332	779	2 932	. .	. .
Flux in iron and steel furnaces	656	3 673	491	2 632	. .	. .
Flux in nonferrous smelters	16	391	162	667	. .	. .
Glass factories	171	2 975	169	2 927	. .	. .
Lime plants, Canada	2 367	18 602	2 354	17 032	. .	. .
Lime plants, foreign	236	1 532	156	1 100	. .	. .
Pulp and paper mills	214	1 850	220	1 857	. .	. .
Sugar refineries	37	274	23	122	. .	. .
Other chemical uses	846	5 332	964	5 456	. .	. .
Pulverized stone						
Whiting (substitute)	53	3 593	50	3 760	. .	. .
Asphalt filler	82	542	80	744	. .	. .
Dusting, coal mines	8	549	3	98	. .	. .
Agricultural purposes and fertilizer plants	858	12 394	848	11 992	. .	. .
Other uses	175	2 242	134	2 091	. .	. .
Miscellaneous stone						
Manufacture of artificial stone	1	10	36	414	. .	. .
Roofing granules	32	384	27	319	. .	. .
Poultry grit	53	1 035	51	926	. .	. .
Stucco dash	11	1 709	12	1 998	. .	. .
Rubble and riprap	547	4 546	457	3 257	. .	. .
Other uses	986	6 602	1 105	7 295	. .	. .
Crushed stone for						
Concrete aggregate	8 583	50 118	7 554	45 469	. .	. .
Asphalt aggregate	6 105	35 624	5 560	30 024	. .	. .
Road metal	40 853	195 657	31 104	154 204	. .	. .
Railroad ballast	985	4 698	260	1 153	. .	. .
Other uses	23 748	124 781	16 138	82 890	. .	. .
Total	100 732	514 665	78 303	417 925	. .	. .

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available; . . . Amount too small to be expressed; n.f. Not finished or dressed.
[1] Data exclude stone used in Canadian cement and lime industries. [2] Data include stone used in the Canadian cement and lime industries.
Note: Numbers may not add to totals due to rounding.

TABLE 4. CANADA, PRODUCTION OF MARBLE,[1] 1990-92

	1990		1991		1992	
	(000 t)	($000)	(000 t)	($000)	(000 t)	($000)
BY PROVINCE						
Nova Scotia	3	253	3	175	2	173
Quebec	537	8 154	417	7 515	391	8 072
Ontario	231	11 547	222	11 202	257	9 047
Total	771	19 955	641	18 892	650	17 292
BY USE						
Dimensional stone						
Rough	19	850	14	672	. .	. .
Monumental and ornamental stone (n.f.)	–	–	. . .	2	. .	. .
Other (flagstone, curbstone, paving, blocks, etc.)	–	–	. . .	2	. .	. .
Pulverized stone						
Agricultural purposes and fertilizer plants	56	801	56	790	. .	. .
Other uses	245	11 852	221	11 451	. .	. .
Miscellaneous stone						
Artificial stone	36	709	–	–	. .	. .
Roofing granules	1	14	1	24	. .	. .
Stucco dash	5	270	–	–	. .	. .
Poultry grit	. . .	11	. . .	12	. .	. .
Terrazzo chips	4	514	4	215	. .	. .
Rock wool	. . .	35	–	–	. .	. .
Rubble and riprap	–	–	–	–	. .	. .
Other uses	7	480	10	935	. .	. .
Crushed stone for						
Concrete aggregate	131	1 283	136	1 363	. .	. .
Road metal	183	869	116	1 141	. .	. .
Other uses	85	2 270	83	2 285	. .	. .
Total	771	19 955	641	18 892	. .	. .

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available; . . . Amount too small to be expressed; n.f. Not finished or dressed.
[1] Marble refers to a commercial definition that may also include limestone, travertine and greenstone (serpentinite or amphibole).
Note: Numbers may not add to totals due to rounding.

TABLE 5. CANADA, PRODUCTION OF GRANITE, 1990-92

	1990		1991		1992	
	(000 t)	($000)	(000 t)	($000)	(000 t)	($000)
BY PROVINCE						
Newfoundland	176	1 803	125	1 491	53	462
Nova Scotia	5 945	32 090	3 450	17 694	3 618	18 459
New Brunswick	2 039	11 364	1 956	9 523	2 225	9 991
Quebec	7 007	66 406	7 027	58 193	9 941	63 123
Ontario	1 927	21 097	1 946	19 354	1 873	20 491
Manitoba	659	2 959	378	5 101	132	1 510
Alberta	4	409	4	412	4	360
British Columbia	1 451	9 654	1 034	10 029	1 080	9 870
Northwest Territories and Yukon	317	1 267	378	3 075	171	877
Total	19 524	147 048	16 297	124 872	19 096	125 143
BY USE						
Dimensional stone						
Rough	108	19 505	74	15 395	. .	. .
Monumental and ornamental stone (n.f.)	55	13 729	41	7 225	. .	. .
Other (flagstone, curbstone, paving blocks, etc.)	3	320	7	1 476	. .	. .
Pulverized stone						
Asphalt filler	57	174	59	180	. .	. .
Miscellaneous stone						
Artificial stone	–	–	2	64	. .	. .
Roofing granules	278	6 083	275	6 037	. .	. .
Rubble and riprap	588	3 882	532	5 647	. .	. .
Poultry grit	1	90	. . .	3	. .	. .
Rock wool	–	–	18	443	. .	. .
Other uses	698	2 044	677	1 767	. .	. .
Crushed stone for						
Concrete aggregate	2 489	13 979	1 373	9 409	. .	. .
Asphalt aggregate	2 698	17 288	2 919	16 301	. .	. .
Road metal	5 817	30 584	3 468	18 913	. .	. .
Railroad ballast	1 630	13 333	850	8 853	. .	. .
Other uses	5 102	26 036	6 002	33 161	. .	. .
Total	19 524	147 048	16 297	124 872	. .	. .

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available; . . . Amount too small to be expressed; n.f. Not finished or dressed.
Note: Numbers may not add to totals due to rounding.

TABLE 6. CANADA, PRODUCTION OF SANDSTONE, 1990-92

	1990		1991		1992	
	(000 t)	($000)	(000 t)	($000)	(000 t)	($000)
BY PROVINCE[1]						
Newfoundland	518	3 528	134	765	90	396
Nova Scotia	1 101	4 972	1 029	4 841	935	4 116
New Brunswick	69	38	45	62	33	66
Quebec	1 269	10 481	1 660	12 695	2 006	13 371
Ontario	7	1 355	9	1 275	7	1 171
Alberta	1	60	. . .	24	4	200
British Columbia	10	100	11	185	–	–
Total	2 975	20 534	2 888	19 850	3 074	19 320
BY USE[2]						
Dimensional stone						
Rough	46	3 451	43	3 169	. .	. .
Monumental and ornamental stone (n.f.)	1	45	. . .	24	. .	. .
Other (flagstone, curbstone, paving blocks, etc.)	19	886	14	677	. .	. .
Chemical process stone						. .
Cement plants, foreign	–	–	–	–	. .	. .
Cement plants, Canadian	11	54	2	12	. .	. .
Miscellaneous stone						
Roofing granules	. . .	. . .	. . .	. . .	. .	. .
Poultry grit	1	66	2	78	. .	. .
Rubble and riprap	155	584	46	121	. .	. .
Other	34	773	. . .	. . .	. .	. .
Crushed stone for						
Concrete aggregate	160	1 235	134	1 010	. .	. .
Asphalt aggregate	268	1 646	365	2 383	. .	. .
Road metal	363	1 875	473	2 754	. .	. .
Railroad ballast	227	1 240	8	32	. .	. .
Other uses	1 700	8 732	1 803	9 600	. .	. .
Total	2 986	20 587	2 890	19 861	. .	. .

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available; . . . Amount too small to be expressed; n.f. Not finished or dressed.
[1] Data exclude stone used in Canadian cement and lime industries. [2] Data include stone used in Canadian cement and lime industries.
Note: Numbers may not add to totals due to rounding.

TABLE 10. CANADA, VALUE OF CONSTRUCTION BY PROVINCE,[1] 1991-93

	1991			1992			1993		
	Building Construction[2]	Engineering Construction[2]	Total	Building Construction[2]	Engineering Construction[2]	Total	Building Construction[2]	Engineering Construction[2]	Total
	($ millions)								
Newfoundland	906	871	1 777	824	1 048	1 873	836	1 438	2 275
Nova Scotia	1 544	955	2 499	1 460	696	2 157	1 526	602	2 129
New Brunswick	1 150	837	1 987	1 160	1 057	2 217	1 120	712	1 832
Prince Edward Island	257	99	356	242	106	348	227	98	326
Quebec	14 032	6 369	20 401	13 106	7 027	20 133	13 261	7 323	20 584
Ontario	24 980	8 978	33 958	23 132	8 941	32 074	23 473	9 502	32 974
Manitoba	1 500	1 226	2 725	1 517	1 200	2 717	1 578	1 135	2 713
Saskatchewan	1 269	2 254	3 523	1 306	1 754	3 060	1 286	1 449	2 735
Alberta	5 577	7 170	12 747	6 204	5 995	12 199	6 030	6 348	12 378
British Columbia, Yukon and Northwest Territories	9 684	4 497	14 182	10 995	4 088	15 083	11 978	4 488	16 465
Total Canada	60 901	33 254	94 155	59 948	31 913	91 861	61 315	33 096	94 411

Sources: Natural Resources Canada; Statistics Canada.
[1] Actual expenditures 1991, preliminary 1992, intentions 1993. [2] Includes total value of new and repair work purchased.
Note: Numbers may not add to totals due to rounding.

Sulphur

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World Overview

For the first time in 13 years, world sulphur production greatly exceeded demand, leading to a massive stockpiling of elemental sulphur in Canada. In 1993, world elemental sulphur production rose marginally to 35.9 Mt, while demand fell to 33.5 Mt.

A decrease in world Frasch sulphur production (–24%) was offset by an 8% increase in output from recovered sulphur. Major declines in Frasch sulphur occurred in Mexico (–71%), Poland (–31%), and Ukraine (–17%). Increases in production of recovered sulphur were registered in the United States, Canada, Western Europe, Kuwait and Japan. In 1993, Frasch sulphur production accounted for 17% of total world sulphur output, a significant decline from the 23% level in 1992. Production of recovered sulphur accounted for 83%, of which gas processing contributed 48%, and oil and heavy oil processing, 35%.

In 1993, world consumption of elemental sulphur declined for a fourth consecutive year to 33.5 Mt, a 6% drop over the previous year. Consumption decreased as a result of a 6% fall in phosphate fertilizer production in Western Europe, the former Soviet Union (FSU), and the United States, while increases were reported in Central Europe. Worldwide, consumption of phosphate-based fertilizers rose slightly despite a major drop registered in China as a result of monetary changes and subsidy reductions on fertilizers. Consumption of elemental sulphur in industrial uses declined 4% to 3.9 Mt; increases were reported in Central Europe, while decreases were reported in North America, Western Europe and the FSU.

Canadian Developments

Elemental Sulphur

In 1993, Canada ranked as the world's second largest producer of elemental sulphur with a 20% share, and remained the leading exporter with a 38% share of world trade. In Canada, sulphur is recovered from the processing of sour natural gas with a high hydrogen sulphide content and from the refining of high-sulphur crude oil and heavy oil; there is no production derived from Frasch mining. Canadian sulphur production from natural gas processing accounted for 88% of total production, while the remainder was from oil sands plants (8%) and oil refineries (4%). Most sulphur production occurs in Alberta and, to a lesser degree, in British Columbia and Saskatchewan. In eastern Canada, all sulphur production is derived from oil refining.

The year was dominated by several events of importance to the Canadian industry. These included a major increase in sulphur production, the commissioning of Shell's Caroline gas plant, continuing declines in prices, a massive stocking of sulphur, an anti-dumping review in the United States, the BC Rail strike, the curtailment of exports by PRISM Sulphur Corporation, and the rumored merger of PRISM and Sultran Ltd.

Production of sulphur in Canada in 1993 was estimated at 7.3 Mt, a 14% increase over the previous year. Increases were reported in all sectors: gas processing, oil sands and oil refining. Gas-related sulphur production rose both in Alberta and British Columbia to 6.4 Mt from 5.7 Mt; most of this increase came from the Caroline gas plant. High levels of sulphur recovery in 1993 were spurred by sustained strong demand for western Canadian natural gas in both the domestic and U.S. markets, with gas prices maintaining their strength since mid-1992.

Sulphur production from the oil sands operations continued to increase, rising 3% over the previous year to 0.6 Mt. Oil-related sulphur production was estimated at 315 000 t, a 42% increase over 1992, with higher sulphur output at both heavy oil upgraders in Saskatchewan more than offsetting reductions in British Columbia where several oil refineries shut down their refining facilities during the year.

In 1993, Canadian shipments of elemental sulphur declined sharply by 1.2 Mt (or 19%) to 5.0 Mt as sales to the United States and offshore dropped due to very weak prices prevailing in these markets. Exports to the United States were estimated at 1.5 Mt, a 19% decline compared to 1992. Sales in the first half of 1993 were relatively strong, but dropped in the second half in response to lower production of phosphate-based fertilizers. The 1993 operating rate in the U.S. phosphoric acid industry was projected at 86%, compared to 97% in 1992. In 1993, the United States remained the dominant export destination for Canadian sulphur, accounting for 35% of Canada's total exports compared to 34% in 1992.

Late in 1992, Pennzoil Sulphur Company, a Frasch producer accounting for 12% of total U.S. sulphur production, requested an administrative review of Canadian sulphur exports to the United States during the period December 1991 to November 1992. The review was requested under the framework of a pending anti-dumping petition filed in 1973. This petition was never terminated, although several Canadian companies gained partial revocation and were allowed to export sulphur to the United States without posting duties. In December 1992, a request for an administrative anti-dumping review was filed with the U.S. Department of Commerce (DOC) against 15 Canadian exporters, who were required to complete an extensive questionnaire for the DOC during the spring of 1993. In December 1993, the DOC requested further information on constructed costs to determine the dumping margins of each supplier. A preliminary determination by the DOC on dumping margins is tentatively scheduled for early 1994.

During the year, Canada's offshore exports of sulphur dropped by 0.9 Mt (or 23%) to 2.8 Mt. Canadian sulphur was exported to more than 30 countries. During the first nine months of 1993, Canada exported close to 2.2 Mt, compared to 2.8 Mt for the same period the previous year. Lower sales were reported in all markets, especially in North Africa (–28%) and Asia (–30%). In Latin America, some increase was registered in Brazil, but it was offset by losses in Mexico, Chile and Argentina. In Africa, Morocco remained the largest destination for Canadian sulphur with a 28% share of our offshore exports; shipments to Morocco and Tunisia totalled 0.9 Mt, compared to 1.3 Mt in 1992. In Asia, major losses in sales were reported in India and South Korea, where Canadian sulphur was displaced by sulphur from the Middle East and Japan, respectively. Sales to Indonesia rose 15%.

Total Canadian sulphur sales in 1993 were estimated at 5.0 Mt, compared to 6.4 Mt in 1992 leading to an increase in stocks by 2.3 Mt to reach 5.5-5.6 Mt by year-end. Canadian sulphur stocks in early January 1993 were estimated at around 3.3 Mt, distributed mostly amongst 18 sites in Alberta. As sulphur prices continued to fall in 1993, the netbacks achieved in offshore export sales dropped and many producers took the least costly option: massive blocking of sulphur. On a net basis, sulphur blocks started to increase during 1992 when blocking rates averaged 50 000 tonnes per month (t/m). In 1993, blocking rates reached over 300 000 t/m in the fall. Sulphur is being blocked at almost all producing locations in Alberta. Of these, only nine account for close to 90% of all sulphur inventory. Major blocking locations were Ram River, Waterton, Rainbow Lake and Kaybob III.

Alberta

In Alberta, Shell Canada Limited commissioned the first train of its new gas plant at Caroline in March 1993. The second train was commissioned in early May. The $540 million gas plant, which took 30 months to complete, has an annual sulphur recovery capacity of 1.5 Mt; the plant had been operating at a rate of 50% in the first six months and at close to 80% by the end of the year. The Caroline plant represented an addition of close to 14% to the annual sulphur capacity in Canada, and will account for 20% of projected sulphur production in Canada over the next five years. Forming facilities were installed at Shantz and have been in operation since the fall of 1992. In 1993, one quarter of sulphur production was blocked. Block capacity at Shantz is estimated at close to 0.6 Mt and is slated for a three-phase expansion; the first phase, to be implemented in 1994, will double current block capacity to 1.2 Mt.

Chevron Canada Resources Limited tied in the Obed gas field to its Kaybob III gas processing plant; only two wells out of five were connected, resulting in lower sulphur recovery than expected. The field was acquired from Imperial Oil Limited in 1992.

Suncor Inc. announced that it will install new sulphur recovery and scrubbing equipment at its oil sands operation in Fort McMurray. This investment will allow a further reduction in sulphur dioxide emissions.

PRISM Sulphur Corporation and Sultran Ltd. announced plans to merge their operations. Sultran is a logistics company set up by Canadian sulphur producers to handle rail transportation from Alberta and British Columbia to port terminals in the Vancouver region. PRISM is a sulphur export consortium which markets Canadian sulphur in offshore markets. A decision to proceed and finalize the merger is expected in the first quarter of 1994.

During 1993, three companies, Atcor Ltd., Supersul Canada Ltd. and AEC Oil and Gas, joined PRISM Sulphur Corporation, raising its membership to 33 members. Late in December, Husky Oil Operations Ltd. gave notice to PRISM that it would terminate its membership by the end of December 1994.

Several other activities were carried out in Alberta in 1993 that were related to the sulphur industry: Ontario Energy Corp. sold its remaining 11% share in Suncor Inc.; Morrison Petroleums Ltd. acquired Saratoga Processing Company Ltd.; Talisman Energy Inc., formerly BP Canada Inc., took over Encor Inc.; Norcen Energy Resources Limited and North Canadian Oils Limited integrated their operations; and Elan Energy Inc. acquired all the assets of OMV (Canada) Limited.

British Columbia

In 1993, major drilling activities continued in northeastern British Columbia. Extensive discoveries of sour natural gas were made in the Monkman region. These occurrences are located close to Westcoast Energy Inc.'s gas processing plant at Pine River where the company pursued its $300 million expansion program to double the plant's processing capacity. Sulphur recovery capacity of the plant will reach 0.7 Mt/y in November 1994. The expansion includes the de-bottlenecking of its two process trains, the addition of a third train, and a 5.5-km liquid sulphur pipeline between the plant and Petrosul International's forming facility at Hasler Flats. Westcoast is also planning another expansion in the same area by 1997/98; the company is considering either a second expansion of its Pine River plant or the construction of a new gas processing plant in the Chetwynd-Tumbler Ridge area.

In 1993, three oil refineries in the Vancouver area ceased to operate and to recover sulphur: Imperial Oil Limited at Ioco, Petro-Canada Products Inc. at Port Moody, and Shell Canada Products Limited at Shelburn. The shut-downs reduced Canada's oil refinery sulphur capacity by 60 000 t/y, down to 990 000 t/y.

During the spring, BC Rail, the third largest rail system in Canada, bought the terminal of Vancouver Wharves for $15.75 million; plans for expanding the sulphur berth are being evaluated. In the summer, workers at BC Rail were on strike for a period of five weeks beginning in mid-July. A major consequence of this strike was the curtailment of sulphur movements in northern British Columbia and a disruption of exports through Vancouver Wharves. During August, the other sulphur terminal on the west coast, Pacific Coast Terminal, underwent a planned three-week maintenance shut-down, lowering sulphur stocks at both terminals to less than 150 000 t in total by mid-September.

Eastern Canada

In Newfoundland, Newfoundland Processing Limited started, on a tentative basis, to recover sulphur at the Come-by-Chance oil refinery in November 1993. Sulphur recovery is expected to increase in 1994 and to be poured on block at the plant site. The refinery's sulphur recovery capacity is estimated at 6000 t/m.

Sulphuric Acid

The production of sulphur products (sulphuric acid, sulphur dioxide and elemental sulphur) from smelters in 1993 was estimated at 912 080 t, a 2% decrease from 1992. Increases in sulphuric acid production in Ontario were offset by decreases in British Columbia, Quebec and New Brunswick. Shipments in 1993 totalled 0.8 Mt, a level similar to last year. Domestic demand for sulphuric acid was reported as weak in eastern Canada with reductions in industrial consumption in the titanium dioxide, uranium leaching, and aluminum sectors. In western Canada, demand for sulphur products continued to be strong in the pulp and paper industry. Domestic prices in eastern Canada registered a 3%-5% decline on an f.o.b. plant basis.

In 1992, Canadian sulphuric acid production totalled 3.68 Mt H_2SO_4, of which smelter acid contributed 2.44 Mt and elemental sulphur 1.23 Mt. Domestic consumption was estimated at 2.3 Mt, a 1% decrease over 1991. Sulphuric acid consumption in eastern Canada amounted to 0.98 Mt, a 3% increase over 1991, and accounted for 43% of total Canadian consumption. Agricultural chemicals accounted for 51% of sulphuric acid consumption, followed mainly by pulp and paper (15%), inorganic chemicals (15%) and uranium mining (5%).

The 1992 consumption of sulphur dioxide (SO_2) in Canada was estimated at about 96 000 t SO_2, of which 75% was used by pulp and paper plants. Exports totalled 72 000 t. Demand for liquid sulphur dioxide remained strong in pulping mills for the manufacture of bleaching agents such as chlorine dioxide.

Brunswick Mining and Smelting Corporation Limited (BMS) closed its phosphate fertilizer unit between May and September. Smelter acid was partly stocked and partly exported to the United States.

Cominco Ltd. of Vancouver, British Columbia, announced in April its intention to scrap its new QSL lead smelter in Trail. The new smelter, which started in December 1989, was shut down in March 1990 due to inadequate performance and low recovery. Cominco Ltd. is contemplating a $100 million alternative using the Russian Kivcet smelting technology. The company also plans to shut down its 160 000-t/y ammonium phosphate facility at Trail next spring, and to expand its production of ammonium sulphate. In 1992, Cominco Ltd. started two new ammonium sulphate crystallizers.

Hudson Bay Mining and Smelting Co., Limited commissioned its new two-stage zinc pressure leach facility in Flin Flon, Manitoba. The $171 million zinc plant will allow the company to meet its sulphur dioxide emissions reduction target of 25% to 220 000 t/y by 1994. Close to 35 000 t/y of contaminated sulphur will be recovered and stacked.

Inco Limited completed the construction of its second of two oxygen flash furnaces at its Copper Cliff smelter operations in Ontario. The first flash furnace and a new 1.0-Mt/y sulphuric acid plant were put on stream in 1991. A slight increase in acid production is expected.

Marsulex Inc. started a new 30 000-t/y liquid sulphur dioxide plant at Falconbridge Ltd.'s Kidd Creek smelter in Timmins, Ontario. Liquid sulphur dioxide will be sold mainly to the pulp and paper and mining industries in eastern Canada and the northeastern United States.

Marsulex Inc. closed its 160 000-t/y sulphuric acid plant in Fort Saskatchewan, Alberta, this past summer. The company negotiated an agreement with Sherritt Gordon Limited in Fort Saskatchewan for supplying its customers. Marsulex's sulphur burning plant is to remain idle indefinitely.

Beginning in 1994, several smelters in Manitoba and in eastern Canada must comply with strict regulations limiting their sulphur dioxide (SO_2) emissions to individual ceilings based on 1985 emissions. Between 1987 and 1994, close to C$1.4 billion will have been invested to reduce emissions. By 1993, improvements in feedstock management and the installation of sulphur containment systems resulted in reductions surpassing the regulatory limits, in some cases with cuts by some smelters above 50%. Federal and provincial accords covering the seven eastern provinces were signed during the period 1985-88; the accords called for a 40% reduction in SO_2 emissions from 3.8 Mt/y to 2.3 Mt/y by 1994, while a permanent national cap of 3.2 Mt/y was set for the year 2000. In 1993, both Inco at Sudbury and Noranda at Horne initiated modifications to improve sulphur recovery and reduce SO_2 emissions beyond 75% by 1994.

WORLD DEVELOPMENTS

In 1993, world production of sulphur in all forms remained flat at 54.9 Mt, of which elemental sulphur accounted for 65%; sulphuric acid, 19%; and pyrites, 16%. Increases in the production of elemental sulphur were offset by reductions in pyrites output; production of sulphuric acid was steady.

For the first nine months of 1993, world trade of elemental sulphur declined by 13% to 9.4 Mt; two thirds of this decrease occurred in Asia and North Africa. Canada accounted for 38% of world trade, compared to a 40% share in 1992. Other major exporters were Poland (18%) and Saudi Arabia (15%). In 1993, sulphur imports dropped in Africa (–16%), Asia (–13%) and Western Europe (–30%), while increases were reported in Eastern Europe (+19%) and Latin America (+5%). North Africa was the leading importing region with volumes reaching 3.1 Mt for the first nine months of 1993; this region accounted for 33% of world sulphur trade, followed by the United States (22%) and Asia (17%). Canada registered lower sales in all of its markets. In 1993, Canadian exporters maintained a strong position in Oceania (78%) and the United States (73%); however, market shares were lost in Africa (to Poland and France), in Asia (to

Iran and Japan), and in Latin America (to the United States and Western Europe). Overall, Japan and Iran registered major gains in exports (+38% and +47%, respectively), particularly in Asia; most of the other exporting countries lost market share during the first nine months of 1993.

United States

The United States was the world's largest sulphur producer as well as the largest Frasch-producing country in 1993, accounting for 26% of world production. Production of elemental sulphur remained stable at 9.4 Mt; sulphur recovered from oil and gas processing plants accounted for 75% of this total, amounting to 7.1 Mt (a 1% increase over 1992 due to higher recovery of sulphur from crude oil offsetting a decline from gas processing). A small decrease in Frasch sulphur production, down by 1% to 2.25 Mt, was due to reduced output from the Culberson (Texas) and Caminada (Louisiana) Frasch mines, while the new Main Pass mine (Louisiana) ran at higher rates, in particular during the second half of 1993. Production of other forms of sulphur (e.g., sulphuric acid) remained unchanged at 1.3 Mt and accounted for approximately 12% of overall production of sulphur in all forms. In 1993, sulphur was produced at 171 plants operating in 32 states. Apparent U.S. consumption was reported at 12.6 Mt for use mostly in fertilizers (60%), chemicals (12%), metal mining (6%) and petroleum refining (4%). Exports dropped by half to 0.5 Mt. Imports declined by 26% to about 2.0 Mt, of which Canada supplied 75%, with the rest coming from Mexico. Producers' stocks of elemental sulphur rose by 0.5 Mt to 1.3 Mt at year-end.

Freeport-McMoran Inc. Resource Partners, Ltd. (FMRP) closed its 0.75-Mt/y Caminada Frasch mine, located off the Louisiana Coast, late in 1993. The permanent shut-down was previously planned for 1995 as its new Main Pass Frasch operation was geared to run at higher rates by 1993. During the first nine months of 1993, production at the 2.0-Mt/y Main Pass operation rose from an average of 1300 long tons per day (lt/d) to more than 3000 lt/d. Daily output at Main Pass was expected to reach 5500 lt/d by early 1994. During 1993, Freeport Sulphur Co. produced close to 1.5 Mt, a 45% increase over the previous year; higher outputs were recorded at Caminada (+14%) and Main Pass (+350%).

Pennzoil Sulphur Co. produced 0.65 Mt of sulphur, down from 1.2 Mt in 1992. During 1993, Pennzoil announced a US$7.4 million investment to reduce production costs at its 2.1-Mt/y Culberson Frasch mine in west Texas. In December 1993, Texasgulf Inc. closed its Boling Dome mine in New Gulf, Texas; Texasgulf's Frasch production has averaged 0.12 Mt/y.

In October, a new regulation under the *Clean Air Act* came into effect. The regulation aims to reduce the sulphur content in diesel fuel. This reduction is expected to result in additional sulphur recovery of close to 0.5 Mt/y in the United States.

Former Soviet Union

In the former Soviet Union (FSU), sulphur was produced in 1993 in Ukraine (Frasch at Rozdol), in Turkmenistan (Frasch at Gaudark), in Russia (recovered from gas at Astrakhan and Orenburg, and by Frasch at Yavorov), in Uzbekistan (recovered from gas at Mubarek), and in Kazakhstan (recovered from oil and gas at Tengiz). In 1993, the FSU was the world's third largest producer of sulphur with a 14% share of world production. Its elemental sulphur production declined 5% to 5.1 Mt, Frasch production decreased by 16% to 1.5 Mt, while recovered sulphur production remained stable at 3.6 Mt.

In 1993, the Astrakhan I sour gas plant operated at a higher rate, resulting in a 7% increase in sulphur recovery to reach 1.1 Mt; part of the production is reportedly being stocked. The Astrakhan 2 plant is expected to start up in 1994. Sulphur production was reported stable at the Orenburg gas plant (1.0 Mt), the Mubarek gas plant (0.5 Mt), and the Yavorov Frasch mine (1.2 Mt). At the Tengiz KTL-1 plant, sulphur production fluctuated around 0.2-0.3 Mt. Frasch production at Gaudark declined marginally to 0.35 Mt, and in Ukraine the Rozdol operation continued to run at a low rate.

In 1993, Chevron Corporation of the United States and the Republic of Kazakhstan signed a 40-year agreement to set up a new joint venture, Tengizchevroil, to develop the Tengiz and Korolev oil and gas fields in western Kazakhstan. The joint venture plans to complete the second gas/oil processing plant (KTL-2) at Tengiz in 1994, instead of the previously planned date of 1993. A third plant (KTL-3) is planned for 1997.

Poland

Poland was the fourth largest world producer of elemental sulphur accounting for 5% of world production. Poland produced Frasch sulphur at three mines and one industrial plant at Baznia (30 000 t/y). The major mines are located at Jeziorko, Osiek and Grzybow. In 1993, sulphur production in Poland dropped by 34% to 1.9 Mt from 2.9 Mt in 1992. The Machow open-pit operation closed in early 1993. The Jeziorko Frasch mine ran at a reduced level during the year, while the Grzybow Frasch operation is gradually being phased out. The Grzybow operation is currently operating at minimal levels, only to support the nearby carbon disulphide (CS_2) plant; sulphur reserves are depleting rapidly. In 1993, the new Osiek Frasch mine was commissioned and is expected to produce 0.7 Mt/y. During the year, Ciech Siarkopol brought on stream two new 1000-t/d wet prilling towers at Gdansk. Once all facilities are operational in 1994, all Polish sulphur exports are to be granulated. Exports in 1993 were estimated at 2.3 Mt, an 11% decrease over 1992; the reduction was planned to allow a 0.5-Mt decrease in sulphur stocks located at Gdansk and Jeziorko.

Saudi Arabia

Saudi Arabia was the fifth largest sulphur producer in the world in 1993 with a 6% share. Saudi Arabian sulphur production was reported at 1.7 Mt. Close to 75% came from natural gas processing at Ras Tanura, Shedgum and Berri, while the remainder was recovered from oil refineries at Al Jubayl and Yanbu. In 1993, the Saudi Arabian government dissolved Samarec, a state agency for marketing sulphur, and transferred Samarec's responsibility to Saudi Aramaco. Sulphur stocks were remelted extensively during the year; reported stocks at Berri were estimated at less than 0.5 Mt, compared to 2.0 Mt in 1992. Saudi Arabia plans some expansions at three of its oil refineries later in the decade.

Japan

Japan was the world's sixth largest producer of sulphur in 1993, accounting for 4% of world production. In 1993, Japanese production rose 4% to 1.43 Mt. All sulphur production is derived from oil refining; the increased output in 1993 reflected higher utilization rates and stronger imports of crude oil. A new refinery came on stream in 1992.

Mexico

Mexico was the world's seventh largest producer of sulphur in 1993, with a 3% share of world production. In 1993, Mexican sulphur production dropped from 1.5 Mt to 0.7 Mt after the closure of all its Frasch mines in 1992 and 1993. Frasch production declined 80% to 0.12 Mt as Compagnhia Exploracion del Istmo (CEDI) shut down the last remaining Frasch mine in Mexico at Texistepec. Petroleos Mexicanos (Pemex), the state-owned energy company, assumed in April 1993 the ownership of all assets of Azufrera Panamericana SA (APSA), which went bankrupt in August 1992. Pemex took control of APSA's three sulphur terminals at Coatzacoalcos (Mexico), Tampa (United States) and Immingham (England). Sulphur production in 1993 from oil refining and gas processing rose marginally to 755 000 t and accounted for 83% of the total Mexican sulphur output; sulphur recovery plants ran at capacity during the year.

PRICES

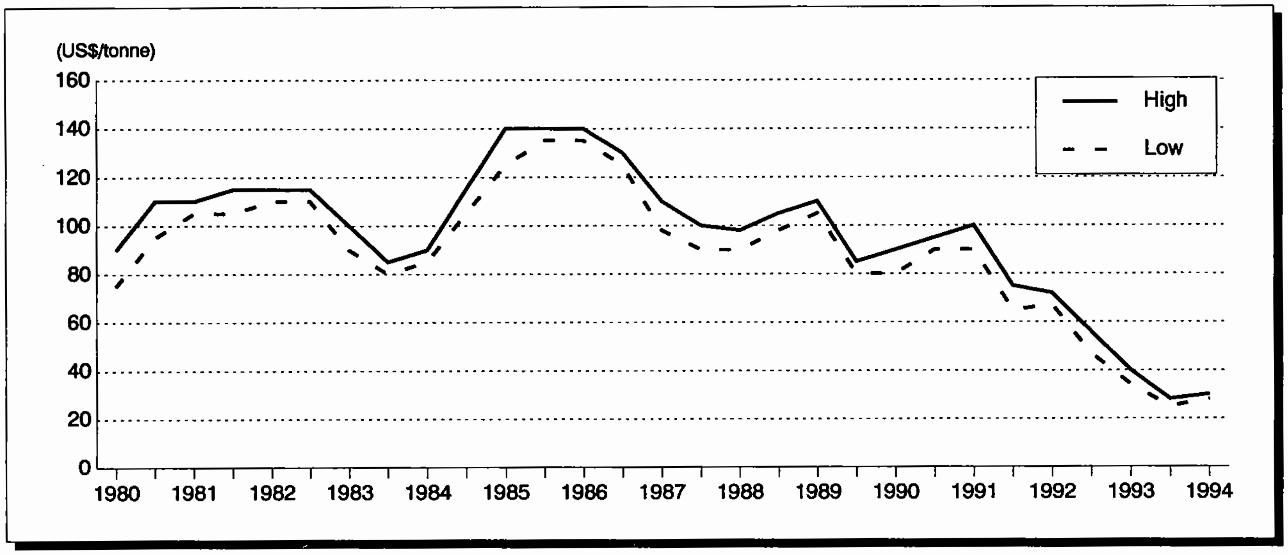
Between January 1991 and January 1994, sulphur prices, quoted on an f.o.b. Vancouver basis, dropped from US$100/t to $30/t; this $70/t decline was reflective of major weaknesses in demand and important increases in involuntary and voluntary (Main Pass) production. In 1993, f.o.b. Vancouver prices for Canadian sulphur were quoted at US$30-40/t in early January, then declined slightly to US$32-35/t in June as ocean freight rates rose; spot quotations were in the US$25-28/t range during June to September. Contract prices bottomed out at US$25-28/t in October, and began a gradual recovery by year-end to reach US$28-30/t as world phosphate fertilizer demand picked up. In November, spot prices rose to the US$28-32/t level.

Prices in North American markets continued to drop. At the beginning of 1993, prices for liquid sulphur (f.o.r. Alberta) varied between US$7/t and $10/t. Quotations remained unchanged until March, when new prices reflected the depressed situation in both offshore and North American markets. In North America, low utilization rates in the phosphate fertilizer industry pushed down prices in the Florida market, resulting in subsequent reductions in f.o.r. Alberta prices to the range of US$5-9/t in the second quarter, US$2-5/t in the third quarter, and US$0-2/t in the fourth quarter. This latter level led to weak levels of Canadian sulphur exports to the United States in the September-December period.

USES

About 60% of all sulphur consumed in the world is used mostly as a process agent in the manufacture of fertilizers such as superphosphate, ammonium phosphate, and ammonium sulphate. The second largest consuming sector is the chemical industry, where sulphur is used as sulphuric acid in products ranging from pharmaceuticals to synthetic

Figure 1
Sulphur Prices, 1980-94
F.O.B. Vancouver Contract



Source: Natural Resources Canada.

fibres. Other consumers of sulphur include the manufacturers of pulp and paper, iron and steel, nonferrous metals, and titanium dioxide pigments. These consuming industries use sulphur in the form of sulphuric acid, which accounts for almost 90% of total sulphur consumption (60% of sulphuric acid consumption is in fertilizers). Manufactured products that require sulphur in non-acid form include insecticides and fungicides, pulp and paper, photography, leather processing, rayon, and rubber.

OUTLOOK

Sulphur demand is expected to improve in 1994 as consumption in both the fertilizer and industrial sectors recovers. World demand for phosphate fertilizers is projected to increase by 3%, with consumption improving in China, India and Brazil. Increased trade in finished and semi-finished phosphate fertilizers will translate into additional demand for elemental sulphur. In 1994, demand for sulphur is forecast to grow by 6% to reach 32.6 Mt, leading to increases in sulphur consumption and trade for 1994, in particular in Latin America, Africa and the United States; a slight decrease is anticipated in the former Soviet Union.

World elemental sulphur production in 1994 is forecast to continue its sustained increase as more recovered sulphur is produced. World production is estimated to reach 38.4 Mt, a 7% increase over 1993. Marginal growth is projected in Frasch sulphur, mostly from higher output at the Main Pass operation reaching a sustainable 2.0-Mt/y production level by 1994. In Poland, a decline in its sulphur capability is anticipated, bringing its future production down to about 1.8 Mt/y from 2.0-2.3 Mt/y in previous years. In the Middle East, Iraq's Mishraq Frasch operation remains idle, but could be reactivated in a short time to reach 1.0-2.0 Mt/y. Production of recovered sulphur in 1994 is forecast to grow by 6%, with higher output related to both oil and gas. In 1994, Canadian sulphur production is projected at 8.0 Mt, a 0.7-Mt increase related to gas processing; production from oil sands and crude oil is expected to stabilize in 1994. Increases in oil-related and gas-related sulphur production in 1994 are expected in Kazakhstan (Tengiz), the Middle East (Kuwait, Iraq and Abu Dabhi), and Western Europe (Germany and Italy).

Canadian sulphur production is expected to reach 8.3 Mt/y by 1998. Sulphur production from gas is set to increase as a result of a strong demand being forecast for Canadian gas in both domestic and U.S. markets. Between 1993 and 1998, demand for western Canadian gas is expected to increase by 20% to reach 153 000 million m^3 in 1998; derived sulphur production from natural gas is projected to increase in the short term to peak at 7.3 Mt/y by 1998. In 1998, sulphur produced from gas in Alberta could range between 6.0 and 6.2 Mt/y; this level will be affected by exploration rates and connections of sour gas fields versus sweet gas fields. In British Columbia, gas-related sulphur production is forecast at between 1.0 and 1.2 Mt/y by 1998; sulphur recovery in British Columbia will double due to increases in processing activities near the Tumbler Ridge-Pine River area. Sulphur recovery from oil sands is expected to level off at 0.65 Mt/y, and production from oil refining is projected to increase by 20% to 0.35 Mt/y.

In the medium term, The Sulphur Institute of Washington, D.C., forecasts that world sulphur demand will grow at an annual rate of 2% between 1993 and 1997, to reach 55.2 Mt/y in 1997. Sulphur consumption in non-fertilizer applications is projected at 22.7 Mt/y in 1997, an overall 9% increase from 1993. Sulphur consumption in fertilizers is forecast to grow at close to 3%/y between 1993 and 1997 to about 32.6 Mt/y by 1997; most of this 3.2-Mt/y increase is to occur in the Middle East, Asia and Africa. According to the International Fertilizer Industry Association of Paris, world consumption of sulphuric acid for the manufacture of fertilizers is forecast to grow at an annual rate of 3.5% between 1993 and 1997, and to reach 100.8 Mt H_2SO_4 by 1997. Major increases are expected in Latin America, North Africa and the United States. Consumption of sulphuric acid for fertilizers is projected to decrease in Western Europe (due to major reforms in domestic agricultural policies), and in the FSU (due to higher production costs and lack of credit for farmers).

The 1998 world production potential for elemental sulphur is estimated at 41.2 Mt, an 18% increase over 1993. Frasch production is expected to remain flat at 6.4-6.5 Mt/y, while recovered sulphur output is to grow by 22% overall. Over the next five years, world supply/demand is expected to remain unbalanced, with annual surpluses ranging between 4.0 and 5.0 Mt/y. This disequilibrium will lead to massive blocking by some high-cost producers and swing suppliers, a position that has been taken since late 1992 and which may last until the end of the decade.

Note: Information in this review was current as of February 1, 1994.

TARIFFS

Item No.	Description	Canada MFN	Canada GPT	Canada USA	United States Canada
2503.00	Sulphur of all kinds, other than sublimed sulphur, precipitated sulphur and colloidal sulphur				
2503.10.00	Crude or unrefined sulphur	Free	Free	Free	Free
2503.90.00	Other	Free	Free	Free	Free
2802.00.00	Sulphur, sublimed or precipitated; colloidal sulphur	Free	Free	Free	Free
2807.00.00	Sulphuric acid; oleum	Free	Free	Free	Free
2811.23.00	Sulphur dioxide	Free	Free	Free	Free

Sources: Customs Tariff, effective January 1994, Revenue Canada, Customs and Excise; Harmonized Tariff Schedule of the United States, 1994.

TABLE 1. CANADA, SULPHUR SHIPMENTS AND TRADE, 1992 AND 1993

Item No.		1992		1993p	
		(tonnes)	($000)	(tonnes)	($000)
SHIPMENTS[1]					
	Sulphur in smelter gases[2]	783 388	88 055	796 992	94 984
	Elemental sulphur[3]	6 393 932	133 047	5 605 076	6 569
	Total sulphur content	7 177 320	221 102	6 402 068	101 553
IMPORTS				(Jan.-Sept.)	
2503.10	Sulphur, crude or unrefined				
	United States	271	55	128	33
	France	76	20	–	–
	Total	347	76	128	33
2503.90	Sulphur, n.e.s.				
	United States	7 974	2 524	5 317	1 940
	Germany	324	92	181	71
	Total	8 298	2 616	5 498	2 011
2802.00	Sulphur sublimed or precipitated; colloidal sulphur				
	United States	936	374	601	216
	France	12	8	165	123
	Germany	...	...	2	1
	Total	948	383	769	342
2807.00	Sulphuric acid; oleum				
	United States	86 221	7 472	81 873	6 103
	South Korea	–	–	15	58
	United Kingdom	15	1	29	3
	Germany	24	3	7	...
	Taiwan	24	3	–	–
	Total	86 284	7 480	81 923	6 166
2811.23	Sulphur dioxide				
	United States	170	79	359	125
	Germany	–	–	3	2
	United Kingdom	–	–	...	...
	Total	170	79	363	127
EXPORTS					
2503.10	Sulphur, crude or unrefined				
	United States	1 916 281	103 357	1 251 545	41 107
	Morocco	1 111 296	79 183	526 840	19 989
	Brazil	276 528	20 785	333 515	15 793
	Indonesia	273 843	20 962	248 884	11 185
	South Africa	217 851	16 133	230 613	8 068
	People's Republic of China	103 120	9 495	114 648	7 539
	Israel	200 564	14 408	151 019	5 903
	Senegal	135 470	11 376	139 402	5 829
	Tunisia	350 764	26 023	99 163	5 700
	New Zealand	150 182	11 297	120 693	5 486
	Taiwan	37 778	1 903	26 768	1 591
	Argentina	79 719	5 373	37 853	1 531
	Australia	89 906	6 097	29 240	1 123
	South Korea	168 668	12 254	21 645	992
	Mexico	89 101	7 508	32 188	918
	Thailand	63 901	4 174	13 158	361
	Philippines	7 174	572	5 881	249
	United Kingdom	320	23	14	2
	Other countries[4]	370 982	26 113	–	–
	Total	5 643 448	377 036	3 383 069	133 375

TABLE 1 (cont'd)

Item No.		1992		Jan.-Sept. 1993p	
		(tonnes)	($000)	(tonnes)	($000)
EXPORTS (cont'd)					
2503.90	Sulphur, n.e.s.				
	United States	4 603	602	21 227	2 459
	New Zealand	5 317	238	5 156	149
	Australia	138	6	–	–
	Total	10 058	848	26 383	2 608
2802.00	Sulphur, sublimed or precipitated; colloidal sulphur				
	United States	110	21	90	11
	Total	110	21	90	11
2807.00	Sulphuric acid; oleum				
	United States	1 340 116	55 669	1 013 309	45 346
	Other countries	97	38	114	37
	Total	1 340 213	55 707	1 013 423	45 383
2811.23	Sulphur dioxide				
	United States	72 059	12 067	46 138	8 767
	Total	72 059	12 067	46 138	8 767

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . . Amount too small to be expressed; n.e.s. Not elsewhere specified; p Preliminary.
[1] Data compiled regardless of origin (i.e., domestic and foreign source materials). [2] Sulphur in liquid SO_2 and H_2SO_4 recovered from the smelting of metallic sulphides and from the roasting of zinc-sulphide concentrates. [3] Producers' shipments of elemental sulphur produced from natural gas; also included are small quantities of sulphur produced in the refining of domestic crude oil and synthetic crude oil. [4] Mainly India, France, Chile, Cuba and Uruguay.
Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, NATURAL SOUR GAS PROCESSING PLANTS, SULPHUR CAPACITY, 1990-93

Operating Company	Source Field or Plant Location	H_2S in Raw Gas	Daily Sulphur Capacity[1] 1990	1991	1992	1993
		(percent)	(tonnes)			
SOUR GAS, ALBERTA						
Alberta Energy Company Ltd.	Sinclair-Hythe	3	256	256	256	256
Amerada Hess Corporation	Olds-Garrington	14	389	389	389	389
Amoco Canada Petroleum Company Ltd.	Bigstone Creek	15	385	385	385	385
Amoco Canada Petroleum Company Ltd.	Caroline North-Garrington	0.3	10.4	10.4	10.4	10.4
Amoco Canada Petroleum Company Ltd.	Caroline South-Harmattan	0.4	8	8	8.3	8.6
Amoco Canada Petroleum Company Ltd.	East Crossfield-Elkton	34	1 797	1 797	1 797	1 797
Amoco Canada Petroleum Company Ltd.	Kaybob I/II-Fir	8	1 090	1 090	1 090	1 090
Amoco Canada Petroleum Company Ltd.	W. Pembina-Brazeau	11	340	520	520	520
Amoco Canada Petroleum Company Ltd.	Windfall-Whitecourt	12	1 330	1 333	1 333	1 333
Canadian Gas Gathering Systems Inc.	Nevis	4	197	197	196.6	245.8
Canadian Occidental Petroleum Ltd.	Mazeppa-Okotoks-Medallion	25	577	577	577	577
Canadian Occidental Petroleum Ltd.	Paddle River	0.1	19	19	19	19.4
Chevron Canada Resources Limited	Kaybob South III-Obed	8	3 557	3 557	3 557	3 557
Chevron Canada Resources Limited	Medicine Lodge	7.5	–	45	55.9	55.9
Co-enerco Resources Ltd.	Zama	4	74	74	74	74
Gulf Canada Limited	Brazeau River-Nordegg	1.7	42	46.5	46.5	46.5
Gulf Canada Limited	Brazeau River-Peco	1.3	110	110	110	110
Gulf Canada Limited	Homeglen-Rimbey	0.5	128	128	127.5	127.5
Gulf Canada Limited	Strachan	9	953	953	953	953
Home Oil Company Limited	Carstairs	0.5	65	65	64.8	64.8
Husky Oil Ltd.	Rainbow Lake	2	139	142	142	142
Husky Oil Ltd.	Ram River (Ricinus)	16.5	4 572	4 572	4 572	4 572
Imperial Oil Resources Limited	Bonnie Glen	0.4	12.5	34.5	34.5	34.5
Imperial Oil Resources Limited	Quirk Creek	9	299	301	301.2	301.2
Imperial Oil Resources Limited	Redwater	3	11	11	11	11
Mobil Oil Canada, Ltd.	Harmattan-Elkton-Leduc	52	490	66	66.2	66.2
Mobil Oil Canada, Ltd.	Lone Pine Creek	13.5	157	162	162	162
Mobil Oil Canada, Ltd.	Wimborne	10.5	182	182	182	182
Norcen Energy Resources Limited	Minnehik-Buck Lake	0.1	45	45	45	45
North Canadian Oils Limited	Progress	0.7	15	16	14.5	14.5
OMV (Canada) Ltd.	Rainbow-Fire	1.0	25	20	19.9	19.9
Pembina Corporation	Turner Valley	1.2	16	16	15.9	15.5
Petro-Canada Inc.	Brazeau River-Peco	21	444	447.3	447.3	447.3
Petro-Canada Inc.	Gold Creek	2.4	43	43	43	43
Petro-Canada Inc.	Hanlan Robb	8	1 092	1 092	1 092	1 092
Petro-Canada Inc.	Wildcat Hills	7	280	280	280.3	280.3
Petrogas Processing Inc.	East Calgary-Balzac	16	1 696	1 696	1 696	1 696
Poco Petroleums Ltd.	Sturgeon Lake South	9.5	98	98	98	98
Saratoga Processing Company Limited	Savannah Creek (Coleman)	12	389	389	389	389
Shell Canada Limited	Burnt Timber Creek	13	489	489	489	489
Shell Canada Limited	Caroline	25	–	–	4 504	4 504
Shell Canada Limited	Caroline-Bearberry	90	–	228	228	–
Shell Canada Limited	Jumping Pound	7.5	597	597	597	597
Shell Canada Limited	Waterton	15	3 107	3 107	3 107	3 107
Suncor Inc.	Rosevear North	8	110	111	111.3	111.3
Suncor Inc.	Rosevear South	6.5	171	171	171	171
Suncor Inc.	Simonette River	5.5	95	95	95	95
Talisman Energy Inc.	Edson-Pine Creek	1.4	289	292	292	292
Talisman Energy Inc.	Teepee Creek	0.4	30	30	23	23
SOUR GAS, BRITISH COLUMBIA						
Amerada Hess Corporation	Boundary Lake	–	3.7	3.7	3.7	3.7
Amoco Canada Petroleum Company Ltd.	Cypress	–	14.1	14.1	14.1	14.1
Westcoast Energy Inc.	Fort Nelson	2	674	674	674	674
Westcoast Energy Inc.	Taylor Flats-McMahon	1.6	460	460	558	558
Westcoast Energy Inc.	Pine River	12	1 055	1 055	1 070	1 085

Source: Energy Resources Conservation Board publication, October 1993.
– Nil.
[1] Maximum design capacity.

TABLE 3. CANADA, CRUDE OIL AND OIL SANDS REFINERY SULPHUR CAPACITIES OPERATING IN 1991-93

Operating Company	Location	Daily Capacity 1991	1992	1993
			(tonnes)	
CRUDE OIL REFINERIES				
Canadian Ultramar Limited	St. Romuald, Quebec	50	50	50
Chevron Canada Limited	Burnaby, British Columbia	10	10	10
Imperial Oil Limited	Dartmouth, Nova Scotia	76	76	76
	Edmonton, Alberta	40	40	40
	Nanticoke, Ontario	35	35	35
	Port Moody, British Columbia[1]	20	20	–
	Sarnia, Ontario	140	140	140
Irving Oil Limited	Saint John, New Brunswick	100	100	100
Petro-Canada Products Inc.	Edmonton, Alberta	56	56	56
	Lake Ontario-Mississauga, Ontario	44	44	44
	Lake Ontario-Oakville, Ontario	40	40	40
	Port Moody, British Columbia[1]	25	25	–
Shell Canada Limited	Burnaby, British Columbia[1]	15	15	–
	Sarnia, Ontario	35	35	35
	Scotford, Alberta	14	14	14
Sulconam Inc.	Montréal, Quebec	300	300	300
Suncor Inc.	Sarnia, Ontario	50	50	50
Total effective capacity[3]		1 050	1 050	990
HEAVY OIL UPGRADERS				
Consumers' Co-operative Refineries Limited	Regina, Saskatchewan	220	220	220
Husky Oil Operations Ltd.[2]	Lloydminster, Saskatchewan	–	250	250
Total effective capacity[3]		220	470	470
OIL SANDS PLANTS				
Suncor Inc.	Mildred Lake, Alberta	850	850	850
Syncrude Canada	Fort McMurray, Alberta	1 255	1 255	1 255
Total effective capacity[3]		2 105	2 105	2 105

Sources: Natural Resources Canada; Company interviews, 1993.
– Nil.
[1] Operations shut down in 1993. [2] Came on stream in 1992. [3] Effective capacity comprises operating productive capacity.

TABLE 4. CANADA, PRINCIPAL SULPHUR DIOXIDE AND SULPHURIC ACID PRODUCTION CAPACITIES, 1993

Operating Company	Plant Location	Raw Material	Annual Capacity		
			Liquefied SO_2	Sulphuric Acid[1]	Sulphur Equivalent[2]
				(000 tonnes)	
EASTERN CANADA					
Brunswick Mining and Smelting Corporation Limited	Belledune, N.B.	SO_2 lead & zinc conc.		176	58
CE Zinc	Valleyfield, Que.	SO_2 zinc conc.		430	140
Falconbridge Limited	Kidd Creek, Ont.	SO_2 zinc conc.		220	72
	Kidd Creek, Ont.	SO_2 copper conc.	30	470	168
	Sudbury, Ont.	SO_2 nickel conc.		355	116
Gaspé Copper Mines, Limited	Murdochville, Que.	SO_2 copper conc.		165	54
Inco Limited	Copper Cliff, Ont.	SO_2 pyrrhotite and nickel conc.		1 000	325
	Copper Cliff, Ont.	SO_2 copper conc.	100	n.a.	50
Noranda Minerals Inc.	Rouyn-Noranda, Que.	SO_2 copper conc.		425	139
Sulco Chemicals Ltd.	Elmira, Ont.	Elem. sulphur		33	11
Subtotal			130	3 274	1 133
WESTERN CANADA					
Border Chemical Company Limited	Transcona, Man.	Elem. sulphur		150	49
Cameco Corporation-Rabbit Lake Operation	Rabbit Lake, Sask.	Elem. sulphur		72	23
Cameco Corporation-Key Lake Operation	Key Lake, Sask.	Elem. sulphur		72	23
Cominco Ltd.	Trail, B.C.[3]	SO_2 lead & zinc conc.	80	430	210
Esso Chemical Canada	Redwater, Alta.	Elem. sulphur		910	297
Hudson Bay Mining and Smelting Co.	Flin Flon, Manitoba	SO_2 zinc conc.		n.a.	35
Marsulex Inc.	Fort Saskatchewan, Alta.	Elem. sulphur		160	52
Sherritt Gordon Limited	Fort Saskatchewan, Alta.	Elem. sulphur		233	75
Westcoast Energy Inc.	Prince George, B.C.	Elem. sulphur	30	75	40
Subtotal			110	2 102	804
Total Canada			240	5 376	1 937

Sources: Natural Resources Canada; Canadian company interviews, 1993.
n.a. Not applicable.
[1] 100% H_2SO_4. [2] Elemental sulphur equivalent of sulphuric acid is 32.7% and sulphur equivalent of liquefied SO_2 is 50%. [3] Cominco operation at Trail also has a 30 000-t/y production capacity for elemental sulphur, which has been added to the total sulphur equivalent production capacity of Cominco.

TABLE 5. CANADA, SULPHUR SHIPMENTS AND TRADE, 1983-93

	Shipments[1]				Imports[2]	Exports[2]
	Pyrites	In Smelter Gases	Elemental Sulphur	Total	Elemental Sulphur	Elemental Sulphur
			(tonnes)			
1983	–	678 286	6 631 123	7 309 409	2 365	5 670 275
1984	–	844 276	8 352 978	9 197 254	3 019	7 326 847
1985	–	822 359	8 102 163	8 924 522	3 167	7 848 380
1986	–	758 231	6 965 775	7 724 006	10 763	6 257 054
1987	–	783 115	7 322 791	8 105 906	24 711	6 571 800
1988	–	856 496	8 106 641	8 963 137	21 825	7 384 160
1989	–	808 789	6 868 930	7 677 719	18 311	5 514 059
1990	–	789 815	6 873 495	7 663 310	13 203	6 057 523
1991	–	748 965	6 937 884r	7 686 849r	9 026	5 845 372r
1992	–	783 388	6 393 932	7 177 320	8 645	5 653 506
1993p	–	796 992	5 605 076	6 402 068	. .	. .

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available; p Preliminary; r Revised.
1 Shipment data compiled regardless of origin (i.e., domestic and foreign source materials). 2 Includes only elemental sulphur in a crude or refined form.

TABLE 6. CANADA, SULPHURIC ACID PRODUCTION, TRADE AND APPARENT CONSUMPTION, 1982-92

	Production	Imports	Exports	Apparent Consumption
		(tonnes – 100% acid)		
1982	3 130 854	192 514	259 740	3 063 628
1983	3 686 427	126 573	273 204	3 539 796
1984	4 043 389	28 330	553 780	3 517 939
1985	3 890 092	17 306	744 732	3 162 666
1986	3 536 062	29 127	755 606	2 809 583
1987	3 436 977	44 623	803 178	2 678 422r
1988	3 804 856	40 078	851 622	2 993 312
1989	3 718 578	28 433	978 190	2 768 821
1990	3 829 570	71 319	1 280 502	2 620 387
1991	3 675 839r	79 207r	1 265 740	2 489 306r
1992	3 776 086	86 284	1 340 213	2 522 157

Sources: Natural Resources Canada; Statistics Canada.
r Revised.

TABLE 7. WORLD PRODUCTION OF SULPHUR, 1990-92

	1990		1991		1992p	
	All Forms[1]	Elemental	All Forms	Elemental	All Forms	Elemental
			(000 tonnes)			
WESTERN EUROPE						
Finland	649	46	648	170	637	40
France	1 079	898	1 193	1 013	1 167	988
Germany	2 035	1 386	2 108	1 396	2 286	1 350
Italy	729	297	700	330	630	310
Norway	310	48	248	13	229	13
Spain	1 026	75	981	85	1 023	159
Others	1 666	859	1 616	780	1 575	930
Total, Western Europe	7 494	3 609	7 494	3 787	7 547	3 790
CENTRAL EUROPE						
Poland	4 607	4 456	4 086	3 917	3 096	2 925
Others	986	96	864	105	818	130
Total, Central Europe	5 593	4 552	4 950	4 022	3 914	3 055
FORMER SOVIET UNION	9 039	5 729	8 534	5 334	8 331	5 181
AFRICA						
South Africa	704	135	546	135	660	135
Others	250	10	226	10	206	10
Total, Africa	954	145	772	145	866	145
NORTH AMERICA						
Canada	6 912	5 923	7 118	6 189	7 431	6 535
United States	12 340	10 192	11 706	9 510	11 614	9 369
Total, North America	19 252	16 115	18 824	15 699	19 045	15 904
LATIN AMERICA						
Mexico	2 401	2 142	2 038	1 791	1 774	1 485
Others	864	328	973	334	1 014	394
Total, Latin America	3 265	2 470	3 011	2 125	2 788	1 879
MIDDLE EAST						
Saudi Arabia	1 850	1 850	2 045	2 045	2 370	2 370
Other	2 144	2 144	1 802	1 707	1 770	1 770
Total, Middle East	3 994	3 994	3 847	3 752	4 140	4 140
ASIA						
China	5 411	329	5 907	313	6 189	340
Japan	2 766	1 268	2 762	1 244	2 886	1 341
Others	1 308	383	1 312	418	1 366	521
Total, Asia	9 485	1 980	9 981	1 975	10 441	2 202
OCEANIA	285	39	295	41	360	51
Total World	59 361	38 633	57 706	36 879	57 432	36 347

Source: The British Sulphur Corporation Limited, 1993.
p Preliminary.
[1] All forms includes elemental sulphur, sulphur contained in pyrites, and contained sulphur recovered from metallurgical waste gases, mostly in the form of sulphuric acid.

TABLE 8. CANADA, SULPHURIC ACID, REPORTED CONSUMPTION BY END USE, 1990-92

	1990	1991	1992p
		(tonnes)	
Agricultural chemicals and fertilizers	1 180 773	1 120 460	1 164 240
Pulp and paper	279 873	336 531r	338 411
Industrial inorganic chemicals	496 600	424 615	336 211
Uranium mines	218 362	123 896	122 723
Nonferrous smelting and refining	100 654	84 049	118 712
Crude and refined petroleum products	37 293	41 971	34 812
Soap and cleaning compounds	19 260	16 829	25 542
Other mines, metal and nonmetal	19 355	30 154	25 261
Leather and textile	27 390	24 178	20 302
Metal rolling and extruding	7 315	11 613	7 120
Electrical products	6 830	5 722	3 529
Plastics and synthetic resins	600	653	2 747
Food, brewery and distillery	821	1 449	2 077
Other end uses	132 513	102 767	99 943
Total	2 527 639	2 324 887r	2 301 630

Source: Reports from producing companies, compiled by Natural Resources Canada.
p Preliminary; r Revised.

Tin

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World tin mine production in 1993 was about 2000 t lower than the 173 400 t of tin in concentrate produced in 1992. This represents the fourth consecutive year of declining production. Low tin prices forced a significant number of tin mines to cease operations during the year, particularly in Southeast Asia, but increases in production in other countries also occurred. World tin metal production was also forecast to be slightly lower than the 188 300 t produced in 1992, as shortages of tin concentrates resulted in some smelters decreasing utilization rates. World consumption of refined tin in 1993 was estimated to be about 200 000 t, 3% lower than the total in 1992. The price of tin in 1993 averaged US$2.34/lb on the London Metal Exchange (LME) compared to $2.55/lb in 1992.

The Association of Tin Producing Countries (ATPC) extended its supply rationalization scheme and set export quotas for member countries for 1994. China also agreed to join the association.

Canadian Developments

The dismantling of facilities and land reclamation at Rio Algom Ltd.'s East Kemptville mine site in Nova Scotia is to commence in early 1994. The mine closed in January 1992 due to low world tin prices. The Nova Scotia government paid for the mine to remain on a care and maintenance basis while new buyers were sought for the operation. East Kemptville had an estimated five to eight years of reserves remaining at the time of closure.

Consumption of tin in Canada in 1992 was just over 3000 t. The greatest domestic use of tin was in solders, accounting for 49% of consumption, followed by tinplate and tinning at 43%.

World Developments

World tin mine production, which by the end of 1992 had fallen for three consecutive years, declined further in 1993. The Malaysian tin mining sector was the most affected with a number of closures during the year, including the withdrawal of the country's largest tin mining company from the domestic tin business. Substantial production cuts were also implemented in Brazil. However, increased production did occur in Portugal, Australia and Peru.

With many tin smelters experiencing difficulties in obtaining concentrates, some curtailments in refined tin production occurred in 1993 with the smelting industry in Thailand being especially hard hit. Malaysian smelters, however, operated at near capacity in 1993 and Malaysia was expected to remain the world's largest producer of refined tin.

Exports of refined tin from China continued at significant levels in 1993 with metal from Russia and Vietnam also entering Western markets.

China

China produced an estimated 38 700 t of tin in concentrate in 1992, making it the world's largest producer. China's production of refined tin in 1992 was 37 700 t, ranking the country second behind Malaysia. With the need to earn foreign currency, China was a significant exporter of refined tin in 1993, despite low tin prices.

China agreed to join the Association of Tin Producing Countries (ATPC) in 1994. China's membership is conditional on its exemption from providing export statistics and from its contributing to the ATPC's research budget. Also, China's contribution to the budget of the ATPC will be based on the country's level of exports and not production levels, which are the criteria for all other members. China's export quota for 1994 was set at 20 000 t of refined tin.

Tin deposits in China are an extension of those in Southeast Asia and are concentrated in the provinces of Yunnan, Guangxi, Guangdong, Jiangxi and Hunan, and on the island of Hainan.

Brazil

Tin-in-concentrate production in 1993 was about 23 000 t compared to 28 500 t in 1992. The forecast reduction was due to cutbacks in response to low tin prices, and continuing legal disputes at the Bom Futuro mine in Rondonia state.

Paranapanema SA, which accounts for 60% of tin mine production in Brazil, announced a 10% cut in production in June. The reduced production came primarily from the company's Pitinga mine in Amazonas state which accounts for about 90% of Paranapanema's output. In early October, a further reduction in output at the Pitinga mine occurred when more than 1200 employees staged a nine-day strike over wages. In 1993, Paranapanema produced 13 000 t of tin in concentrate.

Mineracao Canopus SA also reduced tin mine production in 1993 due to low tin prices. The company has a capacity of 14 000 t/y of tin in concentrate but, since 1991, has only been operating at a rate of 1200 t/y. Canopus initiated production cuts in June and September which reduced output to a rate of 430 t/y.

Empresa Brasileira de Estanho SA (Ebesa), the Brazilian tin company consortium, signed an agreement in June with several cooperatives of independent "garimpeiro" miners to purchase tin concentrate from the Bom Futuro mine site. Ebesa agreed to purchase 70% of the mine's output from the garimpeiro cooperatives at 60% of the LME tin price. The legal dispute at Bom Futuro continued, however, when a Rondonia state judge signed a decree in October declaring the agreement between Ebesa and the cooperatives unconstitutional. Meanwhile, smuggling of concentrate at Bom Futuro continued. Federal police seized 20 t of cassiterite being smuggled off the mine site, believed to have been destined for a small local smelter.

Paranapanema won a bid to develop a tin orebody in Sao Paulo state. The deposit is small, containing only 5000 t of tin ore grading 1.5% tin. However, its location, only 300 km from the city of Sao Paulo, makes development attractive.

Brazil produced 28 500 t of refined tin in 1992. In July, the Brazilian government authorized Companhia Estanifera do Brasil to import and refine up to 10 000 t of Peruvian tin concentrate over a two-year period. The refined tin produced will be exported, mainly to the United States and Europe. There are no tin smelters in Peru. Brazilian refined tin exports for 1993 were about 18 000 t, well below the country's 24 000-t quota set by the ATPC and about 10% less than tin metal exports for 1992.

Malaysia

Malaysian mine production continued the decline seen in recent years. Output in the first nine months of 1993 fell to 8533 t from 10 851 t in the same period in 1992. Malaysia produced 14 300 t of tin in concentrate in 1992 compared to 20 700 t in 1991.

Malaysia Mining Corp. Bhd., the country's largest tin mining company, announced in April that it was withdrawing from the domestic tin mining sector due to low tin prices and poor performance of its tin mining operations. The company accounts for the bulk of Malaysia's tin mine production. Only 63 mines were left operating in April when Malaysia Mining made its announcement, compared to 141 at the end of 1990.

In September, 30 small Malaysian tin producers announced that they would be cutting production by 20% in an attempt to improve tin prices. They indicated that the cutbacks would remain in place until the price of tin rose above their average production cost of US$2.65/lb.

Imports of tin concentrates decreased in 1993 as Malaysia's two tin smelters, operated by Datuk Keramat Holdings Bhd. and Malaysia Smelting Corp. Bhd., cut back production due to weak demand. Malaysia was the world's largest producer of refined tin in 1992, accounting for 45 600 t or 24% of the world total.

Indonesia

Renison Goldfields Consolidated Ltd. announced that it planned to acquire an additional dredge for use at its Koba mine at the cost of US$15 million. The dredge is currently in Malaysia and will not be ready for operation in Indonesia until late 1995. The additional dredge will allow Renison to increase production at the Koba mine from 7500 t/y to 10 000 t/y of tin in concentrate. The decision follows the discovery and delineation of additional reserves in the Bemban area which will support a combined dredge/gravel pump operation for at least 10 years. In 1992, Indonesia produced 29 400 t of tin in concentrate.

Indonesia's only tin smelter, with a capacity of 38 500 t/y of refined tin, is operated by PT Tambang Timah. In 1992, it produced 28 200 t of refined tin.

Thailand

Low tin prices continued to impact on the tin industry in Thailand. Thailand produced 10 900 t of refined tin in 1992. Production of refined tin at the country's largest tin smelter, Billiton BV's Thaisarco plant in Phuket, fell by 19% from 1992 to a total of 7700 t. Deliveries of local concentrates fell by 42% while concentrate imports rose by 155%, reflecting the mine closures taking place in Thailand due to poor market conditions. In 1991 and 1992, 86 mining operations closed in Thailand with further closures taking place in 1993.

Thaisarco began paying local miners a US$119/t subsidy in September in order to secure a reliable supply of local concentrates. Also in September, Thailand's Council of Economic Ministers dissolved the state-owned Offshore Mining Organization following continued large financial losses brought about by low tin prices. Thailand produced 8400 t of tin in concentrate in 1992 compared to 10 900 t in 1991.

Thai Pioneer Enterprises announced in January that it planned to expand capacity at its Pathum Thani tin smelter from 6000 t/y to 12 000 t/y. The plant was re-opened in 1992 after being idle for 10 years. It produces tin of 99.9% purity.

Bolivia

Under a joint-venture agreement with Bolivian state mining company Corporacion Minera de Bolivia (Comibol), Brazilian tin producer Paranapanema announced that it planned to begin recovering 2900 t/y of tin in concentrates from material rejected during 60 years of mining at the Catavi mining complex. The reject material contains 0.3% tin. The extraction plant was due to come on stream by mid-1995. Bolivia produced about 15 000 t of tin in concentrate in 1993 compared to 16 500 t in 1992.

The Metal Mining Agency of Japan, as part of a Japanese government assistance program to Bolivia, discovered additional ore reserves at Comibol's Colquiri tin mine. The underground exploration added approximately 500 000 t of ore grading 227 g/t silver, 0.1% tin, 3.4% zinc and 0.7% lead to the mine's reserves. An additional 190 000 t of lower-grade material was also outlined.

Bolivia produced 14 400 t of refined tin in 1992. State-owned Empresa Nacional de Fundiciones (Enaf) planned to toll-smelt Peruvian tin concentrates to produce 4000 t of refined tin at its Vinto smelter. The 27 000-t/y smelter has been operating at well below capacity in recent years. About 60% of Enaf's production is exported to the United States.

Australia

Australia exports most of its tin mine production. Australian production of tin in concentrates in 1992 was 6600 t while refined tin production was 500 t.

Renison discovered a new tin deposit, Rendeep, below the existing workings of its Renison mine in Tasmania. A decision is expected in 1994 on development of the deposit which would require a 600-m shaft. In the 1992/93 fiscal year ending June 30, the Renison mine increased production by 12% to 6700 t of tin in concentrate as a result of improved mill throughput, higher grades and improved recoveries (now at 80%).

Associated Gold Fields Ltd. and its partners Q International Resources Ltd. and Transit Mining Ltd. installed the first of two concentrators at their Emmaville tin project in New South Wales. The concentrator has a capacity of 240 t/y of tin in concentrate. The partners were constructing a second concentrator which would increase capacity to 1450 t/y of tin in concentrate. At this higher rate, the alluvial deposit would have a life of 2.5 years.

Russia

The Novosibirsk tin works in Siberia was privatized late in the year. Officials at the plant stated that tin metal exports for 1993 would be 1500-2300 t. The tin works plans to dramatically increase exports in 1994 to 15 000 t by treating higher volumes of domestic feed and by increased toll-smelting. However, rising energy and transportation costs make it unlikely that the isolated plant will be able to source enough concentrate to achieve this target. The Novosibirsk smelter has been operating in recent years at well below its capacity of 30 000 t/y of refined tin. Total Russian capacity is 35 000 t/y, but the country only produced an estimated 13 000 t of refined tin in 1992.

United States

The U.S. Defense Logistics Agency released its fiscal year 1994 annual materials plan in May. The plan authorized the disposal of 12 000 t of tin from the National Stockpile in fiscal year 1994, which began on October 1, 1993. The United States sold 6600 t of tin from the stockpile in fiscal year 1993, well below the 12 000 t authorized for sale.

Portugal

Sociedad Minera de Neves-Corvo commissioned the high-grade concentrates circuit at its Neves-Corvo mine in January. As a result, the company planned to double production in 1993 from the 3000 t of tin in concentrate produced in 1992. The mining operation, which primarily produces copper, reached the higher-grade tin zone which averages 6%-7% tin. The high-grade concentrates produced in the new circuit have a minimum grade of 65% tin.

Other Countries

Gold Fields of South Africa Ltd. closed its Rooiberg tin mine and smelter in October. In order to cut costs, the company had undertaken a rationalization program in 1992 which involved the elimination of 500 jobs. However, continuing financial losses due to low tin prices forced the closure of the complex.

A group of 10 Malaysian mining companies travelled to Vietnam in April to examine possible joint ventures to mine Vietnamese tin. The visit followed the decision by many producers to suspend tin mining operations in Malaysia due to declining grades and low tin prices. The Geological Survey of Malaysia has estimated that possible tin reserves in Vietnam total 150 000 t of contained tin.

RECYCLING

Efforts continue to be made in improving the recycling rate for tin-plated steel containers. According to the Tin Can Recycling Association, the amount of tin-plated steel recycled in Canada rose from 35 000 t in 1990 to 74 000 t in 1992, with a total of 250 000 t having been recycled since 1986. The Tin Can Recycling Association is attempting to formulate, through the Canadian Industry Packaging Stewardship Initiative, a nation-wide tin can recycling program using the municipal blue box recycling system.

In the United States, according to the Steel Can Recycling Institute (SCRI), more than 1 Mt of steel cans were recycled in 1992 resulting in a recycling rate of 41%. This compares to a rate of 34% in 1991. The U.S. steel industry's goal is for an overall recycling rate of 66%. The improvement in the recycling rate occurred despite low steel can prices.

The lowest rate of recycling for steel cans is in the general line, which includes containers for such products as paints, varnish and aerosols. In the United States, the recycling rate for this category was 15% in 1992. Once only collected through household hazardous waste collection programs or magnetically at some specialized facilities, more of these cans are now being recycled through curbside recycling programs. The SCRI has called for the increased recycling of general line steel containers. It has also set up educational programs and a toll-free telephone line to disseminate information on steel can recycling facilities.

INTERNATIONAL ORGANIZATIONS

The Association of Tin Producing Countries

The Association of Tin Producing Countries (ATPC) is an organization consisting of seven tin-producing states: Malaysia, Indonesia, Thailand, Bolivia, Australia, Zaire and Nigeria. In 1992, ATPC countries represented only 43% of total world tin mine production. However, China has agreed to join the Association in 1994. With China's membership, ATPC countries would represent approximately 66% of world tin production.

The ATPC began a supply rationalization scheme in March 1987. Its objective was to accelerate the absorption of the huge tin inventories caused by the cessation of the International Tin Council buffer stock operations and to prevent further price declines. The program involved the establishment of yearly export quotas among its members. Brazil, although not a member of the ATPC, has cooperated in recent years in limiting its exports of tin.

After the formation of the supply rationalization scheme, stock levels dropped from 73 000 t to an estimated 31 500 t at the end of 1992. However, stocks climbed in 1993 to an estimated 38 000 t at year-end. The ATPC considers 20 000 t to be a normal stock level for tin. In October, the ATPC agreed to extend the supply rationalization scheme for 1994. Some members had called for a discontinuation of the scheme, contending that it was ineffective in reducing global tin stocks. The ATPC agreed to lower exports by member countries to 78 000 t in 1994 from the 1993 total of 89 400 t. Individual quotas were set as follows: Australia, 6500 t; Bolivia, 16 000 t; Indonesia, 30 500 t; Malaysia, 14 000 t; Nigeria, 1900 t; Thailand, 8000 t; and Zaire, 1100 t. China, upon joining, will be assigned a quota of 20 000 t in 1994 compared to a voluntary limit of 15 000 t in 1993.

Research Organizations

The International Tin Research Institute (ITRI) is entrusted with the task of maintaining and extending the use and effectiveness of tin in modern technology. It is financed by the governments of five of the major tin-producing countries: Indonesia, Malaysia, Nigeria, Thailand and Zaire. Its headquarters and laboratories are in Uxbridge, England, and it maintains information centres in Belgium and the United States. In 1992, the ITRI established the International Tin Research Association, a commercial arm that will allow tin consumers to have greater access to its research and technical resources.

The ITRI is currently concentrating on research in a number of end-use fields such as tin-based flame retardants and smoke suppressants, lead-free solders and solderable coatings for use in electronics, new plating techniques for tinplate applications, and lead-free high-tin alloy capsules for wine and spirit bottles. The ITRI has also commercialized a new cyanide-free tin-zinc plating system known as Stanzec.

The South-East Asian Tin Research and Development (SEATRAD) Centre is a regional organization established by the governments of Indonesia, Malaysia and Thailand, with assistance from the Economic and Social Commission for Asia and the Pacific, and other United Nations agencies. The purpose of the centre is to promote, conduct and coordinate research and training in relation to the technical and economic aspects of exploration, mining, mineral processing and smelting of tin. The centre's headquarters and laboratory are located in Ipoh, Malaysia. In addition to the work being conducted in the laboratory, field projects are maintained in various member countries in Southeast Asia. The centre is financed by equal contributions from member countries.

USES

Solder recently surpassed tinplate as the largest market for tin and currently represents approximately one third of tin consumption in the Western World. In Canada, it accounts for about 50% of tin consumption. Strong growth in the electronics industry, which accounts for over 50% of tin used in solders, has provided a new impetus for tin use. Increasing miniaturization in electronics has led to the development of higher-quality solder pastes capable of finer printings. Increasing environmental concerns over lead content in solders and tin-based solderable coatings has resulted in research and development of lead-free products for the electronics industry to meet possible future legislation.

The amount of tin in solder depends on the application, with the current average being 30%-70%. In tin-lead solders, tin is the active metal forming the bond with the metals being joined. The lead serves to lower the melting point of the solder. For higher-temperature applications, alloys of high tin content (above 95% tin) are often used. The tin is alloyed with small amounts of antimony or silver.

Metals such as bismuth or indium may be added to tin-based solders to lower the melting point. Such solders are known as fusible alloys. A recently developed use for fusible alloys is in the manufacture of plastic components with complex internal structures for use in the automotive and aerospace industries. These components are made using a casting of tin-bismuth or tin-lead-antimony alloy which can then be melted away without damaging the delicate internal configuration of the plastic part.

Tinplate is the second most important use and accounts for about 28% of Western World tin metal consumption. Tinplate use in the canning industry has been under severe competitive pressures from aluminum, except for large containers where, due to rigidity problems with aluminum, tin-plated steel is still preferred. In June, British Steel Corp. introduced a new steel top for steel beverage cans which traditionally have used an aluminum top to facilitate opening the can.

Initiatives to reduce the weight of steel cans have been ongoing for several years. Weirton Steel Corporation and its joint-venture partners, Usinor Sacilor SA and Nippon Steel Corporation, have developed a tinplate using light-gauge, high-tensile steel which, they hope, will enable can-makers to produce a beverage can 20% lighter than existing steel cans.

Tinplate competition also comes from non-tin-coated steel, polymer-coated steel, and tin-free steel (TFS). TFS is steel plate which is electrolytically coated with a thin layer of metallic chrome and chrome oxide.

The American Society for Testing and Materials announced in June a modification to the existing Standard Specification for Pig Tin. In addition to the existing Grade A specification which contains a maximum 0.050% lead, a new level of tin purity with a maximum lead content of 0.020% lead, known as "Grade A Tin for the Manufacture of Tinplate," has been created.

Tin consumption for tinplating is expected to undergo further erosion in the near future due to substitution, principally by aluminum. Although more efficient recycling programs for tinplated steel cans are being developed, thinner tin coatings will be necessary to keep tinplated steel cost-competitive with aluminum.

The fastest growing use for tin has been in chemical applications where consumption has risen steadily in the past few decades. Tin is used in an array of inorganic and organic chemicals, for application as plastic (polyvinyl chloride) stabilizers, in agricultural pesticides, in anti-fouling paints for ships, and in biocidal compounds for the protection of materials such as paints, textiles and building materials.

Recent research has shown the effectiveness of tin-based compounds as flame and smoke inhibitors. As fire retardants, these compounds are non-toxic, safe and easy to handle, and have a wide range of applications. Two such compounds, zinc hydroxystannate and zinc stannate, are being marketed worldwide for use as fire retardants and smoke inhibitors for polymeric materials.

Tin is also used for tinning (which includes electronic uses, hot dipping and electroplating in the electronics industry), in the manufacture of pewterware, and in bronze, brass and other tin-containing alloys. Tin-containing alloys are used in construction, machinery and equipment, and consumer durables. Tin-zinc alloys are known for their corrosion resistance. A recently developed and commercialized tin-nickel alloy electroplating process has led to coatings that are characterized by their hardness, good lubricating qualities and attractive appearance. The requirement for environmentally safe plating systems and finishes has, as with most other applications of tin, resulted in increased research into developing and promoting tin-based products as non-toxic materials.

The use of tin capsules for sealing wines represents a promising new market for tin. Recent bans on the use of tin-lead capsules for sealing wines has led to the successful introduction of tin capsules in wine bottling. Tin is ideal for this purpose because it is non-toxic, is easily adapted to existing capping technology, forms an attractive, high-quality product, and can be easily and safely opened. The International Tin Research Institute, in collaboration with capsule-makers in Europe, has developed a tin capsule which is now being commercially produced. The market for this application could potentially consume 4000 t/y of tin.

World tin consumption is estimated at 200 000 t in 1993 compared to 207 000 t in 1992.

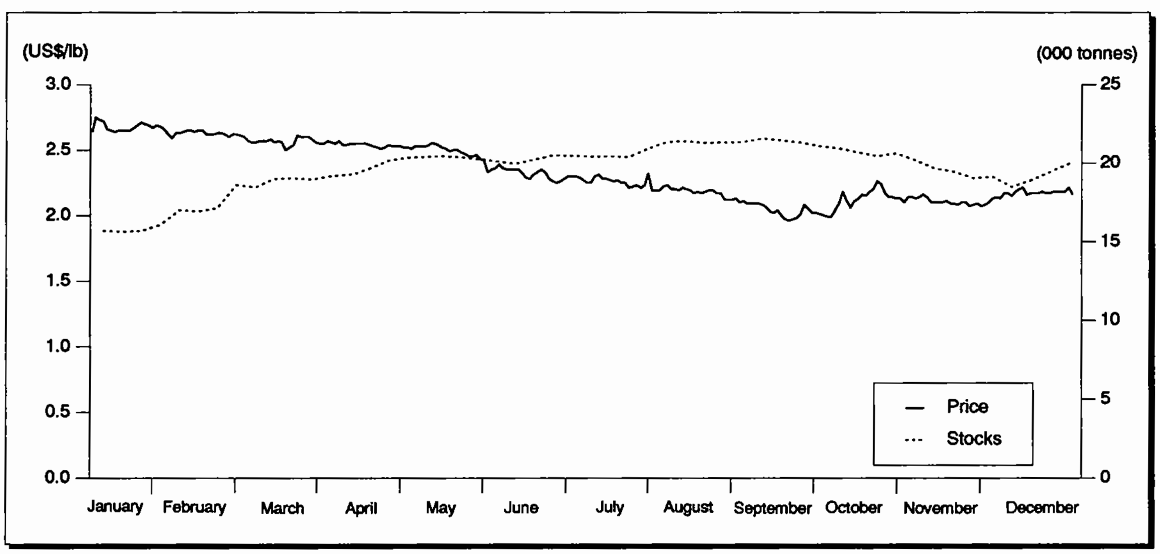
PRICES AND STOCKS

The gradual decline in tin prices seen in the last half of 1992 continued throughout the first nine months of 1993. The price of tin on the LME was US$2.64/lb at the beginning of 1993 and reached its high for the year of $2.75/lb on January 5. Continued poor demand, high stocks, and increasing exports from China and from non-traditional exporters Vietnam and Russia, were responsible for the decline. Tin reached a 20-year low of $1.96/lb on September 20.

Prices rose slightly in October before the meeting of the ATPC on speculation that China would join the group and that the ATPC's supply rationalization scheme would be extended for another year. However, with little change in the poor market conditions, prices again declined slightly in November. The price of tin was $2.16/lb at year-end and averaged $2.34/lb for the year.

According to figures from the United Nations Conference on Trade and Development, total world tin stocks stood at 31 500 t at the end of 1992, including 15 400 t on the LME. With increased exports from China, Vietnam and Russia during the year and continued sales from the U.S. Defense Logistics Agency, LME stocks increased to 20 000 t and total stocks increased to an estimated 38 000 t by the end of 1993.

Figure 1
LME Tin Prices and Stocks, 1993
LME Settlement Prices



Source: Reuters.

OUTLOOK

Demand for tin is predicted to increase modestly in 1994. Consumption of tin for tinplate will likely continue to fall as this end use is affected by further substitution in the packaging sector. This loss will likely be more than offset by a greater use of tin in solders and chemicals due to increasing environmental concerns, and by an improving economy late in 1994.

Further mine closures are predicted in 1994 due to continuing low tin prices. The resultant shortage of concentrates will likely continue to force many Western World smelters to operate at levels well below capacity. Thus, Western World tin metal production in 1994 is predicted to decline from the 1993 level.

Should China be able to restrict tin exports to the level it has agreed to under its 1994 ATPC quota, a modest reduction in world tin stocks may occur. However, overall stocks are likely to remain well above the 20 000 t which the ATPC deems normal. Tin prices are predicted to average US$2.40/lb for 1994.

Note: Information in this review was current as of January 15, 1994.

TARIFFS

Item No.	Description	Canada MFN	Canada GPT	Canada USA	United States Canada	EEC MFN	Japan[1] MFN
2609.00	Tin ores and concentrates	Free	Free	Free	Free	Free	Free
7204.30	Waste and scrap of tinned iron or steel	Free	Free	Free	Free	Free	Free
8001.10	Tin, not alloyed	Free	Free	Free	Free	Free	Free
8001.20	Tin alloys						
8001.20.10	Tin-antimony alloys	Free	Free	Free	Free	Free	3.2%
8001.20.20	Tin-lead-antimony alloys	6.8%	Free	Free	Free	Free	3.2%
8001.20.90	Other	10.2%	6.5%	Free	Free	Free	3.2%
8002.00	Tin waste and scrap	Free	Free	Free	Free	Free	Free
8003.00	Tin bars, rods, profiles and wire						
8003.00.10	Bars and rods, not alloyed or of tin-antimony alloys	Free	Free	Free	Free	3.2%	3.7%
8003.00.10.10	Not alloyed	Free	Free	Free	Free	3.2%	3.7%
8003.00.30	Bars and rods, of phosphor-tin alloys	5.5%	3.5%	Free	Free	3.2%	3.7%
8003.00.50	Bars and rods, of other alloys; profiles; other wire	10.2%	6.5%	Free	Free	3.2%	3.7%
8004.00	Tin plates, sheets and strip, of a thickness exceeding 0.2 mm						
8004.00.10	Of tin-lead-antimony alloys	6.8%	Free	Free	Free	2.5%	3.7%
8004.00.20	Of phosphor-tin alloys	5.5%	3.5%	Free	Free	2.5%	3.7%
8004.00.90	Other	10.2%	6.5%	Free	Free	2.5%	3.7%
8004.00.90.10	Not alloyed	10.2%	6.5%	Free	Free	2.5%	3.7%
8004.00.90.20	Of tin-antimony alloys	10.2%	6.5%	Free	Free	2.5%	3.7%
8004.00.90.90	Other	10.2%	6.5%	Free	Free	2.5%	3.7%
8005.20	Powders and flakes						
8005.20.10	Powders, not alloyed	4%	Free	Free	Free	2.9%	4.9%
8005.20.20	Alloyed powders, flakes	10.2%	6.5%	Free	Free	2.9%	4.9%
8006.00	Tin tubes, pipes and tube or pipe fittings (i.e., couplings, elbows, sleeves)	10.2%	6.5%	Free	Free	4.5%	4.9%
8007.00	Other articles of tin	10.2%	6.5%	4%	1.2%-1.6%	5.3%	5.8%
8007.00.00.10	Anodes for electroplating	10.2%	6.5%	4%	1.2%-1.6%	5.3%	5.8%

Sources: Customs Tariffs, effective January 1994, Revenue Canada, Customs and Excise; Harmonized Tariff Schedule of the United States, 1994; The International Customs Journal, European Economic Community, 1992-93, No. 14, "Conventional" column; Custom Tariff Schedules of Japan, 1993.
[1] GATT rate is shown; lower tariff rates may apply circumstantially.
Note: Where there is a tariff "range," a complete match of the HS code was not available; therefore, the high and low for the product in question is shown.

TABLE 1. CANADA, TIN PRODUCTION AND TRADE, 1992 AND 1993, AND CONSUMPTION, 1991 AND 1992

Item No.		1992		1993p	
		(tonnes)	($000)	(tonnes)	($000)
PRODUCTION					
	Tin content of tin concentrates and lead-tin alloys	58	432	–	–
EXPORTS				**(Jan.-Sept)**	
2609.00	Tin ores and concentrates				
	Malaysia	401	2 654	–	–
	Total	401	2 654	–	–
7204.30	Waste and scrap of tinned iron or steel				
	United States	4 664	1 144	5 047	860
	Other countries	23	20	348	265
	Total	4 687	1 164	5 395	1 125
8001.10	Tin, not alloyed, unwrought				
	United States	48	353	78	601
	Other countries	...	2	...	...
	Total	48	355	78	601
8001.20	Tin alloys, unwrought				
	United States	377	2 633	400	2 737
	Other countries	–	–	...	...
	Total	377	2 633	400	2 737
8002.00	Tin waste and scrap				
	United States	276	493	554	261
	Other countries	209	126	–	–
	Total	485	619	554	261
8003.00	Tin bars, rods, profiles and wire				
	United States	287	1 615	220	1 323
	Total	287	1 615	220	1 323
8004.00	Tin plates, sheets and strip, of a thickness exceeding 0.2 mm				
	Hong Kong	–	–	54	152
	United States	16	26	17	45
	Bangladesh	59	38	–	–
	Total	75	65	71	197
8005.20	Tin powders and flakes				
	South Korea	1	29	3	94
	Other countries	1	9	1	25
	Total	2	38	4	119
8007.00	Tin articles n.e.s.				
	United States	..	3 167	..	2 853
	Other countries	..	1 285	..	1 371
	Total	..	4 452	..	4 224

TABLE 1 (cont'd)

Item No.		1992		Jan.-Sept. 1993p	
		(tonnes)	($000)	(tonnes)	($000)
IMPORTS					
2609.00	Tin ores and concentrates	. . .	2	. . .	. . .
7204.30	Waste and scrap of tinned iron or steel	5 034	472	1 989	423
8001.10	Tin, not alloyed, unwrought	3 195	23 753	2 927	21 384
8001.20.10	Tin-antimony alloys	128	949	27	242
8001.20.20	Tin-lead-antimony alloys	88	441	382	2 124
8001.20.90	Other tin alloys	192	1 619	256	2 272
8003.00.10.10	Tin bars and rods, not alloyed	3	25	2	13
8003.00.50	Tin bars and rods, of other alloys; profiles; other wire	28	260	19	209
8004.00	Tin plates, sheets and strip, of a thickness exceeding 0.2 mm	23	260	10	146
8005.20.10	Tin powders, not alloyed	4	42	4	39
8005.20.20	Tin alloyed powders, flakes	11	187	12	190
8006.00	Tin tubes, pipes and tube or pipe fittings	10	112	9	96
8007.00.00.10	Other articles of tin, anodes for electro-plating	6	60	5	47

		1991	1992p
		(tonnes)	
CONSUMPTION[1]			
	Tinplate and tinning	1 297	1 294
	Solder	1 594r	1 498
	Babbit	97	101
	Bronze	69	45
	Other uses (including collapsible containers, foil, etc.)	121r	105
	Total	3 178r	3 042

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available or not applicable; . . . Amount too small to be expressed; n.e.s. Not elsewhere specified;
p Preliminary; r Revised.
1 Available data as reported by consumers.
Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, TIN PRODUCTION, TRADE[1] AND CONSUMPTION, 1975, 1980, AND 1985-93

	Production[2]	Exports[3]	Imports[4]	Consumption[5]
		(tonnes)		
1975	319	1 052	4 487	4 315
1980	243	883	4 527	4 517
1985	119	358	3 696	3 511
1986	2 356	3 727	3 925	3 270
1987	3 388	2 778	3 792	3 780
1988	3 787	3 591	4 008	3 489
1989	3 479	2 790	3 862	3 567
1990	3 844	2 828	3 624	3 600
1991	4 392	3 716	3 176	3 178r
1992	58	401	3 195	3 042
1993p	–	–a	2 927a	. .

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available; p Preliminary; r Revised.
a Exports and imports are January-September figures.
1 Beginning in 1988, exports and imports are based on the new Harmonized System and may not be in complete accordance with previous method of reporting. 2 Tin content of tin concentrates shipped plus tin content in lead-tin alloys produced. 3 Tin in ores and concentrates (HS class 2609.00). 4 Tin metal (HS class 8001.10).
5 Available data as reported by consumers; current coverage exceeds 90% whereas, until 1972, coverage was in the order of 80%-85%.

TABLE 3. WORLD TIN PRODUCTION, CONSUMPTION AND PRICES, 1985-93

	Production			Prices[2]	
	Tin in Concentrates	Metal[1]	Consumption	LME[3]	N.Y. Dealer
		(000 t)		(US$/lb)	
1985	197	213	216	5.57	5.25
1986	188	201	229	2.87	2.94
1987	186	203	229	3.10	3.15
1988	205	260	237	3.25	3.31
1989	225	262	237	3.93	3.97
1990	209	235	234	2.82	2.88
1991	181	201	218	2.54	2.59
1992	173	188	207	2.77	2.83
1993	. .	. .	. .	2.34	2.39

Source: World Nonferrous Metal Statistics.
. . Not available.
1 From primary and secondary material. 2 "Metals Week." 3 London Metal Exchange. For 1987, 1988 and part of 1989, the "Europe Free Market" in-warehouse Rotterdam prices were used to calculate averages.

TABLE 4. WORLD CONSUMPTION[1] OF TIN METAL, 1988-92

	1988	1989	1990	1991	1992p
			(tonnes)		
WESTERN WORLD					
United States	38 100	37 200	37 000	37 100	33 600
Japan	32 200	33 500	33 800	34 800	31 000
Germany	19 400	18 600	19 300	20 300	20 400
United Kingdom	10 200	10 200	10 400	10 200	10 400
France	7 800	8 100	8 300	8 200	8 300
South Korea	5 000	5 500	7 800	8 400	8 000
Brazil	9 000	9 000	6 100	. .	6 500
Taiwan	3 000	3 900	4 800	6 200	5 900
Italy	6 000	5 900	6 100	5 200	5 500
Hong Kong	3 000	2 500	5 500	5 200	5 000
Malaysia	2 500	2 500	3 100	3 800	4 600
Spain	3 400	3 500	3 500	3 800	4 300
Other	39 900	41 200	39 700	36 900	27 700
Total, Western World	179 500	181 600	185 400	180 100	171 200
EASTERN COUNTRIES					
Former Soviet Union	28 000	24 000	20 000	17 000	15 500
China, People's Republic of	14 000	18 000	18 000	17 000	12 800
Other	15 300	13 300	10 700	3 900	7 500
Total, Eastern countries	57 300	55 300	48 700	37 900	35 800
Total, world	236 800	236 900	234 100	218 000	207 000

Source: World Nonferrous Metal Statistics.
. . not available; p Preliminary.
1 Tin refined from primary and secondary sources.

TABLE 5. WORLD PRODUCTION[1] OF TIN IN CONCENTRATES, 1988-92

	1988	1989	1990	1991	1992p
			(tonnes)		
WESTERN WORLD					
Indonesia	30 600	31 600	30 200	30 100	29 400
Brazil	44 000	50 200	39 100	30 500	28 500
Bolivia	10 500	15 800	17 300	16 800	16 500
Malaysia	28 900	32 000	28 500	20 700	14 300
Peru	4 200	5 100	4 800	6 600	10 200
Thailand	14 000	14 700	14 600	10 900	8 400
Australia	7 000	7 800	7 400	5 400	6 600
Portugal	–	–	1 300	3 100	3 000
Other	15 500	16 000	13 700	10 200	4 900
Total, Western World	154 700	173 200	156 900	134 300	121 800
EASTERN COUNTRIES					
China, People's Republic of	30 000	33 000	35 800	33 700	38 700
Former Soviet Union	15 000	14 000	13 000	12 000	12 000
Other	5 000	5 000	3 200	1 100	900
Total, Eastern countries	50 000	52 000	52 000	46 800	51 600
Total, world	204 700	225 200	208 900	181 100	173 400

Source: World Nonferrous Metal Statistics.
– Nil; p Preliminary.
1 Recoverable tin content of ores and concentrates produced.

TABLE 6. WORLD PRODUCTION[1] OF TIN METAL, 1988-92

	1988	1989	1990	1991	1992p
			(tonnes)		
WESTERN WORLD					
Malaysia	47 400	51 900	49 000	42 700	45 600
Brazil	42 700	44 200	37 000	29 500	28 500
Indonesia	28 400	30 400	30 400	30 400	28 200
Bolivia	5 500	9 700	13 400	14 700	14 400
Thailand	13 400	13 700	15 400	11 000	10 900
Spain	800	2 000	1 300	1 700	2 400
Mexico	3 100	4 800	5 000	2 300	2 000
United Kingdom	16 800	10 800	12 000	5 200	. .
Other	58 300	46 300	19 400	13 400	5 500
Total, Western World	216 400	213 800	182 900	150 900	137 500
EASTERN COUNTRIES					
China, People's Republic of	24 000	30 500	35 800	36 000	37 700
Former Soviet Union	16 000	14 000	13 000	13 000	13 000
Other	3 600	3 300	3 700	600	100
Total, Eastern countries	43 600	47 800	52 500	49 600	50 800
Total, world	260 000	261 600	235 400	200 500	188 300

Source: World Nonferrous Metal Statistics.
. . Not available; p Preliminary.
[1] Tin refined from primary and secondary sources.

TABLE 7. MONTHLY AVERAGE TIN PRICES, 1992 AND 1993

	N.Y. Dealer		London Metal Exchange	
	1992	1993	1992	1993
		(US$/lb)		
January	2.54	2.72	2.49	2.68
February	2.59	2.67	2.55	2.63
March	2.62	2.62	2.56	2.57
April	2.71	2.59	2.65	2.54
May	2.85	2.55	2.78	2.50
June	3.08	2.37	3.01	2.32
July	3.23	2.30	3.18	2.26
August	3.14	2.23	3.08	2.18
September	3.06	2.09	3.02	2.04
October	2.66	2.18	2.73	2.12
November	2.65	2.16	2.60	2.11
December	2.66	2.23	2.62	2.17
Yearly average	2.83	2.39	2.77	2.34

Sources: Metals Week; Reuters.

Uranium

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OVERVIEW

In 1993, uncertainty persisted in the world uranium market, due to overhanging inventories and concerns about the potential impact of the increasing availability of uranium from the former Soviet Union (FSU) on the traditional suppliers of the Western market. In Canada, the environmental assessment and review of several proposed uranium projects in Saskatchewan added to the uncertainty about the future of Canada's uranium industry. However, with the successful advancement of three of the six new uranium mining projects through the environmental review process in Saskatchewan, and the maintenance of its position as the world's leading uranium supplier, Canada seems well placed to compete in the global uranium market in the years ahead.

In Elliot Lake, Ontario, Denison Mines Limited initiated close-out activities following the completion of uranium deliveries to Ontario Hydro in 1992, while Rio Algom Limited maintained production levels to meet its contract commitments to Ontario Hydro, which end in 1996. In Saskatchewan, production levels in 1993 matched those of 1992 at the Key Lake Joint Venture, the Cluff Mining facility, and the Rabbit Lake Joint Venture.

Canada's uranium marketers signed new export contracts in 1993 for the delivery of about 4330 tonnes of uranium (tU). The average price of all 1993 deliveries for export was C$50/kgU, significantly below the 1992 price of C$59/kgU. Less than 1% of all such deliveries in 1993 were spot sales, as has been the case since 1989.

DOMESTIC PRODUCTION AND DEVELOPMENTS

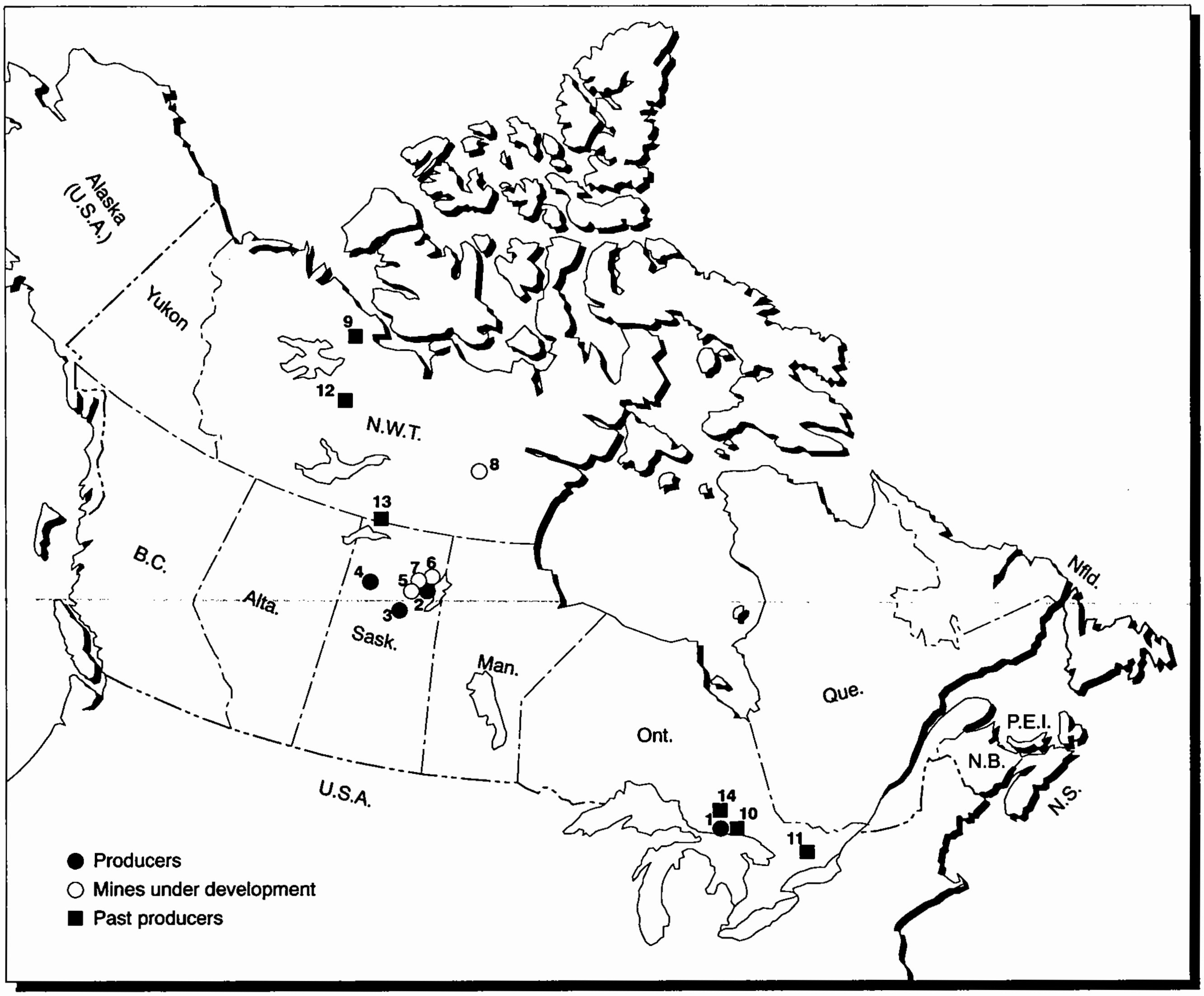
The preliminary estimate of primary Canadian uranium production in 1993 was 9150 tU, close to the 1992 output of 9300 tU but well below Canada's installed production capability, which exceeds 10 000 tU/y. In terms of output value, uranium ranks sixth among Canada's top 10 metal commodities. The preliminary estimate of mine shipments in 1993 under all domestic and export contracts was 9050 tU, valued at C$520 million; final 1992 shipments are reported at 9152 tU, worth $573 million. Following the impact on employment of the Elliot Lake, Ontario, mine closures and workforce reductions, employment in Canada's uranium industry appears to have stabilized at about 1320 workers (as of year-end 1993), although the final approval of new projects in Saskatchewan should increase the level of employment slightly over the next few years.

Table 1 summarizes recent output and employment at Canada's uranium production centres, while Table 2 reports uranium shipments and values from 1988. The difference between annual production and shipments reflects the producers' inventory adjustments. As domestic requirements represent only 15%-20% of current Canadian output, most of Canada's uranium production is available for export. Table 3 lists the main operational characteristics of the existing uranium production centres in Ontario and Saskatchewan as of 1992, the most recent year for which complete data are available. Figure 1 locates Canada's producers and the major uranium deposits, while Figure 2 illustrates the output and ownership share of the domestic uranium production centres during 1992.

Elliot Lake, Ontario

Following the closure of Denison's mine in May 1992, the company has been working closely with the Atomic Energy Control Board (AECB) to develop a site decommissioning plan. In 1992/93, Denison spent in excess of $12 million for site

Figure 1
Uranium Mines in Canada, 1993



Numbers refer to locations on map above.

PRODUCERS

1. Elliot Lake - Stanleigh Operation
2. Rabbit Lake Operation (incl. Eagle Point and Collins Bay)
3. Key Lake Operation
4. Cluff Lake Operation

MINES UNDER DEVELOPMENT

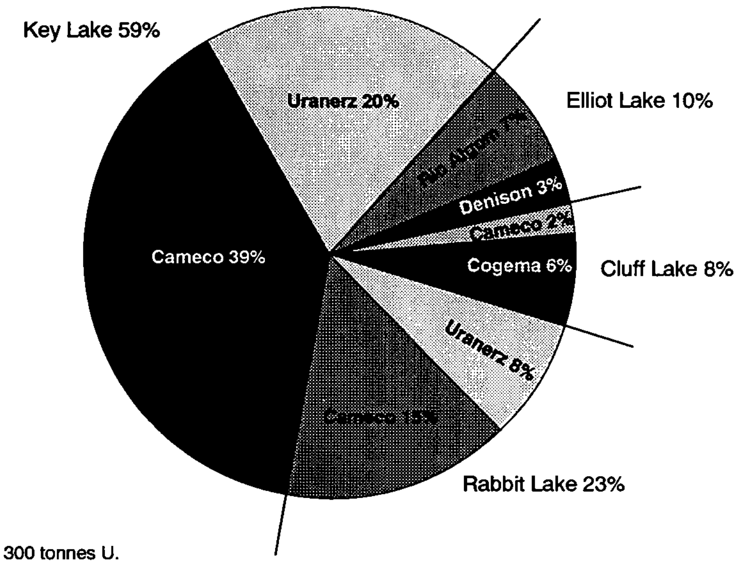
5. McArthur River
6. Midwest/McClean
7. Cigar Lake
8. Kiggavik

PAST PRODUCERS

9. Port Radium
10. Agnew Lake
11. Bancroft
12. Rayrock (Marian River)
13. Beaverlodge
14. Elliot Lake (including Quirke/Panel/Denison)

Source: Uranium Division, Electricity Branch, Natural Resources Canada.

Figure 2
Canadian Uranium Production and Ownership, 1992



1992 Primary Production = 9 300 tonnes U.

Source: Uranium Division, Electricity Branch, Natural Resources Canada.

reclamation and, at year-end 1993, was involved in the public hearings process toward the eventual decommissioning of its uranium tailings site (see below).

Despite having remained in compliance with applicable environmental laws and regulations, Denison was notified on December 22, 1993, that the company, its officers and directors would be served with an Order issued pursuant to the *Environmental Protection Act* of Ontario in relation to its Elliot Lake facilities. Among other things, the Order stipulated that Denison post security of some $100 million on or before December 24, 1993, in cash or by irrevocable letter of credit or in some other acceptable form. The company also received an Order under the *Mining Act* of Ontario to rehabilitate its Elliot Lake facilities and to report. At year-end, Denison was seeking to quash or appeal both Orders.

Rio Algom maintained production levels at its Stanleigh operation under a contract with Ontario Hydro; in 1991, the utility agreed to continue the contract beyond 1993, but only until 1996 as opposed to 2020, as provided in the original contract. Deliveries were increased in 1992 and were to continue at that level until 1995. Under the Ontario Hydro contract, the Stanleigh mine was scheduled to produce about 690 tU in 1993. (See operational data for 1992 in Table 3). Rio Algom is also involved with the AECB in developing a plan for the decommissioning of its various Elliot Lake area tailings sites (see below).

Ontario Hydro/Denison Mines Dispute

The cancellation of Denison's long-term contract by Ontario Hydro precipitated a dispute that centred on whether or not Denison is entitled to consider accelerated depreciation and amortization charges in calculating its costs of production for the period since notice of contract termination was received. Arguing that the $350 million at stake will be needed to fulfil its decommissioning obligations at Elliot Lake, Denison served an arbitration notice regarding calculation of certain prices; Ontario Hydro responded by applying to have the matter resolved in the courts. On June 3, 1992, the Court found that the Agreement had properly provided for the matter to be settled by arbitration and stayed the proceedings.

Both sides claimed the support of "generally accepted accounting principles," but Denison won its choice of forum for resolving those technical details. A three-member panel was formed, comprised of former Chief Justice Brian Dickson of the

Supreme Court of Canada, and James Tory and Kenneth Gunning, to determine certain key prices in accordance with the terms of the Agreement; arbitration hearings began on April 2 and, after a summer recess, concluded on December 10, 1993. The panel was expected to conclude deliberations and make its final decision early in 1994.

Decommissioning Elliot Lake Uranium Tailings

Both Rio Algom and Denison Mines have submitted proposed decommissioning plans to the AECB requesting approval to commence decommissioning their tailings sites in the Elliot Lake area. In October 1992, the AECB decided that these proposals should be referred to the Minister of the Environment for public review by a panel under the Environmental Assessment and Review Process (EARP), with input from the Government of Ontario. During 1993, the Terms of Reference and operating guidelines for an EARP review were proposed and a three-member panel was established; in December, public scoping sessions for the review commenced. The proposals to decommission the Elliot Lake uranium tailings will be the first such proposals reviewed by the EARP process; the review promises to be a major exercise.

Athabasca Basin, Saskatchewan

The Rabbit Lake mill, operated by Cameco Corporation in partnership with Uranerz Exploration and Mining Limited, processed stockpiled ore in 1993 from the now-depleted Collins Bay B deposit, as well as a smaller quantity for test purposes from the adjoining Eagle Point property. Capable of producing 5400 tU/y when nominal capacity is reached later this decade, the Rabbit Lake mill is estimated to have produced about 2300 tU in 1993. At the Eagle Point mine, extensive drilling in 1992 resulted in a sharp reduction in resource estimates, although grades were improved.

With the completion of the environmental assessment and review of the Rabbit Lake expansion (see below), the federal government began finalizing its response to the federal Environmental Review Panel's recommendations. Given a positive response in early 1994, Cameco could begin treating stockpiled pre-production ore from the Eagle Point mine; when the appropriate supplementary information requested by the Panel is made available to the regulators, mining of the Collins Bay A and D zone deposits would be permitted. These developments would provide the Rabbit Lake mill with additional feed of higher grade and, with the overall mineable reserves available, production levels at the Rabbit Lake operation would be assured well into the next century.

The Key Lake mill, also operated by Cameco in partnership with Uranerz, processed ore in 1993 from the Deilmann open pit, which is being mined out expeditiously for use as a tailings disposal facility later this decade, subject to regulatory approval. Capable of producing in excess of 6000 tU/y, the Key Lake mill is estimated to have produced about 5300 tU during 1993. Mineable reserves will maintain production at Key Lake beyond 1997; when the Key Lake ore is exhausted, the mill is scheduled to begin processing ore from McArthur River, given the necessary environmental and regulatory approvals (see below).

The Cluff Lake mill, owned and operated by Cogema Resources Inc., processed ore from stockpile and underground mining, as there was no open-pit production during 1992 and 1993. With a capability of producing in excess of 900 tU/y, the Cluff Lake mill is estimated to have produced some 860 tU in 1993, with the mill continuing to operate on alternate weeks only. With governments approving in principle the extension of the Dominique-Janine (DJ) development, in agreement with the Joint Panel's recommendations (see below), and subject to licensing by the AECB, Cogema can enlarge its DJ pit southward into Cluff Lake. This would prolong open-pit mining and supplement output from underground operations.

Corporate Restructuring and Privatization

On January 1, 1993, Cogema Canada Ltd. announced an amalgamation with its subsidiary, Amok Ltd., under the Cogema Canada name; the new entity manages the Cluff Mining Partnership and Amok Ltd. ceased to exist. On April 5, Cogema Canada Ltd. restructured the management of its mining activities in Canada and the United States through a process of unification and centralization; Cogema Canada Ltd., a uranium exploration and mining company, was renamed Cogema Resources Inc., the same name applying to a U.S.-based subsidiary of Cogema Inc. The head office of Cogema Resources Inc. is in Saskatoon. As of early 1993, all Cogema entities were wholly owned subsidiaries of Compagnie Générale des Matières Nucléaires (COGEMA) of Paris, France, in turn wholly owned by the Commissariat à l'Énergie Atomique (CEA) (note acquisition in COGEMA by Total below). The Cogema Group of companies is involved in all phases of the nuclear fuel cycle, specializing in products and services from uranium mining through waste management.

In April 1992, Denison and Total Compagnie Minière of France entered into an agreement to permit the complementary development of their respective Midwest and McClean Lake uranium deposits. Denison Mines would acquire a 22.5% joint venture interest in McClean Lake, Total would fund Dension's share of the McClean Lake development, and Total would acquire 70% of Denison's share of the Midwest property. Investment Canada reviewed the acquisition of control of Denison's interest in the Midwest Joint Venture by Total's Canadian subsidiary, Total Minatco Limited, and the transaction was approved on March 19, 1993, with resulting ownership as follows: Total Minatco (70%), Denison (22.5%), and OURD[1] (Canada) Co., Ltd. (7.5%) at the McClean Lake project, and Total Minatco (56%), Denison (19.5%), Uranerz (20%), and OURD (4.5%) at the Midwest project.

On April 28, 1993, COGEMA and Total S.A. agreed to a joint stock exchange whereby Total acquired a 10.8% interest in COGEMA, and COGEMA acquired a 4.3% share in Total S.A. In conjunction with this exchange of stock, the two companies agreed to merge their worldwide uranium interests, whereby all of Total's uranium interests would be transferred to COGEMA, making it the largest uranium producer in the world. Total S.A., a publicly owned and fully integrated petroleum company incorporated in France, held uranium interests in France, Namibia, Australia, Canada and the United States through its wholly owned subsidiary, Total Compagnie Minière; Total's Canadian interests were operated by its Canadian subsidiary, Total Minatco Limited, which was headquartered in Saskatoon.

As a result of the COGEMA/Total agreement, COGEMA acquired the Canadian interests of Total Minatco (i.e., McClean/Midwest noted above). The acquisition was subject to review by Investment Canada and received approval by the responsible Minister on July 19, 1993. As a subsidiary of Cogema Resources Inc., Total Minatco became Minatco Limited; the renamed company will operate the McClean Lake project.

In late 1992, Cameco negotiated the sale of its 20% interest in the Cluff Mining Partnership, as well as its interest in several exploration properties near the Cluff Lake site, to Corona Grande Exploration Corporation, a wholly owned subsidiary of the then Cogema Canada Ltd. The sale was approved under the terms of the uranium non-resident ownership policy on January 29 and announced by Cameco on February 1, 1993. The transaction also assigned to Corona Grande a related uranium sales agreement between Cameco and Cogema.

While the transaction resulted in Cameco recording a one-time, non-cash loss of some $84 million against 1992 net earnings, it negated Cameco's development costs associated with the Cluff Lake expansion.

As Cameco's share of Cluff Lake output was only 3% of its 1992 production total and was essentially committed to Cogema, the equity sale will not affect Cameco's ability to meet its future marketing objectives or production targets. However, Cameco noted that the sale allowed the company to follow a strategy of retaining and pursuing only those investments which meet certain profit-generating criteria and in which Cameco has control.

On May 10, 1993, Cameco announced that Canada Eldor Inc., a corporation wholly owned by Canada Development Investment Corporation, itself wholly owned by the Government of Canada, entered into a firm arrangement with a group of underwriters for a secondary sale of some five million common shares of Cameco to the public for C$20.50 per share. The offering, which received regulatory approval, closed on June 7, 1993; it reduced the federal government's interest in Cameco from 19.2% to 9.6% and increased public ownership from 41.9% to 51.5%. Assuming the exercise of all common share purchase warrants issued by the province in late 1991, Cameco will be held 33.7% by the Government of Saskatchewan by October 1994. Complete privatization of Cameco is expected before 1996.

Saskatchewan Environmental Assessment and Review Panels

In 1991, six proposals for new uranium mining projects in Saskatchewan were referred for public review by an independent panel, pursuant to the federal government's EARP Guidelines Order. A Joint Saskatchewan/Canada Panel was established to review five proposals, namely: the Dominique-Janine (Cluff Lake) Extension, South McMahon Lake (Midwest Joint Venture), McClean Lake Project, Cigar Lake Project, and McArthur River Project. The Joint Panel released operational procedures in December 1991 to assist those wishing to participate in the review process by providing information about how the Panel would conduct its review. A federal-only Panel was appointed to review the sixth proposal, the Eagle Point/Collins Bay A & D Expansion, where conditional approval had already been granted by Saskatchewan authorities.

In October 1992, a proposed Underground Exploration Program (UEP) for the McArthur River project was also referred for review by the Joint Panel; the UEP was required to obtain the needed information to prepare an Environmental Impact Statement (EIS) for the overall McArthur River project. The Panel's report, submitted to Ministers on January 15 and released to the public on January 18, 1993, recommended that the UEP be allowed to proceed subject to certain conditions. First, a surface lease agreement should be negotiated in consultation with the First Nations peoples, so as to reflect the wishes of the majority of those represented, and second, this lease agreement should include a revenue-sharing provision that contains an income protection mechanism for traditional land users.

On July 5, 1993, the Saskatchewan government announced that a five-year Underground Exploration Surface Lease for the project had been negotiated with Cameco, the operator; the lease and associated initiatives responded to the provincial jurisdictional issues raised by the Joint Panel. The federal response to the Panel's recommendations, released August 26, agreed that the UEP was timely and appropriate, and noted that some issues within the AECB's regulatory mandate had already been addressed, while others would be dealt with at an appropriate stage in the AECB's licensing process during latter phases of the project.

On March 22-24, 1993, the Joint Panel commenced public hearings for the first three of the five projects being reviewed, namely Dominique-Janine, Midwest, and McClean. The public hearings covered 20 days, beginning in Regina, moving to six different northern communities, and ending with two separate sessions in Saskatoon on May 20. Government departments prepared formal presentations in support of the three projects at the opening session in Regina, and provided further supporting documentation at the closing sessions in Saskatoon, including specialist comments on the proponents' EISs at the technical sessions.

On October 15, the Joint Panel presented its report on the first three proposals to federal and provincial ministers; the report was released to the public on October 29. The Panel recommended that the Dominique-Janine Extension proceed, subject to conditions; that the Midwest Joint Venture not proceed as currently designed; and that the McClean Lake Project be subject to a five-year delay. The key issues identified were related to the justifications for delaying the McClean Lake project, including the Panel's view that more time was required to demonstrate the tailings management system and for the training and education of northerners. These three projects are either wholly or majority-owned by Cogema Resources.

In making public its response to the Joint Panel's report on December 23, the Government of Canada agreed that Dominique-Janine should proceed, subject to the AECB licensing process. This process will address the conditions recommended by the Joint Panel in the evaluation of the licence application, determine whether a licence should be granted, and attach conditions, as required. Regarding the Midwest Joint Venture, the federal government accepted the Joint Panel's conclusion that there may be potential risks in the project, as it has been presented.

However, in supporting the Panel's conclusion that a phased increase in uranium mining activity would provide the greatest benefit for the people of northern Saskatchewan, the Government of Canada noted that the McClean Lake project is one of six proposed over the next several years, and concluded that the AECB's normal licensing process should be allowed to continue. The AECB process will allow all of the technical issues raised by the Joint Panel to be considered within the context of a licence application, and provide sufficient time to address them before the project comes into operation.

In its response to the Joint Panel's recommendations, the Saskatchewan government granted environmental approval of the Dominique-Janine Extension (DJX) and the McClean Lake project, with conditions, but did not approve the Midwest Joint Venture as described in its EIS. The Saskatchewan government concluded that the impacts on the natural environment related to the DJX and McClean Lake projects could be successfully minimized or mitigated through measures outlined in the proponents' EISs and through conditions attached to project approvals, but that the mitigation measures proposed in the Midwest EIS were not sufficient to adequately address the potential adverse environmental effects involved with the project.

Meanwhile, the recommendations of the federal-only Panel were submitted to ministers on December 2 and released to the public on December 7. The Panel's report, relating to the Eagle Point/Collins Bay A & D Expansion at the Rabbit Lake operation, recommended that full-production underground mining of the Eagle Point orebody be approved, subject to certain conditions, but that approval be withheld for open-pit mining of the Collins Bay A and D orebodies until

SUMMARY, CANADIAN URANIUM MINING PROJECTS, AS OF JANUARY 1, 1994

Project/Operator	Owners Share (%)	Deposit Type/ Discovery Date	Resources (Defined)	Ore Grade and Notes	Mining Method/ Milling Rate	Project Status	Project Notes of Interest
NEW PROJECTS PLANNED FOR PRODUCTION							
Cigar Lake, Sask./ Cigar Lake Mining Corporation	Cameco (48.75), Cogema (36.375), Idemitsu (12.875), KEPCO (2 non-vote)	Unconformity-related/ Cogema 1981	Overall property 148 000 tU, *geological, i.e., in-situ*	7.7% U average at depth of 450 m; grades can exceed 50% U	Underground by "non-entry" methods; mill capacity 4600 tU/y	$500 million project; test mining completed in 1992; EIS being prepared; public hearings in 1994/95	670 km N of Saskatoon; 500-m-deep shaft sunk; freezing of ground required to mine ore; start-up by late 1990s
McClean Lake, Sask./Minatco Limited (*Wolly Project*)	Cogema (70), Denison (22.5), OURD (7.5)	Unconformity-related/ original McClean by CanOxy/Inco 1979-80; Jeb & Sue from 1982 to 1990 by Minatco	Overall property 17 000 tU, *mineable*	2.7% U average overall; open-pit depths from 20 to 145 m; McClean ore underground 2% U at depth of 170 m	75% by open pit at Jeb, Sue A, B & C; underground at McClean; co-entreprise mill capacity 2300 tU/y	$200 million project with Midwest; 1993 public hearings; proceeding subject to AECB approvals	350 km N of La Ronge; plan open-pit mining in 1994 and milling by 1996; mine-life of the co-enterprise = 2010
South McMahon Lake, Sask./Cogema (*Midwest Project*)	Cogema (56), Denison (19.5), Uranerz (20), OURD (4.5)	Unconformity-related/ Esso Minerals 1977 (interests of Bow Valley, Numac Oil & Gas, et al bought out by partners)	Overall property 14 000 tU, *geological, i.e., in-situ*	3.8% U average at depth of 200 m; grades down to 2.5% U can be processed	Underground non-entry vertical panel mining; milling at McClean at 2 300 tU/y capacity	Co-venture with McClean Lake; 1993 public hearings led to rejection of proposal as submitted	710 km N of Saskatoon; 185-m-deep shaft sunk and ore test-mined; operator may resubmit project for approvals
McArthur River, Sask./Cameco Corporation	Cameco (53.991), Uranerz (29.775), Cogema (16.234)	Unconformity-related/ Cameco 1988	Overall property 100 000 tU, *geological, i.e., in-situ*	4.2% U average at depth of 500-570 m; 25 m of ore at 35% U; silicified sandstone/clay alteration missing Ni/As	Underground by "non-entry" methods; milling at Key Lake; capacity 6150 tU/y	$100 million project; UEP allowed to go ahead in 1993; EIS being prepared; public hearings in 1994/95	70 km NE of Key Lake; start-up by 1997; will extend mine-life at Key Lake well beyond 2010
Kiggavik, N.W.T./ Urangesellschaft Canada Limited	Urangesellschaft (79), CEGB Expl'n (20), Daewoo Corp. (1)	Unconformity-related/ Urangesellschaft 1977	Overall property 15 000 tU, *mineable*; tributary resources much larger (incl. Andrew Lake)	0.41% U average overall; depth Centre pit 100 m, Main pit 200 m	Open-pit methods; 1200 t/d mill feed; 1200 tU/y	EIS submitted but reviewed as deficient; completion of EIS delayed	75 km W of Baker Lake; start-up not likely before 2000; >11-year mine-life with tributary ore
EXTENSIONS OR EXPANSIONS TO EXISTING OPERATIONS							
Dominique-Janine Extension (DJX) at Cluff Lake, Sask./ Cluff Mining	Cogema Resources Inc. (100)	Unconformity-related/ "D" pit by Mokta 1969 (depleted 1981); Claude et al by Amok 1970-76 (Claude depleted 1989); D-J & Dominique-Peter by Amok 1980-86	D-J Extension, 5250 tU *mineable*; overall property 16 000 tU *mineable*	0.58% U for DJX; mill-head grade for 1990 was 0.64% U	Open pit for D-J and underground at D-P; maximum mill capacity 1540 tU/y; currently milling at half capacity	$10 million extension; 1993 public hearings; proceeding subject to AECB licensing; mining to commence in 1994	720 km N of Saskatoon; mine-life beyond 2000 with D-J Extension
Eagle Point & Collins Bay at Rabbit Lake, Sask./Cameco Corporation	Cameco (66.67), Uranerz (33.33)	Unconformity-related/Gulf Minerals 1968 for Rabbit Lake (depleted 1984); 1970-79 for Collins Bay ("B" pit depleted 1991); 1980 for Eagle Point	Eagle Point et al, 20 000 tU *mineable &* 13 800 tU *geological/ in-situ;* overall property 37 100 tU (incl. stockpiles)	0.80% U for mineable and 0.89% U for in-situ Eagle Point; 3.45% U for Collins "A&D" and 0.59% U for Collins "B," all mineable	Underground for Eagle Point, open pit for remainder; licensed mill capacity 5400 tU/y currently at half capacity	Test mining at Eagle Point during 1992/93; federal EARP Panel reviewed EIS in 1993; federal response expected early 1994	805 km N of Saskatoon; milling of Eagle Point ore expected in 1994; expansion will extend mine-life beyond 2020

Notes: OURD (Canada) Co., Ltd. is a subsidiary of the Overseas Uranium Resources Development Corporation (OURD) of Japan. Minatco Limited is a wholly owned subsidiary of Cogema Resources Inc. Indemitsu Uranium Exploration Canada Ltd. is a wholly owned subsidiary of Idemitsu Kosan Co., Ltd. of Japan. Korea Electric Power Corporation (KEPCO) is the Republic of Korea's only nuclear-electric utility. CEGB Exploration (Canada) Ltd. is wholly owned by Nuclear Electric PLC of Britain, formerly called the Central Electricity Generating Board (CEGB).

additional technical information on waste rock management and decommissioning is provided by the proponents. Rabbit Lake is two thirds owned by Cameco, the operator, and one third owned by Uranerz. At year-end, the Panel's recommendations were being given careful consideration by the appropriate federal departments and the AECB; a response was expected early in 1994.

Additional Production Possibilities

Beyond the existing production centres, there are several uranium projects, including those noted above, that could be brought on stream over the next several years. The start-up dates of these projects depend upon receiving the necessary approvals, developments in the international uranium market, and economic decisions made by the project owners. See Summary table (opposite) for a status review of proposed projects.

EXPLORATION

In 1993, the Uranium Resource Appraisal Group (URAG) of Natural Resources Canada (NRCan) completed its nineteenth annual assessment of Canada's uranium supply capabilities and an associated survey of uranium exploration activity. The results were reported[2] in the third quarter of the year.

As in recent years, uranium exploration activity in 1992/93 remained concentrated in areas favourable for the occurrence of deposits associated with Proterozoic unconformities, most notably in the Athabasca Basin of northern Saskatchewan. Exploration expenditures of $46 million in 1992 were almost unchanged from 1991 ($44 million), despite continued low spot prices and limited market opportunities. The bulk of current annual exploration expenditures reported by URAG is attributable to the geotechnical test-mining program at Cigar Lake, and the advanced underground exploration work being carried out at McArthur River and Eagle Point, all in northeastern Saskatchewan. In comparison, the Saskatchewan government reported that grassroots uranium exploration in the province reached $10 million in 1993, up from the $8 million recorded in 1992. Exploration and surface development drilling during the 1992/93 field season reached 79 000 m according to the URAG survey, a sharp increase from the 67 000 m reported for 1991/92.

In 1992, the number of companies participating in active exploration projects stood at 21, about the same as in 1991. Overall, some 65 exploration projects remain in good standing. Seven major active operators[3] spent virtually the entire $46 million committed in 1992; in alphabetical order they were: Cameco Corporation, Cigar Lake Mining Corporation, Cogema Canada Ltd. (now Cogema Resources Inc.), PNC Exploration (Canada) Co. Ltd., Total Minatco Ltd. (now Minatco Limited – wholly owned by Cogema), Uranerz Exploration and Mining Limited, and Urangesellschaft Canada Limited.

Table 4 summarizes uranium exploration activity in Canada from 1976 to 1992; it shows that from 1982 to 1989 the number of "million-dollar" projects remained relatively constant, but that since 1990 there has been a decline to pre-1980 levels.

RESOURCES

Uranium supply from Canada in the next decade will come from "known" resources, estimates of which are divided into three major categories: measured, indicated and inferred, that reflect different levels of confidence in the reported quantities. Most of these resources are associated with deposits identified in Figure 1.

Of critical importance to NRCan's annual assessment of domestic uranium supply capabilities is the development of estimates of Canada's known uranium resources, based on the results of an evaluation of company data. As noted above, continued exploration successes in northern Saskatchewan and the Northwest Territories have contributed to increases in Canada's known uranium resources, despite production exceeding 17 000 tU in the 1991/92 period and the continued downward adjustment of resources at Elliot Lake, Ontario, as a result of the closure of the Quirke and Panel mines in mid-1990 and the Denison mine in early 1992.

With the deterioration of the uranium market and the decrease in uranium prices, the latest URAG assessment of Canada's known uranium resources was restricted to those resources recoverable from mineable ore at prices of $150/kgU or less. Table 5 provides a breakdown of the estimates of Canada's known uranium resources as of January 1, 1993, compared with those of the previous year, in which estimates were also made for those resources recoverable from mineable ore at prices of $300/kgU or less.

SUPPLY CAPABILITY

Production capability from Canada's existing operations declined sharply in early 1992 with the closure of the Denison facility in Elliot Lake.

However, with the return to nominal throughput capacity of the Rabbit Lake facility in Saskatchewan, actual production increased from the level of output in 1991. In 1993, uranium production was maintained at about the 1992 level, as producers continued to avoid selling on the spot market and geared their output to their existing contract commitments; therefore, output remained well below production capability, which is in excess of 10 000 tU. At most operations, significantly higher uranium prices will be required to bring production up to full capability.

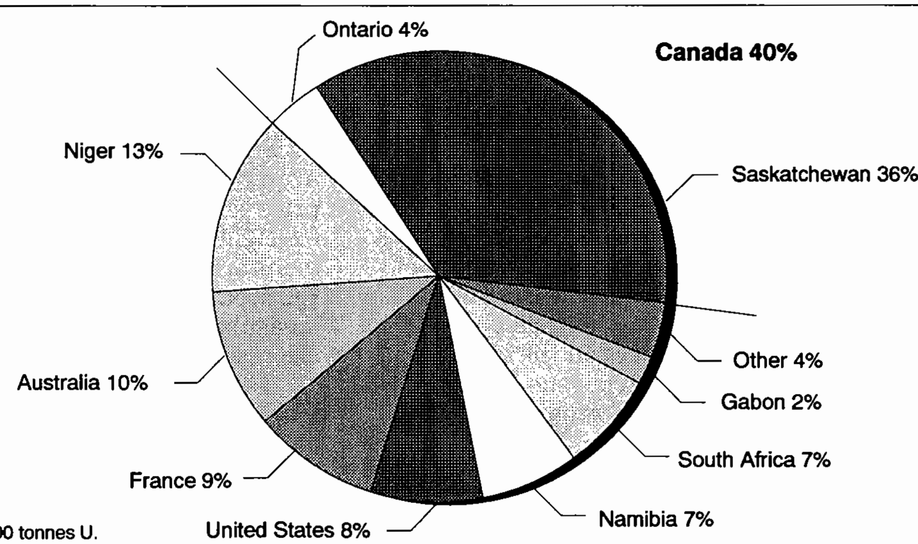
Projections of Canadian short-term uranium availability are based only on existing production centres, and assume a level of production that could be realistically achieved, under current circumstances, supported by known resources recoverable at a price of $100/kgU or less. Firm commitments have not been made to start up any production centres beyond those now in operation. Developments in the international uranium market, and uncertainty regarding the costs associated with certain of the planned projects noted above, make it difficult to project future production capability levels. Table 6 places Canada in a broader context with respect to actual uranium production from 1986 to 1992, inclusive, and Figure 3 illustrates Canada's share of Western World output in 1992 in comparison with other major Western producers.

GOVERNMENT INITIATIVES

The Government of Canada formalized an agreement with the United States on March 5, 1993, whereby Canadian uranium can be exported for use in nuclear reactors on Taiwan for the generation of electricity. Such uranium must be transferred from Canada to the United States for enrichment and fabrication into nuclear fuel elements in the United States prior to re-transfer to Taiwan. These conditions are necessary to ensure that the objectives of Canada's nuclear non-proliferation policy are fulfilled. Canada's "one China" policy does not allow for the conclusion of a government-to-government nuclear cooperation agreement with Taiwan, which is one of the usual prerequisites for nuclear trade. The arrangements that have been put in place by the agreement concluded with the United States satisfy the objectives of Canada's nuclear non-proliferation policy.

Exports of several mineral and metal commodities, including uranium, from the FSU to the West have increased substantially since 1991, causing significant impacts on world markets and a negative impact on world prices. In an undertaking to help Canadian companies facing financial difficulty as a result of the low prices resulting from the increased FSU exports, the federal government launched an interdepartmental task force to

Figure 3
Western World Uranium Production, 1992



Western World production = 23 400 tonnes U.

Note: Total world production approximates 35 000 tonnes U.
Source: Uranium Division, Electricity Branch, Natural Resources Canada.

analyze the implications of FSU exports. The task force completed a background document outlining the impact of FSU exports on four Canadian commodities, namely, aluminum, nickel, potash and uranium, and at year-end a policy paper was being finalized (see Market Overview).

In August 1993, the Australian government released its budget, indicating that, as the uranium market had "improved significantly" since late 1991, it would dispose of "a significant portion of the Commonwealth stockpile" in an orderly manner. This raised concerns that the disposal of more than 1700 tU into an already depressed market could be more disruptive, in light of the FSU situation. However, Australian authorities have stated that the disposal will take place in a manner that causes the least disruption to the uranium market. It is understood that operationally the sale is being conducted by Australian producers, in a staged program, with a sizeable proportion being sold under existing long-term contracts.

In September 1993, sanctions on the import of several strategic South African commodities, including uranium, were lifted. Theoretically, Canadian nuclear utilities are now able to import South African uranium to meet their fuel needs, but it is unlikely that uranium from South Africa will be economically competitive. Of more importance, Canada's conversion facilities, owned by Cameco, will now be able to toll process South African uranium concentrates prior to enrichment outside Canada for use as light water reactor fuel; such opportunities could be significant.

INTERNATIONAL DEVELOPMENTS

Effective April 2, Cameco ceased participating in CRISLA Technologies Inc., a joint venture conducting research work into the enrichment of uranium through the application of laser technology. While the project had yielded some encouraging experimental results, Cameco concluded that continuation of the CRISLA research was not warranted, due primarily to the availability of enriched uranium from the FSU and its impact on the enrichment market. Formed in 1990 to pursue the commercial development of an isotope separation technology called CRISLA (Chemical Reaction by Isotope Selective Laser Activation), the joint venture contemplated several possible commercial applications, including the production of enriched uranium, the preparation of ultra-pure metals for use in a range of high-technology products, the production of pure isotopes for environmental monitoring, and potential applications in the production of high-purity pharmaceuticals.

On September 8, 1993, Cameco and Uranerz announced an agreement with the Kazakh National Joint Stock Company of Atomic Power Engineering and Industry (KATEP), which has exclusive control of the uranium resources of the Republic of Kazakhstan. Under the 10-year agreement, Cameco and Uranerz will share their expertise in the uranium industry with KATEP; invest about US$3 million in Kazakhstan's uranium facilities to improve efficiencies, upgrade safety and protect the environment; and ultimately cooperate in the development of the Republic's substantial uranium resources. In turn, KATEP will market a share of its uncommitted production exclusively through Cameco and Uranerz, acting as independent agents.

Since 1988, the Western uranium industry has been adversely impacted by very active Soviet marketing in the West; it has exacerbated an already depressed uranium market, leading to historic low prices in real terms, many mine closures and cutbacks in production levels, and an increasing concentration of ownership in the international uranium production industry. The disintegration of the Soviet Union at the end of 1991 has led to a fragmentation of the Soviet industry, compounding the problem through increased competition for hard currency.

With domestic requirements probably being met from large civilian inventories, the entire uranium output of the FSU is available for export. The rapid increase in exports into the United States resulted in an anti-dumping investigation being initiated there in 1991, leading to the signing of quantitative restraint agreements with the six producing Republics in October 1992. As long as these "suspension agreements" remain in effect, the anti-dumping investigation is deferred. The agreements specify quota limits on imports of uranium which are tied to the observed market price of uranium in the United States; they extend for eight years, and allow a further two years for monitoring. In the European Community, the Euratom Supply Agency has taken broadly similar measures to restrict the flow of FSU uranium into the market.

However, in December 1993, the United States and the Russian Federation initialled an amendment to the suspension agreements between those two countries that was to have been signed by President Clinton in Moscow in January 1994 and which would become effective during 1994 and 1995. If executed, the amendment would allow a specified quantity of Russian uranium to be imported into the United States provided it is matched on an equal basis with U.S. uranium supplied by a U.S. producer.

Under the terms of the amendment, the price received by the U.S. producer must be at least equal to the final price paid by the U.S. utility consumer, effectively allowing "dumped" Russian uranium to subsidize higher-cost U.S. producers, in competition with Canadian and other international producers. The allowed quantities would be very large in relation to the available market, and would very likely lead to further price suppression. Early in 1994, Kazakhstan and Uzbekistan were already seeking similar concessions.

On January 7, 1994, Canada presented a Diplomatic Note to the United States pointing out that the proposed U.S./Russia amendment would endanger the viability of Canada's uranium production industry and that it would be inconsistent with the obligations of the United States under both the North American Free Trade Agreement (NAFTA) and the General Agreement on Tariffs and Trade (GATT), including the national treatment provisions of those agreements. Canada requested that U.S. authorities address the matter; other uranium-producing countries and several companies and other parties interested in the international uranium business also made formal representations to the U.S. government. As of February 1, 1994, the amendment had not been executed.

A separate agreement between the United States and the Russian Federation calls for highly enriched uranium (HEU) from dismantled Russian nuclear weapons to be blended down to low enriched uranium (LEU) in Russia and then imported into the United States by the United States Enrichment Corporation (USEC). The HEU agreement involves quantities sufficient to supply all global uranium requirements for about three years, although this quantity was estimated to be less than half the Russian HEU stockpile. The United States has given only vague assurances that this uranium will be disposed of in a way that would minimize market impact, leading many to suggest that the HEU would be fed into the market over a fairly long period. In early 1994, it was unclear whether this uranium could be resold immediately or whether it would have to be held in inventory until after the above-noted suspension agreements expire in 2000; the USEC may well be tempted to resell the uranium acquired under the HEU agreement on world markets due to fiscal pressures.

MARKET OVERVIEW

World uranium production remained well below reactor requirements in 1993, and various accumulated inventories continue to find their way into the market. Russia holds the major portion of these, comprised of the combined excess inventories from several Eastern European countries and perhaps those of many FSU Republics as well. The prospect of large additional quantities being made available from the dismantling of FSU nuclear weapons was of increasing concern to traditional suppliers (see HEU agreement above).

Maintaining its position as the world's leading uranium supplier in 1993, Canada's uranium marketers signed new export contracts for the delivery of about 4330 tU, destined to be exported to a broad range of consumer countries among those shown in Table 7; these 1993 sales, representing new business, do not reflect contract amendments and the exercising of quantity-flexibility options under existing contracts.

Table 7 indicates, by country of buyer, the nominal cumulative amount of uranium under Canadian export contracts reviewed and accepted since 1974, and illustrates Canada's diverse export base. As of January 1, 1994, forward commitments under all export contracts exceeded 30 000 tU. The development of several new Saskatchewan orebodies now progressing through the environmental review process should form the basis of continued production well into the next century. Notwithstanding the uncertainty about the future level of exports from the FSU, which continues to cloud the outlook in the near-term market, Canada's uranium producers are very competitive and well placed to meet future demands.

In July 1992, Ontario Hydro requested bids to supply uranium concentrates for its long-term requirements. In February 1993, the utility selected four suppliers of uranium for the period from 1996 to 2002 from among a large number of very competitive bids. Annual deliveries of approximately 600 tU in concentrates over this period represent about 35% of Ontario Hydro's projected requirements. The utility estimates the value of the contracts at about \$220 million, or about C\$20.15/lb U_3O_8, significantly less than Ontario Hydro had been paying to Elliot Lake producers under contracts which will terminate by 1996. Cameco, Cogema and Uranerz will each supply about 150 tU in concentrates annually during that period from mines in northern Saskatchewan. The remaining suppliers will be the joint venture participants in the Olympic Dam project in South Australia, marking the first time that a Canadian utility has purchased uranium from outside Canada.

On September 21, 1993, Ontario Hydro issued a second bid request to supply 50 tU and/or 75 tU annually for the years from 1997 to 2000. As with the first request, only companies that have ownership in ore reserves and established production operations in Canada, the United States, Australia or Namibia will be considered; the other key provisions stipulate that the supplier must provide assurances that its production operation is in compliance with all regulations, including those for environmental protection, and that the proposals submitted offer both a market-related price with a ceiling and a base price with escalation.

URANIUM PRICES

Considering the above-noted uncertainty surrounding the effectiveness of the U.S. suspension agreements with the FSU Republics, the uranium spot market price remained relatively stable in 1993. The NUEXCO[4] Exchange Value *Restricted American Market Penalty (RAMP)* moved between US$9.70 and $10.05/lb U_3O_8, ending the year at US$9.85. In Canada, however, the average price of all deliveries for export made in 1993 fell sharply to C$50/kgU (US$15/lb U_3O_8) from the 1992 average, reflecting the ongoing completion of older, higher-priced export contracts, mainly with Ontario producers. Less than 1% of Canada's deliveries for export in 1993 were made as spot sales, consistent with the situation from 1989 to 1992, compared with a high of 35% in 1987, and the previous level of 1% in 1981. The average price of Canadian deliveries for export from 1974 to 1993 is reported in Table 8. Table 9 shows actual exports of Canadian-origin natural uranium from 1986 to 1992 for Canada's principal export customers; actual exports in 1993 are expected to match those of 1992. The destination of Canadian exports of uranium in concentrates on a cumulative basis (1988-92 inclusive) is illustrated in Figure 4, which highlights the importance of the United States as a customer.

REFINING AND CONVERSION

Cameco operates Canada's only uranium refining and conversion facilities, located at Blind River and Port Hope, Ontario, respectively. At Blind River, uranium concentrates are refined to uranium trioxide (UO_3), an intermediate product, and then trucked to Port Hope. There the UO_3 is converted to either uranium hexafluoride (UF_6), for use in foreign light-water reactors following enrichment outside of Canada, or uranium dioxide (UO_2), for use in CANDU reactors. In response to the continuing weak conversion market, Cameco adjusted its operating schedules and reduced production further in 1992; from the end of 1991 to year-end 1992, the number of employees at Cameco's refining and conversion facilities declined from 319 to 277.

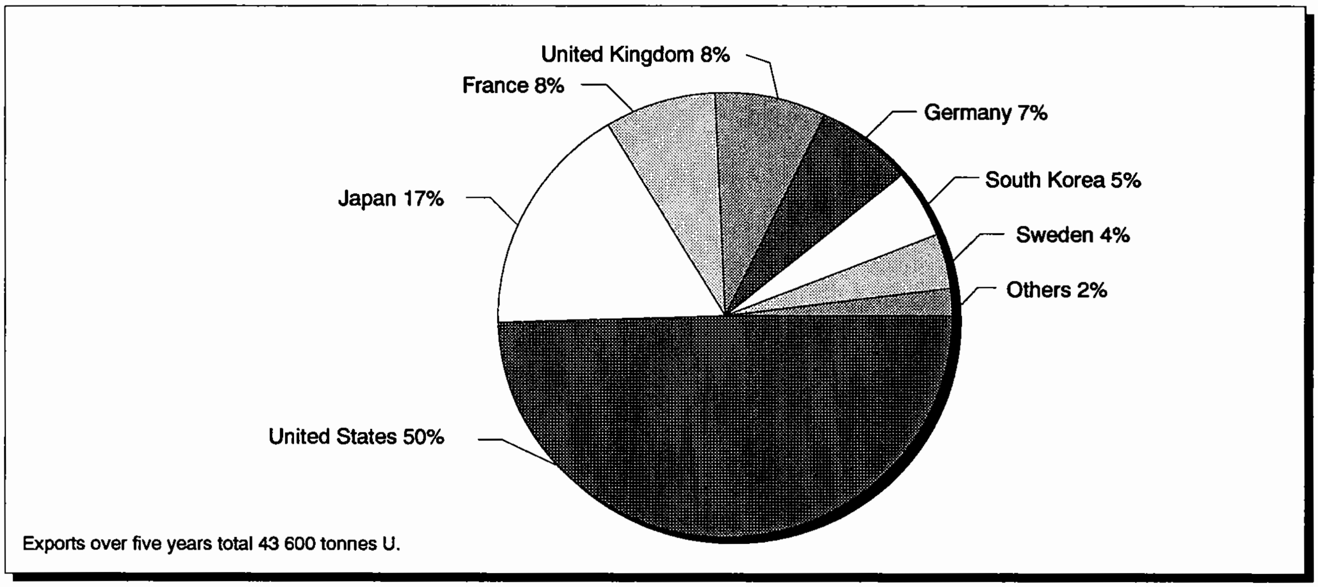
The Blind River refinery, with a nominal annual throughput capacity of some 10 000 tU as UO_3, processes uranium concentrates from several countries. The depressed conversion market, and Cameco's decision to limit production, saw refinery output in 1992 decline to 5914 tU as UO_3 from the 1991 level of 9198 tU as UO_3. The Port Hope facilities, with a capacity of some 10 500 tU as UF_6 and 2500 tU as UO_2, resumed simultaneous operation in 1992 but at reduced levels. While combined 1992 production fell to 5481 tU from 8983 tU in 1991, overall throughput increased 43% in 1993 to 7853 tU as sales volumes of uranium conversion services grew significantly. Cameco has UF_6 conversion contracts totalling some 21 000 tU for the period 1992 through 1996 under long-term agreements, and commitments for the 10 years beyond 1992 totalling 28 400 tU as UF_6.

NUCLEAR POWER DEVELOPMENTS

As in previous years, developments in Canada in 1993 had an important impact on the domestic nuclear program. By the end of 1993, the combined generating capacity of Canada's 22 in-service CANDU reactors approximated 15 350 megawatts electric (MWe) (see Table 10), at which time over 17% of Canada's electric power was nuclear generated; in Ontario, nuclear-generated electricity reached 55%, and in New Brunswick it was 35%.

In March, Ontario Hydro restricted the maximum power level of its four Bruce A and four Bruce B reactors, northwest of Toronto, to 60% and 80% of full power, respectively, due to a safety risk associated with the possibility that the fuel may shift position inside of pressure tubes. A solution to the problem was identified that was expected to lead to restored full-power operation early in 1994. All four of the utility's reactors at Darlington, east of Toronto, were in-service at year-end 1993 and performing well; Unit 4 was declared in-service on June 14.

Figure 4
Canadian Uranium Exports, by Country of Final Destination, 1988-92



Source: Atomic Energy Control Board (AECB), Canada.

On October 13, Unit 7 of Ontario Hydro's Pickering station, also east of Toronto, passed the previous world record of 533 days for continuous power generation by a water-cooled nuclear plant. The CANDU 6 units operating at Point Lepreau (New Brunswick) and Gentilly (Quebec) are also performing particularly well; for several years Point Lepreau, with a lifetime capacity factor exceeding 93%, has ranked among the top three reactors in the world.

In March 1993, Ontario Hydro's Board of Directors announced an extensive cost reduction and reorganization program. The program will see cost reductions ranging from $875 million in 1994 to $1.4 billion in 1996, as well as a $13 billion reduction in debt. A debt-to-equity ratio of 60:40 is targeted instead of the longstanding 80:20 ratio, and there is also a commitment to zero rate increases in real terms for the next 10 years. While the announced program did not include mothballing or decommissioning any operating reactors, the large reserve generating capacity, immediate capital constraints, and debt reduction targets prompted the Board to delay the retubing of Bruce units 1 and 2, previously scheduled to commence in 1997 at a cost of about $1.6 billion. The utility's in-depth review of the economics of retubing these plants showed that, relative to other generating options, retubing would ultimately save its customers close to $2 billion, despite the cost of refurbishment.

On December 2, 1993, Ontario Hydro's Management Committee approved a plan to close one of the two units operating at the Bruce heavy water plant, reducing future annual production of heavy water from more than 600 t/y to some 300 t/y. Shortly after the plan was announced, Atomic Energy of Canada Limited (AECL) won a $270 million contract to supply heavy water to the Korea Electric Power Corporation from plants operated by Ontario Hydro. The closure of one heavy water production unit will not affect the viability of the CANDU program or Canada's ability to supply heavy water for new CANDU reactor orders.

On the international front, three CANDU 6 units are under construction in South Korea at the Wolsong site, and the first of a five-unit CANDU station in Romania is nearing completion and scheduled to go into operation in December 1994. The two CANDU 6 units at Wolsong in Korea and Embalse in Argentina are also performing very well; the Wolsong and Embalse reactors achieved capacity factors of 100% and 99%, respectively, for the period January 1 to September 30, 1993, surpassing the outstanding record 94.5% capacity factor over the same period set by Point Lepreau.

OUTLOOK

Despite the continued uncertainty in the international uranium market, Canada's uranium industry made significant progress in 1993 as several new mining proposals advanced through the environmental review process. Uranium production in Canada approached 9200 tU in 1993, almost matching the 9300 tU produced in 1992. The new uranium mining proposals in Saskatchewan that progressed past the public review stage under the environmental assessment process should form the basis of continued production well into the next century, as the shift in domestic uranium production from Ontario to the world-class, low-cost deposits of Saskatchewan continues.

In the long term, there is significant potential for the discovery of additional uranium resources in Canada, and policies are in place to encourage investment in the industry and to maintain Canada's role as a reliable and very competitive supplier to its trading partners. With a firm baseload of long-term supply contracts with customers in the United States, Western Europe and the Far East, Canada's uranium producers are very well positioned to compete with the world's foremost uranium suppliers. Given adequate market incentives, Canada's uranium industry has the capability to maintain its position as the world's leading supplier of uranium for years to come.

REFERENCES

[1] A subsidiary of Overseas Uranium Resources Development Corporation (OURD) of Japan.

[2] "Annual Assessment of Canada's Uranium Supply Capabilities" – NRCan mailing, September 3, 1993.

[3] In certain cases, the identified operator has reported the total expenditures of a joint-venture effort. Therefore, contributions by other parties not responding to the URAG survey are accounted for in the $46 million total.

[4] NUEXCO, a Colorado-based uranium brokerage firm, originally called the Nuclear Exchange Corporation, publishes a monthly spot-market price, known as the Exchange Value. However, after the suspension agreements ended anti-dumping investigations, NUEXCO established a second spot price, the *Restricted American Market Penalty (RAMP)*, applicable to the United States where most of the spot transactions occur. It is the *RAMP* price that is referred to in the text above.

Note: Information in this review was current as of February 1, 1994.

TABLE 1. URANIUM PRODUCTION IN CANADA AND WORK FORCE SUMMARY, 1991 AND 1992

Province and Producer	Total Work Force[1] (Dec. 31) 1991	1992	Annual Output[2] (tU) 1991	1992
ATHABASCA BASIN, SASKATCHEWAN				
Cluff Mining (Cogema Resources Inc., 100%))	119	115	717	742
Key Lake JV (Cameco, 67%; Uranerz, 33%)	389	392	5 421	5 452
Rabbit Lake JV[3] (Cameco, 67%; Uranerz, 33%)[3]	209	230	745	2 160
Subtotal	717	737	6 883	8 354
ELLIOT LAKE, ONTARIO				
Denison Mines Limited[3]	902	4	757	268
Rio Algom Limited[3]				
Stanleigh	576	569	520	675
Subtotal	1 478	573	1 277	943
Total	2 195	1 310	8 160	9 297

Sources: Company annual reports; Atomic Energy Control Board open files.
1 Figures (rounded) are for company employees only; on-site contractors are not included.
2 Primary output only. In 1992, an additional 40 tU was recovered by the Elliot Lake producers from Cameco's refinery/conversion facility by-products, compared with about 44 tU in 1991. These amounts are NOT included in the Canadian totals of primary uranium production. 3 The Rabbit Lake mill, owned by Cameco Corporation and Uranerz Exploration and Mining Limited, was closed throughout 1990 and restarted in August 1991; the Quirke and Panel operations were permanently closed in August 1990, and the Denison mine was permanently closed in March 1992.

TABLE 2. VALUE[1] OF URANIUM SHIPMENTS[2] BY PROVINCE, 1988-93

	Unit	1988	1989	1990	1991	1992	1993p
Ontario producer shipments	tU	3 872	4 099	4 597	1 288	1 027	ND
Value of shipments	$ millions	446	501	627	271	173	ND
Saskatchewan producer shipments	tU	8 194	6 896	5 123	6 911	8 125	ND
Value of shipments	$ millions	572	412	261	333	400	ND
Total producer shipments	tU	12 066	10 995	9 720	8 199	9 152	9 050
Total value of shipments	$ millions	1 018	913	888	604	573	520

ND: No disclosure provincially, as only one producer in Ontario.
p Preliminary.
1 Value of shipments includes the value of uranium recovered from the refinery/conversion facility by-products, noted in Table 1, which are not included in primary production. 2 Shipments in tonnes of uranium (tU), contained in concentrate, from ore-processing plants.

TABLE 3. OPERATIONAL CHARACTERISTICS OF EXISTING CANADIAN URANIUM PRODUCTION CENTRES, 1992

	Ore-Processing Plant[1]			
	Capacity	Recovery	Annual Throughput	
Company/ Facility Name	Nameplate/ Actual	Overall	Ore Total	Ore Grade
	(t/d)	(%)	(t)	(%)
Cluff Mining/ (Cogema operator) Cluff Lake	+ 900/ 770	98	119 000	0.64
Denison Mines Limited/ Elliot Lake	7 700/ 6 400	94e	235 000	0.08
Rabbit Lake JV (Cameco operator)/ Rabbit Lake	2 500e/ 2 360	96	375 000	0.6
Key Lake JV (Cameco operator)/ Key Lake	+ 800/ 810e	99	263 000	2.1
Rio Algom Limited/ Elliot Lake Stanleigh	+ 4 500/3 200	95	914 000	0.09

Sources: Corporate annual reports; Atomic Energy Control Board open files.
e Estimated.
1 Figures are rounded.

TABLE 4. URANIUM EXPLORATION ACTIVITY IN CANADA, 1976-92

Year	Expenditures[1]	Drilling[2]	Million-Dollar Projects[3]
	($ millions)	(km)	(number)
1976	44	155	4
1978	90	334	7
1980	128	503	24
1982	71	247	13
1984	35	197	12
1986	33	162	11
1987	37	164	12
1988	59	201	11
1989	58	158	11
1990	45	66	6
1991	44	67	4
1992	46	79	4

1 Direct exploration and drilling expenditures in current dollars. 2 Exploration and surface development drilling; excludes development drilling on producing properties. 3 Number of projects where direct exploration and drilling expenditures exceeded $1 million in current dollars.

TABLE 5. ESTIMATES OF CANADA'S URANIUM RESOURCES RECOVERABLE FROM MINEABLE ORE,[1] JANUARY 1, 1992, AND JANUARY 1, 1993

Price Ranges Within Which Mineable Ore is Assessed[2]	Measured		Indicated		Inferred	
	1/1/92	1/1/93	1/1/92	1/1/93	1/1/92	1/1/93
	(000 tU)					
Up to $100/kgU	35	47	240	230	30	31
$100 to $150/kgU	1	1	84	119	60	43
Subtotal	36	48	324	349	90	74
$150 to $300/kgU	0.1	NE[3]	8	NE[3]	0.9	NE[3]
Total	36	. .	332	. .	91	. .

. . Not available.
[1] Actual or expected losses in mining recovery and ore processing have been accounted for; these factors were individually applied to resources tributary to existing or prospective production centres. In underground operations, mineable ore is generally 75% to 85% of the ore-in-place; higher mining recoveries are achievable in open-pit operations. Ore-processing recoveries in Canada normally range from 90% to 97%; Canada's weighted average mill recovery for existing conventional uranium operations was 96% over this two-year period. [2] The Canadian dollar figures reflect the price of a quantity of uranium concentrate containing 1 kg of elemental uranium. The prices were used in determining the cut-off grade at each deposit assessed, taking into account the mining method used and the processing losses expected. The price of $100/kgU was used by URAG to illustrate those resources that were of economic interest to Canada in 1991 and 1992. [3] NE: Not Estimated. The uranium market deterioration and the closure of operations supported mainly by higher-priced resources has meant that assessing resources recoverable at prices greater than $150/kgU is not relevant.
Note: $1/lb U_3O_8 = $2.6/kgU.

TABLE 6. PRODUCTION OF URANIUM IN CONCENTRATES BY MAJOR PRODUCING COUNTRIES, 1986-92

	1986	1987	1988	1989	1990	1991	1992
	(tonnes U)						
Canada[1]	11 720	12 440	12 470	11 350	8 780	8 200	9 340
United States	5 200	5 000	5 190	5 320	3 420	3 060	1 860
South Africa	4 610	3 960	3 850	2 950	2 530	1 710	1 670
Namibia	3 300	3 540	3 600	3 100	3 210	2 450	1 680
Australia	4 150	3 780	3 530	3 660	3 530	3 780	2 330
Niger	3 110	3 000	2 970	2 990	2 830	2 960	2 970
France	3 250	3 380	3 390	3 240	2 830	2 480	2 150
Gabon	900	800	930	850	710	690	540
Other[2]	870	890	910	940	3 800	2 250	1 340
Total[3]	37 110	36 790	36 840	34 400	31 640	27 580	23 880

Sources: *Uranium: Resources, Production and Demand*, a biennial report published jointly by the Nuclear Energy Agency of the OECD and the International Atomic Energy Agency, and miscellaneous corporate, national and international reports.
[1] Canadian figures from 1988 onward include uranium recovered from refinery/conversion facility by-products, and differ from primary production figures shown elsewhere. [2] Includes Argentina, Belgium, Brazil, Germany, India, Israel, Japan, Portugal, Spain and Yugoslavia; for 1990, 1991 and 1992, Pakistan and Hungary are included. [3] Totals are of the listed figures only.
Note: Country figures are rounded to the nearest 10 tU.

TABLE 7. CANADIAN URANIUM UNDER EXPORT CONTRACTS[1]

Country of Buyer[2]	Tonnes U
Argentina[3]	69
Belgium	3 110
Finland	2 942
France	10 230
Germany	14 331
Italy	1 115
Japan	20 716
South Korea	8 042
Spain	4 068
Sweden	9 628
Switzerland	154
United Kingdom	7 039
United States	78 904
Total	160 348

[1] The nominal quantity of uranium in all contracts reviewed and accepted under Canadian uranium export policy since September 5, 1974. Country totals are adjusted to reflect new and amended contracts, and the exercising of quantity-flexibility options, as of December 31, 1993. [2] In most cases, indicates country of end-user. [3] Initially as manufactured fuel bundles for Argentina's CANDU reactor.

TABLE 8. CANADIAN URANIUM EXPORT PRICE,[1] 1974-93

	Average Export Prices		Spot Sale
Year	Current Dollars	Constant 1993 Dollars	Portion of Deliveries
	($kg/U[2])		(%)
1974	39	108	n.r.
1975	52	131	n.r.
1976	104	240	n.r.
1977	110	239	n.r.
1978	125	256	n.r.
1979	130	242	n.r.
1980	135	227	n.r.
1981	110	167	1
1982	113	158	1.5
1983	98	131	10
1984	90	116	26
1985	91	115	20
1986	89	109	21
1987	79	93	35
1988	79	89	13
1989	74	79	<1
1990	71	74	<1
1991	61	62	<2
1992	59	59	<1
1993	50	50	<1

n.r. Not reported.
[1] NRCan's Uranium Resource Appraisal Group (URAG) derives the Export Price figure annually. It is based on the average price under all export contracts made by Canadian producers for deliveries in the given year; prices are rounded.
[2] \$/kgU x 0.38465 = \$/lb U_3O_8.
Note: The constant dollar values are derived using the Implicit Price Index for Gross Domestic Product.

TABLE 9. EXPORTS OF URANIUM OF CANADIAN ORIGIN, 1986-92

Country of Final Destination	1986	1987	1988	1989	1990	1991	1992
	(tonnes of contained uranium[1])						
Argentina	–	–	–	–	–	19	20
Belgium	63	–	153	190	–	–	–
Finland	116	142	151	71	83	–	–
France	1 013	1 438	964	696	799	822	111
Germany	654	1 317	806	615	220	459	534
Indonesia	–	–	–	1	–	–	–
Italy	301	293	–	46	–	–	–
Japan	816	1 317	717	1 729	2 005	399	2 328
Netherlands	85	40	–	–	–	–	–
South Korea	402	828	874	635	339	215	104
Spain	150	150	100	97	–	–	–
Sweden	449	377	783	497	285	91	170
Turkey	2	–	–	–	–	–	–
United Kingdom	700	824	1 204	871	882	498	19
United States	3 692	6 063	4 682	3 950	4 035	5 307	4 032
Total	8 443	12 789	10 434	9 398	8 648	7 810	7 318

Source: Atomic Energy Control Board.
– Nil.
[1] Some of this uranium was first exported to an intermediate country for conversion and/or enrichment prior to transfer to the country of final destination.

TABLE 10. NUCLEAR POWER PLANTS IN CANADA[1]

Reactors	Owners	Net Capacity	In-Service Dates
		(MWe)	
Pickering 1 to 4	Ontario Hydro	2 060	1971-73
Bruce 1 to 4	Ontario Hydro	3 076	1977-79
Point Lepreau	NB Power[2]	635	1983
Gentilly 2	Hydro-Québec	638	1983
Pickering 5 to 8	Ontario Hydro	2 064	1983-86
Bruce 5 to 8	Ontario Hydro	3 348	1984-87
Darlington 1 to 4	Ontario Hydro	3 524	1990-93
Total net capacity (MWe)		15 345	

[1] As of December 1993. [2] The New Brunswick Power Corporation.

Zinc

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Western World zinc consumption reached a record 5 460 000 t in 1993, an increase of 2% over 1992 and similar to 1993 Western World metal production. However, high levels of exports of zinc metal from the former Soviet Union (FSU) and China continued throughout the year. This was reflected in the steady increase in London Metal Exchange (LME) warehouse stocks to a record 907 000 t by year-end. Prices averaged US44¢/lb in 1993 compared to 56¢/lb in 1992.

An increasing scarcity of zinc concentrates occurred toward year-end due to producer cutbacks, particularly in Canada and Australia. According to preliminary figures of the International Lead and Zinc Study Group, Western World zinc mine production totalled 5 125 000 t in 1993, 9% lower than in 1992.

Despite the lower mine production, zinc smelters operated at high rates throughout the year. Zinc metal production in 1993 totalled a record 5 456 000 t, a slight increase from 1992. Smelters benefited from higher treatment charges in the first part of the year due to the zinc concentrate surpluses which had accumulated over the past few years.

Canadian Developments

Canadian zinc mine production totalled 1 007 000 t in 1993, a 25% decrease from that of 1992. The decline was due to the closure of Curragh Inc.'s lead-zinc operations early in the year and production cuts by other Canadian producers in response to low zinc prices and a large world surplus of zinc concentrates. In addition, Westmin Resources Limited experienced a lengthy labour dispute which, by year-end, had not yet been resolved. Despite the reductions, Canada remained the world's largest producer of zinc concentrates, accounting for 20% of Western World supply in 1993.

From December 1992 to early 1994, eight zinc mines closed while no new mines came on stream. The resultant loss in capacity was 315 000 t/y of zinc in concentrate. However, of this amount, only 20 000 t/y was the result of exhaustion of ore reserves. The remainder could be reactivated when zinc prices improve.

Canadian zinc metal production in 1993 was 662 000 t, slightly less than the 1992 total and sufficient for Canada to rank second in the world behind Japan. With the exception of a one-month closure of Cominco's Trail operations in April, and some loss in production at Hudson Bay Mining & Smelting Co., Limited's Flin Flon plant due to conversion to a zinc pressure leach process, Canada's four zinc refineries operated near full capacity throughout the year.

Yukon

Curragh's Faro and Sa Dena Hes lead-zinc mines were placed in receivership in September after the company failed to present an adequate finance and restructuring plan to an Ontario court. The court had placed Curragh under creditor protection on April 1, 1993, on the condition that it present the plan by September 20. The company failed to secure a $29 million loan to complete the stripping of the Grum deposit at Faro and an offer from Korea Zinc Co. Ltd. and Samsung Corporation for 50% of the company for $50 million was rejected by Curragh.

The Sa Dena Hes mine had been closed since December 1992 and the Faro operation ceased milling ore in March. Lost capacity from the two mines totals 250 000 t/y of zinc in concentrate.

On December 16, Cominco and Teck Corporation announced that, with Korea Zinc and Samsung, they had agreed to purchase the Sa Dena Hes mine near Watson Lake and the Stronsay deposit in British Columbia. The re-opening of Sa Dena Hes will depend on an improvement in metal prices.

British Columbia

Cominco closed its Trail metallurgical complex for the month of April. The closure was the result of high world zinc inventories and low prices. The company's Sullivan mine in Kimberley was also closed from June 26 to September 12. Cominco began implementing a package of measures aimed at reducing costs by $50 million/year at Trail. Measures included the layoff of 95 workers in July and a further 190 in November. The company announced that management staff would also be reduced through early retirements.

Treminco Resources Ltd.'s Silvana mine near New Denver closed April 3, coinciding with the Trail closure, and remained shut for the balance of the year due to low metal prices. The mine has a capacity of 1800 t/y of zinc in concentrate.

Westmin Resources closed the Lynx mine at its Myra Falls operations and placed it on a care and maintenance basis due to high smelter treatment charges and low zinc and copper prices. The company planned to increase production at the higher-grade H-W mine to offset the loss in production. However, all operations were closed after a lock-out of unionized workers in late April. The subsequent labour dispute continued throughout the remainder of the year. The company declared force majeure on all its contracts, although management staff carried out limited exploration, development and production at the mine.

Curragh's Stronsay deposit near Mackenzie was placed in receivership in September by its chief creditor, the Bank of Nova Scotia, after the company failed to present an acceptable finance and restructuring plan to the courts. Stronsay had received a Mine Development Certificate in December 1992 from the British Columbia government. Stronsay contains a geological reserve of 52 Mt grading 8% zinc and 2% lead with appreciable silver. Cominco and Teck, which, along with Korea Zinc and Samsung, agreed to purchase Stronsay, have indicated that development will depend on an improvement in lead and zinc prices.

A feasibility study on the Eskay Creek project of Prime Resources Group Inc. was completed showing it to be economically viable. The project is currently in the application phase for a British Columbia Mine Development Certificate. The predominantly gold-silver deposit contains appreciable zinc and copper. Production could start as early as late 1995, producing 5500 t/y of zinc in concentrate. The high-grade ore from the mine will be trucked approximately 560 km to Equity Silver Mines Limited's mill near Houston for processing.

Northwest Territories

Nanisivik Mines Ltd. reduced shipments of zinc concentrate from its Nanisivik mine on northern Baffin Island for the 1993 shipping season due to low zinc prices and high treatment charges. There were no production cuts at the mine. Nanisivik shipped 52 000 t of zinc in concentrate in 1992.

Metall Mining Corporation commenced a feasibility study on its Izok Lake copper-zinc-lead deposit west of Contwoyto Lake in March. The deposit, with geological reserves of 15.6 Mt grading 2.4% copper, 13.8% zinc, 1.4% lead and 75 g/t silver, is amenable to open-pit mining. A major consideration in the development of a mine will be the construction of port facilities at Coppermine on the Arctic coast and an all-weather road connecting the port and mine site. The mine could come on stream in 1996 at a production rate of 120 000 t/y of zinc in concentrate.

San Andreas Resources Corporation continued exploration of its Prairie Creek lead-zinc deposit in the Nahanni River area. The orebody was developed in 1969, and again in the early 1980s when a 1200-t/d mill was constructed on-site. However, due to the collapse of silver prices, the mine never went into production. Current proven reserves are 4 Mt grading 15.6% zinc, 13.7% lead and 192 g/t silver.

Manitoba

Hudson Bay Mining & Smelting Co., Limited (HBMS) completed the zinc pressure leach facility at its Flin Flon smelting complex in July. The plant, which replaces the conventional roasting and leaching circuits in the zinc refinery, reached its full capacity of 95 000 t/y of zinc metal at the end of August. The new Sherritt Gordon zinc pressure leach plant will reduce sulphur dioxide emissions by 25% and particulate emissions by over 50%.

HBMS's Stall Lake mine near Snow Lake was scheduled to close in early 1994 due to exhaustion of reserves. The company's only other Snow Lake mine, at Chisel Lake, was also scheduled to close at this time with the resultant closure of the Snow Lake mill and a capacity loss of 20 000 t/y of zinc in concentrate.

Ontario

Falconbridge Limited intersected ore-grade mineralization in deep drilling at its No. 3 mine at Kidd Creek. The deepest intersection indicates that the orebody extends to at least 1800 feet below the 5600 level, the current limit of proven and probable reserves, and may contain as much as 10 Mt of additional ore. Ore-grade mineralization was also discovered to the south of the main orebody.

Falconbridge also announced in June that it would lay off 250 workers at its Kidd Creek metallurgical complex due to declining metal prices.

Quebec

Les Mines Selbaie closed the underground mine at its Selbaie copper-zinc operation near Joutel at year-end. The company plans to maintain production of 7600 t/d by increasing tonnages from the A-1 zone open pit and two satellite pits. Modifications were made to the concentrator to convert the circuit treating underground ore to process the additional open-pit material. Changes to the ore handling system were also necessary. Personnel reductions were implemented in the transition to a full open-pit operation. Current open-pit reserves are sufficient for at least seven years of production.

Noranda Minerals Inc. closed its Matagami Division from July 18 to August 2 as part of the company's plan to cut overall zinc concentrate production by 70 000 t in 1993 due to worldwide surpluses in concentrate stocks. Meanwhile, on its Bell Allard South property at Matagami, Noranda intersected a new massive sulphide orebody through surface diamond drilling. The zone occurs at depths ranging from 950 to 1200 m below the surface.

Development continued throughout the year on the Louvicourt copper-zinc deposit of Aur Resources Inc., Teck and Novicourt, and is near completion. The $350 million project includes the sinking of a production shaft to 1040 m, an exploration shaft to 745 m, underground development, and 75 000 m of underground diamond drilling. Construction of milling facilities and a tailings area is also in progress. Expected start-up of the mine is in July 1994 with production of 28 000 t/y of zinc in concentrate.

At their Mobrun mine near Rouyn-Noranda, Audrey Resources Inc. and Metall Mining continued exploration and development of the 1100 Lens. Deepening of the shaft by 1200 feet was completed after a fire in the headframe in February caused a two-month delay. Development of an exploration drift on the 4650 level was also completed and 23 000 feet of underground diamond drilling commenced in November. A decision is expected in early 1994 on possible start-up in 1995.

In June, Cambior Inc. acquired 100% interest in the Grevet zinc-copper deposit near Lebel-sur-Quévillon. A $26 million underground exploration program was completed during the year. Commercial production is scheduled to begin in the third quarter of 1995, subject to approval of a feasibility study to be completed in early 1994.

New Brunswick

As part of a 70 000-t/y cut in zinc-in-concentrate production announced by Noranda, the Brunswick mine of Brunswick Mining and Smelting Company Limited near Bathurst closed from July 18 to August 16, 1993. In October, the company announced that it would be reducing its 1140-person workforce by 10% by year-end to ensure the long-term viability of its operations. Also as part of the Noranda production curtailments, the Heath Steele mine was closed on June 28 and remained closed for the remainder of the year. Re-opening will depend on improved metal prices. Heath Steele produced 26 000 t of zinc in concentrate in the first half of 1993.

Brunswick Mining and Smelting announced in September a significant increase in reserves at its Half Mile Lake property, 20 km west of the Heath Steele mine. Based on recent surface diamond drilling, geological reserves at the property now stand at 7.8 Mt grading 3.7% lead, 10.5% zinc, 0.1% copper and 44 g/t silver. The company is conducting metallurgical tests on the deposit in preparation for further studies.

Stratabound Minerals Corp. closed its CNE lead-zinc mine in late 1992 due to low metal prices. The mine intermittently supplied ore to the Heath Steele mill on a custom basis.

World Developments

Western World zinc mine production totalled 5 125 000 t in 1993, down from 5 654 000 t in 1992. Decreases occurred in all major areas of the world as mine closures and cutbacks were initiated due to low metal prices and high inventories of zinc concentrate. The largest reduction was in Canada.

Europe

European mine production of zinc was down 16% from the 1992 level due to the permanent closure of several uneconomic mines during the year. Europe accounted for 13% of Western World production. Fourteen zinc mines closed in Europe with the loss of 245 000 t/y of zinc in concentrate. By contrast, no new zinc mines were opened.

In Spain, Boliden AB closed its Aznalcollar mine in May due to water shortages. The mine remained closed throughout the year and no date for re-opening has been announced. Drought also caused the closure of Portman Golf's Silicatos mine. The third Spanish mine to close was Exploracion Minera Internacional Espana S.A.'s La Troya mine in June. Lost capacity from the three Spanish mines totals 97 000 t/y of zinc in concentrate.

Several mine projects in Spain are in progress or are being considered. Andaluza de Piritas S.A. is developing a second open pit to replace the current pit at its Los Frilas zinc-lead-copper mine. The new open pit will raise capacity by 77 000 t/y of zinc in concentrate to 130 000 t/y. Almagrera S.A. is undertaking an expansion of 5000 t/y of zinc in concentrate at its Sotiel underground zinc-lead-copper mine to raise capacity to 25 000 t/y. Also, Navan Resources Plc has submitted a planning application to develop its Mazarron deposit, which has current mineable reserves of 7.5 Mt grading 2.9% zinc equivalent. Navan believes that it can mine the former underground producer more economically by open pit.

Italian company Ente Nazionale Idrocarburi closed its Monteponi, Masua and Montevecchio mines in Sardinia in February due to low prices. The closures were part of a plan by the Italian government to close all uneconomic mines in the region. Lost capacity from the three closures was 68 000 t/y of zinc in concentrate.

In Sweden, the Lovisa mine was closed due to bankruptcy of its owner, Lovisa Mines AB. The mine opened in 1992. Also in Sweden, the Stora mine of Stora Mines AB was permanently closed. Total capacity of the two mines was 22 000 t/y of zinc in concentrate.

Metaleurop S.A. announced that it would be closing its 20 000-t/y Saint Salvy mine in France by the end of the year due to near-exhaustion of reserves and low metal prices. Other closures in Europe included the 18 000-t/y capacity Bleiberg mine in Austria, the 2400-t/y capacity Horni Benesov mine in the Czech Republic, the 6000-t/y capacity Tverlfjellet mine in Norway, and the 2000-t/y capacity Banska mine in the Slovak Republic.

The Galmoy zinc-lead project in Ireland, owned by ARCON International Resources Plc, received planning permission from the Kilkenny County Council. Exploration continued on the Galmoy deposit, which has proven reserves of 6.2 Mt grading 11.3% zinc and 1.1% lead. Construction of the mine is expected to begin in early 1994 with start-up in the latter half of 1995 and an eventual capacity of 70 000 t/y of zinc in concentrate.

Also in Ireland, Lac Minerals Ltd. made a US$70 million bid for the 52.5% stake of Chevron Minerals Ltd. in the Lisheen zinc-lead project. However, junior partner Ivernia West Plc exercised its pre-emptive rights clause in its joint-venture agreement with Chevron to buy Chevron's stake. Lac Minerals has challenged Ivernia West's right to do so. The Lisheen deposit contains a proven reserve of 22 Mt grading 12.2% zinc, 2.2% lead and 31 g/t silver.

Australia

Australian mine production in 1993 was 3% lower than the 1992 total and represented 19% of Western World production. Pasminco Ltd. closed its North mine at Broken Hill at the end of February due to declining reserves and low lead and zinc prices. At the same time, the company increased production at its South mine resulting in a net loss of only 20 000 t/y of zinc in concentrate.

Development of the US$165 million McArthur River lead-zinc mine in the Northern Territory commenced late in the year. The new mine, owned 70% by MIM Holdings Ltd. and 30% by a Japanese consortium, is expected to start up in 1995 and will, at full capacity, produce a bulk concentrate yielding 160 000 t/y of zinc in concentrate. It is planned to ship a portion of the bulk concentrate to MIM's newly acquired Avonmouth plant in the United Kingdom, which uses the Imperial Smelting Process (ISP). The McArthur River orebody contains proven reserves of 227 Mt grading 9.2% zinc, 4.1% lead and 41 g/t silver.

Several lead-zinc projects in Queensland hold great potential for development. BHP Minerals Ltd. completed a surface diamond drilling program at its Cannington project, which indicated an inferred geological reserve of 47 Mt grading 10.7% lead, 4.6% zinc and 470 g/t silver. The company was to commence a decline in order to carry out underground exploration in preparation for a feasibility study on mining the deposit.

Meanwhile, CRA Ltd. announced that production from the company's Century deposit, originally scheduled for 1995, has been delayed due to metallurgical problems which require further testing. The large Century deposit has geological reserves of 118 Mt grading 10.2% zinc, 1.5% lead and 35 g/t silver. A third promising project is the Dugald River zinc-lead deposit, a joint venture between CRA and Pasminco which is undergoing advanced mining and metallurgical investigations.

United States

Zinc concentrate production decreased by 9% from the 1992 total as several mine closures more than offset improved metallurgical recoveries at Cominco's Red Dog mine in Alaska. U.S. production was 10% of the Western World total in 1993.

In Alaska, Kennecott Corp. closed its 54%-owned Greens Creek zinc-silver-lead mine on April 9 due to low metal prices. Development and engineering work continued at the mine in anticipation of re-opening at a later date when prices improve. Greens Creek has a capacity of 30 000 t/y of zinc in concentrate.

Equinox Resources Ltd. placed its Van Stone mine in Washington on a care and maintenance basis in January to conserve reserves during the current period of low metal prices. Closed in November 1991, the mine was re-opened in August 1992. Capacity at Van Stone is 14 000 t/y of zinc in concentrate.

Asarco Inc. temporarily closed its Young mill and Coy, Immel and Young zinc mines in Tennessee in July and laid off 340 employees. The closures and layoffs were caused by technical problems at the Young mill. The company estimated the resultant loss in production at 13 600 t of zinc in concentrate. Also in Tennessee, Union Minière SA's subsidiary Jersey Minière Zinc Co. cut output at its Jefferson City mine by 25% in July due to low metal prices and declining reserves. The mine has a capacity of 16 000 t/y of zinc in concentrate.

Metallurgical zinc recoveries at Cominco's Red Dog mine increased from 73% to 81% in the first quarter of the year. The company also completed modifications to the grinding circuit to permit higher ore throughput. Red Dog ore has proven to be mineralogically more complex than first anticipated.

Exxon Corp. and Rio Algom Ltd. formed a joint venture to develop the Crandon zinc-copper deposit in Wisconsin. The deposit contains a mineable reserve of 27 Mt grading 9.4% zinc and 0.4% copper. The joint venture has applied for permits to proceed with development of the project, which would have a mine life of about 25 years.

South America

Peruvian mine production increased slightly from 1992 and represented 12% of Western World production. The Peruvian government announced its intention to privatize state-owned mining company Centromin Peru S.A. Centromin owns and operates six zinc mines with a total capacity of 237 000 t/y of zinc in concentrate, as well as the La Oroya zinc smelter. The sale is expected to be initiated early in 1994. A total of 24 mining companies, including several from Canada, have submitted bids.

Three underground zinc-lead mines with a combined capacity of 25 000 t/y of zinc in concentrate closed in Peru early in the year. They were Cia Minera Santa Rita S.A's Anticona y Condenado mine, Cia de Minerales Santander S.A.'s Santander mine, and Soc. Minera Yauli S.A.'s Manuelita mine.

Development of the Iscaycruz zinc mine in Peru has been held up due to differences amongst shareholders concerning the project. Brazil's Cia Paraibuna de Metais holds the largest share in the project at 45%. When in production, the new mine would have a capacity of 55 000 t/y of zinc in concentrate.

Bolivian company Cia Minera del Sur S.A. entered into a joint venture with state mining company Corporacion Minera de Bolivia to re-open and expand the former producing Bolivar tin-zinc-lead mine and construct a new mill at the site. The expanded mine would have a capacity of 35 000 t/y of zinc in concentrate.

Bolivia experienced a net loss of 18 000 t/y in zinc-in-concentrate capacity during the year. Cia Minera Quioma S.A. completed a mill expansion at its Asientos mine to raise capacity by 4000 t/y to 18 000 t/y. However, four mines, with a combined capacity of 22 000 t/y, closed. They were Comibol's Unificada, Colquiri and San Vincente mines and Cia Minera Tiwanacu S.A.'s Monserrat mine and Cantumarca mill.

In Brazil, Cia Mercantil e Industrial Inga installed more efficient flotation technology at its Vazante mine. The new technology increased zinc recovery in the oxide ores from 23% to 45%, resulting in a capacity increase of 33 000 t/y to 78 000 t/y of contained zinc.

Mexico

Minera San Francisco del Oro S.A. de C.V. reached an agreement in February for the closure of its Frisco, Clarines and Mesa mines. The lower-cost Grenadena mine, employing more advanced mining techniques, was to be re-opened. Zinc-in-concentrate production at the San Francisco de Oro operation was reduced to 1260 t/y from 2100 t/y.

Minera Real de Angeles, S.A. de C.V. closed its Real de Angeles silver-zinc-lead mine in April due to the falling price of silver. However, a recovery in silver prices later in the year resulted in the mine re-opening in September at a reduced rate. The mine produced 40 000 t of zinc in concentrate in 1992.

Japan

Dowa Mining Co. Ltd. announced in November that it would be closing three of its copper-zinc-lead mines at the end of March 1994 due to low metal prices and appreciation of the yen. The three mines, Matsumine and Fukazawa in the Akita prefecture and Nurukawa in the Aomori prefecture, have a combined average annual production of 24 000 t/y of zinc in concentrate. Meanwhile, the Metal Mining Agency of Japan announced that it had discovered a deposit of high-grade zinc ore at the Kamioka mine in the Gifu prefecture.

China

Development of the large open-pit Lanping zinc-lead mine in Yunnan province was started, with production expected in 1995. When in full production the new mine would have a capacity of 60 000 t/y of zinc in concentrate. In addition, the Changba zinc-lead mine commenced a 38 000-t/y expansion, scheduled for completion in 1994, which would raise capacity to 55 000 t/y of zinc in concentrate.

Three other mine projects in China progressed during the year. In Shaanxi province, joint-venture partners Asia Minerals Corp. and China National Nonferrous Metals Industry Corp. engaged Cominco Engineering Services Ltd. to undertake a detailed feasibility study on the Qiandongshan zinc-lead deposit. Reserves currently stand at 12.2 Mt grading 7.9% zinc, 1.7% lead and 23 g/t silver. The new mine could potentially start up in late 1996 at a capacity of 24 000 t/y of zinc in concentrate.

Asia Minerals is also examining the possible development of the Ashele copper-zinc deposit in Xinjiang province. Asia Minerals signed an agreement with the Altay regional government and was to complete a pre-feasibility study by November 30. The Ashele deposit contains geological reserves of 24 Mt grading 3.1% copper and 1.0% zinc, and is open down-dip and down-plunge.

The third major project is the state-owned Lijiagou zinc-lead deposit in Gansu province. Studies are currently under way for development of a mine which could produce 44 500 t/y of zinc in concentrate.

India

Hindustan Zinc Ltd. announced that it plans to double production at its Rampura Agucha open-pit zinc-lead mine in Rajastan state. The expansion, designed to replace the import component of smelter feed at the company's three zinc smelters, will raise output to 140 000 t/y of zinc in concentrate. The expansion should be completed by 1996.

Thailand

Padaeng Industry Co. Ltd. announced in September that it had discovered over one million tonnes of additional zinc ore at its Mae Sod mine in Tak province. The mine was scheduled to be exhausted in three years but the discovery will extend mine life by an additional five to eight years. Padaeng Industry mines zinc silicate ore at the Mae Sod mine, producing 78 000 t/y of contained zinc.

Africa

In South Africa, Gold Fields of South Africa Ltd. and Anglo American Corporation of South Africa Ltd. completed a feasibility study for an open-pit mining operation at the Gamsberg zinc-lead deposit. The deposit has proven ore reserves of 100 Mt grading 7% zinc and 0.5% lead. Metallurgical problems exist due to a high manganese content in the ore. No decision has yet been made on development of the mine, which would cost US$473 million.

The Perkoa underground zinc mine project of Boliden in Burkina Faso has been put on hold due to concerns over potential instability in neighbouring countries. Concentrates, which could total 84 000 t/y of zinc content, would have to be shipped through neighbouring countries that are currently demonstrating political instability.

SMELTING

Western World zinc metal production in 1993 totalled 5 456 000 t, slightly higher than the total in 1992. Reductions in Europe, Japan, Australia and Canada were compensated by a return to more normal production levels in Peru and Mexico.

Europe

European zinc metal production in 1993 was 2 161 000 t, a decrease of 2% from 1992. The reduction was primarily due to the temporary closure of a refinery in Germany.

Talks among European zinc producers and the European Commission on the problem of zinc smelter overcapacity in Europe were initiated late in the year. Under a proposed plan to reduce capacity, producers would pay compensation for one or two plants to close, thereby improving market conditions for the others. By year-end, a draft agreement had been discussed but no candidates had been selected for closure. A similar plan was proposed in the mid-1980s but metal prices recovered before the plan could be implemented.

An explosion at Metaleurop's Noyelles Godault zinc smelter in France on July 16 killed seven workers. Zinc production was virtually unaffected. In June the company announced that it would eliminate 100 jobs at the ISP smelter in order to reduce operating costs.

In Germany, Metallgesellschaft AG closed its 200 000-t/y capacity Datteln zinc smelter from mid-April until the end of June. The closure was in order to complete modernization work and resulted in the planned loss of about 30 000 t of refined zinc.

Pasminco sold its Avonmouth zinc smelter in the United Kingdom to MIM Holdings for US$72 million. The 105 000-t/y Avonmouth smelter uses ISP technology and will be capable of treating bulk concentrates from MIM's McArthur River mine when it comes on stream in 1995. Pasminco sold its U.K. assets, which also included a downstream zinc-processing plant, in order to concentrate on its Pacific Rim interests. However, Pasminco retains its 50% interest in the Budelco zinc smelter in the Netherlands. In November, MIM Holdings announced that it planned to reduce the workforce at Avonmouth by 115 people and, at the same time, increase zinc production to 120 000 t/y of refined zinc.

Pasminco and equal partner Billiton B.V. received a licence from the Dutch government to continue storing jarosite residue until 1998 at the site of their 205 000-t/y capacity zinc refinery at Budel, Netherlands. By this time, the partners must have developed a process to treat the residue. This will be a critical factor in the smelter's continued operation beyond 1997. Jarosite is an unstable iron compound formed as a waste in the leach section of the zinc electrolytic process; it also contains small amounts of other heavy metals.

Japan

Japan remained the world's largest producer of refined zinc, accounting for 696 000 t or 13% of the Western World total. Kamioka Mining and Smelting Co. Ltd. completed a new cellhouse in March at its Kamioka smelter in the Gifu prefecture. The new cellhouse will replace an older facility on the same site, maintaining the same capacity of 72 000 t/y of refined zinc. Meanwhile, in the Hyogo prefecture, Sumitomo Metal Mining Co. Ltd. completed an 11 000-t/y expansion at its Harima smelter in April to bring its total capacity to 90 000 t/y of refined zinc.

Toho Zinc Co. Ltd. closed its Annaka smelter from July 18 to August 31 for furnace repairs. The closure was part of its announced plan to cut zinc production by 7500 t in 1993 due to poor demand and low zinc prices.

Pacific Zinc Corp., a partnership of MIM Holdings of Australia and several Japanese mining companies, has placed on hold its plan to build a new 120 000-t/y capacity ISP zinc smelter by mid-1995. The new smelter was to be built on the site of the existing 108 000-t/y Hachinohe zinc smelter. Completion was to coincide with the start-up of MIM's McArthur River zinc-lead mine in Australia which will produce bulk concentrates that must be processed in ISP smelters. Rapid appreciation of the Japanese yen and low lead and zinc prices were given as reasons for the decision to defer the project.

Australia

Pasminco reduced the workforce by 140 at its Port Pirie zinc refinery in South Australia and by 350 at its Risdon zinc refinery in Tasmania in an effort to reduce costs. The company did not expect the cuts to affect production. The announced layoffs at the Risdon refinery precipitated a two-day strike at the plant. The Port Pirie and Risdon electrolytic refineries have capacities of 45 000 and 220 000 t/y of refined zinc, respectively. Pasminco's Cockle Creek ISP smelter in New South Wales closed on August 1 for seven weeks for maintenance and to allow completion of a 10 000-t/y expansion to 90 000 t/y of refined zinc.

Dragon Mining Ltd. purchased 500 000 t of smelter slag from the former Zeehan lead smelter. The slag grades 13% zinc. Dragon Mining plans to use pyrosmelting techniques to recover 50 000 t of zinc metal.

United States

Zinc Corporation of America closed its 54 000-t/y capacity Bartlesville electrolytic zinc refinery in Oklahoma in September. The closure, undertaken for maintenance and environmental retrofit, is expected to last up to one year.

Elkem Technology Ltd. abandoned its US$25 million project to treat electric arc furnace dusts at the Laclede Steel plant in Illinois. The flue dust treatment plant was supposed to process 40 000 t/y of zinc-containing dust to produce 7000 t/y of Prime Western Grade zinc metal. However, the furnace never operated properly.

The U.S. Defense Logistics Agency (DLA) began selling excess zinc from its stockpile in late March. By the end of September (the close of the 1992/93 fiscal year) the agency had sold just over 11 000 t of zinc, well below the 68 000 t authorized in the Annual Materials Plan. The agency was authorized to dispose of just over 45 000 t under the 1993/94 plan. The Market Impact Committee of the DLA has assured zinc producers that it will not dispose of zinc from its stockpile in a manner that would disrupt zinc markets. Zinc prices are currently depressed due to weak world demand and record stocks on the London Metal Exchange. In December, the DLA announced that it would begin selling zinc on a long-term contract basis beginning in mid-1994, in addition to the twice-monthly bid structure now in place.

Peru

Peru's refined metal production was up 29% from 1992, reflecting a return to more normal operating levels after shortages of power due to droughts in 1992. State-owned Minero Peru plans to sell its 102 000-t/y capacity Cajamarquilla zinc refinery to the private sector in early 1994. Also scheduled for privatization in early 1994 is Centromin's 70 000-t/y capacity La Oroya zinc refinery.

Mexico

Met-Mex Penoles S.A. de C.V. laid off 519 workers at its Torreon electrolytic zinc refinery in May. The company planned to maintain full production at the 130 000-t/y capacity facility. Meanwhile, Industrial Minera Mexico S.A. de C.V. continued layoffs at its San Luis Potosi electrolytic zinc refinery. The company has reduced its workforce by 900 over the last year. The San Luis Potosi plant has a capacity of 113 000 t/y of refined zinc.

Other

In China, North West Lead and Zinc Smelter opened its new Baiyin electrolytic zinc refinery in Gansu province. The new plant has a capacity of 100 000 t/y of refined zinc. Metallgesellschaft and Padaeng Industry approved the construction of a 90 000-t/y capacity zinc smelter in Thailand. The US$320 million smelter would start up in 1996. In Zambia, Zambia Consolidated Copper Mines Ltd. closed its ISP zinc smelter and partially replaced it with a modernized leach plant in order to prolong the life of nearby mines. There was no net change in capacity.

In Bolivia, a consortium of zinc producers signed a letter of intent with Minproc Technology of the United States to carry out a pre-feasibility study for a 150 000-t/y capacity zinc smelter. Minproc planned on examining the possibility of using its zinc fuming technology followed by electrowinning to treat Bolivia's traditionally lower-grade concentrates.

The Greenland government granted permission to Platinova A/S to undertake a feasibility study for the establishment of a 150 000-t/y capacity zinc refinery in Nuuk. The government also indicated that it planned to undertake detailed studies for the expansion of hydro-electric capacity to supply the proposed refinery. A final decision on whether or not to proceed with the project is expected in early 1994.

SECONDARY ZINC

Zinc from secondary sources has become increasingly important in recent years. Figures from the International Lead and Zinc Study Group (ILZSG) indicate that the total recovery of zinc from secondary materials in the Western World in 1992 was 1.66 Mt. Secondary zinc includes high-purity refined zinc, remelted zinc of a purity less than 98.5% zinc, and scrap zinc used in the production of zinc alloys.

With increasing use of zinc-galvanized steel in the automobile and construction industries, secondary zinc from electric arc furnace dusts has become a significant source of zinc. These dusts contain various elements in a form that renders the dusts inappropriate for disposal in standard landfill sites. Due to the environmental conditions in a landfill, acid generation could result in the mobilization of some deleterious elements and compounds such as cadmium. Consequently, authorities direct that electric arc furnace dusts are to be put into landfills for hazardous wastes. The decreasing space available at such sites and the associated increases in disposal costs have provided a further incentive for recycling. As vehicles manufactured in the 1980s begin to be recycled, the recovery of zinc from flue dusts should rise.

In recent years, technologies for recycling these zinc-bearing materials have been developed. The

Waelz kiln is the most common method of processing electric arc furnace dusts. Waelz oxides are treated in imperial smelting furnaces for production of refined zinc. The requirement of Waelz kilns to be near their feed source, i.e., steel mill complexes, would suggest that treatment of these dusts will be most important in the United States, Japan and Western Europe. ILZSG figures indicate that these areas currently have a capacity to produce just over 200 000 t/y of zinc from such dusts, or approximately 89% of Western World electric arc furnace dust treatment capacity.

Canada does not currently process electric arc furnace dusts, although the construction of facilities to do so is being considered. Canada's secondary zinc facilities, Federated Genco Ltd. and Purity Zinc Metals Co. Ltd., have a capacity to produce 17 000 t/y of remelted zinc. Materials which are reprocessed by remelting include drosses and skimmings from both the primary refining and galvanizing processes.

The fertilizer and chemical industries also make use of zinc-bearing wastes to create zinc sulphate and chloride compounds. The chemicals are then used in the production of fertilizer micro-nutrients.

CONSUMPTION AND USES

Western World consumption of zinc increased to a record 5 460 000 t in 1993, an increase of 2% from the level in 1992. Demand continued to improve in North America and in most parts of Asia. However, European and Japanese demand fell by 4% and 5% respectively. The German and Japanese economies, which began to weaken in 1992, fell further into recession in 1993.

The use of zinc for galvanizing has grown steadily in recent years and this trend is expected to continue in the future. Galvanizing represented 49% of zinc consumption in 1992. Zinc is used extensively in the automotive and construction industries for corrosion protection and remains the most cost-effective means of protecting steel against corrosion. The galvanization of steel is the fastest growing use of zinc and has grown steadily in recent years at the expense of almost all other end uses. This trend is expected to continue in the future.

Galvanized steel is used in automobile construction to protect steel from corrosion. The brightest prospects for galvanized steel in the automobile industry are currently in Asia. Japanese and other Asian manufacturers are using increasing amounts of galvanized sheet in response to demands for increased corrosion protection. In North America, where galvanized steel is already extensively used in automobile construction, applications of dual-sided galvanized steel have become increasingly important for exposed body surfaces.

Dofasco Inc. and Japanese partners National Steel Corporation and Nippon Kokan KK opened their new 360 000-t/y hot-dipped galvanizing line at Windsor, Ontario, during the year. The plant has the capability to produce dual-sided galvanized steel sheet as well as galvannealed steel. Stelco Inc.'s 320 000-t/y capacity Z-line galvanizing facility in Hamilton also possesses these capabilities. The Z-line facility was awarded the 1993 Project of the Year Award by the Professional Engineers of Ontario and the Hamilton Engineering Institute, in addition to the Chrysler Quality Excellence Award.

Galvanized steel is also used in construction for structural components, roofing, siding and reinforcement bars. Zinc and zinc-aluminum thermally sprayed coatings are utilized for long-term corrosion protection of large steel structures such as bridges and hydro-electric transmission towers. At the end of 1991, the U.S. government passed the *Intermodal Surface Transportation Efficiency Act* authorizing the expenditure of US$108 billion over six years on infrastructure construction and repair in the United States. However, the U.S. Congress has blocked most of the $21 billion allocated to highway spending under the act.

The Japanese government also recently initiated a fiscal stimulus package of US$117 billion to increase spending on infrastructure and housing. The package is one of several fiscal measures expected to initiate consumption growth for galvanized steel in Japan.

A number of zinc alloy coatings have been developed over the years which have more superior qualities than pure zinc in specific applications. These include Galfan (90% zinc, 5% aluminum and the remainder rare earth elements) and Galvalume (55% aluminum, 43.4% zinc and 1.6% silicon), as well as zinc-iron and zinc-nickel alloys. Galfan, for example, exhibits higher formability and paintability than other coatings, and zinc-nickel alloys reduce the reactivity of high-silicon steels.

The manufacture of brass and bronze is the second most important use of zinc, accounting for 1 062 000 t or 19% of consumption in 1992. These alloys are used in plumbing fittings, heating and air conditioning components, and other products. Consumption of brass and bronze is highly dependent upon the performance of the construction industry.

The third most important use of zinc, accounting for 14% of consumption in 1992, is in the die-casting industry for products such as builders' hardware and automobile fittings. The goal of weight reduction in automobiles for increased fuel efficiency has led to a reduction in the use of zinc die-castings. The amount of zinc in automobiles has decreased from an average of 23 kg in the early 1970s to 10 kg in the early 1990s. The development of new alloys and manufacturing techniques like thin-walled die-casting has taken place in recent years to make zinc alloy castings more competitive relative to plastics and other substitute materials.

One promising series of alloys is ACuZinc, which contains 5%-11% copper and 2.8%-4.0% aluminum, with the balance being zinc. These alloys increase the durability and performance or reduce the thickness of automotive die-castings compared to many other zinc alloys.

The balance of zinc consumption is for such items as zinc semi-manufactures, oxides, chemicals and zinc dust. Zinc oxide is an important component in the manufacture of tires and rubber products. Rolled zinc has been a popular roofing material in parts of Europe for many years.

Increased research has been conducted in recent years into the use of zinc in batteries. A zinc-air battery for use in personal computers has recently been developed. This battery uses atmospheric air to generate an electrochemical reaction instead of oxygen like the standard nickel-cadmium battery. The zinc-air battery, which is easily recyclable, is said to last three times longer than the nickel-cadmium battery.

Zinc powder is used in the production of mercury-free alkaline batteries. Zinc Corporation of America and Mitsui Mining & Smelting Co. Ltd. produce high-quality zinc powder at ZCA's Monaca, Pennsylvania, smelting complex for the U.S. battery market.

INTERNATIONAL LEAD AND ZINC STUDY GROUP

The International Lead and Zinc Study Group was formed in 1959 to improve market information and to provide opportunities for regular intergovernmental consultations on lead and zinc markets. Particular attention is given to providing regular and frequent information on supply and demand and on the outlook for lead and zinc.

The Study Group is headquartered in London, England. Its membership includes most major lead- and zinc-producing and consuming countries. While it has an extensive information-gathering and dissemination role, the Group has no market intervention powers. It holds a general session each year in the fall. Member countries' delegations include industry representatives as advisors. Canada has been an active member since its inception.

The 38th Session of the Study Group was held in Berlin, Germany, in October 1993 and was attended by representatives of 28 member countries as well as observers from several nations and organizations. The 1993 session examined statistical trends, current mine and smelter projects, and the economic outlook for lead and zinc. In addition, recent legislative initiatives in the United States on lead and a proposed OECD Council Act on restricting and phasing out a number of uses of lead were discussed. An update on recent developments related to the Basel Convention and its restrictions imposed on the trade of recyclable materials was also given.

PRICES AND STOCKS

Zinc stocks rose throughout the year, with London Metal Exchange (LME) stocks almost doubling from the record level at the end of 1992. The high stocks, continuing weak demand, especially in Germany and Japan, and a lack of reduction in smelter capacity resulted in a deterioration of zinc prices throughout much of the year. The average price on the LME for 1993 was US43.6¢/lb.

Zinc prices began 1993 at US48.1¢/lb and reached a high for the year of 50.3¢/lb on January 29. However, despite an increasing scarcity of zinc concentrates throughout 1993, most smelters continued to produce metal at or near capacity. The closure of the 54 000-t/y capacity Bartlesville refinery in the United States was the only significant loss of capacity and prices declined slowly throughout the first nine months of the year. Zinc reached its low for 1993 of 39.0¢/lb on September 29.

In December, zinc prices edged up slightly in expectation that European zinc producers would announce a plan to permanently close some capacity in 1994. Zinc closed the year at 45.4¢/lb.

Zinc stocks stood at 999 000 t at the end of 1992, including a record 488 000 t on the LME. Record Western World zinc metal production, less-than-expected growth in consumption, and continued high exports from C.I.S. countries and China resulted in increasing stocks throughout 1993. At the end of the year, stocks stood at 1 425 000 t representing almost 14 weeks of consumption. Of this, LME stocks stood at a record 907 000 t.

OUTLOOK

Consumption of zinc is expected to increase modestly in 1994 as demand in the United States continues to improve strongly and the economies of Germany and Japan begin to recover. Western World zinc consumption in 1994 is expected to reach 5 500 000 t, 1% more than the record level in 1993.

Western World mine production in 1994 is expected to be similar to the 1993 total of 5 126 000 t. This will be well below the record of 5 654 000 t in 1992 as cutbacks in zinc mine production, initiated in 1993 due to low metal prices and a surplus of zinc concentrates, remain in place.

Western World zinc metal production in 1994 is predicted to reach about 5 400 000 t, approximately 100 000 t lower than expected consumption. The increasing scarcity of zinc concentrates will likely negatively impact on zinc metal production. This could speed the closure of 150 000-200 000 t of excess zinc smelting capacity in Europe if European producers can come to an agreement on this issue.

Exports from C.I.S. countries and China are predicted to decline in 1994. With the increasing scarcity of zinc concentrates, toll smelting in C.I.S. countries should decline. In addition, the deteriorating state of infrastructure and operating equipment will likely lead to increased production losses at both mines and smelters. Chinese exports are not expected to fully compensate for the reduction.

With an improving economy, lower Western World zinc metal production, and a likely decrease in metal exports from C.I.S. countries and China, zinc metal stocks should begin a gradual decline in the latter part of 1994. This should cause a corresponding rise in zinc prices. The average price for zinc in 1994 is predicted to be US50¢/lb. In the longer term, the price through the year 2000 is expected to average US55¢-70¢/lb in constant 1993 dollars.

Zinc consumption is expected to average almost 2.5% per year through the year 2002. Growth will be strongest in the galvanized steel sector, especially for continuous galvanized sheet. The highest growth rate for galvanized sheet will be in Southeast Asia, with Europe and North America also seeing lesser but steady increases in this sector. Growth in the consumption of zinc for brass is expected to grow by less than 1% while zinc in die-casting will see little growth due to substitution in the automotive industry to further decrease vehicle weight.

In 1994, Canadian mine production is expected to be marginally higher than the total of 1 007 000 t in 1993 and well below totals in the first portion of the decade. Much of the mine capacity idled in 1993 will remain closed until an improvement in zinc prices takes place. Canadian zinc metal production is predicted to be slightly above the 1993 total of 662 000 t due to the relative scarcity of zinc metal supplies in North America, especially with the closure for much of the year of the Bartlesville zinc refinery in the United States.

Mine closures are expected in the Northwest Territories and Ontario in the mid-1990s but will be offset by openings in Quebec, the Yukon and the Northwest Territories. Further closures are expected as the new century begins.

Note: Information in this review was current as of January 14, 1994.

TARIFFS

Item No.	Description	Canada MFN	Canada GPT	Canada USA	United States Canada	EEC MFN	Japan[1] MFN
2603.00	Copper ores and concentrates						
2603.00.00.30	Zinc content	Free	Free	Free	Free	Free	Free
2607.00	Lead ores and concentrates						
2607.00.00.30	Zinc content	Free	Free	Free	0.6¢/kg on lead content	Free	Free
2608.00	Zinc ores and concentrates						
2608.00.00.30	Zinc content	Free	Free	Free	0.6¢/kg on lead content	Free	Free
2616.10	Silver ores and concentrates	Free	Free	Free	Free	Free	Free
2616.10.00.30	Zinc content	Free	Free	Free	Free	Free	Free
26.20	Ash and residues (other than from the manufacture of iron or steel), containing metals or metallic compounds containing mainly zinc						
2620.11	Hard zinc spelter	Free	Free	Free	0.6%	Free	Free
2817.00	Zinc oxide; zinc peroxide	10.5%	Free	4.1%	Free	11%	6.5%
28.33	Sulphates; alums; peroxosulphates (persulphates)						
2833.26	Of zinc	9.2%	6%	Free	Free	9%	5.8%
79.01	Unwrought zinc						
	Zinc, not alloyed:						
7901.11	Containing by weight 99.99% or more of zinc	Free	Free	Free	0.6%	3.5%	8 yen/kg
7901.12	Containing by weight less than 99.99% of zinc	Free	Free	Free	0.6%-7.6%	3.5%	8 yen/kg
7901.20	Zinc alloys:						
7901.20.10	Containing by weight 90% or more but less than 97.5% of zinc	Free	Free	Free	7.6%	3.5%	7.2-7.8 yen/kg
7901.20.20	Containing by weight less than 90% of zinc	17.5%	11.5%	6.9%	7.6%	3.5%	7.2-7.8 yen/kg
7902.00	Zinc waste and scrap	Free	Free	Free	Free	Free	1.9%
79.03	Zinc dust, powders and flakes						
7903.10	Zinc dust	Free	Free	Free	0.2¢/kg	4.4%	5.8%
7903.90	Other:						
7903.90.10	Powders, not alloyed	4%	Free	1.6%	0.2¢/kg	4.4%	5.8%
7903.90.20	Alloyed powders; flakes	10.2%	6.5%	4%	3.8%	4.4%	5.8%
7904.00	Zinc bars, rods, profiles and wires						
7904.00.10	Bars, rods or profiles, containing by weight 90% or more of zinc	Free	Free	Free	1.6%	8%	4.8%
7904.00.21	Bars, rods or profiles; wire, coated or covered	10.2%	6.5%	4%	1.6%	8%	4.8%
7904.00.22	Wire, not coated or covered	8%	5%	3.2%	1.6%	8%	4.8%
7905.00	Zinc plates, sheets, strip and foil containing by weight 90% or more of zinc						
7905.00.11	Of a thickness exceeding 0.15 mm but less than 4.75 mm, for making offset printing plates; of a thickness exceeding 0.15 mm but less than 4.75 mm, not polished, coated on one side with acid-resisting material, imported for use by grinders and polishers, to be prepared for use in photo-engraving	Free	Free	Free	1.6%	8%	7.2%
7905.00.19	Other:	5.5%	3.5%	2.1%	1.6%	8%	7.2%
7905.00.20	Containing by weight less than 90% of zinc	10.2%	6.5%	4%	1.6%	8%	7.2%
7906.00	Zinc tubes, pipes and tube or pipe fittings (for example, couplings, elbows, sleeves)	10.2%	6.5%	4%	1.5%	8%	4.8%
79.07	Other articles of zinc						
7907.10	Gutters, roof capping, skylight frames and other fabricated building components	10.2%	6.5%	4%	2.2%	7%	4.9%
7907.90	Other:						
7907.90.10	Anodes for electroplating	Free	Free	Free	1.3%-2.2%	7%	5.8%
7907.90.20	Discs or slugs, containing by weight 90% or more of zinc	5.5%	3.5%	2.1%	1.3%-2.2%	7%	5.8%
7907.90.90	Other:	10.2%	6.5%	4%	1.3%-2.2%	7%	5.8%
7907.90.90.11	Not alloyed	10.2%	6.5%	4%	1.3%-2.2%	7%	5.8%
7907.90.90.12	Alloyed	10.2%	6.5%	4%	1.3%-2.2%	7%	5.8%

Sources: Customs Tariff, effective January 1994, Revenue Canada, Customs and Excise; Harmonized Tariff Schedule of the United States, 1994; The International Customs Journal, European Economic Community, 1992-93, No. 14, "Conventional" column; Custom Tariff Schedules of Japan, 1993.
[1] GATT rate is shown; lower tariff rates may apply circumstantially.
Note: Where there is a tariff "range," a complete match of the HS code was not available; therefore, the high and low for the product in question is shown.

TABLE 1. CANADA, ZINC PRODUCTION AND TRADE, 1992 AND 1993, AND CONSUMPTION, 1990-92

Item No.		1992		1993p	
		(tonnes)	($000)	(tonnes)	($000)
PRODUCTION					
	All forms[1]				
	Nova Scotia	582	871	–	–
	New Brunswick	301 020	450 928	308 579	379 861
	Quebec	107 466	160 984	128 065	157 648
	Ontario	190 523	285 403	182 873	225 117
	Manitoba	89 211	133 638	95 476	117 531
	British Columbia	133 149	199 458	103 307	127 171
	Yukon	202 304	303 051	33 906	41 738
	Northwest Territories	171 481	256 878	146 027	179 760
	Total	1 195 736	1 791 212	998 234	1 228 826
	Mine output[2]	1 324 675	..	999 789	..
	Refined[3]	671 702	..	660 000	..
EXPORTS					**(Jan.-Sept.)**
2608.00.30	Zinc content in zinc ores and concentrates				
	Germany	115 720	98 624	95 965	77 337
	France	46 270	37 041	35 770	27 814
	Belgium	106 145	71 832	52 181	26 684
	Spain	96 762	76 430	49 213	24 524
	Italy	71 661	52 918	37 392	21 610
	Finland	22 992	22 234	17 718	16 371
	Netherlands	43 121	22 946	21 974	11 867
	Poland	19 361	14 413	19 651	10 471
	Japan	70 720	61 057	13 905	9 135
	Norway	18 661	17 113	11 367	7 811
	South Korea	54 425	44 406	15 534	7 350
	United Kingdom	–	–	3 957	3 656
	United States	5 165	2 025	494	168
	Other countries	5 609	3 469	–	–
	Total	676 612	524 508	375 121	244 803
2600.00	Zinc content in other ores and concentrates[4]	5 831	1 036	746	29
2603.00.30	Zinc content in copper	3 145	397	746	29
2607.00.30	Zinc content in lead	2 686	639	–	–
2620.11	Ash and residues containing hard zinc spelter				
	India	724	464	307	198
	United States	–	–	10	5
	Taiwan	150	149	–	–
	Total	874	614	317	204
2620.19	Ash and residues containing mainly zinc, n.e.s.				
	United States	9 958	8 281	5 112	4 271
	India	392	336	1 172	903
	United Kingdom	124	56	80	69
	South Korea	111	130	115	56
	Taiwan	1 280	1 209	36	30
	France	70	30	–	–
	Total	11 935	10 044	6 515	5 331
2817.00	Zinc oxide; zinc peroxide				
	United States	20 144	32 126	17 394	24 273
	Singapore	30	52	21	33
	Other countries	58	95	–	–
	Total	20 232	32 273	17 415	24 306
2833.26	Zinc sulphate	–	–	4	3
7901.11	Zinc, not alloyed, unwrought, containing by weight 99.99% or more of zinc				
	United States	261 553	397 937	183 639	245 350
	Taiwan	6 766	10 342	5 716	8 165
	Belgium	299	412	2 208	2 956
	Japan	2 911	4 171	1 867	2 619
	Kenya	800	1 197	399	548
	Philippines	–	–	313	275
	United Kingdom	–	–	49	73
	Israel	76	112	51	65
	Trinidad-Tobago	–	–	20	26
	Brazil	489	906	–	–
	Bolivia	59	94	–	–
	Total	272 953	415 175	194 262	260 080

TABLE 1 (cont'd)

Item No.		1992		Jan.-Sept. 1993p	
		(tonnes)	($000)	(tonnes)	($000)
EXPORTS (cont'd)					
7901.12	Zinc, not alloyed, unwrought, containing by weight less than 99.99% of zinc				
	United States	155 437	239 441	124 472	165 021
	Taiwan	26 938	39 053	18 024	23 108
	Philippines	8 064	11 766	9 102	11 574
	Indonesia	10 981	15 815	8 149	10 378
	Japan	11 575	17 063	4 273	5 476
	Malaysia	2 153	3 225	1 349	1 822
	Portugal	1 277	1 879	818	1 173
	Hong Kong	1 301	1 865	878	1 146
	Brazil	1 958	3 345	690	995
	Singapore	357	534	733	904
	Sri Lanka	791	1 170	606	878
	Germany	4 612	6 663	632	796
	Italy	7 803	11 093	418	607
	Norway	1 543	2 218	400	558
	United Kingdom	–	–	190	330
	Israel	177	264	128	196
	Jamaica	249	371	50	74
	Trinidad-Tobago	38	64	41	60
	Ecuador	394	627	28	45
	Australia	237	385	120	32
	Other countries	1 249	1 799	–	–
	Total	237 134	358 654	171 101	225 185
7901.20	Zinc alloys, unwrought				
	Hong Kong	3 052	4 878	1 424	2 090
	Thailand	499	763	765	1 190
	Taiwan	1 139	1 874	598	851
	Japan	556	923	518	720
	People's Republic of China	398	618	200	259
	Philippines	97	156	136	187
	Indonesia	219	327	79	116
	Other countries	179	291	6	8
	Total	6 139	9 835	3 726	5 426
7902.00	Zinc waste and scrap				
	United States	27 541	15 932	25 315	13 486
	Taiwan	4 212	3 749	2 824	2 056
	People's Republic of China	22	7	668	178
	Other countries	197	105	184	115
	Total	31 972	19 795	28 991	15 837
7903.10	Zinc dust				
	United States	6 132	12 314	6 410	12 030
	Other countries	347	337	15	37
	Total	6 479	12 653	6 425	12 068
7903.90	Zinc powders and flakes				
	United States	6 689	12 867	3 425	6 391
	Singapore	582	1 173	218	467
	Australia	143	256	–	–
	Total	7 414	14 297	3 643	6 858
7904.00	Zinc bars, rods, profiles and wire				
	United States	102	304	76	226
	Other countries	20	21	1	5
	Total	122	325	77	232
7905.00	Zinc plates, sheets, strip and foil				
	United States	48	166	29	104
	Total	48	166	29	104
7906.00	Zinc pipes or tubes and fittings				
	United States	. . .	4	21	223
	Total	. . .	4	21	223
7907.90	Articles of zinc, n.e.s.				
	United States	1 019	5 955	1 306	6 630
	Germany	–	–	16	112
	United Kingdom	18	161	9	104
	Other countries	56	179	6	80
	Total	1 093	6 295	1 337	6 926

TABLE 1 (cont'd)

Item No.		1992 (tonnes)	1992 ($000)	Jan.-Sept. 1993p (tonnes)	Jan.-Sept. 1993p ($000)
IMPORTS					
2608.00.00.30	Zinc content in zinc ores and concentrates	151 679	114 458	51 487	23 148
2603.00.00.30	Zinc content in copper ores and concentrates	201	351	519	673
2607.00.00.30	Zinc content in lead ores and concentrates	252	344	268	252
2620.19	Ash and residues containing mainly zinc, n.e.s.	1 028	767	767	551
2817.00	Zinc oxides; zinc peroxide	4 413	5 578	3 195	3 607
2833.26	Zinc sulphate	3 145	1 804	2 807	1 650
7901.11	Zinc, not alloyed, unwrought, containing by weight 99.99% or more of zinc	55	77	859	1 072
7901.12	Zinc, not alloyed, unwrought, containing by weight less than 99.99% of zinc	323	541	74	101
7901.20	Zinc alloys, unwrought	5 301	8 400	5 234	8 603
7902.00	Zinc waste and scrap	1 526	1 541	1 560	1 499
7903.10	Zinc dust	211	518	211	400
7903.90	Zinc powders and flakes	350	672	243	463
7904.00	Zinc bars, rods, profiles and wire	563	1 151	289	876
7905.00	Zinc plates, sheets, strip and foil	592	1 638	351	840
7906.00	Zinc pipes or tubes and fittings	1 393	5 111	954	3 498
7907.90	Articles of zinc, n.e.s.	2 277	7 455	1 970	6 223
	Total Imports	173 309	150 406	70 788	53 456

	1990			1991			1992p		
	Primary	Secondary	Total	Primary	Secondary	Total	Primary	Secondary	Total
	(tonnes)								
CONSUMPTION[5]									
Zinc used for or in the production of:									
Copper alloys (brass, bronze, etc.)	x	x	3 529	x	x	3 547	x	x	3 154
Galvanizing: electro	x	x	2 243	x	x	2 047	x	x	2 075
hot dip	x	x	61 090	x	x	52 266	x	x	63 946
Zinc die-cast alloy	x	x	22 451r	x	x	20 748r	x	x	21 132
Other products (including rolled and ribbon zinc, zinc oxides)	x	x	32 189	x	x	26 295r	x	x	24 418
Total	116 074r	5 428	121 502r	101 187r	3 715	104 902r	109 093	5 632	114 725
Consumer stocks, year-end	10 068r	1 098	11 166r	7 363r	287	7 650r	10 272	726	10 998

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available; . . . Amount too small to be expressed; n.e.s. Not elsewhere specified; p Preliminary; r Revised; x Confidential.
[1] New refined zinc produced from domestic primary materials (concentrates, slags, residues, etc.) plus estimated recoverable zinc in ores and concentrates shipped for export. [2] Zinc content of ores and concentrates produced. [3] Refined zinc produced from domestic and imported ores. [4] Includes HS classes 2603.00.30 and 2607.00.30. [5] Consumer survey does not represent 100% of Canadian consumption and is therefore consistently less than apparent consumption.
Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, ZINC PRODUCTION, EXPORTS[1] AND DOMESTIC SHIPMENTS, 1975, 1980 AND 1985-93

	Production		Exports		
	All Forms[2]	Refined[3]	In Ores and Concentrates	Refined	Total
			(tonnes)		
1975	1 055 151	426 902	705 088	247 474	952 562
1980	883 697	591 565	434 178	471 949	906 127
1985	1 049 275	692 406	396 103	555 621	951 724
1986	988 173	570 981	450 249	427 176	877 425
1987	1 157 936	609 909	613 185	441 227	1 054 412
1988	1 370 000	703 206	816 884	551 521	1 368 405
1989	1 272 854	669 677	614 223	495 061	1 109 284
1990	1 179 372	591 786	716 185	452 251	1 168 436
1991	1 083 008	660 552	566 815	520 508r	1 087 323r
1992	1 195 736	671 702	682 443r	510 088r	1 192 531r
1993p	998 234	660 000	375 867a	365 362a	741 229a

Sources: Natural Resources Canada; Statistics Canada.
p Preliminary; r Revised.
a Exports and imports are January-September figures.
1 Beginning in 1988, exports are based on the new Harmonized System and may not be in complete accordance with previous method of reporting. Ores and concentrates include HS classes 2608.00.30, 2603.00.30 and 2607.00.30. Refined includes HS classes 7901.11 and 7901.12. 2 New refined zinc produced from domestic primary materials (concentrates, slags, residues, etc.) plus estimated recoverable zinc in ores and concentrates shipped for export.
3 Refined zinc produced from domestic and imported ores.

TABLE 3. WESTERN WORLD, PRIMARY ZINC STATISTICS, 1989-93

	1989	1990	1991	1992	1993p
			(000 tonnes)		
Mine production (zinc content)	5 117	5 396	5 587	5 654	5 125
Metal production	5 219	5 206	5 405	5 449	5 456
Metal consumption	5 190	5 200	5 387	5 362	5 460

Source: International Lead and Zinc Study Group.
p Preliminary.

TABLE 4. WESTERN WORLD ZINC MINE PRODUCTION, 1989-93

	1989	1990	1991	1992	1993p
			(000 tonnes)		
EUROPE					
Finland	58	52	55	31	22
Germany	64	59	54	14	–
Ireland	169	166	188	194	194
Spain	266	257	265	208	162
Sweden	163	158	157	171	171
Yugoslavia	75	76	74	47	36
Others	203	182	131	124	74
Subtotal	998	950	924	789	659
AFRICA					
Namibia	39	41	36	36	29
South Africa	77	75	64	72	77
Zaire	73	62	43	36	20
Others	60	64	61	48	87
Subtotal	249	242	204	192	213
OCEANIA					
Australia	811	884	1 048	1 013	985
AMERICAS					
Bolivia	74	104	130	142	110
Canada	1 216	1 203	1 157	1 312	1 007
Mexico	284	307	317	353	335
Peru	621	598	638	602	639
United States	288	543	547	552	500
Others	196	206	211	223	222
Subtotal	2 679	2 961	3 000	3 184	2 813
ASIA					
India	65	70	102	152	150
Japan	132	127	133	134	119
Thailand	91	81	87	69	69
Others	92	81	106	242	117
Subtotal	380	359	411	476	455
Total, Western World	5 117	5 396	5 587	5 654	5 125
Other countries	1 668	1 570	1 644	1 606	. .
Total, World	6 785	6 966	7 231	7 260	. .

Source: International Lead and Zinc Study Group.
– Nil; . . Not available; p Preliminary.

TABLE 5. WESTERN WORLD ZINC METAL PRODUCTION, 1989-93

	1989	1990	1991	1992	1993p
			(000 tonnes)		
EUROPE					
Belgium	285	290	298	217	210
Finland	162	175	170	171	171
France	266	264	299	304	310
Germany	353	338	346	383	380
Italy	246	248	346	383	380
Netherlands	203	207	201	205	207
Spain	257	257	274	368	342
Others	353	365	350	302	290
Subtotal	2 125	2 144	2 194	2 203	2 161
AFRICA					
Algeria	28	24	29	32	30
South Africa	85	92	92	83	96
Zaire	54	38	28	19	5
Others	13	11	7	7	6
Subtotal	180	165	156	141	137
AMERICAS					
Argentina	32	32	36	35	31
Brazil	156	172	172	180	193
Canada	670	592	661	672	662
Mexico	194	199	189	151	208
Peru	141	120	154	124	160
United States	358	358	376	400	396
Subtotal	1 551	1 473	1 588	1 562	1 650
ASIA					
Japan	665	687	731	729	696
Korea, Republic of	240	257	232	256	271
Others	164	177	178	226	224
Subtotal	1 069	1 121	1 141	1 211	1 191
OCEANIA					
Australia	294	303	326	332	317
Total, Western World	5 219	5 206	5 405	5 449	5 456
Other countries	1 568	1 518	1 479	1 521	. .
Total, World	6 787	6 724	6 884	6 970	. .

Source: International Lead and Zinc Study Group.
. . Not available; p Preliminary.

TABLE 6. WESTERN WORLD ZINC CONSUMPTION, 1989-93

	1989	1990	1991	1992	1993p
			(000 tonnes)		
EUROPE					
Belgium	175	185	200	189	194
France	279	284	289	258	208
Germany	453	484	540	532	440
Italy	262	275	283	300	271
Spain	116	125	129	112	106
United Kingdom	195	193	184	190	180
Others	366	351	380	331	291
Subtotal	1 846	1 897	2 005	1 912	1 690
AFRICA					
South Africa	98	85	91	85	88
Others	63	60	63	54	50
Subtotal	161	145	154	139	138
OCEANIA					
Australia	88	114	113	119	12
New Zealand	23	16	17	15	15
Subtotal	111	130	130	134	135
AMERICAS					
Brazil	155	125	106	98	114
Canada	148	123	121	126	124
Mexico	105	111	110	107	84
United States	1 060	992	931	1 038	1 038
Others	129	120	126	131	117
Subtotal	1 597	1 471	1 394	1 500	1 477
ASIA					
India	135	130	130	140	132
Japan	769	814	845	784	670
Korea, Republic of	196	230	269	257	274
Others	375	383	460	482	508
Subtotal	1 475	1 557	1 704	1 663	1 584
Total, Western World	5 190	5 200	5 387	5 348	5 024
Other countries	1 536	1 464	1 261	1 162	. .
Total, World	6 726	6 664	6 648	6 510	. .

Source: International Lead and Zinc Study Group.
. . Not available; p January-November.

TABLE 7. CANADA, ZINC METAL CAPACITY, 1993

Company and Location	Annual Rated Capacity
	(000 tonnes of slab zinc)
PRIMARY	
Canadian Electrolytic Zinc Limited (CEZ) Valleyfield, Quebec	230
Falconbridge Limited Timmins, Ontario	133
Hudson Bay Mining and Smelting Co., Limited (HBMS) Flin Flon, Manitoba	95
Cominco Ltd. Trail, British Columbia	300
Total primary, Canada	758
SECONDARY	
Federated Genco Ltd. Burlington, Ontario	9
Purity Zinc Metals Co. Ltd. Stoney Creek, Ontario	8
Total secondary, Canada	17

Source: Natural Resources Canada.

TABLE 8. MONTHLY AVERAGE ZINC PRICES, 1992 AND 1993

	North American Special High Grade	LME Special High Grade Settlement
	(US¢/lb)	
1993		
January	50.5	48.2
February	50.9	48.7
March	47.3	45.2
April	48.1	45.6
May	47.2	44.5
June	44.8	42.0
July	45.1	42.1
August	42.9	40.1
September	42.4	39.7
October	43.9	41.5
November	44.3	42.1
December	46.4	44.2
Year average	46.2	43.7
1992		
January	54.4	52.4
February	52.9	51.3
March	56.9	55.1
April	60.5	59.2
May	63.2	62.3
June	63.8	62.9
July	62.4	59.9
August	65.0	61.7
September	65.4	62.1
October	56.0	52.8
November	50.0	47.5
December	50.1	48.0
Year average	58.4	56.2

Sources: Metals Week; Reuters.

Principal Canadian Nonferrous and Precious Metal Mine Production in 1992

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PRINCIPAL CANADIAN NONFERROUS AND PRECIOUS METAL MINE PRODUCTION IN 1992

Company and Mine Name	Capacity	Grades of Ore Milled						Ore Milled	Metal Contained in All Concentrates Produced					
		Cu	Ni	Pb	Zn	Ag	Au		Copper	Nickel	Lead	Zinc	Silver	Gold
	(tonnes per day)	(percent)				(grams/tonne)		(tonnes)	(tonnes)				(kilograms)	
NEWFOUNDLAND														
Royal Oak Mines Inc. Hope Brook mine Couteau Bay	3 495	–	–	–	–	0.30	3.74	490 256	–	–	–	–	104	1 577
NEW BRUNSWICK														
Brunswick Mining and Smelting Corporation Limited No. 12 mine Bathurst	10 250	0.38	–	3.30	8.68	109.03	0.69	3 871 864	12 091	–	84 627	292 978	285 991	797
Noranda Minerals Inc. Heath Steele and Stratmat mines Bathurst	2 536	0.60	–	2.48	6.60	68.09	–	997 903	4 879	–	16 997	57 473	37 100	–
NovaGold Resources Inc. Murray Brook mine Bathurst	1 045	–	–	–	–	62.74	1.10	167 829	–	–	–	–	1 387	118
Stratabound Minerals Inc. CNE mine Newcastle	250	–	–	2.82	7.65	97.89	–	13 619	–	–	308	890	989	–
QUEBEC														
Agnico-Eagle Mines Limited														
Joutel Division Joutel	1 633	–	–	–	–	3.05	7.20	183 386	–	–	–	–	469	1 144
LaRonde mine Cadillac	2 000	0.74	–	–	–	16.80	8.23	545 268	3 430	–	–	–	8 541	4 307
American Barrick Resources Corporation Camflo Division Val-d'Or	1 205	–	–	–	–	0.43	4.25	301 614	–	–	–	–	115	1 201
Aur Resources Inc. Dumont, Ferderber and Kierens mines Val-d'Or	1 360	–	–	–	–	0.65	5.29	480 267	–	–	–	–	271	2 304
Billiton Metals Canada Inc. Les Mines Selbaie OP and UG mines Joutel	6 650	1.14	–	0.10	2.19	42.72	0.66	2 919 320	31 443	–	2 126	58 405	87 475	1 557
Cambior inc. Doyon mine Val-d'Or	3 150	–	–	–	–	1.30	7.17	1 157 780	–	–	–	–	1 313	7 740

Pierre Beauchemin, Chimo and Mouska mines Rouyn-Noranda	1 200	–	–	–	–	1.82	6.27	500 131	–	–	–	–	825	3 010
Lucien C. Beliveau mine Val-d'Or	2 200	–	–	–	–	0.40	2.74	425 740	–	–	–	–	140	1 073
Campbell Resources Inc. Joe Mann mine Chibougamau	2 175	0.24	–	–	–	4.42	9.12	266 712	594	–	–	–	812	2 215
LAC Minerals Ltd.														
Bousquet No. 1 mine Cadillac	1 495	–	–	–	–	1.13	6.17	351 443	–	–	–	–	341	1 976
Bousquet No. 2 mine Malartic	1 680	0.96	–	–	–	14.74	9.87	495 323	4 024	–	–	–	6 925	4 653
Minnova Inc.														
Lac Shortt Division Lac Shortt mine tailings and custom ore (Bachelor Lake) Desmaraisville	1 150	–	–	–	–	0.24	4.18	108 862	–	–	–	–	25	430
Lake Dufault Division Ansil mine Noranda	1 450	5.80	–	–	1.00	22.77	1.80	403 000	22 340	–	–	3 147	6 428	659
Noranda Minerals Inc.														
Division Mines Gaspé Copper Mountain and Needle Mountain mines Murdochville	10 000	1.81	–	–	–	12.75	0.10	1 240 697	21 210	–	–	–	12 089	28
Matagami Division Îsle Dieu and Norita East mines Mattagami Lake	2 175	1.04	–	0.21	12.70	55.20	0.65	483 470	4 660	–	676	58 147	20 218	191
Noranda Minerals Inc.– Cambior inc. joint venture Silidor mine Rouyn-Noranda	1 100	–	–	–	–	1.10	5.54	417 490	–	–	–	–	413	2 303
Placer Dome Inc.														
Kiena mine	1 250	–	–	–	–	0.89	5.25	501 673	–	–	–	–	395	2 525
Sigma mine Val-d'Or	1 360	–	–	–	–	1.30	6.10	444 521	–	–	–	–	459	2 610
Richmont Mines Inc. Francoeur mine Rouyn-Noranda	360	–	–	–	–	0.80	7.20	105 109	–	–	–	–	59	757
Ronrico Explorations Ltd. and Louvicourt Gold Mines Inc. Simkar mine Val-d'Or	300	–	–	–	–	1.00	7.70	3 925	–	–	–	–	3	27
TVX Gold Inc. Casa Berardi East and West mines La Sarre	1 800	–	–	–	–	3.15	8.24	348 359	–	–	–	–	923	2 498
Westminer Canada Limited Copper Rand and Portage mines Chibougamau	3 085	1.45	–	–	–	56.23	4.39	385 554	5 401	–	–	–	1 555	1 503

PRINCIPAL CANADIAN NONFERROUS AND PRECIOUS METAL MINE PRODUCTION IN 1992 (cont'd)

Company and Mine	Capacity	Grades of Ore Milled						Ore Milled	Metal Contained in All Concentrates Produced					
		Cu	Ni	Pb	Zn	Ag	Au		Copper	Nickel	Lead	Zinc	Silver	Gold
	(tonnes per day)	(percent)				(grams/tonne)		(tonnes)	(tonnes)				(kilograms)	
ONTARIO														
American Barrick Resources Corporation Holt-McDermott mine Kirkland Lake	1 360	–	–	–	–	0.82	3.77	411 270	–	–	–	–	131	1 441
Dickenson Mines Limited Arthur White mine Red Lake	910	–	–	–	–	1.03	9.94	293 021	–	–	–	–	231	2 334
Falconbridge Gold Corporation Hoyle Pond, Owl Creek and Bell Creek mines	12 00	–	–	–	–	1.13	17.07	119 113	–	–	–	–	121	1 991
Falconbridge Limited Sudbury operations (6 mines)	8 170	1.68	1.74	–	–	7.54	0.21	2 415 470	38 777	36 041	–	–	15 798	409
Timmins operations Kidd Creek mines	13 500	3.18	–	0.09	5.03	41.50	–	3 500 000	107 979	–	2 080	155 863	119 524	–
GSR Mining Corp. Kerr, Cheminis and Buffonta mines Virginiatown	1 995	–	–	–	–	0.45	4.11	365 992	–	–	–	–	112	892
Hemlo Gold Mines Inc. Golden Giant mine Marathon	3 000	–	–	–	–	0.65	13.89	1 071 900	–	–	–	–	613	14 040
Inco Limited Sudbury and Shebandowan operations	57 520	1.14	1.27	–	–	5.48	0.33	9 135 350	97 800	94 320	–	–	35 000	1 842
LAC Minerals Ltd. Golden Patricia mine Pickle Lake	350	–	–	–	–	5.25	19.51	136 078	–	–	–	–	357	2 534
Macassa Division Macassa mine	1 135	–	–	–	–	2.40	18.62	133 356	–	–	–	–	250	2 402
Lake Shore tailings operation Kirkland Lake	–	–	–	–	–	0.34	2.50	253 105	–	–	–	–	43	462
Minnova Inc. Winston Lake mine Winston Lake	1 000	1.30	–	–	15.80	40.32	1.78	347 000	4 166	–	–	52 848	9 980	372
Muscocho Explorations Ltd. Magino mine Wawa	600	–	–	–	–	0.69	3.84	140 614	–	–	–	–	87	512
Noranda Inc. Geco Division Geco mine Manitouwadge	3 630	1.74	–	–	3.64	49.03	0.17	1 205 930	20 165	–	–	40 624	45 856	104

Placer Dome Inc.														
Campbell mine Red Lake	1 360	–	–	–	–	1.37	21.60	460 850	–	–	–	–	586	9 295
Detour Lake mine Detour Lake	2 500	–	–	–	–	3.50	4.94	872 712	–	–	–	–	1 752	4 029
Dome mine South Porcupine	3 000	–	–	–	–	0.82	4.15	1 368 035	–	–	–	–	1 025	5 381
Dona Lake mine Pickle Lake	500	–	–	–	–	0.75	7.27	204 117	–	–	–	–	140	1 431
Royal Oak Mines Inc. Timmins Division	3 265	–	–	–	–	2.02	3.05	1 111 117	–	–	–	–	518	3 070
St. Andrew Goldfields Ltd. Stock Township mine Timmins	900	–	–	–	–	0.82	6.79	173 410	–	–	–	–	121	1 117
Teck Corporation - Homestake Canada Inc. joint venture														
David Bell mine	1 000	–	–	–	–	0.55	14.61	469 298	–	–	–	–	231	6 548
Williams mine Hemlo	6 000	–	–	–	–	0.69	7.03	2 299 713	–	–	–	–	1 135	15 420
MANITOBA														
Hudson Bay Mining and Smelting Co., Limited (6 mines), including Flin Flon, Saskatchewan portion	10 520	2.02	–	0.13	5.41	21.44	2.01	1 933 946	34 685	–	2 820	93 792	28 000	2 622
Ruttan mine Leaf Rapids	7 200	1.29	–	–	0.89	10.77	0.45	1 896 923	23 088	–	–	12 836	11 606	427
Hudson Bay–Outokumpu Mines Ltd. joint venture Namew Lake mine Flin Flon	1 905	0.66	1.93	–	–	–	–	575 464	3 642	8 322	–	–	–	–
Inco Limited Thompson UG, OP, and Birchtree mines Thompson district	14 970	0.18	2.57	–	–	5.14	0.10	2 439 420	4 157	58 212	–	–	7 527	196
SASKATCHEWAN														
Claude Resources Inc. Seabee mine La Ronge	500	–	–	–	–	12.38	12.75	167 500	–	–	–	–	1 860	1 920
BRITISH COLUMBIA														
Bethlehem Resources Corporation–Goldnev Resources Inc. joint venture Goldstream mine Revelstoke	1 100	4.05	–	–	2.94	–	–	428 191	16 091	–	–	2 525	–	–
BHP Minerals Canada Ltd. Island Copper mine Port Hardy	49 895	0.29	–	–	–	1.30	0.17	19 649 621	45 061	–	–	–	12 744	1 570

PRINCIPAL CANADIAN NONFERROUS AND PRECIOUS METAL MINE PRODUCTION IN 1992 (cont'd)

Company and Mine	Capacity	Grades of Ore Milled						Ore Milled	Metal Contained in All Concentrates Produced					
		Cu	Ni	Pb	Zn	Ag	Au		Copper	Nickel	Lead	Zinc	Silver	Gold
	(tonnes per day)	(percent)				(grams/tonne)		(tonnes)	(tonnes)				(kilograms)	
BRITISH COLUMBIA (cont'd)														
Cheni Gold Mines Inc. Lawyers mine Toodoggone area	500	–	–	–	–	257.25	9.81	108 853	–	–	–	–	23 307	980
Cominco Ltd.														
Snip mine Stewart	272	–	–	–	–	2.40	31.54	164 745	–	–	–	–	337	4 780
Sullivan mine Kimberley	9 070	–	–	4.60	7.10	27.09	–	1 597 371	–	–	65 876	104 882	41 169	–
Equity Silver Mines Ltd. Equity Silver mine Houston	9 000	0.26	–	–	–	73.37	1.06	2 639 000	4 628	–	–	–	96 085	1 533
Gibraltar Mines Limited														
Gibraltar mine	36 285	0.34	–	–	–	1.03	–	12 672 464	31 798	–	–	–	5 875	–
Waste rock operation McLeese Lake	19 960	0.10	–	–	–	–	–	9 979 032	3 129	–	–	–	–	–
Highland Valley Copper Ltd. (Partnership of Cominco Ltd.–Rio Algom Limited–Teck Corporation) Logan Lake	132 995	0.45	–	–	–	3.09	0.03	44 062 507	176 470	–	–	–	67 982	435
Homestake Canada Inc. Nickel Plate mine Hedley	3 175	–	–	–	–	0.96	2.50	1 270 059	–	–	–	–	761	2 634
Minnova Inc. Samatosum mine Adams Lake	455	0.66	–	1.10	2.08	567.02	1.10	129 000	772	–	1 118	2 239	66 819	102
Noranda Minerals Inc. Bell Copper mine Babine Lake	15 420	0.77	–	–	–	0.99	0.31	1 099 336	6 351	–	–	–	855	233
North American Metals Corp. Golden Bear mine Telegraph Creek	360	–	–	–	–	3.67	15.43	132 993	–	–	–	–	391	1 811
Princeton Mining Corporation Similco mine Princeton	22 680	0.45	–	–	–	2.74	0.14	7 377 226	25 629	–	–	–	10 138	516
Timmins Nickel Inc.–Habsburg Resources Inc. joint venture Dome Mountain mine Smithers	320	–	–	–	–	54.42	15.30	3 944	–	–	–	–	97	56
Treminco Resources Ltd. Silvana mine New Denver	110	–	–	6.12	6.21	522.86	–	16 511	–	–	982	940	8 307	–

Westmin Resources Limited H-W and Lynx mines Buttle Lake	3 990	1.73	–	0.22	3.18	27.14	2.01	1 171 629	18 429	–	1 955	32 839	20 304	983
Premier Gold and SB mines Stewart	2 000	–	–	–	–	50.70	3.06	394 000	–	–	–	–	8 723	1 107
YUKON TERRITORY														
Curragh Inc. Faro and Vangorda mines Faro	10 000	–	–	3.03	4.55	38.74	0.48	4 718 268	–	–	116 650	171 860	109 841	690
Sa Dena Hes mine Watson Lake	1 500	–	–	7.10	12.10	92.57	–	527 002	–	–	34 558	57 000	24 389	–
NORTHWEST TERRITORIES														
Cominco Ltd. Polaris mine Little Cornwallis Island	2 070	–	–	4.10	13.00	–	–	1 067 000	–	–	42 699	135 738	–	–
Echo Bay Mines Ltd. Lupin mine Contwoyto Lake	1 905	–	–	–	–	2.06	10.56	674 764	–	–	–	–	1 079	6 671
Nanisivik Mines Ltd. Nanisivik mine Baffin Island	1 890	–	–	0.25	7.65	31.61	–	694 541	–	–	1 433	51 333	16 196	–
NERCO Minerals Company Con mine Yellowknife	1 090	–	–	–	–	2.81	11.21	365 233	–	–	–	–	902	3 744
Royal Oak Resources Ltd. Giant mine Yellowknife	1 135	–	–	–	–	2.06	9.84	360 152	–	–	–	–	600	2 982
Treminco Resources Ltd. Ptarmigan and Tom mines Yellowknife	225	–	–	–	–	6.17	10.29	40 823	–	–	–	–	153	397
Total Canada	541 746	0.49	0.14	0.27	0.91	11.36	1.04	162 456 084	772 889	196 895	374 905	1 386 359	1 275 023	159 218

OP Open-pit; UG Underground.
– Nil.
Notes: Not included in the above are several small mine/mill operations and operations that were not officially in production in 1992, or for which no information was available to enable the completion of a reliable production assessment. The overall contribution to the Canadian production total in 1992 from these omitted operations is estimated to be less than 1%.

Statistical Report

This statistical summary of the mineral industry in Canada has been compiled by the staff of the Mineral and Metal Statistics Division, Mining Sector, Natural Resources Canada (NRCan), under the general direction of Teri Newman, Acting Director. This report was prepared by Lorraine Ralph, Kosta Kokkinos and Despo Makris.

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Statistics contained in this summary are obtained from a variety of sources. Principal sources include the statistical survey program of NRCan, Statistics Canada and Labour Canada. The statistical survey program of the Modelling and Mining Statistics Division of NRCan is conducted jointly with the provincial governments and Statistics Canada in order to minimize the reporting burden on the mineral industry. The cooperation of the companies providing information is greatly appreciated. Sources for the international mineral statistics include the U.S. Bureau of Mines, the American Bureau of Metal Statistics, the World Bureau of Metal Statistics, "Metals Week," "Northern Miner," Metallgesellschaft, and the "Engineering and Mining Journal."

*(**Note to Reader**: We are reviewing the tables of the Statistical Report to establish the requirements of the users. We would appreciate feedback from clients on which tables are important. Please contact Laurie Morrison at (613) 992-6767 to give us your input.)*

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CANADA, GENERAL ECONOMIC INDICATORS, 1983-92

		1983	1984	1985	1986	1987	1988	1989	1990	1991	1992p
Gross domestic product, current dollars	$ millions	405 717	444 735	477 988	505 666	551 597	605 906	650 748r	670 952r	675 928	688 541
Gross domestic product, constant dollars (1986 = 100)	"	439 448	467 167	489 437	505 666	526 730	552 958	566 486r	565 576r	556 029	560 048
Mining's gross domestic product (1986 = 100)	"	15 959	18 122	18 919	17 595	18 724r	20 536	19 982	19 926	20 126	20 450
Manufacturing's gross domestic product (1986 = 100)	"	72 311	81 622	86 218	86 849r	91 025r	95 643r	95 830	90 947	84 929	85 368
Industrial production's gross domestic product (1986 = 100)	"	102 436	114 883	121 273	120 356r	126 226r	132 918	132 361	126 807	121 680	122 782
Value of manufacturing industry shipment	"	203 019	229 848	248 673	253 343	272 037	297 692	308 987	299 195r	280 968	283 612
Value of mineral production	"	38 539	43 789	44 730	32 446	36 361	36 955	39 333	40 778	35 190r	35 404
Merchandise exports	"	90 556	111 330	119 061	120 318	126 340	137 779r	141 514r	146 096r	141 097	156 567
Merchandise imports	"	73 098	91 493	102 669	110 374	115 119	128 862r	135 455r	136 642r	136 107	147 588
Balance of payments, current account	"	2 102	1 686	-3 095	-11 394	-11 601	-15 493	-23 393r	-25 947r	-29 035	-27 683
Corporation profits before taxes	"	37 072	45 855	49 490	45 355	56 571	64 667	60 093r	47 060r	33 323	31 928
Business investment, current dollars	"	70 832	73 309	81 312	88 993	103 831	119 100	130 812r	125 102r	117 104	113 440
Business investment, constant dollars (1986 = 100)	"	74 742	75 869	82 863	88 993	99 693	110 794	117 153r	111 632r	108 315	106 062
Population	000	24 787	24 978r	25 165	25 353	25 617	25 909	26 240	26 610	27 004	27 402
Labour force	"	12 109	12 316	12 532	12 746	13 011	13 275r	13 503r	13 681	13 757	13 797
Employed	"	10 675	10 932	11 221	11 531	11 861	12 245	12 486	12 572	12 340	12 240
Unemployed	"	1 434	1 384	1 311	1 215	1 150	1 031	1 018	1 109	1 417	1 556
Unemployment rate	percent	11.8	11.2	10.5	9.5	8.8	7.8	7.5	8.1	10.3	11.3
Labour income	$ millions	219 386	236 257	254 777	271 853	295 691	324 412	349 848r	368 090r	376 660	388 058
Consumer price index	1986 = 100	88.5r	92.4	96.0	100.0	104.4r	108.6	114.0	119.5	126.2	128.1

Source: Statistics Canada, Catalogue nos. 11-210 and 26-202.
p Preliminary; r Revised.

TABLE 1. MINERAL PRODUCTION OF CANADA, 1991, 1992 AND 1993, AND AVERAGE, 1989-93

	Unit of Measure	1991		1992		1993p		Average 1989-93	
	(000)	(Quantity)	($000)	(Quantity)	($000)	(Quantity)	($000)	(Quantity)	($000)
METALS									
Antimony	kg	429	897	796	1 678	622	1 358	1 046	2 415
Bismuth	kg	60	446	204	1 360	157	1 047	130	1 166
Cadmium	kg	1 549	7 724	1 393	3 366	1 242	1 592	1 446	10 459
Calcium	kg	x	x	x	x	x	x	137	1 385
Cesium, pollucite	kg	x	x	x	x	x	x	192	528
Cobalt	kg	2 171	77 549	2 223	131 353	2 370	89 819	2 258	78 813
Columbium (niobium) (Cb_2O_5)	kg	x	x	x	x	x	x	3 340	21 384
Copper	kg	780 362	2 112 152	761 694	2 137 039	698 799	1 759 675	743 344	2 165 310
Germanium	kg	–	–	–	–	–	–	2	528
Gold	g	175 282r	2 338 614r	159 858	2 134 586	152 578	2 258 007	162 917	2 290 944
Ilmenite	t	x	x	x	x	x	x	414	21 687
Indium	g	x	x	x	x	x	x	18 830	3 987
Iron ore	t	35 421	1 228 188	31 582	1 084 773	31 720	1 036 587	34 768	1 195 507
Iron remelt	t	x	x	x	x	x	x	675	186 124
Lead	kg	248 102	210 886	336 878	247 268	187 554	96 215	254 959	222 672
Lithium	kg	x	x	x	x	x	x	1 048	4 674
Magnesium	kg	x	x	x	x	x	x	4 816	17 325
Molybdenum	kg	11 437	65 928	8 870	52 253	10 006	66 731	11 209	76 272
Nickel	kg	188 098	1 807 619	177 555	1 502 112	180 763	1 215 994	187 395	1 919 184
Platinum group	g	11 123	150 155	11 311	130 204	13 116	138 799	11 309	150 062
Rare earths	t	–	–	–	–	–	–	–	–
Rhenium	kg	x	x	x	x	x	x	1	1 250
Rubidium	kg	x	x	x	x	–	–	2	23
Selenium	kg	227	3 937	345	5 013	482	6 517	327	5 294
Silver	kg	1 261	187 676	1 169	178 738	869	152 891	1 199	208 758
Tantalum (Ta_2O_5)	kg	114	10 254	54	3 977	7	603	75	6 827
Tellurium	kg	16	1 128	25	1 891	31	2 345	18	1 390
Tin	kg	4 392	25 241	58	432	–	–	2 354	18 040
Tungsten (WO_3)	kg	–	–	–	–	–	–	–	–
Uranium (U)	kg	8 162	595 467	9 114	566 352	9 015	509 025	9 401	694 301
Vanadium	kg	x	x	–	–	–	–	8	36
Yttrium (Y_2O_3)	kg	–	–	–	–	–	–	31	1 090
Zinc	kg	1 083 008	1 385 167	1 195 736	1 791 212	998 234	1 228 826	1 145 840	1 883 407
Total metals			10 461 797r		10 201 641		8 808 352		11 190 841
NONMETALS									
Arsenious trioxide	t	–	–	–	–	–	–	2	305
Asbestos	t	686	271 030	587	231 020	509	215 076	636	255 676
Barite	t	47	3 013	35	2 852	37	3 114	40	3 036
Fluorspar	t	–	–	–	–	–	–	14	1 744
Gemstones	kg	542	663	1 283	842	1 215	757	879	1 284
Graphite	t	x	x	x	x	x	x	13	10 552
Gypsum	t	6 727	71 654	7 295	71 820	7 836	83 107	7 603	78 475
Magnesite	t	x	x	x	x	x	x	176	24 036
Marl	t	x	x	x	x	x	x	1	18
Mica	t	x	x	x	x	x	x	17	7 014
Nepheline syenite	t	486	25 105	557	28 109	557	32 924	537	26 573
Peat	t	833	100 133	828	116 869	820	119 174	815	105 116
Potash (K_2O)	t	7 087	931 932	7 040	980 855	6 970	901 539	7 091	959 354
Potassium sulphate	t	x	x	x	x	x	x	3	865
Salt	t	11 871	259 166	11 088	266 441	11 371	279 796	11 336	264 382
Serpentine	t	x	x	x	x	x	x	3	524
Soapstone, talc and pyrophyllite	t	115	13 278	113	13 132	108	14 176	122	13 918
Sodium sulphate	t	335	25 457	281	21 193	316	22 289	321	24 474
Sulphur in smelter gas	t	749	89 187	783	88 055	797	94 984	786	88 073
Sulphur, elemental	t	6 180	335 381	6 479	130 634	7 313	2 444	6 309	251 373
Titanium dioxide	t	x	x	x	x	x	x	620	230 998
Tremolite	t	x	x	x	x	x	x	. . .	56
Total nonmetals			2 381 705		2 207 090		1 994 862		2 347 846
FUELS									
Coal	t	71 133	1 916 780	65 612	1 669 300	68 600	1 783 000	68 841	1 819 972
Natural gas	$000m^3$	105 244	5 394 073	116 664	5 718 636	129 245	7 248 635	109 208	5 889 529
Natural gas by-products	m^3	24 919	2 178 094	26 735	2 434 914	28 463	2 792 960	25 407	2 279 403
Petroleum, crude	m^3	89 788	10 456 364	93 256	10 907 793	97 249	11 154 997	92 243	11 297 089
Total fuels			19 945 311		20 730 643		22 979 592		21 285 993
STRUCTURAL MATERIALS									
Clay products	$	. .	119 838	. .	114 262	. .	108 127	. .	135 679
Cement	t	9 372	810 769	8 598	682 422	9 842	764 589	10 430	841 844
Lime	t	2 375	193 541	2 384	191 313	2 447	200 663	1 910	195 074
Sand and gravel	t	215 576r	737 728r	240 616	760 367	229 940	736 479	186 138	785 194
Stone	t	87 807r	539 569r	89 338	516 518	79 209	469 550	97 409	571 234
Total structural materials			2 401 445r		2 264 882		2 279 407		2 529 025
Total all minerals			35 190 259r		35 404 256		36 062 213		37 353 706

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available; . . . Amount too small to be expressed; p Preliminary; r Revised; x Confidential.
Notes: Numbers may not add to totals due to rounding. Confidential values are included in totals.

TABLE 2. CANADA, VALUE OF MINERAL PRODUCTION, PER CAPITA VALUE OF MINERAL PRODUCTION, AND POPULATION, 1964-93

	Metallics	Industrial Minerals	Fuels	Other Minerals[1]	Total	Per Capita Value of Mineral Production	Population of Canada
			($ millions)			($)	(000)
1964	1 702	691	973		3 365	174.44	19 291
1965	1 908	761	1 046		3 715	189.11	19 644
1966	1 985	844	1 152		3 981	198.88	20 015
1967	2 285	861	1 235		4 381	214.98	20 378
1968	2 493	886	1 343		4 722	228.12	20 701
1969	2 378	893	1 465		4 736	225.51	21 001
1970	3 073	931	1 718		5 722	268.68	21 297
1971	2 940	1 008	2 014		5 963	276.46	21 568
1972	2 956	1 085	2 368		6 408	293.92	21 802
1973	3 850	1 292	3 227		8 370	379.69	22 043
1974	4 821	1 731	5 202		11 753	525.55	22 364
1975	4 795	1 898	6 653		13 347	588.05	22 697
1976	5 315	2 269	8 109		15 693	682.51	22 993
1977	5 988	2 612	9 873		18 473	793.74r	23 273r
1978	5 698	2 986	11 578		20 261	861.55r	23 517r
1979	7 951	3 514	14 617		26 081	1 098.29r	23 747r
1980	9 697	4 201	17 944		31 842	1 324.39r	24 043r
1981	8 753	4 485	19 046	136	32 420	1 331.88r	24 342r
1982	6 874	3 703	23 038	216	33 831	1 376.21r	24 583r
1983	7 399	3 741	27 154	245	38 539	1 554.79r	24 787r
1984	8 670	4 318	30 399	401	43 789	1 753.09r	24 978r
1985	8 709	4 859	31 120	41	44 730	1 777.43r	25 165r
1986	8 798	4 863	18 763	22	32 446	1 279.77	25 353
1987	10 962	5 125	20 274	–	36 361	1 419.39	25 617
1988	13 608	5 574	17 773	–	36 955	1 426.32r	25 909
1989	13 982	5 566	19 785	–	39 333	1 498.97	26 240
1990	12 500	5 289	22 990	–	40 778	1 532.42r	26 610r
1991	10 462r	4 783	19 945	–	35 190r	1 303.13r	27 004r
1992	10 202	4 472	20 731	–	35 404	1 245.05	27 436
1993p	8 808	4 274	22 980	–	36 062	1 254.21	28 753

Sources: Natural Resources Canada; Statistics Canada.
– Nil; p Preliminary; r Revised.
1 1981-86: Other minerals may include arsenious trioxide, bentonite, calcium, cesium, cobalt, diatomite, ilmenite, indium, iron remelt, lithium, marl, magnesium, niobium, perlite, rhenium, serpentine, sodium antimonate, strontium, tin, tungsten or yttrium, for which the value of production may be confidential in that year. Beginning in 1987, this category was discontinued.
Notes: Beginning in 1986, bentonite, diatomite and sodium antimonate are reported in industrial minerals. Numbers may not add to totals due to rounding.

TABLE 3. CANADA, VALUE OF MINERAL PRODUCTION BY PROVINCE, TERRITORY AND MINERAL CLASS, 1993P

	Metals		Industrial Minerals		Fuels		Total	
	($000)	(% of total)	($000)	(% of total)	($000)	(% of total)	($000)	(% of total)
Alberta	281	. . .	308 975	7.2	18 333 017	79.8	18 642 273	51.7
Ontario	3 187 469	36.2	1 204 299	28.2	76 126	0.3	4 467 894	12.4
British Columbia	1 178 103	13.4	385 694	9.0	1 964 590	8.5	3 528 387	9.8
Saskatchewan	436 288	5.0	821 351	19.2	1 915 696	8.3	3 173 335	8.8
Quebec	1 593 597	18.1	960 140	22.5	–	–	2 553 738	7.1
Manitoba	740 492	8.4	92 437	2.2	79 570	0.3	912 499	2.5
New Brunswick	492 072	5.6	255 791	6.0	33 800	0.1	781 663	2.2
Newfoundland	679 871	7.7	48 163	1.1	–	–	728 034	2.0
Northwest Territories	389 079	4.4	13 790	0.3	204 481	0.9	607 349	1.7
Nova Scotia	–	–	175 669	4.1	353 849	1.5	529 518	1.5
Yukon	111 100	1.3	6 261	0.1	18 463	0.1	135 824	0.4
Prince Edward Island	–	–	1 700	. . .	–	–	1 700	. . .
Total	8 808 352	100.0	4 274 269	100.0	22 979 592	100.0	36 062 213	100.0

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . . Amount too small to be expressed; P Preliminary.
Note: Numbers may not add to totals due to rounding.

TABLE 3a. CANADA, VALUE OF MINERAL PRODUCTION BY PROVINCE, TERRITORY AND MINERAL CLASS, 1992

	Metals		Industrial Minerals		Fuels		Total	
	($000)	(% of total)	($000)	(% of total)	($000)	(% of total)	($000)	(% of total)
Alberta	452	. . .	414 203	9.3	16 470 719	79.5	16 885 374	47.7
Ontario	3 505 366	34.4	1 188 958	26.6	75 254	0.4	4 769 578	13.5
British Columbia	1 501 697	14.7	367 885	8.2	1 629 622	7.9	3 499 204	9.9
Saskatchewan	424 379	4.2	875 882	19.6	1 857 490	9.0	3 157 751	8.9
Quebec	1 663 010	16.3	1 031 398	23.1	–	–	2 694 407	7.6
Manitoba	905 808	8.9	89 386	2.0	86 850	0.4	1 082 044	3.1
New Brunswick	594 174	5.8	281 747	6.3	32 200	0.2	908 121	2.6
Newfoundland	664 767	6.5	40 906	0.9	–	–	705 673	2.0
Northwest Territories	468 506	4.6	13 352	0.3	199 286	1.0	681 144	1.9
Nova Scotia	1 925	. . .	160 111	3.6	360 997	1.7	523 033	1.5
Yukon	471 558	4.6	6 446	0.1	18 225	0.1	496 230	1.4
Prince Edward Island	–	–	1 699	. . .	–	–	1 699	. . .
Total	10 201 641	100.0	4 471 972	100.0	20 730 643	100.0	35 404 256	100.0

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . . Amount too small to be expressed.
Note: Numbers may not add to totals due to rounding.

TABLE 4. CANADA, VALUE OF MINERAL PRODUCTION BY PROVINCE AND TERRITORY, 1987-93

	1987	1988	1989	1990	1991	1992	1993p
				($ millions)			
Alberta	17 080	15 062	16 456	19 111	16 373	16 885	18 642
Ontario	5 652	6 895	7 308	6 446	5 101	4 770	4 468
British Columbia	3 615	3 943	4 123	3 954	3 840	3 499	3 528
Saskatchewan	3 151	3 043	3 017	3 183	2 863	3 158	3 173
Quebec	2 780	2 712	2 878	3 037	2 930	2 694	2 554
Manitoba	1 000	1 627	1 668	1 311	1 125r	1 082	912
New Brunswick	624	911	859	878	671	908	782
Newfoundland	743	865	897	866	772	706	728
Northwest Territories	870	957	1 149	988	711	681	607
Nova Scotia	407	446	442	459	460	523	530
Yukon	437	492	534	542	341	496	136
Prince Edward Island	3	2	2	3	3	2	2
Total	36 361	36 955	39 333	40 778	35 190r	35 404	36 062

Sources: Natural Resources Canada; Statistics Canada.
p Preliminary; r Revised.
Note: Numbers may not add to totals due to rounding.

TABLE 5. CANADA, PERCENTAGE CONTRIBUTION OF PROVINCES AND TERRITORIES TO TOTAL VALUE OF MINERAL PRODUCTION, 1987-93

	1987	1988	1989	1990	1991	1992	1993p
Alberta	47.0	40.8	41.8	46.9	46.5	52.7	52.7
Ontario	15.5	18.7	18.6	15.8	14.5	12.6	12.6
British Columbia	9.9	10.7	10.5	9.7	10.9	10.0	10.0
Saskatchewan	8.7	8.2	7.7	7.8	8.1	9.0	9.0
Quebec	7.6	7.3	7.3	7.4	8.3	7.2	7.2
Manitoba	2.8	4.4	4.2	3.2	3.2	2.6	2.6
New Brunswick	1.7	2.5	2.2	2.2	1.9	2.2	2.2
Newfoundland	2.0	2.3	2.3	2.1	2.2	2.1	2.1
Northwest Territories	2.4	2.6	2.9	2.4	2.0	1.7	1.7
Nova Scotia	1.1	1.2	1.1	1.1	1.3	1.5	1.5
Yukon	1.2	1.3	1.4	1.3	1.0	0.4	0.4
Prince Edward Island	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Sources: Natural Resources Canada; Statistics Canada.
. . . Amount too small to be expressed; p Preliminary.
Note: Numbers may not add to totals due to rounding.

TABLE 6. CANADA, PRODUCTION OF LEADING MINERALS, 1992 AND 1993

		Volume 1992	Volume 1993p	Percent Change 1993/1992	Value 1992	Value 1993p	Percent Change 1993/1992
		(000 tonnes except where noted)			($ millions)		
METALS							
Gold	kg	159 858.2	152 578.3	–4.6	2 134.6	2 258.0	5.8
Copper		761.7	698.8	–8.3	2 137.0	1 759.7	–17.7
Zinc		1 195.7	998.2	–16.5	1 791.2	1 228.8	–31.4
Nickel		177.6	180.8	1.8	1 502.1	1 216.0	–19.0
Iron ore		31 582.0	31 720.5	0.4	1 084.8	1 036.6	–4.4
Uranium	tU	9 114.1	9 015.4	–1.1	566.4	509.0	–10.1
Silver	t	1 169.0	868.7	–25.7	178.7	152.9	–14.5
Platinum group	kg	11 311.3	13 116.4	16.0	130.2	138.8	6.6
Lead		336.9	187.6	–44.3	247.3	96.2	–61.1
Cobalt		2.2	2.4	6.6	131.4	89.8	–31.6
NONMETALS							
Potash (K_2O)		7 039.6	6 969.8	–1.0	980.9	901.5	–8.1
Salt		11 088.0	11 371.4	2.6	266.4	279.8	5.0
Asbestos		587.0	509.3	–13.2	231.0	215.1	–6.9
Peat		827.9	820.0	–1.0	116.9	119.2	2.0
Sulphur, in smelter gas		783.4	797.0	1.7	88.1	95.0	7.9
Gypsum		7 294.7	7 835.9	7.4	71.8	83.1	15.7
STRUCTURALS							
Cement		8 598.2	9 841.6	14.5	682.4	764.6	12.0
Sand and gravel		240 616.0	229 940.5	–4.4	760.4	736.5	–3.1
Stone		89 337.7	79 208.6	–11.3	516.5	469.6	–9.1
Lime		2 384.3	2 446.6	2.6	191.3	200.7	4.9
Clay products		. .	. .	. .	114.3	108.1	–5.4
FUELS							
Petroleum, crude	000 m^3	93 255.8	97 249.3	4.3	10 907.8	11 155.0	2.3
Natural gas	million m^3	116 663.5	129 245.1	10.8	5 718.6	7 248.6	26.8
Natural gas by-products	000 m^3	26 734.5	28 462.6	6.5	2 434.9	2 793.0	14.7
Coal		65 612.0	68 600.0	4.6	1 669.3	1 783.0	6.8

Sources: Natural Resources Canada; Statistics Canada.
. . Not available; p Preliminary.
Note: Numbers have been rounded.

TABLE 7. VALUE OF LEADING MINERALS IN THE PROVINCES, TERRITORIES AND CANADA, 1992 AND 1993

	Value of Production			
	1992	1993p	Change 1993/1992	1993p Proportion of Provincial Total
	($ millions)		(percent)	
NEWFOUNDLAND				
Iron ore	645.3	637.0	–1.3	87.5
Gold	x	x	x	x
Sand and gravel	17.6	17.5	–0.7	2.4
Cement	x	x	x	x
Stone	4.8	9.5	98.1	1.3
Asbestos	3.5	5.2	49.0	0.7
Total	705.7	728.0	3.2	100.0
PRINCE EDWARD ISLAND				
Sand and gravel	1.7	1.7	–	100.0
Total	1.7	1.7	–	100.0
NOVA SCOTIA				
Coal	264.9	222.2	–16.1	42.0
Petroleum, crude	96.1	131.6	36.9	24.9
Gypsum	47.3	57.7	22.0	10.9
Salt	x	x	x	x
Stone	24.9	26.5	6.4	5.0
Cement	x	x	x	x
Total	523.0	529.5	1.2	100.0
NEW BRUNSWICK				
Zinc	450.9	379.9	–15.7	48.6
Potash (K_2O)	x	x	x	x
Silver	38.8	39.3	1.3	5.0
Lead	57.4	37.5	–34.7	4.8
Coal	32.2	33.8	5.0	4.3
Peat	38.1	33.2	–12.9	4.2
Total	908.1	781.7	–13.9	100.0
QUEBEC				
Gold	595.4	619.9	4.1	24.3
Iron ore	x	x	x	x
Asbestos	224.5	209.9	–6.5	8.2
Copper	258.0	196.3	–23.9	7.7
Stone	207.5	176.8	–14.8	6.9
Titanium dioxide	x	x	x	x
Total	2 694.4	2 553.7	–5.2	100.0
ONTARIO				
Gold	992.7	1 064.9	7.3	23.8
Nickel	1 005.6	836.2	–16.8	18.7
Copper	763.8	677.2	–11.3	15.2
Cement	269.9	301.8	11.8	6.8
Sand and gravel	266.4	265.3	–0.4	5.9
Zinc	285.4	225.1	–21.1	5.0
Total	4 769.6	4 467.9	–6.3	100.0
MANITOBA				
Nickel	496.6	379.8	–23.5	41.6
Copper	168.4	155.2	–7.8	17.0
Zinc	133.6	117.5	–12.1	12.9
Petroleum, crude	86.3	79.0	–8.5	8.7
Gold	41.5	45.1	8.7	4.9
Sand and gravel	35.2	31.9	–9.4	3.5
Total	1 082.0	912.5	–15.7	100.0

TABLE 7 (cont'd)

	Value of Production			
	1992	1993p	Change 1993/1992	1993p Proportion of Provincial Total
	($ millions)		(percent)	
ALBERTA				
Petroleum, crude	8 823.9	9 016.1	2.2	48.4
Natural gas	4 736.2	6 045.2	27.6	32.4
Natural gas by-products	2 346.4	2 698.8	15.0	14.5
Coal	564.2	573.0	1.6	3.1
Cement	x	x	x	x
Sand and gravel	125.3	118.4	–5.5	0.6
Total	16 885.3	18 642.3	10.4	100.0
BRITISH COLUMBIA				
Coal	706.3	850.0	20.3	24.1
Natural gas	588.0	795.5	35.3	22.5
Copper	908.4	703.6	–22.5	19.9
Petroleum, crude	262.8	241.8	–8.0	6.9
Gold	224.0	212.5	–5.1	6.0
Cement	119.3	133.4	11.8	3.8
Total	3 499.2	3 528.4	0.8	100.0
YUKON				
Gold	49.9	50.4	1.0	37.1
Zinc	303.1	41.7	–86.2	30.7
Natural gas	18.2	18.5	1.6	13.6
Lead	99.6	13.9	–86.0	10.2
Sand and gravel	6.4	6.3	–1.6	4.6
Silver	19.0	5.0	–73.7	3.7
Total	496.2	135.8	–72.6	100.0
NORTHWEST TERRITORIES				
Gold	180.5	192.6	6.7	31.7
Petroleum, crude	187.7	190.7	1.6	31.4
Zinc	256.9	179.8	–30.0	29.6
Lead	28.7	14.8	–48.4	2.4
Sand and gravel	10.7	11.6	8.4	1.9
Natural gas	8.7	10.8	24.1	1.8
Total	681.1	607.3	–10.8	100.0
CANADA				**(Proportion of Canadian Total)**
Petroleum, crude	10 907.8	11 155.0	2.3	30.9
Natural gas	5 718.6	7 248.6	26.8	20.1
Natural gas by-products	2 434.9	2 793.0	14.7	7.7
Gold	2 134.6	2 258.0	5.8	6.3
Coal	1 669.3	1 783.0	6.8	4.9
Copper	2 137.0	1 759.7	–17.7	4.9
Zinc	1 791.2	1 228.8	–31.4	3.4
Nickel	1 502.1	1 216.0	–19.0	3.4
Iron ore	1 084.8	1 036.6	–4.4	2.9
Potash (K_2O)	980.9	901.5	–8.1	2.5
Grand total	35 404.3	36 062.2	1.9	100.0

Sources: Natural Resources Canada; Statistics Canada.
– Nil; p Preliminary; x Confidential.

TABLE 8. PRODUCTION OF LEADING MINERALS, BY PROVINCE AND TERRITORY IN CANADA, 1993p

	Unit of Measure	Nfld.	P.E.I.	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskat-chewan	Alberta	British Columbia	Yukon	N.W.T.	Total Canada
	(000)													
Petroleum, crude	m^3	–	–	1 077	–	–	245	633	14 749	76 710	1 966	–	1 869	97 249
	$	–	–	131 649	–	–	36 795	78 950	1 459 053	9 016 060	241 757	–	190 733	11 154 997
Natural gas	000 m^3	–	–	–	–	–	410	–	6 362	105 351	16 512	399	212	129 245
	$	–	–	–	–	–	39 331	–	339 370	6 045 160	795 543	18 463	10 768	7 248 635
Natural gas by-products	m^3	–	–	–	–	–	–	6	129	27 482	816	–	29	28 463
	$	–	–	–	–	–	–	620	13 273	2 698 797	77 290	–	2 980	2 792 960
Gold	g	x	–	–	492	41 891	71 957	3 045	x	19	14 357	3 407	13 016	152 578
	$	x	–	–	7 288	619 945	1 064 891	45 062	x	281	212 477	50 426	192 630	2 258 007
Coal	t	–	–	3 500	390	–	–	–	9 950	34 210	20 550	–	–	68 600
	$	–	–	222 200	33 800	–	–	–	104 000	573 000	850 000	–	–	1 783 000
Copper	kg	350	–	–	10 517	77 963	268 944	61 618	–	–	279 407	–	–	698 799
	$	881	–	–	26 484	196 322	677 239	155 163	–	–	703 585	–	–	1 759 675
Zinc	kg	–	–	–	308 579	128 065	182 873	95 476	–	–	103 307	33 906	146 027	998 234
	$	–	–	–	379 861	157 648	225 117	117 531	–	–	127 171	41 738	179 760	1 228 826
Nickel	kg	–	–	–	–	–	124 299	56 464	–	–	–	–	–	180 763
	$	–	–	–	–	–	836 163	379 832	–	–	–	–	–	1 215 994
Iron ore	t	17 547	–	–	–	13 626	490	–	–	–	57	–	–	31 720
	$	636 989	–	–	–	x	x	–	–	–	1 327	–	–	1 036 587
Potash (K_2O)	t	–	–	–	x	–	–	–	x	–	–	–	–	6 970
	$	–	–	–	x	–	–	–	x	–	–	–	–	901 539
Cement	t	x	–	x	–	2 530	4 142	x	x	x	1 461	–	–	9 842
	$	x	–	x	–	146 482	301 764	x	x	x	133 418	–	–	764 589
Sand and gravel	t	3 551	448	5 629	6 684	30 445	90 000	8 766	6 147	34 003	39 431	2 236	2 601	229 940
	$	17 477	1 700	19 906	14 041	104 961	265 305	31 871	17 835	118 402	127 134	6 261	11 585	736 479
Uranium (U)	kg	–	–	–	–	–	x	–	x	–	–	–	–	9 015
	$	–	–	–	–	–	x	–	x	–	–	–	–	509 025
Stone	t	2 367	–	4 671	2 694	29 044	33 451	1 967	–	300	4 247	–	467	79 209
	$	9 508	–	26 499	14 556	176 822	193 811	9 878	–	4 137	32 134	–	2 205	469 550
Salt	t	–	–	x	x	x	6 916	–	533	1 359	–	–	–	11 371
	$	–	–	x	x	x	168 049	–	25 654	13 672	–	–	–	279 796
Asbestos	t	15	–	–	–	494	–	–	–	–	–	–	–	509
	$	5 216	–	–	–	209 860	–	–	–	–	–	–	–	215 076
Lime	t	–	–	–	x	x	1 495	x	–	207	x	–	–	2 447
	$	–	–	–	x	x	114 468	x	–	20 362	x	–	–	200 663
Silver	kg	x	–	–	223	134	239	41	x	–	192	29	11	869
	$	x	–	–	39 273	23 653	42 039	7 182	x	–	33 845	5 027	1 855	152 891
Platinum group	g	–	–	–	–	–	x	x	–	–	–	–	–	13 116
	$	–	–	–	–	–	x	x	–	–	–	–	–	138 799
Peat	t	2	–	x	274	292	x	x	x	94	–	–	–	820
	$	259	–	x	33 224	41 250	x	x	x	21 034	–	–	–	119 174
Clay products	$	x	–	x	x	x	68 228	–	x	x	x	–	–	108 127
Lead	kg	–	–	–	73 076	–	–	2 099	–	–	56 353	27 112	28 914	187 554
	$	–	–	–	37 488	–	–	1 077	–	–	28 909	13 908	14 833	96 215
Sulphur, in smelter gas	t	–	–	–	102	109	463	. . .	–	–	123	–	–	797
	$	–	–	–	14 920	16 093	29 152	30	–	–	34 789	–	–	94 984
Cobalt	kg	–	–	–	–	–	1 994	375	–	–	–	–	–	2 370
	$	–	–	–	–	–	75 600	14 219	–	–	–	–	–	89 819
Gypsum	t	x	–	6 130	–	–	866	x	–	–	414	–	–	7 836
	$	x	–	57 707	–	–	14 350	x	–	–	x	–	–	83 107
Total leading minerals	$	726 651	1 700	528 543	779 969	2 139 384	4 392 627	903 819	3 148 185	18 641 215	3 433 248	135 824	607 349	35 438 514
Total all minerals	$	728 034	1 700	529 518	781 663	2 553 738	4 467 894	912 499	3 173 335	18 642 273	3 528 387	135 824	607 349	36 062 213
Leading minerals as % of all minerals		99.8	100.0	99.8	99.8	83.8	98.3	99.0	99.2	100.0	97.3	100.0	100.0	98.3

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . . Amount too small to be expressed; p Preliminary; x Confidential.
Notes: Certain minerals are not included in the leading minerals due to confidentiality constraints. Confidential values are included in "Total all minerals." Numbers may not add to totals due to rounding.

TABLE 8a. PRODUCTION OF LEADING MINERALS, BY PROVINCE AND TERRITORY IN CANADA, 1992

	Unit of Measure	Nfld.	P.E.I.	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskat-chewan	Alberta	British Columbia	Yukon	N.W.T.	Total Canada
	(000)													
Petroleum, crude	m^3	–	–	577	–	–	224	656	13 355	74 505	2 060	–	1 878	93 256
	$	–	–	96 097	–	–	35 175	86 289	1 415 908	8 823 901	262 772	–	187 651	10 907 793
Natural gas	000 m^3	–	–	–	–	–	427	–	6 182	95 180	14 293	393	188	116 664
	$	–	–	–	–	–	40 079	–	327 466	4 736 172	588 006	18 225	8 688	5 718 636
Natural gas	m^3	–	–	–	–	–	–	6	129	25 798	772	–	30	26 735
by-products	$	–	–	–	–	–	–	561	12 416	2 346 446	72 544	–	2 947	2 434 914
Copper	kg	–	–	–	13 697	91 950	272 242	60 024	–	–	323 781	–	–	761 694
	$	–	–	–	38 428	257 979	763 814	168 405	–	–	908 412	–	–	2 137 039
Gold	g	x	–	–	490	44 589	74 343	3 106	x	34	16 773	3 737	13 518	159 858
	$	x	–	–	6 541	595 400	992 705	41 471	x	452	223 966	49 898	180 501	2 134 586
Zinc	kg	–	–	582	301 020	107 466	190 523	89 211	–	–	133 149	202 304	171 481	1 195 736
	$	–	–	871	450 928	160 984	285 403	133 638	–	–	199 458	303 051	256 878	1 791 212
Coal	t	–	–	4 486	399	–	–	–	10 027	33 526	17 174	–	–	65 612
	$	–	–	264 900	32 200	–	–	–	101 700	564 200	706 300	–	–	1 669 300
Nickel	kg	–	–	–	–	–	118 860	58 695	–	–	–	–	–	177 555
	$	–	–	–	–	–	1 005 556	496 556	–	–	–	–	–	1 502 112
Iron ore	t	17 692	–	–	–	13 350	482	–	–	–	59	–	–	31 582
	$	645 333	–	–	–	x	x	–	–	–	1 353	–	–	1 084 773
Potash (K_2O)	t	–	–	–	x	–	–	–	x	–	–	–	–	7 040
	$	–	–	–	x	–	–	–	x	–	–	–	–	980 855
Sand and gravel	t	3 537	444	5 976	6 552	37 307	87 647	9 591	6 236	38 094	39 923	2 318	2 991	240 616
	$	17 610	1 699	20 462	13 161	116 968	266 368	35 239	17 841	125 277	128 624	6 446	10 673	760 367
Gement	t	x	–	x	–	1 909	3 789	x	x	x	1 336	–	–	8 598
	$	x	–	x	–	129 662	269 861	x	x	x	119 313	–	–	682 422
Uranium (U)	kg	–	–	–	–	–	989	–	8 125	–	–	–	–	9 114
	$	–	–	–	–	–	166 204	–	400 148	–	–	–	–	566 352
Stone	t	1 000	–	4 705	2 784	36 524	37 666	1 549	–	316	3 910	–	884	89 338
	$	4 758	–	24 910	15 799	207 500	219 388	7 770	–	3 600	30 113	–	2 679	516 518
Salt	t	–	–	x	x	x	6 638	–	565	1 271	–	–	–	11 088
	$	–	–	x	x	x	155 390	–	24 475	13 617	–	–	–	266 441
Lead	kg	–	–	834	78 137	–	–	1 487	–	–	81 591	135 688	39 141	336 878
	$	–	–	612	57 352	–	–	1 091	–	–	59 888	99 595	28 729	247 268
Asbestos	t	14	–	–	–	567	–	–	–	–	6	–	–	587
	$	3 531	–	–	–	224 549	–	–	–	–	2 939	–	–	231 020
Lime	t	–	–	–	x	x	1 456	x	–	191	x	–	–	2 384
	$	–	–	–	x	x	108 470	x	–	18 463	x	–	–	191 313
Silver	kg	x	–	. . .	254	143	247	41	x	–	345	124	16	1 169
	$	x	–	4	38 500	21 798	37 725	6 246	x	–	52 741	19 014	2 397	178 738
Cobalt	kg	–	–	–	–	–	1 706	517	–	–	–	–	–	2 223
	$	–	–	–	–	–	100 797	30 556	–	–	–	–	–	131 353
Sulphur, elemental	t	–	–	–	–	–	x	–	75	5 868	x	–	–	6 479
	$	–	–	–	–	–	x	–	2 082	115 297	x	–	–	130 634
Platinum group	g	–	–	–	–	–	x	x	–	–	–	–	–	11 311
	$	–	–	–	–	–	x	x	–	–	–	–	–	130 204
Peat	t	5	–	x	323	271	–	x	x	94	–	–	–	828
	$	725	–	x	38 053	36 944	–	x	x	20 500	–	–	–	116 869
Clay products	$	x	–	x	x	x	74 871	–	x	x	x	–	–	114 262
Sulphur, in smelter	t	–	–	. . .	95	109	511	2	–	–	66	–	–	783
gas	$	–	–	46	15 349	17 893	37 909	400	–	–	16 458	–	–	88 055
Total leading minerals	$	701 674	1 699	474 394	905 977	2 257 407	4 690 322	1 069 756	3 135 802	16 885 374	3 413 259	496 229	681 144	34 713 037
Total all minerals	$	705 673	1 699	523 033	908 121	2 694 407	4 769 578	1 082 044	3 157 751	16 885 374	3 499 204	496 230	681 144	35 404 256
Leading minerals as % of all minerals		99.4	100.0	90.7	99.8	83.8	98.3	98.9	99.3	100.0	97.5	100.0	100.0	98.0

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . . Amount too small to be expressed; x Confidential.
Notes: Certain minerals are not included in the leading minerals due to confidentiality constraints. Confidential values are included in "Total all minerals." Numbers may not add to totals due to rounding.

TABLE 9. CANADA, PERCENTAGE CONTRIBUTION OF LEADING MINERALS TO TOTAL VALUE OF MINERAL PRODUCTION, 1987-93

	1987	1988	1989	1990	1991r	1992	1993p
Petroleum, crude	33.4	24.8	27.7	32.1	29.7	30.8	30.9
Natural gas	12.7	14.1	13.7	14.0	15.3	16.2	20.1
Natural gas by-products	5.2	4.3	4.1	5.8	6.2	6.9	7.7
Gold	6.1	6.3	5.9	5.9	6.6	6.0	6.3
Coal	4.5	4.9	4.9	4.5	5.4	4.7	4.9
Copper	5.3	6.5	6.1	6.0	6.0	6.0	4.9
Zinc	4.1	6.1	7.0	5.6	3.9	5.1	3.4
Nickel	3.5	7.5	7.7	5.0	5.1	4.2	3.4
Iron ore	3.8	3.6	3.5	3.1	3.5	3.1	2.9
Potash (K_2O)	2.0	3.2	2.6	2.4	2.6	2.8	2.5
Cement	2.7	2.6	2.4	2.4	2.3	1.9	2.1
Sand and gravel	2.1	2.3	2.2	2.0	2.1	2.1	2.0
Uranium (U)	3.3	2.8	2.3	2.2	1.7	1.6	1.4
Stone	1.6	1.7	1.7	1.6	1.5	1.5	1.3
Salt	0.7	0.7	0.6	0.6	0.7	0.8	0.8
Asbestos	0.7	0.7	0.7	0.7	0.8	0.7	0.6
Lime	0.5	0.5	0.5	0.5	0.5	0.5	0.6
Silver	1.2	1.0	0.7	0.6	0.5	0.5	0.4
Platinum group	0.5	0.5	0.4	0.5	0.4	0.4	0.4
Peat	0.2	0.2	0.3	0.2	0.3	0.3	0.3
Clay products	0.6	0.5	0.5	0.3	0.3	0.3	0.3
Lead	1.1	1.0	0.7	0.7	0.6	0.7	0.3
Sulphur in smelter gas	0.3	0.2	0.2	0.2	0.3	0.2	0.3
Cobalt	0.1	0.1	0.1	0.1	0.2	0.4	0.2
Gypsum	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Other minerals	3.5	3.6	3.3	2.3	2.9	2.1	1.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Sources: Natural Resources Canada; Statistics Canada.
p Preliminary; r Revised.
Note: Numbers may not add to totals due to rounding.

TABLE 10. PRODUCTION OF CANADA'S TEN LEADING[1] MINERAL COMMODITIES, 1986-93

	Unit	1986	1987	1988	1989	1990	1991	1992	1993p
	(000)								
Petroleum, crude	m^3	85 468	89 140	93 806	90 641	90 279	89 788	93 256	97 249
Natural gas	000 m^3	71 896	78 267	90 911	96 117	98 771	105 244	116 664	129 245
Natural gas by-products	m^3	19 127	21 560	22 556	23 055	23 863	24 919	26 735	28 463
Gold	g	102 899	115 818	134 813	159 494	167 373	175 282r	159 858	152 578
Coal	t	57 811	61 211	70 644	70 527	68 332	71 133	65 612	68 600
Copper	kg	698 527	794 149	758 478	704 432	771 433	780 362	761 694	698 799
Zinc	kg	988 173	1 157 936	1 370 000	1 272 854	1 179 372	1 083 008	1 195 736	998 234
Nickel	kg	163 639	189 086	198 744	195 554	195 004	188 098	177 555	180 763
Iron ore	t	36 167	37 702	39 934	39 445	35 670	35 421	31 582	31 720
Potash (K_2O)	t	6 753	7 668	8 154	7 014	7 345	7 087	7 040	6 970

Sources: Natural Resources Canada; Statistics Canada.
p Preliminary; r Revised.
[1] Based on contribution in 1993 to value of mineral production.

TABLE 11. CANADA'S WORLD ROLE AS A PRODUCER OF CERTAIN IMPORTANT MINERALS, 1992[p]

		World	Rank of Five Leading Countries 1	2	3	4	5
			Canada	FSU	Germany	United States	Israel
Potash (K_2O equivalent)	000 t	24 036	**7 270**	6 948	3 525	1 658	1 296
(mine production)	% of world total		**30.2**	28.9	14.7	6.9	5.4
			Canada	FSU	Niger	Australia	France
Uranium (U concentrates)	t	34 921	**9 298[a]**	8 300[e]	2 965	2 333	2 119
(mine production)	% of world total		**26.6**	23.8	8.5	6.7	6.1
			Canada	FSU	New Caledonia	Indonesia	Australia
Nickel (mine production)	000 t	853	**186**	180[e]	101	78	58
	% of world total		**21.8**	21.1	11.8	9.1	6.8
			Canada	Australia	China	Peru	United States
Zinc (mine production)	000 t	7 231	**1 325**	1 013	706	603	552
	% of world total		**18.3**	14.0	9.8	8.3	7.6
			United States	**Canada**	FSU	Poland	Saudi Arabia
Sulphur, elemental	000 t	36 368	9 369	**6 556**	5 181	2 925	2 370
(mine production)	% of world total		25.8	**18.0**	14.2	8.0	6.5
			FSU	**Canada**	Brazil	China	Zimbabwe
Asbestos (mine production)	000 t	3 685	2 200[e]	**591**	250[e]	220[e]	160[e]
	% of world total		59.7	**16.0**	6.8	6.0	4.3
			Japan	**Canada**	United States	Belgium	FSU
Cadmium (refined production)	t	19 463	2 987	**1 963**	1 620	1 550	1 320[e]
	% of world total		15.3	**10.1**	8.3	8.0	6.8
			Australia	South Africa	**Canada**	Norway	FSU
Titanium concentrates (ilmenite)	000 t	5 660	1 718	959	**753[e,b]**	718	358
	% of world total		30.4	16.9	**13.3**	12.7	6.3
			Australia	United States	**Canada**	China	FSU
Lead (mine production)	000 t	2 980	572	408	**344**	287	225
	% of world total		19.2	13.7	**11.5**	9.6	7.6
			United States	FSU	**Canada**	Australia	Brazil
Aluminum (primary metal)	000 t	19 453	4 042	3 200[e]	**1 972**	1 236	1 193
	% of world total		20.8	16.6	**10.1**	6.4	6.1
			South Africa	Russia	**Canada**	United States	Colombia
Platinum group metals	kg	193 402	145 000	112 500	**11 907**	8 310	1 600
(mine production)	% of world total		75.0	58.2	**6.2**	4.3	0.8
			Zaire	Zambia	FSU	**Canada**	Australia
Cobalt (shipments)	t	21 786	6 625	4 610	4 400[e]	**2 223**	1 670
	% of world total		30.4	21.2	20.2	**10.2**	7.7
			Chile	United States	FSU	**Canada**	Zambia
Copper (mine production)	000 t	9 259	1 933	1 761	800	**769**	433
	% of world total		20.9	19.0	8.6	**8.3**	4.7
			United States	China	Iran	**Canada**	Thailand
Gypsum (mine production)	000 t	98 303	14 759	10 977	7 983	**7 566**	6 985
	% of world total		15.0	11.2	8.1	**7.7**	7.1
			Mexico	United States	Peru	Australia	**Canada**
Silver (mine production)	t	13 825	2 316	1 804	1 570	1 248	**1 214**
	% of world total		16.8	13.0	11.4	9.0	**8.8**
			United States	China	FSU	Chile	**Canada**
Molybdenum (Mo content)	t	111 532	49 725	16 000[e]	15 000[e]	14 500	**9 405**
(mine production)	% of world total		44.6	14.3	13.4	13.0	**8.4**
			South Africa	United States	FSU	Australia	**Canada**
Gold (mine production)	t	2 165	613	296	253[e]	243	**161**
	% of world total		28.3	13.7	11.7	11.2	**7.4**

[e] Estimated; [p] Preliminary.
FSU: former Soviet Union.
[a] Includes uranium (tU) recovered by Elliot Lake producers from refinery/conversion facility wastes. [b] Titaniferous slag with 80% TiO_2 content.

TABLE 12. CANADA'S WORLD ROLE AS A PRODUCER OF CERTAIN IMPORTANT MINERALS, 1991

		World	Rank of Five Leading Countries 1	2	3	4	5
Zinc (mine production)			**Canada**	Australia	China	Peru	FSU
	000 t	7 245	**1 157**	1 048	710	638	610
	% of world total		**16.0**	14.5	9.8	8.8	8.4
Potash (K_2O equivalent) (mine production)			FSU	**Canada**	Germany	United States	Israel
	000 t	26 035	8 510	**7 405**	3 902	1 692	1 270
	% of world total		32.7	**28.4**	15.0	6.5	4.9
Nickel (mine production)			FSU	**Canada**	New Caledonia	Indonesia	Australia
	000 t	886	200[e]	**192**	100	70	69
	% of world total		22.6	**21.7**	11.3	7.9	7.8
Uranium (U concentrates) (mine production)			FSU	**Canada**	Australia	United States	Niger
	t	41 074	10 500[e]	**8 161[a]**	3 776	3 040	2 964
	% of world total		25.6	**19.9**	9.2	7.4	7.2
Sulphur, elemental (mine production)			United States	**Canada**	FSU	Poland	Saudi Arabia
	000 t	36 948	9 510	**6 258**	5 334	3 917	2 045
	% of world total		25.7	**16.9**	14.4	10.6	5.5
Asbestos (mine production)			FSU	**Canada**	Brazil	China	Zimbabwe
	000 t	4 011	2 500[e]	**639[e]**	200[e]	200[e]	160[e]
	% of world total		62.3	**15.9**	5.0	5.0	4.0
Cadmium (refined production)			Japan	**Canada**	Belgium	United States	FSU
	t	20 066	2 889	**1 829**	1 810	1 676	1 500
	% of world total		14.4	**9.1**	9.0	8.4	7.5
Titanium concentrates (ilmenite)			Australia	South Africa	**Canada**	Norway	FSU
	000 t	5 378	1 582	883	**701[e,b]**	625	409
	% of world total		29.4	16.4	**12.6**	13.0	7.6
Aluminum (primary metal)			United States	FSU	**Canada**	Australia	Brazil
	000 t	19 685	4 121	3 251	**1 822**	1 229	1 140
	% of world total		20.9	16.5	**9.3**	6.2	5.8
Platinum group metals (mine production)			South Africa	FSU	**Canada**	United States	Japan
	kg	288 338	142 861	121 500	**11 708**	7 780	2 041
	% of world total		49.5	42.1	**4.1**	2.7	0.7
Silver (mine production)			Mexico	United States	Peru	**Canada**	Australia
	t	13 961	2 224	1 855	1 770	**1 339**	1 180
	% of world total		15.9	13.3	12.7	**9.6**	8.5
Copper (mine production)			Chile	United States	FSU	**Canada**	Zambia
	000 t	9 099	1 814	1 631	840	**811**	423
	% of world total		19.9	17.9	9.2	**8.9**	4.6
Lead (mine production)			Australia	United States	China	**Canada**	FSU
	000 t	3 122	579	477	320	**277**	230
	% of world total		18.5	15.3	10.2	**8.9**	48.2
Cobalt (shipments)			Zaire	FSU	Zambia	**Canada**	Australia
	t	24 965	8 620	5 200[e]	4 817	**2 171**	1 512[e]
	% of world total		34.5	20.8	19.3	**8.7**	6.1
Molybdenum (Mo content) (mine production)			United States	China	FSU	Chile	**Canada**
	t	117 732	53 364	16 000[e]	16 000[e]	14 434	**11 329**
	% of world total		45.3	13.6	13.6	12.3	**9.6**
Gold (mine production)			South Africa	United States	FSU	Australia	**Canada**
	t	2 164	601	290	260[e]	236	**177**
	% of world total		27.8	13.4	12.0	10.9	**8.2**
Gypsum (mine production)			United States	China	Iran	Thailand	**Canada**
	000 t	92 762	14 021	8 165	8 001	7 197	**6 830**
	% of world total		15.1	8.8	8.6	7.8	**7.4**

[e] Estimated.
FSU: former Soviet Union.
[a] Includes uranium (tU) recovered by Elliot Lake producers from refinery/conversion facility wastes. [b] Titaniferous slag with 80% TiO_2 content.

TABLE 13. CANADA, GROSS DOMESTIC PRODUCT OF INDUSTRIAL PRODUCTION, MINING AND MINERAL MANUFACTURING AT FACTOR COST AT 1986 PRICES, 1986-92

	1986	1987	1988	1989	1990	1991	1992p
				($ millions)			
Total industrial production	120 363.8	126 226.0	132 919.0	132 729.0	128 551.6	123 847.8	124 356.1
Total mining	17 502.0	18 631.7	20 422.3	19 621.4	19 468.6	19 711.2	19 938.1
METALS							
Gold mines	880.6	987.1	1 213.8	1 541.6	1 687.5	1 787.7	1 621.6
Other metal mines	2 346.5	2 734.0	2 708.7	2 272.1	2 147.6	2 128.3	2 199.4
Iron mines	452.7	505.1	568.5	607.2	493.5	478.2	448.7
FUELS							
Crude oil and natural gas	9 762.6	10 379.4	11 449.2	11 208.7	11 175.7	11 500.6	12 265.7
NONMETALS							
Asbestos	102.0	103.7	102.3	124.0	118.2	105.6	94.0
All nonmetals	485.4	583.4	609.0	534.7	507.1	509.6	501.3
Potash	309.9	369.9	439.8	368.1	337.3	354.8	348.2
Salt	135.6	125.8	138.9	143.9	144.0	152.4	140.9
Coal	755.2	849.8	1 012.7	987.7	1 047.7	1 111.0	916.1
Quarry and sand pits	643.7	687.7	721.4	685.9	591.7	550.2	511.1
SERVICES RELATED TO MINING	1 937.7	1 675.7	1 897.8	1 515.6	1 555.6	1 387.6	1 239.3
MINERAL MANUFACTURING							
Primary metals	6 127.7	6 773.1	7 130.8	6 922.1	6 557.1	6 655.7	6 849.2
Primary steel	2 625.8	2 827.1	2 957.8	2 966.7	2 568.1	2 479.0	2 592.8
Steel pipe and tube mills	277.7	328.6	485.2	467.0	456.0	539.8	420.4
Iron foundries	460.8	424.4	439.9	394.3	451.5	415.1	436.4
Nonferrous smelting and refining	1 954.7	2 301.2	2 316.8	2 155.1	2 220.2	2 412.4	2 520.2
Nonmetallic mineral products	2 971.3	3 256.9	3 308.0	3 230.5	2 926.1	2 480.1	2 293.0
Cement	384.0	431.2	449.8	461.5	457.6	387.3	355.0
Concrete products	448.4	476.8	523.8	528.5	443.1	346.7	294.6
Ready-mix concrete	507.1	568.7	519.8	535.3	487.1	399.9	359.6
Glass and glass products	647.8	694.5	667.6	632.0	576.7	531.7	516.8
Miscellaneous nonmetallic products	787.0	866.9	962.9	915.3	851.5	723.9	678.0
Petroleum and coal products	1 731.5	1 823.9	1 870.7	1 952.1	2 091.7	2 043.2	1 996.0

Source: Statistics Canada.
p Preliminary.

TABLE 14. CANADA, GROSS DOMESTIC PRODUCT BY INDUSTRY AT FACTOR COST AT 1986 PRICES, 1986-92

	1986	1987	1988	1989	1990	1991	1992p
				($ millions)			
Gross domestic product, all industries	451 845.3	471 519.4	492 588.0	505 049.5	504 787.4	498 932.2	503 637.5
Agriculture	11 056.7	9 965.7	9 451.7	10 231.4	11 717.2	11 594.9	11 025.1
Fishing and trapping	980.2	885.5	946.3	1 023.0	1 061.7	963.6	822.1
Forestry	2 690.8	3 008.2	3 044.2	3 128.8	2 968.0	2 718.4	2 946.2
Mines (including milling), quarries and oil wells	17 502.0	18 631.7	20 422.3	19 621.4	19 468.6	19 711.2	19 938.1
Manufacturing	86 797.1	90 967.2	95 600.0	96 453.8	93 288.0	87 851.2	88 046.9
Construction	28 081.7	29 686.5	30 815.0	32 502.4	32 497.5	31 090.3	29 034.2
Transportation and storage	20 253.4	21 659.9	22 756.3	22 403.2	22 103.1	21 590.2	21 915.5
Communications	13 247.9	14 140.2	15 223.2	16 835.7	17 850.8	18 586.4	18 987.8
Electric power, gas and water utilities	15 197.7	15 755.6	16 003.9	15 735.8	14 820.5	15 285.9	15 383.5
Trade, wholesale	23 312.0	25 131.6	26 971.7	28 111.3	28 082.5	28 185.7	30 253.9
Trade, retail	28 269.2	29 929.2	30 854.9	31 613.1	30 632.6	29 368.5	29 913.2
Finance, insurance and real estate	69 033.9	71 931.4	74 721.7	76 700.5	77 102.3	80 034.8	82 833.9
Community, business and personal services	52 119.0	55 102.8	59 240.1	62 123.5	62 477.9	60 159.2	59 808.5
Government services	31 365.5	31 418.1	31 906.0	32 560.3	33 216.3	33 604.9	34 041.5

Source: Statistics Canada.
p Preliminary.

TABLE 15. CANADA, EXPORTS OF MINERAL COMMODITIES BY COUNTRY AND BY COMMODITY AS DEFINED BY THE HARMONIZED SYSTEM (HS), 1993 (9 MONTHS)

HS Chapter[1]	Description	United States		EC[2]		Japan		Mexico		Other		Total	
		($000)	(%)	($000)	(%)	($000)	(%)	($000)	(%)	($000)	(%)	($000)	(%)
25	Salts; sulphur; earths or stone, plastering materials, lime and cement	388 951	53.8	50 397	7.0	44 472	6.2	13 699	1.9	225 522	31.2	723 041	100
26	Ores, slag and ash	283 308	19.1	634 194	42.8	362 841	24.5	19 683	1.3	182 704	12.3	1 482 730	100
27	Mineral fuels, oils and products of their distillation; bituminous substances; mineral waxes[3]	12 855 047	89.4	72 688	0.5	891 221	6.2	12 117	0.1	540 227	3.8	14 371 300	100
28	Inorganic chemicals; compounds of precious metals, radioactive elements, etc.	1 114 828	86.0	79 101	6.1	37 137	2.9	846	0.1	64 980	5.0	1 296 892	100
31	Fertilizers	849 168	69.2	10 660	0.9	47 628	3.9	5 747	0.5	314 723	25.6	1 227 926	100
68	Articles of stone, plaster, cement, asbestos, mica or similar materials	312 172	91.5	11 155	3.3	2 811	0.8	73	–	14 804	4.3	341 015	100
69	Ceramic products	32 254	81.1	1 957	4.9	617	1.6	7	–	4 957	12.5	39 792	100
70	Glass and glassware	341 846	84.0	43 464	10.7	1 473	0.4	218	0.1	19 999	4.9	407 000	100
71	Natural/cultured pearls, precious stones and metals, coins, etc.	1 851 009	70.8	144 678	5.5	6 504	0.2	52	–	611 048	23.4	2 613 291	100
72	Iron and steel	1 955 338	91.3	11 436	0.5	4 609	0.2	30 723	1.4	138 728	6.5	2 140 834	100
73	Articles of iron or steel	1 448 772	90.9	21 120	1.3	1 691	0.1	7 014	0.4	115 383	7.2	1 593 980	100
74	Copper and articles thereof	767 056	64.8	248 579	21.0	4 460	0.4	45	–	163 899	13.8	1 184 039	100
75	Nickel and articles thereof	356 732	32.5	330 731	30.2	38 229	3.5	5 419	0.5	365 292	33.3	1 096 403	100
76	Aluminum and articles thereof	2 241 806	73.7	451 209	14.8	194 152	6.4	688	–	155 327	5.1	3 043 182	100
78	Lead and articles thereof	60 872	81.2	1 324	1.8	511	0.7	–	–	12 266	16.4	74 973	100
79	Zinc and articles thereof	449 466	84.3	6 231	1.2	8 816	1.7	–	–	68 431	12.8	532 944	100
80	Tin and articles thereof	7 838	82.8	620	6.5	174	1.8	–	–	835	8.8	9 467	100
81	Other base metals; cermets; and articles thereof	60 142	35.6	30 501	18.1	17 192	10.2	401	0.2	60 500	35.9	168 736	100
	Total mineral exports	25 376 605	78.4	2 150 045	6.6	1 664 538	5.1	96 732	0.3	3 059 625	9.5	32 347 545	100
	Total domestic exports	104 275 804	80.5	7 467 155	5.8	6 298 346	4.9	545 467	0.4	11 019 328	8.5	129 606 100	100
	Percentage, mineral to domestic	24.3		28.8		26.4		17.7		27.8		25.0	

Source: Statistics Canada, Catalogue no. 65-003 (Quarterly).
– Nil.
[1] Chapter refers to a group of commodities covered in a specified chapter of the "Harmonized Commodity Description and Coding System," as of January 1, 1988. Canadian external trade statistics are classified according to the Harmonized System. [2] EC: European Community. [3] Total value of coal exports included in Chapter 27 is $1440 million.

TABLE 16. CANADA, IMPORTS OF MINERAL COMMODITIES BY COUNTRY AND BY COMMODITY AS DEFINED BY THE HARMONIZED SYSTEM (HS), 1993 (9 MONTHS)

HS Chapter[1]	Description	United States		EC[2]		Japan		Mexico		Other		Total	
		($000)	(%)	($000)	(%)	($000)	(%)	($000)	(%)	($000)	(%)	($000)	(%)
25	Salts; sulphur; earths or stone, plastering materials, lime and cement	265 346	78.7	7 478	2.2	495	0.1	7 844	2.3	55 960	16.6	337 123	100
26	Ores, slag and ash	330 368	58.8	53 342	9.5	–	–	1 251	0.2	177 289	31.5	562 250	100
27	Mineral fuels, oils and products of their distillation; bituminous substances; mineral waxes[3]	1 128 433	22.5	1 093 381	21.8	765	–	189 396	3.8	2 594 018	51.8	5 005 993	100
28	Inorganic chemicals; compounds of precious metals, radioactive elements, etc.	622 155	53.0	56 776	4.8	8 479	0.7	562	–	486 050	41.4	1 174 022	100
31	Fertilizers	163 179	80.9	19 530	9.7	766	0.4	–	–	18 136	9.0	201 611	100
68	Articles of stone, plaster, cement, asbestos, mica or similar materials	237 626	76.3	43 489	14.0	4 556	1.5	2 030	0.7	23 553	7.6	311 254	100
69	Ceramic products	150 546	36.1	126 737	30.4	29 403	7.1	8 745	2.1	101 420	24.3	416 851	100
70	Glass and glassware	765 700	79.9	61 709	6.4	42 865	4.5	33 942	3.5	53 622	5.6	957 838	100
71	Natural/cultured pearls, precious stones and metals, coins, etc.	1 057 366	72.6	86 153	5.9	3 029	0.2	2 002	0.1	307 251	21.1	1 455 801	100
72	Iron and steel	1 045 139	61.5	342 485	20.2	88 641	5.2	5 747	0.3	217 077	12.8	1 699 089	100
73	Articles of iron or steel	1 794 869	75.1	199 616	8.4	129 801	5.4	14 618	0.6	251 135	10.5	2 390 039	100
74	Copper and articles thereof	371 062	85.6	31 059	7.2	2 003	0.5	936	0.2	28 435	6.6	433 495	100
75	Nickel and articles thereof	59 222	27.5	19 095	8.9	118	0.1	226	0.1	136 589	63.5	215 250	100
76	Aluminum and articles thereof	1 002 406	86.5	76 498	6.6	6 006	0.5	1 089	0.1	73 367	6.3	1 159 366	100
78	Lead and articles thereof	11 666	88.8	159	1.2	16	0.1	1 288	9.8	11	0.1	13 140	100
79	Zinc and articles thereof	21 077	88.3	283	1.2	158	0.7	–	–	2 351	9.8	23 869	100
80	Tin and articles thereof	10 487	29.1	1 535	4.3	1	–	21	0.1	24 055	66.6	36 099	100
81	Other base metals; cermets; and articles thereof	85 129	71.6	15 062	12.7	2 267	1.9	–	–	16 508	13.9	118 966	100
	Total mineral imports	9 121 776	55.2	2 234 387	13.5	319 369	1.9	269 697	1.6	4 566 827	27.7	16 512 056	100
	Total domestic imports	83 495 095	67.1	10 604 879	8.5	7 924 097	6.4	2 494 622	2.0	20 004 238	16.1	124 522 931	100
	Percentage, mineral to domestic	10.9		21.1		4.0		10.8		22.8		13.3	

Source: Statistics Canada, Catalogue no. 65-006 (Quarterly).
– Nil.
1 Chapter refers to a group of commodities covered in a specified chapter of the "Harmonized Commodity Description and Coding System," as of January 1, 1988. Canadian external trade statistics are classified according to the Harmonized System. 2 EC: European Community. 3 Total value of coal imports included in Chapter 27 is $361.30 million.

TABLE 17. CANADA, EXPORTS OF MINERAL COMMODITIES BY COUNTRY AND BY COMMODITY AS DEFINED BY THE HARMONIZED SYSTEM (HS), 1992 REVISED

HS Chapter[1]	Description	United States		EC[2]		Japan		Mexico		Other		Total	
		($000)	(%)	($000)	(%)	($000)	(%)	($000)	(%)	($000)	(%)	($000)	(%)
25	Salts; sulphur; earths or stone, plastering materials, lime and cement	489 319	42.4	96 246	8.3	64 997	5.6	20 347	1.8	483 480	41.9	1 154 389	100
26	Ores, slag and ash	434 289	17.9	1 059 504	43.6	668 060	27.5	12 176	0.5	255 666	10.5	2 429 695	100
27	Mineral fuels, oils and products of their distillation; bituminous substances; mineral waxes[3]	15 138 941	88.7	255 593	1.5	1 094 692	6.4	39 108	0.2	545 096	3.2	17 073 430	100
28	Inorganic chemicals; compounds of precious metals, radioactive elements, etc.	1 341 980	81.8	115 664	7.1	84 240	5.1	769	...	97 609	6.0	1 640 262	100
31	Fertilizers	1 038 900	65.7	50 137	3.2	71 636	4.5	–	–	420 188	26.6	1 580 861	100
68	Articles of stone, plaster, cement, asbestos, mica or similar materials	320 152	92.1	8 207	2.4	5 766	1.7	–	–	13 671	3.9	347 796	100
69	Ceramic products	39 881	80.6	2 371	4.8	312	0.6	6	...	6 904	14.0	49 474	100
70	Glass and glassware	349 044	82.5	52 952	12.5	4 268	1.0	217	0.1	16 531	3.9	423 012	100
71	Natural/cultured pearls, precious stones and metals, coins, etc.	1 812 967	54.8	146 028	4.4	56 960	1.7	156	...	1 289 791	39.0	3 305 902	100
72	Iron and steel	2 086 921	83.8	119 145	4.8	8 157	0.3	63 367	2.5	214 043	8.6	2 491 633	100
73	Articles of iron or steel	1 539 283	91.6	26 715	1.6	2 821	0.2	24 481	1.5	86 332	5.1	1 679 632	100
74	Copper and articles thereof	961 038	63.4	404 475	26.7	2 347	0.2	5	...	147 223	9.7	1 515 088	100
75	Nickel and articles thereof	559 525	33.5	488 921	29.3	87 642	5.2	4 819	0.3	529 745	31.7	1 670 652	100
76	Aluminum and articles thereof	2 607 860	72.7	437 201	12.2	250 294	7.0	523	...	289 746	8.1	3 585 624	100
78	Lead and articles thereof	93 526	74.0	12 305	9.7	2 154	1.7	–	–	18 398	14.6	126 383	100
79	Zinc and articles thereof	684 437	81.8	20 869	2.5	22 158	2.6	–	–	109 373	13.1	836 837	100
80	Tin and articles thereof	8 296	84.8	336	3.4	273	2.8	–	–	876	9.0	9 781	100
81	Other base metals; cermets; and articles thereof	85 670	35.4	47 555	19.7	14 491	6.0	8 661	3.6	85 588	35.4	241 965	100
	Total mineral exports	29 592 029	73.7	3 344 224	8.3	2 441 268	6.1	174 635	0.4	4 610 260	11.5	40 162 416	100
	Total domestic exports	118 665 324	76.8	11 215 688	7.3	7 452 222	4.8	800 834	0.5	16 392 000	10.6	154 526 068	100
	Percentage, mineral to domestic	24.9		29.8		32.8		21.8		28.1		26.0	

Source: Statistics Canada, Catalogue no. 65-003 (Quarterly).
– Nil; . . . Amount too small to be expressed.
[1] HS Chapter refers to a group of commodities covered in a specified chapter of the "Harmonized Commodity Description and Coding System," as of January 1, 1988. Canadian external trade statistics are classified according to the Harmonized System. [2] EC: European Community. [3] Value of coal exports included in Chapter 27 is $1.889 billion.
Note: Numbers may not add to totals due to rounding.

TABLE 18. CANADA, IMPORTS OF MINERAL COMMODITIES BY COUNTRY AND BY COMMODITY AS DEFINED BY THE HARMONIZED SYSTEM (HS), 1992 Revised

HS Chapter[1]	Description	United States		EC[2]		Japan		Mexico		Other		Total	
		($000)	(%)	($000)	(%)	($000)	(%)	($000)	(%)	($000)	(%)	($000)	(%)
25	Salts; sulphur; earths or stone, plastering material, lime and cement	329 585	78.7	9 284	2.2	1 152	0.3	11 141	2.7	67 425	16.1	418 587	100
26	Ores, slag and ash	496 215	57.6	74 955	8.7	–	–	–	–	289 692	33.7	860 862	100
27	Mineral fuels, oils and products of their distillation; bituminous substances; mineral waxes[3]	1 562 047	24.3	1 566 723	24.4	1 095	...	188 375	2.9	3 114 527	48.4	6 432 767	100
28	Inorganic chemicals; compounds of precious metals, radioactive elements, etc.	747 821	54.8	84 986	6.2	12 356	0.9	960	0.1	518 622	38.0	1 364 745	100
31	Fertilizers	194 359	83.6	19 602	8.4	697	0.3	17	...	17 847	7.7	232 522	100
68	Articles of stone, plaster, cement, asbestos, mica or similar materials	272 246	73.9	61 974	16.8	5 104	1.4	2 596	0.7	26 236	7.1	368 156	100
69	Ceramic products	182 362	34.3	175 094	32.9	48 592	9.1	6 491	1.2	119 234	22.4	531 773	100
70	Glass and glassware	891 756	79.2	86 665	7.7	46 439	4.1	35 026	3.1	66 230	5.9	1 126 116	100
71	Natural/cultured pearls, precious stones and metals, coins, etc.	845 861	62.4	121 346	9.0	5 079	0.4	1 225	0.1	381 561	28.2	1 355 072	100
72	Iron and steel	1 134 033	61.6	344 073	18.7	120 346	6.5	777	...	243 147	13.2	1 842 376	100
73	Articles of iron or steel	2 046 451	76.3	206 312	7.7	128 893	4.8	19 371	0.7	282 492	10.5	2 683 519	100
74	Copper and articles thereof	426 266	83.3	36 868	7.2	3 118	0.6	1 889	0.4	43 459	8.5	511 600	100
75	Nickel and articles thereof	63 765	23.8	32 272	12.0	1 197	0.4	219	0.1	171 030	63.7	268 483	100
76	Aluminum and articles thereof	1 246 050	88.4	105 079	7.5	4 496	0.3	1 287	0.1	52 558	3.7	1 409 470	100
78	Lead and articles thereof	18 104	91.9	210	1.1	52	0.3	1 270	6.4	54	0.3	19 690	100
79	Zinc and articles thereof	23 536	85.9	469	1.7	262	1.0	–	–	3 127	11.4	27 394	100
80	Tin and articles thereof	10 727	27.4	3 180	8.1	10	...	28	0.1	25 268	64.4	39 213	100
81	Other base metals; cermets; and articles thereof	97 632	56.0	15 507	8.9	1 649	0.9	–	–	59 414	34.1	174 202	100
	Total mineral imports	10 588 816	53.8	2 944 599	15.0	380 537	1.9	270 672	1.4	5 481 923	27.9	19 666 547	100
	Total domestic imports	96 468 463	65.2	14 436 888	9.8	10 762 190	7.3	2 772 866	1.9	23 572 855	15.9	148 013 262	100
	Percentage, mineral to domestic	11.0		20.4		3.5		9.8		23.3		13.3	

Source: Statistics Canada, Catalogue no. 65-006 (Quarterly).
– Nil; ... Amount too small to be expressed.
[1] HS Chapter refers to a group of commodities covered in a specified chapter of the "Harmonized Commodity Description and Coding System," as of January 1, 1988. Canadian external trade statistics are classified according to the Harmonized System. [2] EC: European Community. [3] Total value of coal imports included in Chapter 27 is $655.88 million.
Note: Numbers may not add to totals due to rounding.

TABLE 19. CANADA, APPARENT CONSUMPTION[1] OF SOME MINERALS AND RELATION TO PRODUCTION,[2] 1990-92

	1990			1991			1992		
	Apparent Consumption	Production	Consumption as % of Production	Apparent Consumption	Production	Consumption as % of Production	Apparent Consumption	Production	Consumption as % of Production
	(tonnes)			(tonnes)			(tonnes)		
Quartz silica	2 921 507	2 081 170	140.4	2 115 866r	1 495 146	141.5	2 282 897	1 753 894	130.2
Lime	2 266 328	2 340 737	96.8	2 304 345	2 375 260	97.0	2 282 828	2 384 344	95.7
Salt	11 388 890	11 191 385	101.8	10 290 717	11 870 859	86.7	9 512 946	11 088 026	85.8
Cement[3]	9 560 239	11 745 152	81.4	7 194 192	9 372 219	76.8	6 207 877	8 598 231	72.2
Gypsum	2 538 472	7 977 685	31.8	2 046 891r	6 727 221	30.4r	2 513 450	7 294 700	34.5
Iron ore	12 742 241	35 670 008	35.7	10 709 643r	35 421 247	30.2	11 773 552	31 582 043	37.3
Potash (K_2O)	354 596	7 344 620	4.8	663 808	7 087 027	9.4	839 815	7 039 590	11.9
Asbestos	37 021	685 627	5.4	822	686 008	0.1	–	586 994	. .

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available; r Revised.
[1] "Apparent consumption" is production plus imports, less exports. [2] "Production" refers to producers' shipments. [3] Apparent consumption contains clinker cement in the trade data.

TABLE 20. CANADA, REPORTED CONSUMPTION OF MINERALS AND RELATION TO PRODUCTION, 1990-92

	Unit of Measure	1990			1991			1992p		
		Consumption	Production	Consumption as % of Production	Consumption	Production	Consumption as % of Production	Consumption	Production	Consumption as % of Production
METALS										
Aluminum[1]	t	465 144r	1 567 395	29.7r	465 302r	1 821 642	25.5r	501 680	1 971 843	25.4
Antimony	kg	294 321	564 527	52.1	406 221	428 559	94.8	355 423	796 373	44.6
Bismuth	kg	12 032	74 300	16.2	32 036	59 526	53.8	56 231	203 789	27.6
Cadmium	kg	35 194	1 333 664	2.6	27 667	1 549 087	1.8	29 873	1 393 099	2.1
Chromium (chromite)	t	19 921	–	. .	14 722r	–	. .	10 752	–	. .
Cobalt	kg	194 205	2 183 620	8.9	165 908	2 171 483	7.6	204 724	2 222 862	9.2
Copper[2]	t	184 497	771 433	23.9	185 055	780 362	23.7	175 737	761 694	23.1
Lead[3]	t	71 468	233 372	30.6	79 556r	248 102	32.1r	91 719	336 878	27.2
Magnesium	t	15 125	x	x	15 745r	x	x	17 707	x	x
Manganese ore	t	253 002	–	. .	109 028	–	. .	8 860	–	. .
Mercury	kg	33 907	–	. .	9 299	–	. .	4 515	–	. .
Molybdenum (Mo content)	t	1 179	12 188	9.7	1 644	11 437	14.4	1 535	8 870	17.3
Nickel	t	7 910r	195 004	4.1r	9 978r	188 098	5.3	12 118	177 555	6.8
Selenium	kg	13 798	369 193	3.7	18 479	226 636	8.2	16 347	344 988	4.7
Silver	kg	579 407	1 381 257	41.9	399 295	1 261 359	31.7	364 471	1 168 950	31.2
Tellurium	kg	x	12 212	x	x	16 108	x	x	25 228	x
Tin	t	3 600	3 844	93.7	3 178r	4 392	72.4r	3 042	58	5 244.8
Tungsten (W content)	kg	326 216	–	. .	256 597r	–	. .	340 040	–	. .
Zinc[3]	t	121 502	1 179 372	10.3	104 902r	1 083 008	9.7	114 725	1 195 736	9.6
NONMETALS										
Barite	t	17 153r	43 906	39.1r	11 629r	46 614	24.9	9 187	34 870	26.3
Feldspar	t	2 177	–	. .	1 806r	–	. .	1 476	–	. .
Fluorspar	t	142 240r	x	x	110 495r	–	. .	93 785	–	. .
Mica	kg	4 213r	x	x	3 555r	x	x	3 379	x	x
Nepheline syenite	t	72 258	532 911	13.6	60 223r	485 520	12.4	63 438	556 926	11.4
Phosphate rock	t	1 392 043	–	. .	1 181 971	–	. .	1 209 712	–	. .
Potash (K_2O)	t	262 934	7 344 620	3.6	263 133r	7 087 027	3.7r	259 122	7 039 590	3.7
Sodium sulphate	t	184 035r	346 607	53.1r	144 287	334 959	43.1	132 411	281 246	47.1
Sulphur	t	1 017 273	6 611 933	15.4	917 869r	6 929 014	13.2r	924 906	7 262 241	12.7
Talc, etc.	t	70 004	130 861	53.5	65 682r	114 898	57.2r	72 421	113 270	63.9
FUELS										
Coal	000 t	49 039	68 332	71.8	50 280	71 133	70.7	51 012	65 612	77.7
Crude oil[4]	000 m^3	90 207	90 279	99.9	84 359	89 788	94.0	81 364	93 256	87.2
Natural gas[5]	million m^3	50 565	98 771	51.2	49 983	105 244	47.5	50 685	116 664	43.4

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available; p Preliminary; r Revised; x Confidential.
[1] Consumption of primary aluminum ingot and alloys, secondary ingot and scrap, reported by consumers. [2] Consumption defined as domestic shipments of refined copper plus imports of refined copper. [3] Consumption of primary and secondary refined metal. [4] Consumption defined as refinery receipts. [5] Consumption defined as domestic sales.
Notes: Unless otherwise stated, consumption refers to reported consumption of refined metals or nonmetallic minerals by consumers. Production of metals, in most cases, refers to production in all forms, and includes the recoverable content of ores, concentrates, matte, etc., and metal content of primary products recoverable at domestic smelters and refineries. Production of nonmetals refers to producers' shipments. For fuels, production is equivalent to actual output less waste.

TABLE 21. CANADA, DOMESTIC CONSUMPTION OF PRINCIPAL REFINED METALS IN RELATION TO REFINERY PRODUCTION,[1] 1986-92

	Unit of Measure	1986	1987	1988	1989	1990	1991	1992p
ALUMINUM								
Domestic consumption[2]	t	388 879	413 237	493 986	508 810	465 144r	465 302r	501 680
Production	t	1 355 161	1 540 439	1 534 499	1 554 753	1 567 395	1 821 642	1 971 843
Consumption of production	%	28.7	26.8	32.2	32.7	29.7r	25.5r	25.4
COPPER								
Domestic consumption[3]	t	225 586	231 288	236 280	218 571	184 497	185 055	175 737
Production	t	493 445	491 124	528 723	515 216	515 835	538 339	539 302
Consumption of production	%	45.7	47.1	44.7	42.4	35.8	34.4	32.6
LEAD								
Domestic consumption[4]	t	94 680	97 281	88 041	87 715	71 468	79 556r	91 719
Production[5]	t	257 680	230 661	268 076	242 845	183 645	212 366	255 188
Consumption of production	%	36.7	42.2	32.8	36.1	38.9	37.5r	35.9
ZINC								
Domestic consumption[4]	t	126 115	131 659	150 616	145 282	121 502r	104 902r	114 725
Production	t	570 981	609 909	703 206	669 677	591 786	660 552	671 702
Consumption of production	%	22.1	21.6	21.4	21.7	20.5r	15.9r	17.1

Source: Natural Resources Canada.
p Preliminary; r Revised.
1 Production of refined metal from all sources, including metal derived from secondary materials at primary refineries. 2 Consumption of primary aluminum ingot and alloys, secondary ingot and scrap, reported by consumers. 3 Consumption defined as domestic shipments of refined copper plus imports of refined copper. 4 Consumption of primary and secondary refined metal, reported by consumers. 5 Production of primary and secondary refined lead.

TABLE 22. AVERAGE ANNUAL PRICES[1] OF SELECTED MINERALS, 1987-93

	Unit of Measure	1987	1988	1989	1990	1991	1992	1993
Aluminum, London Metal Exchange	¢/lb	71.004	115.394	88.242	74.361	59.066	56.893	51.639
Antimony, New York dealer	$/lb	1.116	1.039	0.943	0.818	0.828	0.791	0.769
Asbestos, No. 4T cement fibre	C$/t	1 083.000	1 080.000	1 080.000	1 080.000	1 080.000	1 080.000	1 080.000
Bismuth, New York dealer	$/lb	3.629	5.726	5.657	3.474	2.969	2.506	2.350
Cadmium, New York dealer	$/lb	1.768	7.031	6.277	3.378	1.974	0.907	0.451
Calcium, metal crowns (Producer Price List)	$/lb	3.850	3.850	3.850	3.850	3.850	3.850	3.850
Chrome, U.S. metal, 9% carbon	$/lb	2.700	2.700	3.621	4.241	4.437	4.500	4.500
Cobalt, metal, shot/cathode/250 kg	$/lb	7.000	7.532	8.400	8.400	11.000	24.300	18.000
Columbium, pyrochlore	$/lb	3.250	2.600	2.600	2.800	2.800	3.500	2.600
Copper, electrolytic cathode, COMEX	¢/lb	77.837	119.183	129.454	124.085	108.211	102.721	85.283
Gold, London[2]	$/troy oz	446.470[r]	437.110[r]	381.431[r]	383.466	362.183	343.731	359.769
Iridium, New York dealer[3]	$/troy oz	513.750	301.813	302.667	307.313	281.354	155.167	45.667
Iron ore, taconite pellets	¢/ltu	77.548	72.441	72.450	72.450	72.450	72.450	72.450
Lead, producer	C¢/lb	47.985	46.013	47.171	53.181	38.556	41.469	44.000
Magnesium, U.S. primary ingot (Producer Price List)	$/lb	1.530	1.563	1.630	1.613	1.430	1.438	1.530
Manganese, U.S. metal, regular	¢/lb	80.687	86.417	91.000	92.896	104.000	104.000	104.000
Mercury, Free Market Warehouse, min. 99.9%[4]	$/flask (76 lb)	295.503	335.517	287.722	249.218	122.424	167.603	107.167
Molybdenum, dealer, oxide	$/lb	2.899	3.449	3.341	2.807	2.349	2.197	2.279
Nickel, New York dealer, cathode	$/lb	2.278	6.122	5.982	4.074	3.796	3.177	2.428
Osmium, New York dealer	$/troy oz	632.458	588.750	547.917	413.438	400.000	400.000	400.000
Palladium, London PM fix	$/troy oz	131.399	124.256	144.578	114.915	88.290	88.228	122.348
Platinum, London PM fix	$/troy oz	555.956	530.777	509.636	471.583	376.083	359.799	374.027
Potash, coarse, major producer, 60% K_2O	$/st	68.000	86.000	88.000	88.000	87.500	87.000	83.670
Rhodium, New York dealer[3]	$/troy oz	1 240.000	1 275.000	1 275.000	3 565.185	3 739.126	2 365.102	1 066.111
Ruthenium, New York dealer	$/troy oz	69.796	62.204	62.258	60.917	55.233	28.538	12.996
Selenium, New York dealer	$/lb	6.479	10.085	7.451	5.676	5.241	4.947	4.900
Silver, Handy & Harman, Toronto	$/troy oz	7.009	6.535	5.499	4.870[r]	4.039	3.936	4.300
Sulphur, elemental, North American deliveries	C$/t	88.234	71.050	72.060	62.030	56.814	22.050	0.000
Tantalum, tantalite ore, spot	$/lb	20.542	37.700	35.302	30.077	28.538	27.365	25.850
Tin, New York dealer	$/lb	3.156	3.309	3.973	2.877	2.588	2.822	2.392
Tungsten, U.S. spot ore	$/ltu	41.687	50.346	45.525	34.721	53.417	49.325	34.800
Uranium, U_3O_8	US$/lb	23.000	25.000	24.000	24.000	21.000	19.000	15.000
Zinc, special high grade	¢/lb	36.198[r]	57.528[r]	75.124[r]	68.850	50.647	56.235	43.635

Sources: Natural Resources Canada; Alberta Energy Resource Industries Monthly Statistics (Sulphur); "Engineering and Mining Journal" (Asbestos); "Metals Bulletin" (Mercury); "Industrial Minerals" (Potash); "Metals Week"; "Northern Miner."
COMEX: Commodities Exchange Inc.
[r] Revised.
[1] Prices, except where noted, are in U.S. currency. [2] Average afternoon fixings of London bullion dealers. [3] The Impala producer price is given for the years 1987-89.
[4] New source for 1993 price is "Metals Bulletin"; 1987-92, New York dealer, "Metals Week."

TABLE 23. CANADIAN AVERAGE ANNUAL PRICES OF SELECTED MINERALS, 1987-93

	Unit of Measure	1987	1988	1989	1990	1991	1992	1993
Aluminum, London Metal Exchange	$/kg	2.076	3.131	2.304	1.913	1.492	1.516	1.469
Antimony, New York dealer	$/kg	3.262	2.819	2.462	2.104	2.092	2.107	2.187
Asbestos, No. 4T cement fibre	$/t	1 083.000	1 080.000	1 080.000	1 080.000	1 080.000	1 080.000	1 080.000
Bismuth, New York dealer	$/kg	10.609	15.538	14.769	8.936	7.500	6.676	6.684
Cadmium, New York dealer	$/kg	5.168	19.079	16.387	8.689	4.986	2.416	1.283
Calcium, metal crowns (Producer Price List)	$/kg	11.255	10.447	10.051	9.904	9.725	10.256	10.950
Chrome, U.S. metal, 9% carbon	$/kg	7.893	7.327	9.453	10.909	11.208	11.987	12.799
Cobalt, metal, shot/cathode/250 kg	$/kg	20.463	20.439	21.930	21.608	27.787	64.731	51.195
Columbium, pyrochlore	$/kg	9.501	7.055	6.788	7.203	7.073	9.323	7.395
Copper, electrolytic cathode, COMEX	$/kg	2.275	3.234	3.380	3.192	2.733	2.736	2.426
Gold, London[1]	$/g	19.034	17.298	14.522	14.385[r]	13.342[r]	13.353[r]	14.922
Iridium, New York dealer[2]	$/g	21.902	11.944	11.523	11.528	10.365	6.028	1.894
Iron ore, taconite pellets	¢/mtu	101.204	87.757	84.440	83.200	81.702	86.159	91.992
Lead, producer	¢/kg	105.789	101.441	103.994	117.244	85.001	91.423	97.003
Magnesium, U.S. primary ingot (Producer Price List)	$/kg	4.473	4.241	4.255	4.149	3.612	3.831	4.352
Manganese, U.S. metal, regular	$/kg	2.359	2.345	2.376	2.390	2.627	2.770	2.958
Mercury, Free Market Warehouse, min. 99.9%[3]	$/kg	11.366	11.980	9.884	8.435	4.069	5.875	4.011
Molybdenum, dealer, oxide	$/kg	8.475	9.359	8.722	7.221	5.934	5.852	6.482
Nickel, New York dealer, cathode	$/kg	6.659	16.613	15.617	10.480	9.589	8.463	6.906
Osmium, New York dealer	$/g	26.963	23.299	20.861	15.510	14.735	15.539	16.591
Palladium, London PM fix	$/g	5.602	4.917	5.505	4.311	3.252	3.427	5.075
Platinum, London PM fix	$/g	23.701	21.005	19.403	17.691	13.854	13.977	15.514
Potash, coarse, major producer, 60% K_2O	$/t	99.392	116.685	114.871	113.184	110.515	115.877	118.986
Rhodium, New York dealer[2]	$/g	52.863	50.456	48.543	133.743	137.743	91.879	44.220
Ruthenium, New York dealer	$/g	2.976	2.462	2.370	2.285	2.035	1.109	0.539
Selenium, New York dealer	$/kg	18.940	27.367	19.452	14.601	13.239	13.178	13.936
Silver, Handy & Harman, Toronto	$/kg	298.804	258.611	209.363	182.691[r]	148.790	152.905	178.354
Sulphur, elemental, North American deliveries	$/t	88.234	71.050	72.060	62.030	56.814	22.050	0.000
Tantalum, tantalite ore, spot	$/kg	60.050	102.302	92.163	77.369	72.089	72.896	73.522
Tin, New York dealer	$/kg	9.226	8.979	10.372	7.401	6.537	7.517	6.803
Tungsten, U.S. spot ore	$/mtu	54.403	60.990	53.059	39.873	60.239	58.658	44.186
Uranium, U	$/kg	79.000	79.000	74.000	71.000	61.000	59.000	50.000
Zinc, special high grade	$/kg	1.058[r]	1.561[r]	1.961[r]	1.771[r]	1.279[r]	1.498[r]	1.241

Sources: Natural Resources Canada; Alberta Energy Resource Industries Monthly Statistics (Sulphur); "Engineering and Mining Journal" (Asbestos); "Metals Bulletin" (Mercury); "Industrial Minerals" (Potash); "Metals Week"; "Northern Miner."
COMEX: Commodities Exchange Inc.
[r] Revised.
[1] Average afternoon fixings of London bullion dealers. [2] The Impala producer price is given for the years 1987-89. [3] New source for 1993 price is "Metals Bulletin"; 1987-92, New York Dealer, "Metals Week. "

TABLE 24. CANADA, MINERAL PRODUCTS INDUSTRIES, SELLING PRICE INDEXES, 1986-92

Base (1986 = 100)	1986	1987	1988	1989	1990	1991	1992p
IRON AND STEEL PRODUCTS INDUSTRIES							
Ferroalloy and steel foundry industries	100.0	100.7	106.3	116.1	108.6	108.2	109.1
Iron foundries	100.0	100.8	103.2	106.3	109.8	110.9	113.1
Primary steel industries	100.0	101.6	107.5	110.0	108.1	105.0r	97.9
Steel pipe and tube industry	100.0	100.5	104.7	105.7	102.3	101.2r	94.0
NONFERROUS PRIMARY METAL PRODUCTS INDUSTRIES							
Aluminum rolling, casting and extruding industry	100.0	104.4	123.2	117.2	100.5	91.5r	90.3
Copper rolling, casting and extruding industry	100.0	111.5	146.5	161.1	154.4	138.9	142.4
Jewellery and precious metals industries	100.0	103.8	98.8	91.0	90.8	89.7r	90.2
Other rolling, casting and extruding industry	100.0	106.3	122.4	124.3	113.7	101.7	102.8
Nonferrous metal smelting and refining industries	100.0	111.6	148.2	141.4	117.0	99.0	99.5
NONMETALLIC MINERAL PRODUCTS INDUSTRIES							
Agricultural chemicals industries	100.0	94.4	98.3	98.8	95.1	97.6	97.4
Hydraulic cement industry	100.0	100.8	102.1	104.8	106.8	110.3	109.5
Clay products industry (from domestic clay)	100.0	107.7	110.8	117.3	122.2r	119.8r	117.5
Clay products industry (from imported clay)	100.0	105.2	112.3	118.0	123.4	124.6	125.8
Concrete products industries	100.0	104.8	113.0	116.2	118.3	119.9	117.7
Glass and glass products industries	100.0	104.5	110.2	111.1	110.7	109.8	108.6
Nonmetallic mineral insulating materials industry	100.0	104.5	109.6	114.1	114.5	114.2	115.2
Refined petroleum and coal products industries	100.0	95.0	88.2	89.5	100.9	97.7	89.9
FABRICATED METAL PRODUCTS INDUSTRIES							
Agricultural implement industry	100.0	101.8	104.3	106.7	109.0	109.9	112.4
Miscellaneous fabricated structural metal products	100.0	102.1	108.1	111.8	112.8	111.4	107.8
Hardware, tool and cutlery industries	100.0	103.9	109.2	113.7	117.4	120.0	122.1
Heating equipment industry	100.0	102.3	106.3	110.6	113.1	115.6	118.0
Other metal fabricating industries	100.0	102.2	107.5	112.8	115.4	117.8	118.2
Power boiler and heat exchanger industry	100.0	107.8	112.7	120.7	125.3	130.1	136.7
Stamped, pressed and coated metal products industries	100.0	102.3	105.1	105.6	104.7	103.9	103.7
Wire and wire products industries	100.0	101.4	106.9	111.5	112.7	112.7	113.8

Source: Statistics Canada, Catalogue no. 62-011.
p Preliminary; r Revised.

TABLE 25. CANADA, SELLING PRICE INDEXES OF MINERAL RAW MATERIALS, 1986-92

Base (1986 = 100)	1986	1987	1988	1989	1990	1991	1992p
METALLIC MINERALS							
Copper concentrates	100.0	118.7	158.7	165.3	153.0	131.5	134.7
Iron ore	100.0	96.4	91.0	85.5	82.8	81.7	85.2
Lead concentrates	100.0	156.9	151.9	154.1	170.4	123.9	121.7
Nickel concentrates	100.0	111.1	263.3	251.6	166.0	149.9	133.0
Other base metals	100.0	107.0	130.6	119.4	96.0	80.3	81.0
Precious metals	100.0	114.5	103.9	87.8	85.4	78.0	78.0
Gold and alloys in primary form	100.0	114.2	103.9	87.8	85.9	78.8	78.7
Platinum	100.0	116.5	101.8	95.5	86.9	68.4	68.6
Silver	100.0	121.9	106.2	86.4	74.7	61.7	63.2
Radioactive concentrates	100.0	97.9	86.8	60.0	57.8	49.8	48.1
Zinc concentrates	100.0	106.2	138.8	184.8	165.7	121.9	126.9
NONMETALLIC MINERALS							
Asbestos fibres	100.0	100.1	100.9	107.2	108.9	111.0	117.0
Other crude minerals	100.0	100.4	106.0	105.7	104.6	104.7	103.9
Potash (muriate)	100.0	107.7	145.3	140.8	133.4	137.9	136.5
Quartz and silica sand	100.0	100.5	107.6	106.8	109.8	108.3	98.9
Sand and gravel	100.0	104.6	114.2	125.2	126.8	124.3	124.9
Stone	100.0	102.9	107.9	109.6	114.6	116.4	114.1
Building	100.0	103.5	106.5	111.4	117.2	119.5	119.7
Crushed	100.0	104.2	109.1	110.5	116.4	120.4	121.8
Other	100.0	103.5	106.5	111.4	117.2	119.5	119.7
Sulphur	100.0	81.4	65.8	65.9	57.6	53.0	20.6
MINERAL FUELS							
Coal (thermal)	100.0	100.7	89.7	90.0	90.7	94.6	99.9
Crude mineral oil	100.0	110.6	86.5	99.0	120.0	108.3	105.0
Natural gas	100.0	96.7	89.1	85.0	85.8	87.2r	87.4

Source: Statistics Canada, Catalogue no. 62-011.
p Preliminary; r Revised.

TABLE 26. CANADA, PRINCIPAL STATISTICS OF THE MINERAL INDUSTRY,[1] 1991

	Mining Activity								Total Activity[2]		
		Production and Related Workers			Costs						
	Establish-ments	Employees	Person-Hours Paid	Wages	Fuel and Electricity	Materials and Supplies	Value of Production	Value Added	Employees	Salaries and Wages	Value Added
	(number)	(number)	(000)	($000)	($000)	($000)	($000)	($000)	(number)	($000)	($000)
METALS											
Nickel-copper-zinc	27	13 454	30 194	690 877	246 507	1 912 099	4 898 042	2 739 436	18 634	980 522	2 772 333
Gold	60	8 563	18 555	463 010	139 954	546 017	2 228 023	1 542 051	10 869	594 521	1 543 209
Iron	5	4 230	9 257	239 064	162 588	397 999	1 226 507	665 920	5 683	327 029	674 318
Uranium	5	1 924	3 828	93 853	43 372	69 375	609 045	496 298	2 391	130 846	495 795
Silver-lead-zinc	12	2 167	4 994	106 737	57 670	475 175	978 570	445 726	3 459	176 256	446 009
Miscellaneous metal mines[3]	5	830	1 839	33 712	17 607	51 990	154 812	85 215	1 056	44 382	87 220
Total	114	31 168	68 666	1 627 254	667 698	3 452 655	10 094 999	5 974 646	42 092	2 253 556	6 018 884
INDUSTRIALS											
Potash	11	2 854	6 292	120 649	106 277	134 869	988 361	747 215	3 825	172 675	745 379
Stone	118	2 080	4 756	73 171	31 679	90 474	386 445	264 292	2 774	101 872	268 870
Miscellaneous nonmetals[4]	34	1 686	3 643	63 692	30 446	57 674	345 556	257 435	2 409	96 105	256 748
Sand and gravel	122	1 564	3 647	52 859	25 254	74 841	313 472	213 376	2 252	77 813	218 755
Asbestos	5	1 769	3 790	72 591	32 269	57 080	273 954	184 604	2 423	107 260	190 147
Peat	51	1 229	2 747	27 723	6 280	30 713	131 783	94 790	1 519	36 823	97 044
Gypsum	10	517	1 205	16 826	6 975	15 511	66 981	44 496	636	21 873	44 145
Total	351	11 699	26 080	427 512	239 180	461 163	2 506 551	1 806 208	15 838	614 421	1 821 088
FUELS											
Oil, crude and natural gas	674	8 724	17 670	480 966	383 096	1 504 989	16 092 573	14 204 488	31 450	1 940 737	14 423 165
Coal	30	9 253	18 711	444 628	136 675	438 531	1 767 063	1 191 857	11 237	554 597	1 211 927
Total	704	17 977	36 381	925 594	519 771	1 943 520	17 859 636	15 396 345	42 687	2 495 334	15 635 092
Total mineral industry	1 169	60 844	131 127	2 980 360	1 426 650	5 857 338	30 461 187	23 177 199	100 617	5 363 311	23 475 063

Sources: Natural Resources Canada; Statistics Canada.
[1] Cement manufacturing, lime manufacturing, clay and clay products (domestic clays) are included in the mineral manufacturing industry. [2] Total activity includes sales and head offices.
[3] Includes molybdenum. [4] Includes salt.
Note: Numbers may not add to totals due to rounding.

TABLE 26a. CANADA, PRINCIPAL STATISTICS OF THE MINERAL INDUSTRY,[1] 1990

		Mining Activity							Total Activity[2]		
		Production and Related Workers			Costs						
	Establish-ments	Employees	Person-Hours Paid	Wages	Fuel and Electricity	Materials and Supplies	Value of Production	Value Added	Employees	Salaries and Wages	Value Added
	(number)	(number)	(000)	($000)	($000)	($000)	($000)	($000)	(number)	($000)	($000)
METALS											
Nickel-copper-zinc	28	13 705	30 821	653 915	236 549	1 991 490	5 836 150	3 608 111	19 104	945 838	3 638 147
Gold	66	9 591	20 943	492 259	135 252	559 464	2 282 757	1 588 041	11 807	604 836	1 584 276
Silver-lead-zinc	16	2 304	5 246	103 173	73 145	575 428r	1 476 505	827 931r	3 727	174 141	833 188r
Iron	7	4 384	9 400	226 563	167 528	410 416	1 214 158	636 214	5 820	306 016	632 704r
Uranium	5	3 066	6 370	161 643	54 056	125 160	735 694	556 478	3 702	198 024	556 969
Miscellaneous metal mines[3]	5	845	1 838	36 498	15 284	59 421	168 803	94 098	1 088	48 681	94 554
Total	127	33 895	74 617	1 674 050	681 814	3 721 379r	11 714 067	7 310 874r	45 248	2 277 536	7 339 838r
INDUSTRIALS											
Potash	11	2 810	6 249	111 612	101 372	137 292	968 512	729 848	3 822	162 523	732 506
Stone	123	2 270	5 165	80 360	37 522	118 233	476 858	321 104	2 951	108 954	326 558
Sand and gravel	132	1 696	3 972	58 040	28 182	86 885	365 266	250 199	2 425	85 128	259 954
Miscellaneous nonmetals[4]	34	1 804	3 956	63 789	29 642	61 567	332 826	241 616	2 468	92 392	240 712
Asbestos	4	2 080	4 752	77 772	35 802	53 618	293 731	204 311	2 699	107 764	204 902
Peat	48	1 386	3 063	28 299	5 606	27 713	118 414	85 095	1 740	39 437	85 231
Gypsum	10	656	1 515	18 853	7 105	20 292	88 575	61 178	786	23 948	61 029
Total	362	12 702	28 673	438 725	245 232	505 601	2 644 181	1 893 349	16 891	620 145	1 910 891
FUELS											
Oil, crude and natural gas	714	8 699	17 654	430 018	359 799	1 395 421	18 664 566r	16 926 515	31 926	1 742 725	17 100 697
Coal	30r	9 312r	19 019r	447 543	137 092	428 729r	1 825 127r	1 259 306r	11 406r	550 214	1 281 113r
Total	744r	18 011r	36 673r	877 561	496 891	1 824 150r	20 489 693r	18 185 821r	43 332r	2 292 939	18 381 810r
Total mineral industry	1 233r	64 608r	139 963r	2 990 336	1 423 937	6 051 130r	34 847 941r	27 390 044r	105 471r	5 190 620	27 632 539r

Sources: Natural Resources Canada; Statistics Canada.
r Revised.
1 Cement manufacturing, lime manufacturing, clay and clay products (domestic clays) are included in the mineral manufacturing industry. 2 Total activity includes sales and head offices.
3 Includes molybdenum. 4 Includes salt.
Note: Numbers may not add to totals due to rounding.

TABLE 27. CANADA, PRINCIPAL STATISTICS OF THE MINERAL MANUFACTURING INDUSTRIES, 1991

	Mineral Manufacturing Activity								Total Activity[1]		
		Production and Related Workers			Costs						
	Establish-ments	Employees	Person-Hours Paid	Wages	Fuel and Electricity	Materials and Supplies	Value of Shipments	Value Added	Employees	Salaries and Wages	Value Added
	(number)	(number)	(000)	($000)	($000)	($000)	($000)	($000)	(number)	($000)	($000)
PRIMARY METAL INDUSTRIES											
Smelting and refining	36	20 006	43 798	954 933	594 819	2 767 593	5 873 880	2 515 718	28 817	1 424 983	2 544 680
Primary steel	63	29 282	61 677	1 277 185	522 127	3 794 421	6 826 510	2 472 013	38 126	1 735 019	2 466 248
Wire and wire products industries[2]	274	9 552	19 841	281 946	40 141	875 134	1 550 156	620 143	12 369	397 305	656 795
Steel pipe and tube	48	4 458	9 325	169 698	20 085	1 026 188	1 590 376	537 988	5 618	224 167	537 451
Iron foundries	84	6 537	13 802	253 240	65 467	342 781	897 381	484 206	7 680	311 277	489 632
Aluminum rolling, casting and extruding	64	4 007	8 843	148 799	32 053	1 034 703	1 473 404	393 939	5 169	210 410	392 016
Metal rolling, casting and extruding n.e.s.	100	4 008	8 409	128 132	25 450	446 666	775 754	299 456	4 710	161 598	297 277
Copper and alloy rolling, casting and extruding	43	1 840	3 788	58 503	12 920	261 678	413 888	140 803	2 211	76 566	140 619
Total	712	79 690	169 483	3 272 436	1 313 062	10 549 164	19 401 349	7 464 266	104 700	4 541 325	7 524 718
NONMETALLIC MINERAL PRODUCTS INDUSTRIES											
Ready-mix concrete	658	9 526	20 146	297 317	65 838	964 443	1 672 825	646 957	11 633	379 778	660 234
Cement	21	1 964	4 247	85 405	138 030	152 132	746 276	465 054	3 111	140 662	476 565
Glass products	155	4 747	9 917	142 099	18 727	260 224	586 880	307 642	5 660	178 557	357 377
Primary glass and glass containers	19	4 129	8 631	137 082	50 495	159 064	498 267	280 526	5 195	187 587	300 937
Mineral insulating products	42	1 989	4 244	64 048	33 160	146 058	401 845	220 404	2 956	111 300	287 532
Other concrete products	267	4 227	8 874	107 295	20 113	224 446	486 709	239 719	4 993	138 116	253 240
Structural concrete products	58	2 505	5 284	81 332	5 361	96 118	291 904	185 706	3 101	105 011	184 016
Other nonmetallic mineral products	158	2 710	5 700	72 795	12 709	116 320	296 505	174 310	3 206	91 413	180 598
Refractory products	29	1 154	2 369	34 953	6 677	73 837	197 608	111 912	1 668	56 885	127 254
Gypsum products	29	1 137	2 392	39 624	22 791	163 983	295 661	108 831	1 711	64 357	117 435
Concrete pipe	41	1 049	2 329	33 975	5 499	61 858	172 788	100 373	1 348	46 691	105 177
Lime	13	647	1 368	26 301	39 218	28 229	168 954	102 124	861	37 824	103 324
Abrasives	30	1 046	2 205	31 193	33 442	84 230	205 922	86 895	1 408	46 402	100 196
Clay products (domestic)	28	730	1 533	21 512	14 983	14 808	106 749	69 693	1 036	33 546	71 139
Clay products (imported)	39	1 032	2 089	26 348	5 827	32 871	105 473	67 237	1 218	33 681	69 290
Asbestos products industry	6	164	377	4 442	380	8 191	17 220	8 099	229	7 031	9 702
Total	1 593	38 756	81 707	1 205 721	473 250	2 586 812	6 251 586	3 175 482	49 334	1 658 841	3 404 016

FABRICATED METAL PRODUCTS INDUSTRIES											
Stamped and pressed metal products industries	963	24 932	52 724	713 004	84 394	2 158 718	3 950 549	1 682 420	30 348	927 153	1 750 726
Fabricated structural metal products industries	469	15 099	31 248	490 799	31 392	1 079 018	2 235 906	1 117 521	18 667	637 978	1 136 528
Hardware, tool and cutlery industry	815	19 559	40 873	591 512	31 303	584 874	1 660 346	1 035 594	21 912	688 310	1 064 639
Other metal fabricating industries	596	13 087	27 357	372 422	38 821	995 685	2 001 972	962 543	16 770	516 627	1 007 093
Machine shop industry	1 564	21 198	44 121	593 473	40 440	553 048	1 493 641	901 720	23 092	656 780	923 203
Ornamental and architectural metal products industries	784	15 966	32 888	415 224	27 419	1 026 021	1 961 590	895 119	19 885	566 788	915 900
Power boiler and heat exchanger industry	42	3 211	6 908	120 381	6 559	235 636	568 003	286 955	5 081	199 180	297 021
Heating equipment industry	142	4 265	8 861	101 613	6 657	251 630	502 269	243 906	5 246	136 042	248 245
Total	5 375	117 317	244 980	3 398 428	266 985	6 884 630	14 374 276	7 125 778	141 001	4 328 858	7 343 355
PETROLEUM AND COAL PRODUCTS INDUSTRIES											
Petroleum refining products	33	5 582	11 713	301 828	382 237	14 248 136	17 512 636	2 234 534	12 459	680 969	2 227 092
Lubricating oils and greases	28	649	1 426	23 076	6 558	181 595	275 000	85 990	1 046	40 154	99 683
Other petroleum and coal products	79	789	1 677	24 992	14 052	178 412	278 799	83 375	1 138	38 705	99 586
Total	140	7 020	14 815	349 896	402 847	14 608 143	18 066 435	2 403 899	14 643	759 828	2 426 361
Total mineral manufacturing industries	7 820	242 783	510 984	8 226 481	2 456 144	34 628 749	58 093 646	20 169 425	309 678	11 288 852	20 698 450

Source: Statistics Canada, Catalogue no. 31-203.
n.e.s. Not elsewhere specified.
1 Total activity includes sales and head offices. 2 Wire and wire products have been included in the primary metal industries group.
Note: Numbers may not add to totals due to rounding.

TABLE 27a. CANADA, PRINCIPAL STATISTICS OF THE MINERAL MANUFACTURING INDUSTRIES, 1990

	Mineral Manufacturing Activity								Total Activity[1]		
		Production and Related Workers			Costs						
	Establish-ments	Employees	Person-Hours Paid	Wages	Fuel and Electricity	Materials and Supplies	Value of Shipments	Value Added	Employees	Salaries and Wages	Value Added
	(number)	(number)	(000)	($000)	($000)	($000)	($000)	($000)	(number)	($000)	($000)
PRIMARY METAL INDUSTRIES											
Smelting and refining	34	21 547	46 541	956 637	538 268	2 723 598	5 926 236	2 679 881	30 573	1 412 544	2 740 455
Primary steel	66	29 388	62 716	1 248 366	491 114	4 098 911	7 640 121	2 738 273	39 120	1 728 684	2 711 834
Wire and wire products industries[2]	299	9 833	20 420	284 609	36 571	878 261	1 618 797	692 080	12 965	403 562	721 949
Iron foundries	98	7 148	15 580	272 290	54 162	395 092	1 013 596	574 566	8 397	330 968	575 366
Steel pipe and tube	50	4 194	8 719	150 117	19 839	945 341	1 447 674	481 076	5 319	201 210	484 264
Aluminum rolling, casting and extruding	68	4 205	9 269	151 157	31 022	1 289 454	1 826 344	484 004	5 463	209 305	482 621
Metal rolling, casting and extruding n.e.s.	118	4 618	9 641	142 596	26 806	558 244	943 425	357 706	5 479	183 764	360 065
Copper and alloy rolling, casting and extruding	40	1 912	3 932	59 521	12 952	283 827	446 379	146 125	2 316	78 158	145 652
Total	773	82 845	176 817	3 265 293	1 210 734	11 172 728	20 862 572	8 153 711	109 632	4 548 195	8 222 206
NONMETALLIC MINERAL PRODUCTS INDUSTRIES											
Ready-mix concrete	676	10 920	23 490	342 988	75 665	1 155 541	2 004 627	775 753	12 798	417 824	791 183
Cement	21	2 079	4 558	90 988	155 008	184 105	952 766	621 820	3 259	147 444	626 183
Glass products	172	5 212	10 863	151 634	17 102	286 307	674 194	369 799	6 222	194 396	393 423
Primary glass and glass containers	24	4 337	8 902	137 477	50 337	174 412	561 751	326 600	5 511	192 967	352 583
Mineral insulating products	47	2 215	4 896	72 496	35 402	174 589	431 862	226 757	3 294	121 974	337 435
Other concrete products	279	5 062	10 429	123 173	19 645	259 242	565 948	289 383	5 774	152 948	303 746
Structural concrete products	64	2 479	5 376	84 797	5 551	117 072	342 821	220 594	3 163	111 063	220 552
Other nonmetallic mineral products	167	2 992	6 336	78 026	12 918	124 647	318 655	180 134	3 431	95 608	182 311
Gypsum products	31	1 435	3 161	50 542	26 592	199 596	391 607	163 121	2 102	79 599	172 248
Refractory products	31	1 168	2 426	33 683	6 996	87 478	220 171	127 126	1 862	61 265	150 845
Concrete pipe	47	1 353	3 022	43 020	5 604	83 305	222 423	131 108	1 690	57 075	131 900
Abrasives	36	1 415	3 068	41 810	42 666	105 794	263 439	117 111	1 837	59 118	130 763
Lime	13	626	1 355	24 699	39 456	30 949	175 781	105 248	836	34 971	105 503
Clay products (domestic)	29	882	1 937	29 727	18 443	19 705	126 932	93 988	1 238	42 336	94 339
Clay products (imported)	48	1 111	2 202	27 379	5 936	33 834	118 685	78 275	1 325	35 228	79 420
Asbestos products industry	6	196	410	4 720	711	9 031	19 987	9 319	263	7 229	14 912
Total	1 691	43 482	92 431	1 337 159	518 032	3 045 607	7 391 649	3 836 136	54 605	1 811 045	4 087 346

FABRICATED METAL PRODUCTS INDUSTRIES											
Stamped and pressed metal products industries	1 020	27 548	57 338	735 851	85 407	2 750 121	4 713 312	1 864 149	33 665	974 793	1 942 969
Fabricated structural metal products industries	492	16 885	34 746	527 235	33 069	1 251 713	2 617 991	1 315 046	21 277	706 034	1 333 993
Hardware, tool and cutlery industry	877	19 454	41 007	565 217	28 035	594 371	1 788 022	1 157 877	22 475	689 586	1 173 662
Other metal fabricating industries	642	14 761	30 666	412 721	38 011	1 074 097	2 217 030	1 087 108	19 298	587 254	1 127 706
Ornamental and architectural metal products industries	835	17 193	35 507	424 929	25 099	1 124 687	2 177 886	1 030 463	21 075	577 282	1 047 325
Machine shop industry	1 668	23 630	49 433	633 359	33 023	627 297	1 614 361	951 758	24 721	672 093	975 980
Power boiler and heat exchanger industry	44	3 276	7 027	119 638	5 981	232 076	579 496	305 353	5 234	198 658	312 396
Heating equipment industry	153	4 838	10 081	113 547	6 739	265 650	550 053	274 245	6 112	157 875	278 547
Total	5 731	127 585	265 806	3 532 497	255 364	7 920 012	16 258 151	7 985 999	153 857	4 563 575	8 192 578
PETROLEUM AND COAL PRODUCTS INDUSTRIES											
Petroleum refining products	33	5 471	11 654	292 025	333 257	15 796 510	18 028 692	2 554 629	13 820	726 665	2 560 874
Other petroleum and coal products	76	714	1 470	21 925	11 787	178 574	267 776	73 569	1 000	33 122	106 720
Lubricating oils and greases	29	596	1 263	20 462	6 055	191 723	272 986	75 713	1 048	39 423	93 106
Total	138	6 781	14 387	334 412	351 099	16 166 807	18 569 454	2 703 911	15 868	799 210	2 760 700
Total mineral manufacturing industries	8 333	260 693	549 440	8 469 361	2 335 229	38 305 154	63 081 826	22 679 757	333 962	11 722 025	23 262 830

Source: Statistics Canada, Catalogue no. 31-203.
n.e.s. Not elsewhere specified.
1 Total activity includes sales and head offices. 2 Wire and wire products have been included in the primary metal industries group.
Note: Numbers may not add to totals due to rounding.

TABLE 28. CANADA, PRINCIPAL STATISTICS OF THE MINERAL INDUSTRY[1] BY REGION, 1991

	Mines, Quarries and Oil Wells Activity								Total Activity[2]		
		Production and Related Workers			Costs						
	Establishments	Employees	Person-Hours Paid	Wages	Fuel and Electricity	Materials and Supplies	Value of Production	Value Added	Employees	Salaries and Wages	Value Added
	(number)	(number)	(000)	($000)	($000)	($000)	($000)	($000)	(number)	($000)	($000)
Atlantic provinces[3]	82	7 391	15 476	313 528	134 284	514 729	1 569 618	920 606	9 624	422 511	951 282
Quebec	175	10 401	22 587	472 169	217 523	804 665	2 425 060	1 402 872	14 285	668 759	1 427 696
Ontario	145	14 570	32 396	726 572	223 355	1 239 862	4 585 131	3 121 914	19 895	1 033 717	3 137 122
Prairie provinces	557	16 742	34 697	843 362	581 860	2 054 471	17 723 156	15 086 825	41 696	2 427 443	15 258 759
British Columbia[4]	182	9 870	21 495	508 612	213 705	1 000 195	3 224 012	2 010 112	12 502	655 301	2 060 187
Yukon and Northwest Territories[5]	28	1 870	4 476	116 117	55 923	243 417	934 210	634 870	2 615	155 580	640 018
Total	1 169	60 844	131 127	2 980 360	1 426 650	5 857 338	30 461 187	23 177 199	100 617	5 363 311	23 475 063

Sources: Natural Resources Canada; Statistics Canada.
[1] Cement manufacturing, lime manufacturing, clay and clay products (domestic clays) are included in the mineral manufacturing industry. [2] Total activity includes sales and head offices.
[3] Includes eastern Canada offshore. [4] Includes western Canada offshore. [5] Includes Arctic Islands.
Note: Numbers may not add to totals due to rounding.

TABLE 28a. CANADA, PRINCIPAL STATISTICS OF THE MINERAL INDUSTRY[1] BY REGION, 1990

	Mines, Quarries and Oil Wells Activity								Total Activity[2]		
		Production and Related Workers			Costs						
	Establishments	Employees	Person-Hours Paid	Wages	Fuel and Electricity	Materials and Supplies	Value of Production	Value Added	Employees	Salaries and Wages	Value Added
	(number)	(number)	(000)	($000)	($000)	($000)	($000)	($000)	(number)	($000)	($000)
Atlantic provinces[3]	85[r]	8 253[r]	17 354[r]	309 664	150 992	630 680[r]	1 793 866[r]	1 012 191[r]	10 640[r]	416 926	1 017 736[r]
Quebec	183	10 777	23 497	462 174	214 085	780 391	2 437 732	1 443 258	14 751	651 791	1 463 206
Ontario	152	16 297	36 215	763 508	232 569	1 432 595	5 443 462	3 778 297	21 907	1 060 611	3 801 042
Prairie provinces	597	16 849	34 897[r]	785 998	551 720	1 955 227[r]	20 372 667[r]	17 888 529[r]	42 491	2 225 155	18 040 624[r]
British Columbia[4]	180	10 095	22 435	526 293	216 949	978 542[r]	3 474 855[r]	2 282 284[r]	12 577	654 998	2 307 947[r]
Yukon and Northwest Territories[5]	36	2 337	5 568	142 698	57 624	273 694	1 325 362[r]	985 487	3 105	181 141	1 001 983[r]
Total	1 233[r]	64 608[r]	139 963[r]	2 990 336	1 423 937	6 051 130[r]	34 847 941[r]	27 390 044[r]	105 471[r]	5 190 620	27 632 539[r]

Sources: Natural Resources Canada; Statistics Canada.
[r] Revised.
[1] Cement manufacturing, lime manufacturing, clay and clay products (domestic clays) are included in the mineral manufacturing industry. [2] Total activity includes sales and head offices.
[3] Includes eastern Canada offshore. [4] Includes western Canada offshore. [5] Includes Arctic Islands.
Note: Numbers may not add to totals due to rounding.

TABLE 29. CANADA, PRINCIPAL STATISTICS OF THE MINERAL MANUFACTURING INDUSTRIES BY REGION, 1991

	Mineral Manufacturing Activity									Total Activity[1]		
		Production and Related Workers			Costs							
	Establish-ments	Employees	Person-Hours Paid	Wages	Fuel and Electricity	Materials and Supplies	Value of Shipments	Value Added	Employees	Salaries and Wages	Value Added
	(number)	(number)	(000)	($000)	($000)	($000)	($000)	($000)	(number)	($000)	($000)
PRIMARY METALS INDUSTRY											
Atlantic provinces	8	x	x	x	x	x	x	x	x	x	x
Quebec	120	17 893	39 264	779 928	519 902	3 126 689	5 683 536	1 975 047	25 324	1 151 429	1 995 130
Ontario	211	42 009	89 038	1 782 489	582 698	5 044 980	9 285 599	3 659 229	53 150	2 373 996	3 647 244
Prairie provinces	51	x	x	x	x	x	x	x	x	x	x
British Columbia	48	4 611	9 450	202 134	20 135	388 059	780 255	376 539	6 240	287 808	402 356
Yukon and Northwest Territories	–	–	–	–	–	–	–	–	–	–	–
Total Canada	438	70 138	149 642	2 990 490	1 272 921	9 674 030	17 851 193	6 844 123	92 331	4 144 020	6 867 923
NONMETALLIC MINERAL PRODUCTS INDUSTRY											
Atlantic provinces	117	1 762	3 652	45 271	20 583	98 005	244 165	120 281	2 163	60 459	122 220
Quebec	424	8 707	18 663	266 296	107 537	529 065	1 399 657	759 443	11 657	380 162	789 576
Ontario	584	19 782	41 449	614 470	247 455	1 289 403	3 011 194	1 458 947	24 761	839 341	1 621 190
Prairie provinces	297	4 922	10 537	149 774	55 095	365 811	856 380	451 188	6 286	205 853	473 721
British Columbia	171	3 583	7 406	129 910	42 580	304 528	740 190	385 623	4 467	173 026	397 309
Yukon and Northwest Territories	–	–	–	–	–	–	–	–	–	–	–
Total Canada	1 593	38 756	81 707	1 205 721	473 250	2 586 812	6 251 586	3 175 482	49 334	1 658 841	3 404 016
FABRICATED METAL PRODUCTS INDUSTRY[2]											
Atlantic provinces	179	2 830	5 792	77 711	5 006	195 569	372 952	175 699	3 636	105 894	196 800
Quebec	1 466	24 207	50 452	696 593	69 316	1 700 321	3 672 464	1 874 791	33 436	1 021 847	1 915 788
Ontario	2 785	77 648	162 180	2 243 739	183 575	4 414 089	8 977 259	4 295 695	89 357	2 741 249	4 437 434
Prairie provinces	669	13 607	28 593	377 854	29 316	792 807	1 621 467	787 706	16 318	482 181	817 485
British Columbia	550	8 577	17 802	284 477	19 913	656 978	1 280 290	612 030	10 623	374 992	632 643
Yukon and Northwest Territories	–	–	–	–	–	–	–	–	–	–	–
Total Canada	5 649	126 869	264 821	3 680 374	307 126	7 759 764	15 924 432	7 745 921	153 370	4 726 163	8 000 150
PETROLEUM AND COAL PRODUCTS INDUSTRY											
Atlantic provinces	9	x	x	x	x	x	x	x	x	x	x
Quebec	34	1 172	2 398	59 017	107 366	2 949 079	3 510 743	260 547	1 892	97 056	272 600
Ontario	50	2 926	6 109	143 591	164 280	5 480 645	6 748 738	921 322	6 645	363 264	922 005
Prairie provinces	31	x	x	x	x	x	x	x	x	x	x
British Columbia	15	642	1 319	32 048	20 720	1 339 196	1 939 109	516 471	920	49 492	522 968
Yukon and Northwest Territories	1	x	x	x	x	x	x	x	x	x	x
Total Canada	140	7 020	14 815	349 896	402 847	14 608 143	18 066 435	2 403 899	14 643	759 828	2 426 361
TOTAL MINERAL MANUFACTURING INDUSTRIES											
Atlantic provinces	313	x	x	x	x	x	x	x	x	x	x
Quebec	2 044	51 979	110 777	1 801 834	804 121	8 305 154	14 266 400	4 869 828	72 309	2 650 494	4 973 094
Ontario	3 630	142 365	298 776	4 784 289	1 178 008	16 229 117	28 022 790	10 335 193	173 913	6 317 850	10 627 873
Prairie provinces	1 048	x	x	x	x	x	x	x	x	x	x
British Columbia	784	17 413	35 978	648 569	103 348	2 688 761	4 739 844	1 890 663	22 250	885 318	1 955 276
Yukon and Northwest Territories	1	x	x	x	x	x	x	x	x	x	x
Total Canada	7 820	242 783	510 984	8 226 481	2 456 144	34 628 749	58 093 646	20 169 425	309 678	11 288 852	20 698 450

Source: Statistics Canada, Catalogue no. 31-203.
– Nil; x Confidential.
[1] Total activity includes sales and head offices. [2] For reasons of confidentiality, Standard Industrial Classification 305 (wire and wire products), normally included in Primary Metals, is included in Fabricated Metal Products.

TABLE 29a. CANADA, PRINCIPAL STATISTICS OF THE MINERAL MANUFACTURING INDUSTRIES BY REGION, 1990

	Mineral Manufacturing Activity								Total Activity[1]		
		Production and Related Workers			Costs						
	Establish-ments	Employees	Person-Hours Paid	Wages	Fuel and Electricity	Materials and Supplies	Value of Shipments	Value Added	Employees	Salaries and Wages	Value Added
	(number)	(number)	(000)	($000)	($000)	($000)	($000)	($000)	(number)	($000)	($000)
PRIMARY METALS INDUSTRY[2]											
Atlantic provinces	9	x	x	x	x	x	x	x	x	x	x
Quebec	134	19 378	41 837	802 117	493 397	3 281 507	6 236 082	2 463 619	27 579	1 194 188	2 456 492
Ontario	230	42 332	90 697	1 722 727	505 367	5 456 485	10 139 701	3 841 046	54 055	2 317 500	3 823 991
Prairie provinces	53	x	x	x	x	x	x	x	x	x	x
British Columbia	48	5 236	11 045	219 463	19 629	435 914	909 575	454 113	6 887	298 550	528 748
Yukon and Northwest Territories	–	–	–	–	–	–	–	–	–	–	–
Total Canada	474	73 012	156 396	2 980 684	1 174 163	10 294 467	19 243 775	7 461 631	96 667	4 144 633	7 500 257
NONMETALLIC MINERAL PRODUCTS INDUSTRY											
Atlantic provinces	118	1 827	3 870	48 888	22 924	114 400	276 550	141 063	2 358	68 317	142 486
Quebec	473	10 516	21 958	299 771	123 181	654 660	1 632 915	857 035	13 021	405 738	882 797
Ontario	613	22 792	48 755	713 740	270 696	1 572 361	3 786 196	1 938 152	28 358	959 245	2 139 567
Prairie provinces	312	4 663	10 140	143 364	57 853	370 649	903 197	473 422	6 219	203 447	487 679
British Columbia	175	3 684	7 707	131 396	43 378	333 537	792 791	426 464	4 649	174 298	434 817
Yukon and Northwest Territories	–	–	–	–	–	–	–	–	–	–	–
Total Canada	1 691	43 482	92 431	1 337 159	518 032	3 045 607	7 391 649	3 836 136	54 605	1 811 045	4 087 346
FABRICATED METAL PRODUCTS INDUSTRY[2]											
Atlantic provinces	187	2 854	5 881	75 772	4 835	188 192	378 286	186 205	3 834	108 719	202 513
Quebec	1 590	30 700	62 842	814 773	69 981	1 922 417	4 072 681	2 066 447	37 954	1 074 896	2 100 465
Ontario	2 971	81 696	171 430	2 288 851	173 393	5 177 743	10 370 343	4 931 530	97 317	2 931 536	5 071 832
Prairie provinces	707	13 319	27 630	354 070	25 556	825 224	1 705 547	850 134	16 707	477 154	873 176
British Columbia	575	8 849	18 443	283 640	18 170	684 697	1 350 091	643 763	11 010	374 832	666 541
Yukon and Northwest Territories	–	–	–	–	–	–	–	–	–	–	–
Total Canada	6 030	137 418	286 226	3 817 106	291 935	8 798 273	17 876 948	8 678 079	166 822	4 967 137	8 914 527
PETROLEUM AND COAL PRODUCTS INDUSTRY											
Atlantic provinces	9	x	x	x	x	x	x	x	x	x	x
Quebec	33	1 112	2 350	56 948	77 930	3 241 898	3 514 819	389 222	1 801	93 446	408 933
Ontario	50	2 831	6 001	139 478	153 234	6 040 749	7 198 006	1 201 861	7 305	382 161	1 214 300
Prairie provinces	31	x	x	x	x	x	x	x	x	x	x
British Columbia	14	653	1 324	33 207	19 322	1 449 907	1 709 577	291 023	984	53 051	294 132
Yukon and Northwest Territories	1	x	x	x	x	x	x	x	x	x	x
Total Canada	138	6 781	14 387	334 412	351 099	16 166 807	18 569 454	2 703 911	15 868	799 210	2 760 700
TOTAL MINERAL MANUFACTURING INDUSTRIES											
Atlantic provinces	323	x	x	x	x	x	x	x	x	x	x
Quebec	2 230	61 706	128 987	1 973 609	764 489	9 100 482	15 456 497	5 776 323	80 355	2 768 268	5 848 687
Ontario	3 864	149 651	316 883	4 864 796	1 102 690	18 247 338	31 494 246	11 912 589	187 035	6 590 442	12 249 690
Prairie provinces	1 103	x	x	x	x	x	x	x	x	x	x
British Columbia	812	18 422	38 520	667 706	100 499	2 904 055	4 762 034	1 815 363	23 530	900 731	1 924 238
Yukon and Northwest Territories	1	x	x	x	x	x	x	x	x	x	x
Total Canada	8 333	260 693	549 440	8 469 361	2 335 229	38 305 154	63 081 826	22 679 757	333 962	11 722 025	23 262 830

Source: Statistics Canada, Catalogue no. 31-203.
– Nil; x Confidential.
[1] Total activity includes sales and head offices. [2] For reasons of confidentiality, Standard Industrial Classification 305 (wire and wire products), normally included in Primary Metals, is included in Fabricated Metal Products.

TABLE 30. CANADA, PRINCIPAL STATISTICS OF THE MINERAL INDUSTRY,[1] 1984-91

	Mines, Quarries and Oil Wells Activity									Total Activity[2]		
		Production and Related Workers			Costs							
	Establish-ments	Employees	Person-Hours Paid	Wages	Fuel and Electricity	Materials and Supplies	Value of Production	Value Added	Employees	Salaries and Wages	Value Added
	(number)	(number)	(000)	($000)	($000)	($000)	($000)	($000)	(number)	($000)	($000)
1984	1 381	69 650	140 567	2 295 256	1 204 008	4 290 972	37 976 019	32 481 039	115 790	4 106 049	32 545 525
1985	1 385	66 945	140 092	2 347 084	1 264 619	4 442 358	38 127 807	32 420 830	116 383	4 421 553	32 495 098
1986	1 507	64 360	135 055	2 378 524	1 240 371	4 649 767	27 785 615	21 895 474	109 433	4 445 569	22 224 015
1987	1 276	64 370	138 236	2 444 934	1 233 806	4 870 150	30 652 347	24 548 391	107 676	4 449 357	24 803 839
1988	1 340	67 360	144 551	2 749 351	1 296 757	5 685 034	31 777 388	24 795 628	110 757	4 876 209	25 100 343
1989	1 262	68 704	148 555	2 985 561	1 349 568	6 065 134r	33 555 133r	26 135 430r	110 975	5 232 986	26 436 361r
1990	1 233r	64 608r	139 963r	2 990 336	1 423 937	6 051 130r	34 847 941r	27 390 044r	105 471r	5 190 620	27 632 539r
1991	1 169	60 844	131 127	2 980 360	1 426 650	5 857 338	30 461 187	23 177 199	100 617	5 363 311	23 475 063

Sources: Natural Resources Canada; Statistics Canada.
r Revised.
[1] Cement manufacturing, lime manufacturing, clay and clay products (domestic clays) are included in the mineral manufacturing industry. [2] Total activity includes sales and head offices.

TABLE 31. CANADA, PRINCIPAL STATISTICS OF THE MINERAL MANUFACTURING INDUSTRIES,[1] 1980-91

		Mineral Manufacturing Activity							Total Activity[2]		
		Production and Related Workers			Costs						
	Establish-ments	Employees	Person-Hours Paid	Wages	Fuel and Electricity	Materials and Supplies	Value of Shipments	Value Added	Employees	Salaries and Wages	Value Added
	(number)	(number)	(000)	($000)	($000)	($000)	($000)	($000)	(number)	($000)	($000)
1980	7 229	270 529	565 988	4 991 451	1 411 101	28 394 177	43 895 507	14 758 224	366 120	7 262 688	15 160 467
1981	7 196	261 364	546 732	5 393 636	1 720 151	34 570 420	51 870 979	16 791 049	361 883	8 076 300	17 200 686
1982	5 687	229 518	475 378	5 333 201	1 728 740	34 241 605	50 045 037	14 497 245	321 785	8 126 238	14 823 990
1983	7 370	216 944	447 947	5 420 307	1 905 777	34 720 416	52 773 875	15 861 491	301 112	8 143 674	16 196 749
1984	7 511	223 816	470 367	5 948 626	2 125 032	37 738 117	57 207 764	17 980 271	304 309	8 719 151	18 265 131
1985	7 625	238 544	506 377	6 507 081	2 229 270	39 497 925	61 241 939	19 305 730	313 850	9 271 447	19 646 938
1986	7 841	248 039	524 184	6 829 899	2 096 145	31 806 478	54 521 641	19 788 464	319 950	9 563 918	20 124 687
1987	7 598	..	..	..	2 154 276r	35 570 988r	59 787 220r	22 189 903r	333 536r	10 188 110r	22 733 514r
1988	8 309	277 965	586 697	8 187 249r	2 268 149r	35 436 715r	62 739 083r	25 125 477r	350 917	11 191 039r	25 725 203r
1989	8 300	288 494r	606 841r	8 893 139r	2 341 578	38 785 940	64 981 175r	24 317 984r	360 004r	12 014 330r	29 859 105r
1990	8 333	260 693	549 440	8 469 361	2 335 229	38 305 154	63 081 826	22 679 757	333 962	11 722 025	23 262 830
1991	7 820	242 783	510 984	8 226 481	2 456 144	34 628 749	58 093 646	20 169 425	309 678	11 288 852	20 698 450

Source: Statistics Canada.
. . Not available; r Revised.
[1] Includes the following industries: Primary Metals, Nonmetallic Mineral Products, Fabricated Metal Poducts, and Petroleum and Coal Products. [2] Total activity includes sales and head offices.

TABLE 32. CANADA, CONSUMPTION OF FUEL AND ELECTRICITY IN THE MINERAL INDUSTRY,[1] 1991

	Unit	Metals	Industrials[2]	Total
Coal	000 t	153	–	153
	$000	10 941	–	10 941
Gasoline	000 litres	18 940	17 477	36 417
	$000	9 006	7 756	16 762
Fuel oil, kerosene, diesel oil	000 litres	785 070	247 098	1 032 168
	$000	186 715	65 983	252 698
Liquefied petroleum gas	000 litres	110 807	13 470	124 277
	$000	21 728	2 957	24 685
Natural gas	000 m^3	134 320	675 645	809 965
	$000	14 750	46 426	61 176
Other fuels[3]	$000	20 068	1 589	21 657
Total value of fuels	$000	263 207	124 709	387 916
Electricity purchased	million kWh	12 390	2 453	14 843
	$000	404 491	114 471	518 962
Total value of fuels and electricity purchased in the nonfuel mineral industry	$000	667 698	239 180	906 878
Total value of fuels and electricity purchased in the fuel industry	$000	. .	. .	519 771
Total value of fuels and electricity purchased in the mineral industry, all reporting companies	$000	. .	. .	1 426 650

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available.
[1] Cement manufacturing, lime manufacturing, clay and clay products (domestic clays) are included in the mineral manufacturing industry. [2] Includes structural materials. [3] Includes wood, manufactured gas, steam purchased, and other miscellaneous fuels.
Note: Numbers may not add to totals due to rounding.

TABLE 33. CANADA, COST OF FUEL AND ELECTRICITY USED IN THE MINERAL INDUSTRY,[1] 1984-91

	Unit	1984	1985	1986	1987	1988	1989	1990	1991
METALS									
Fuel	$000	331 231	337 445	276 894	249 932	251 343	254 442	270 811	263 207
Electricity purchased	million kWh	11 672	11 504	12 066	12 128	13 264	13 396	13 097	12 390
	$000	272 932	281 373	320 828	345 068	368 369	398 188	411 002	404 491
Total cost of fuel and electricity	$000	604 163	618 818	597 722	595 000	619 714	652 630	681 813	667 698
INDUSTRIALS[2]									
Fuel	$000	169 486	165 665	153 442	137 873	130 932	127 612	131 080	124 709
Electricity purchased	million kWh	2 120	2 122	2 107	2 237	2 471	2 548	2 842	2 453
	$000	76 884	82 114	86 571	96 876	105 825	113 108	114 151	114 471
Total cost of fuel and electricity	$000	246 370	247 779	240 013	234 749	236 757	240 720	245 231	239 180
TOTAL NONFUEL MINERAL INDUSTRY									
Fuel	$000	500 717	503 110	430 336	387 805	382 275	382 054	401 891	387 916
Electricity purchased	million kWh	13 792	13 626	14 173	14 365	15 735	15 944	15 939	14 843
	$000	349 816	363 487	407 399	441 944	474 194	511 296	525 153	518 962
Total cost of fuel and electricity	$000	850 533	866 597	837 735	829 749	856 471	893 350	927 044	906 878
FUELS[3]									
Fuel	$000	89 237	101 049	73 426	67 103	68 654	. .	. .	. .
Electricity purchased	million kWh	5 840	6 569	7 183	7 822	8 726	. .	. .	. .
	$000	264 233	296 973	329 208	336 952	371 632	. .	. .	. .
Total cost of fuel and electricity	$000	353 470	398 022	402 634	404 055	440 286	456 219	496 891	519 771
TOTAL MINERAL INDUSTRY									
Fuel	$000	589 954	604 159	503 762	454 908	450 929	. .	. .	. .
Electricity purchased	million kWh	19 632	20 195	21 356	22 187	24 461	. .	. .	. .
	$000	614 049	660 460	736 607	778 896	845 826	. .	. .	. .
Total cost of fuel and electricity	$000	1 204 003	1 264 619	1 240 371	1 233 806	1 296 757	1 349 568	1 423 937	1 426 650

Sources: Natural Resources Canada; Statistics Canada.
. . Not available.
1 Cement manufacturing, lime manufacturing, clay and clay products (domestic clays) are included in the mineral manufacturing industry. 2 Includes structural materials.
3 Breakdown not available for the fuel industries from 1989 to 1991.
Note: Numbers may not add to totals due to rounding.

TABLE 34. CANADA, EMPLOYMENT IN THE MINERAL INDUSTRY, STAGE I – MINERAL EXTRACTION AND CONCENTRATING (TOTAL ACTIVITY),[1] 1961-93

	Metal Mines	Nonmetal Mines	Structural Materials	Nonfuel Mining	Coal	Crude Oil and Natural Gas	Total Nonfuel and Fuel
SIC no.	061	062	081, 082	061, 062 081, 082	063	071	
				(number)			
1961	58 591	11 003	5 235	74 829	10 302	11 184	96 315
1962	58 243	11 408	5 514	75 165	9 897	11 232	96 294
1963	57 119	11 661	5 686	74 466	9 828	11 237	95 531
1964	57 648	11 727	6 044	75 419	9 796	11 242	96 457
1965	60 942	12 116	6 248	79 306	9 697	11 817	100 820
1966	61 670	12 422	6 312	80 404	9 281	12 378	102 063
1967	61 728	13 077	5 779	80 584	8 981	13 113	102 678
1968	63 369	13 673	5 836	82 878	8 427	13 611	104 916
1969	60 550	14 322	5 692	80 564	7 371	14 153	102 088
1970	66 590	15 150	5 510	87 250	7 874	14 970	110 094
1971	66 012	15 105	5 328	86 445	8 069	15 896	110 410
1972	61 994	14 866	5 154	82 014	8 704	16 604	107 322
1973	66 134	15 391	5 276	86 801	7 856	16 786	111 443
1974	70 038	16 198	6 197	92 433	8 142	18 155	118 730
1975	69 161	13 703	6 382	89 246	8 416	18 053	115 715
1976	68 269	15 649	5 685	89 603	8 995	19 096	117 694
1977	67 242	16 608	5 190	89 040	9 781	20 240	119 061
1978	56 447	16 035	4 847	77 329	10 574	22 045	109 948
1979	58 960	16 770	4 692	80 422	10 269	24 554	115 245
1980	66 118	16 979	4 461	87 558	11 416	27 448	126 422
1981	68 712	16 391	4 183	89 286	11 182	28 783	129 251
1982	61 503	13 680	3 491	78 674	13 113	31 699	123 486
1983	52 194	13 170	3 403	68 767	11 646	33 418	113 831
1984	52 683	13 698	3 560	69 941	11 905	33 944	115 790
1985	48 672	12 974	3 941	65 587	12 076	38 720	116 383
1986	46 487	12 376	4 887	63 750	10 747	34 936	109 433
1987	45 496	12 181	5 738	63 415	10 406	33 855	107 676
1988	48 277	11 679	5 917	65 873	11 122	33 762	110 757
1989	49 405	11 714	5 881	67 000	11 279	32 696	110 975
1990	45 248	11 515	5 376	62 139	11 406r	31 926	105 471
1991	42 092	10 812	5 026	57 930	11 237	31 450	100 617
1992p	37 774	10 306	4 305	52 385	8 964f	28 433	89 782
1993f	34 968	10 279	4 260	49 507	7 800	23 137	80 444

Sources: Natural Resources Canada; Statistics Canada.
SIC: Standard Industrial Classification, 1980.
f Forecast; p Preliminary; r Revised.
1 Total activity includes sales and head offices.

TABLE 35. CANADA, EMPLOYMENT IN THE NONFUEL MINERAL INDUSTRY, STAGE I – MINERAL EXTRACTION AND CONCENTRATING (TOTAL ACTIVITY),1 1961-93

	Gold	Uranium	Iron	Nickel, Copper, Zinc	Silver, Lead, Zinc	Other Nonferrous	Asbestos	Peat	Gypsum	Potash	Other Nonmetal	Stone Quarries	Sand and Gravel	Total Nonfuel Mining
SIC no.	0611	0616	0617	0612, 0613	0614	0615, 0619	0621	0622	0623	0624	0625, 0629	081	082	
							(number)							
1961	15 994	(2)	8 446	23 351	4 524	6 276	6 773	1 207	599	(3)	2 424	3 173	2 062	74 829
1962	15 425	(2)	9 181	23 383	4 669	5 585	6 936	1 220	594	(3)	2 658	3 221	2 293	75 165
1963	14 639	(2)	9 608	22 703	5 163	5 006	6 828	1 303	677	(3)	2 853	3 477	2 209	74 466
1964	14 012	(2)	9 544	23 848	5 898	4 346	6 544	1 290	710	(3)	3 183	3 718	2 326	75 419
1965	13 155	(2)	11 739	25 892	6 121	4 035	6 536	1 201	646	1 050	2 683	3 511	2 737	79 306
1966	11 656	(2)	11 464	27 651	6 356	4 543	6 736	1 254	585	1 195	2 652	3 701	2 611	80 404
1967	10 355	(2)	10 899	29 288	6 030	5 156	6 931	1 261	505	1 724	2 656	3 381	2 398	80 584
1968	9 001	(2)	11 342	30 557	6 320	6 149	7 213	1 306	489	2 086	2 579	3 340	2 496	82 878
1969	8 221	(2)	10 490	28 679	6 467	6 693	7 242	1 156	657	2 713	2 554	3 252	2 440	80 564
1970	7 185	(2)	11 336	36 253	7 103	4 713	7 664	1 195	671	2 837	2 783	3 023	2 487	87 250
1971	6 148	(2)	11 524	37 713	6 506	4 121	8 101	1 269	603	2 519	2 613	2 832	2 496	86 445
1972	5 579	(2)	10 842	36 012	6 057	3 504	7 843	1 114	670	2 440	2 799	2 803	2 351	82 014
1973	5 603	(2)	13 395	37 602	6 112	3 422	8 027	1 236	676	2 684	2 768	3 097	2 179	86 801
1974	5 665	(2)	15 019	38 876	6 722	3 756	8 131	1 288	671	3 224	2 884	3 458	2 739	92 433
1975	5 798	(2)	16 155	35 538	7 362	4 308	6 042	1 303	576	3 351	2 431	3 544	2 838	89 246
1976	5 051	3 430	16 765	34 049	7 351	1 623	7 900	1 168	591	3 270	2 720	3 217	2 468	89 603
1977	4 643	4 140	15 550	33 703	7 512	1 694	8 302	1 244	652	3 628	2 782	3 004	2 186	89 040
1978	4 943	4 965	12 103	25 610	7 073	1 753	7 752	1 295	683	3 708	2 597	2 876	1 971	77 329
1979	5 013	5 858	14 563	25 116	7 081	1 329	8 067	1 372	738	3 905	2 688	2 860	1 832	80 422
1980	5 839	6 304	13 753	31 063	7 349	1 810	8 055	1 308	715	4 160	2 741	2 660	1 801	87 558
1981	6 809	6 869	12 397	33 246	7 740	1 651	6 829	1 441	711	4 661	2 749	2 418	1 765	89 286
1982	7 350	6 035	10 676	28 851	6 837	1 754	4 973	1 323	614	4 076	2 694	2 028	1 463	78 674
1983	7 956	5 390	8 236	24 953	5 073	586	4 617	1 301	682	3 696	2 874	1 980	1 423	68 767
1984	8 450	6 249	7 843	24 000	5 165	976	4 177	1 369	770	4 508	2 874	2 256	1 304	69 941
1985	7 862	5 989	7 077	22 073	4 724	947	3 569	1 363	753	4 488	2 801	2 340	1 601	65 587
1986	8 562	5 608	6 379	20 616	4 162	1 160	2 766	1 468	990	4 315	2 837	2 627	2 260	63 750
1987	9 757	5 289	6 039	18 979	4 372	1 060	2 858	1 510	929	4 094	2 790	2 911	2 827	63 415
1988	12 594	5 103	6 095	18 881	4 443	1 161	2 720	1 581	956	3 970	2 452	2 981	2 936	65 873
1989	12 631	4 839	6 303	19 837	4 487	1 308	2 800	1 713	965	3 893	2 343	3 145	2 736	67 000
1990	11 807	3 702	5 820	19 104	3 727	1 088	2 699	1 740	786	3 822	2 468	2 951	2 425	62 139
1991	10 869	2 391	5 683	18 634	3 459	1 056	2 423	1 519	636	3 825	2 409	2 774	2 252	57 930
1992p	9 403	1 702	5 090	17 128	3 664	787	2 289	1 335	672	3 779	2 231	2 463	1 842	52 385
1993f	8 705pr	1 576pr	4 860(4)	15 707pr	3 392pr	729pr	2 283pr	1 332pr	670pr	3 769pr	2 225pr	2 435(4)	1 825(4)	49 507

Sources: Natural Resources Canada; Statistics Canada.
SIC: Standard Industrial Classification, 1980.
f Forecast; p Preliminary; pr Pro-rated.
1 Total activity includes sales and head offices. (2) Included in "Other Nonferrous." (3) Included in "Other Nonmetal." (4) Estimated by Natural Resources Canada.
Note: Numbers may not add to totals due to rounding.

TABLE 36. CANADA, EMPLOYMENT IN THE MINERAL INDUSTRY, STAGE II – SMELTING AND REFINING (TOTAL ACTIVITY),[1] 1961-93

	Smelting/ Refining	Iron and Steel Mills	Total Primary Metals	Petroleum Refineries	Total Smelting and Refining
SIC no.	295	291	291, 295	3611	
			(number)		
1961	29 938	34 749	64 687	10 660	75 347
1962	29 693	36 593	66 286	10 184	76 470
1963	28 516	38 196	66 712	9 734	76 446
1964	30 153	41 505	71 658	9 547	81 205
1965	31 835	44 274	76 109	8 976	85 085
1966	34 237	45 999	80 236	8 996	89 232
1967	34 764	44 203	78 967	9 147	88 114
1968	34 710	44 634	79 344	9 091	88 435
1969	33 376	42 954	76 330	8 765	85 095
1970	37 298	49 169	86 467	14 725	101 192
1971	36 445	49 601	86 046	14 506	100 552
1972	33 829	49 758	83 587	14 376	97 963
1973	32 396	53 008	85 404	14 843	100 247
1974	35 249	54 253	89 502	15 967	105 469
1975	35 577	54 003	89 580	15 624	105 204
1976	34 246	51 978	86 224	15 105	101 329
1977	35 647	52 709	88 356	16 464	104 820
1978	32 652	56 669	89 321	18 958	108 279
1979	32 869	59 167	92 036	18 037	110 073
1980	36 137	61 238	97 375	18 743	116 118
1981	38 011	56 543	94 554	21 325	115 879
1982	33 215	52 330	85 545	20 155	105 700
1983	31 788	47 693	79 481	17 557	97 038
1984	31 752	48 899	80 651	15 847	96 498
1985	30 567	47 685	78 252	15 326	93 578
1986	29 058	46 461	75 519	13 287	88 806
1987	29 397	46 493	75 890	13 252	89 142
1988	30 099	48 259	78 358	13 358	91 716
1989	30 651	46 738	77 389	13 881	91 270
1990	30 573	39 120	69 693	13 842	83 535
1991	28 817[a]	38 126	66 943[a]	12 573	79 516
1992[e]	25 999[a]	35 430	61 430[a]	12 223	73 653
1993[f]	27 232[a]	33 325	60 557[a]	9 703	70 260

Sources: Natural Resources Canada; Statistics Canada.
SIC: Standard Industrial Classification, 1980.
[e] Estimated; [f] Forecast.
[a] Change is partially due to the reclassification of a unit from SIC 295 to SIC 296 effective May 1991.
[1] Total activity includes sales and head offices.
Note: Numbers may not add to totals due to rounding.

TABLE 37. CANADA, EMPLOYMENT IN THE MINERAL INDUSTRY, STAGE III – SEMI-FABRICATION (TOTAL ACTIVITY),[1] 1961-93

	Total Nonfuel Semi-Fabrication	Miscellaneous Petroleum and Coal Products	Lubricating Oil and Greases	Total Semi-Fabrication
SIC no.[2]		369	3612	
		(number)		
1961	77 063	581	331	77 975
1962	80 606	608	352	81 566
1963	82 420	635	354	83 409
1964	87 843	726	373	88 942
1965	93 912	531	408	94 851
1966	98 602	585	424	99 611
1967	96 033	546	407	96 986
1968	96 375	518	397	97 290
1969	99 438	532	438	100 408
1970	96 144	499	423	97 066
1971	95 831	561	450	96 842
1972	101 109	555	478	102 142
1973	105 884	757	487	107 128
1974	109 818	954	514	111 286
1975	104 296	984	656	105 936
1976	103 411	982	602	104 995
1977	101 257	716	669	102 642
1978	107 234	683	712	108 629
1979	111 231	461	695	112 387
1980	105 902	532	798	107 232
1981	103 192	584	729	104 505
1982	90 194	571	792	91 557
1983	86 814	503	857	88 174
1984	91 405	521	896	92 822
1985	94 515	513	900	95 928
1986	96 744	778	1 001	98 523
1987	99 963	894	1 002	101 859
1988	103 307	1 161	1 091	105 559
1989	101 419	1 135	1 029	103 583
1990	94 544	1 000	1 026pr	96 570
1991	87 091	1 138	932pr	89 161
1992e	85 079	1 222	906pr	87 208
1993f	82 806	1 342	727pr	84 875

Sources: Natural Resources Canada; Statistics Canada.
e Estimated; f Forecast; pr Prorated.
[1] Includes sales and head offices. [2] 1970 Standard Industrial Classification for years 1961-82.
Note: Numbers may not add to totals due to rounding.

TABLE 38. CANADA, EMPLOYMENT IN THE MINERAL INDUSTRY, STAGE III – NONFUEL SEMI-FABRICATION (TOTAL ACTIVITY),[1] 1961-93

	Steel Pipe and Tube	Iron Foundries	Aluminum Rolling, Casting, Extruding	Copper Rolling, Casting, Extruding	Other Rolling, Casting, Extruding	Wire and Wire Products	Clay and Clay Products	Cement	Concrete Products	Ready-Mix Concrete	Glass and Glass Products[2]	Abrasives	Lime	Other Non-metallic Products	Total Nonfuel Semi-Fabrication
SIC no.	292	294	296	297	299	305	351	352	354	355	356	357	358	359	
								(number)							
1961	3 407	8 178	5 095	3 482	2 731	12 227	5 327	3 590	8 503	4 232	9 802	2 481	847	7 161	77 063
1962	3 676	8 546	5 118	3 492	2 770	13 045	5 468	3 679	9 156	4 886	10 042	2 577	949	7 202	80 606
1963	3 840	8 216	5 164	3 651	3 038	13 743	5 376	3 566	9 317	5 411	10 346	2 464	886	7 402	82 420
1964	4 437	9 620	4 834	3 849	3 382	14 850	5 582	3 592	10 225	6 171	10 362	2 580	815	7 544	87 843
1965	4 799	11 714	4 654	3 620	3 736	16 099	5 675	3 837	10 988	6 559	10 873	2 821	800	7 737	93 912
1966	4 795	13 027	4 943	4 199	4 103	16 391	5 876	4 053	11 090	7 349	11 248	3 044	785	7 699	98 602
1967	5 012	11 970	5 468	4 027	4 287	16 060	5 559	3 972	10 321	7 137	11 388	2 734	724	7 374	96 033
1968	5 441	11 131	5 491	3 947	4 585	16 082	5 515	3 747	10 166	7 440	11 992	2 617	662	7 559	96 375
1969	5 146	11 582	6 028	3 922	4 856	17 014	5 383	3 778	11 011	7 509	12 031	2 697	707	7 774	99 438
1970	5 314	10 663	6 297	3 744	4 060	16 598	4 938	3 887	9 562	7 340	11 654	2 559	660	8 868	96 144
1971	5 306	9 897	5 612	3 608	3 845	16 272	4 682	3 954	10 719	7 997	11 672	2 310	670	9 287	95 831
1972	6 268	9 948	6 200	3 740	4 215	17 651	4 695	4 732	10 817	8 240	12 045	2 367	651	9 540	101109
1973	5 288	10 965	6 206	3 736	4 863	18 877	5 001	4 871	10 790	9 233	12 840	2 555	724	9 935	105 884
1974	5 845	12 054	6 162	3 779	4 877	19 535	5 289	4 666	11 602	9 219	12 915	2 676	840	10 359	109 818
1975	5 785	11 480	5 672	3 240	4 573	17 614	5 042	4 577	11 201	9 541	11 779	2 318	790	10 684	104 296
1976	5 546	10 365	6 255	3 297	5 354	17 573	4 791	4 517	10 773	9 128	11 836	2 535	804	10 637	103 411
1977	5 634	10 459	6 884	3 183	4 703	17 886	4 553	4 265	10 001	8 521	11 204	2 557	828	10 579	101 257
1978	6 289	10 472	7 060	3 586	5 268	18 823	4 366	4 520	10 486	9 520	11 595	2 678	784	11 787	107 234
1979	6 480	10 520	7 698	3 728	6 292	19 765	4 947	4 828	9 766	9 332	11 835	2 660	925	12 455	111 231
1980	6 514	9 245	6 627	3 230	5 749	18 529	4 875	4 791	9 280	9 348	11 967	2 628	1 003	12 116	105 902
1981	7 531	8 358	6 512	3 031	5 182	17 309	4 145	4 726	9 121	10 053	12 003	2 571	968	11 682	103 192
1982	6 017	8 163	6 255	2 541	4 694	14 575	3 004	4 317	8 245	8 034	11 016	2 170	895	10 268	90 194
1983	4 521	7 364	6 415	2 744	4 827	13 493	3 008	4 057	7 286	8 390	11 896	1 852	862	10 099	86 814
1984	5 482	7 911	6 661	2 971	5 274	14 212	3 070	3 771	7 657	8 802	12 754	1 949	876	10 015	91 405
1985	5 978	7 750	6 196	3 012	5 620	15 354	2 727	3 533	8 336	9 210	12 872	1 895	783	11 249	94 515
1986	4 829	7 547	6 200	3 059	6 357	15 262	3 770	3 514	9 174	10 422	13 448	1 827	778	10 557	96 744
1987	4 964	7 860	6 143	2 828	6 403	14 943	3 930	3 646	10 309	11 910	13 605	1 693	784	10 945	99 963
1988	6 008	8 095	6 124	3 040	7 049	15 154	3 261	3 388	11 386	12 461	13 336	1 917	873	11 215	103 307
1989	5 438	7 538	6 285	3 119	6 645	15 077	3 044	3 350	11 505	12 377	12 664	2 039	871	11 467	101 419
1990	5 319	8 397	5 463	2 316	5 479	12 965	2 563	3 259	10 627	12 798	11 733	1 837	836	10 952	94 544
1991	5 618	7 680	5 169[a]	2 211	4 710	12 369	2 254	3 111	9 442	11 633	10 855	1 408	861	9 770	87 091
1992[e]	5 325	7 090	5 766[a]	2 026	5 014	12 908	2 110	2 969	8 458	12 097	8 991	1 149	944	10 232	85 079
1993[f]	5 265	7 667	5 578[a]	2 042	6 029	12 547	1 961	2 258	7 130	11 285	9 480	926	1 022	9 615	82 806

Sources: Natural Resources Canada; Statistics Canada.
SIC: 1980 Standard Industrial Classification.
[e] Estimated; [f] Forecast.
[a] Increase is primarily due to the reclassification of an establishment from SIC 295 to SIC 296 effective May 1991.
[1] Includes sales and head offices. [2] Includes sealed window manufacturers until 1969; thereafter, these are included in Stage IV – Ornamental Metal Products.
Note: Numbers may not add to totals due to rounding.

TABLE 39. CANADA, EMPLOYMENT IN THE MINERAL INDUSTRY, STAGE IV – METALLIC MINERAL MANUFACTURING (TOTAL ACTIVITY),[1] 1961-93

	Boilers	Structural Metal Products	Ornamental Metal Products	Stamped, Pressed and Coated Products	Hardware Tool and Cutlery	Heating Equipment	Machine Parts	Other Metal Fabricating	Total Mineral Manufacturing
SIC no.	301	302	303	304	306	307	308	309	
					(number)				
1961	4 709	14 231	10 641	21 156	9 135	5 137	7 756	15 249	88 014
1962	4 886	14 802	11 640	23 606	10 223	5 349	8 603	16 283	95 392
1963	5 350	14 212	12 459	24 024	11 112	5 586	9 179	16 627	98 549
1964	5 429	14 602	12 808	25 192	13 110	5 673	10 137	18 088	105 039
1965	6 496	18 072	13 439	27 925	13 570	5 711	11 618	20 017	116 848
1966	7 239	21 038	13 488	29 577	14 326	5 464	13 235	21 431	125 798
1967	6 622	18 547	12 994	29 830	14 056	5 461	13 810	21 007	122 327
1968	7 962	17 150	12 664	29 560	14 166	4 930	13 501	20 825	120 758
1969	7 494	18 203	12 784	30 463	14 401	5 059	14 517	20 895	123 816
1970	7 661	19 104	12 417	29 709	15 241	4 670	14 221	20 543	123 566
1971	7 847	17 556	12 614	28 710	14 920	4 749	13 097	20 755	120 248
1972	8 136	17 113	13 611	27 939	16 386	4 238	11 731	21 504	120 658
1973	8 013	18 164	13 937	30 026	18 819	4 453	10 138	22 494	126 044
1974	8 681	20 020	14 470	31 276	20 234	4 930	10 936	23 663	134 210
1975	10 211	19 101	15 241	30 273	18 990	4 717	10 922	23 810	133 265
1976	10 704	18 056	15 541	31 487	19 316	4 977	10 764	23 704	134 549
1977	9 660	17 209	14 800	30 888	17 867	4 538	10 762	23 298	129 022
1978	9 124	16 759	16 753	34 181	18 856	5 086	12 029	24 904	137 692
1979	9 477	18 676	18 018	33 548	21 090	5 818	13 081	23 705	143 413
1980	10 374	17 700	17 890	32 266	20 830	5 993	13 449	24 217	142 719
1981	11 215	18 445	17 603	32 459	19 575	5 806	14 297	22 123	141 523
1982	10 965	17 021	15 228	29 865	17 342	5 317	13 083	18 167	126 988
1983	5 413	18 437	13 537	27 947	16 609	5 032	12 881	16 044	115 900
1984	4 548	17 162	13 538	27 758	17 308	4 220	14 200	16 256	114 990
1985	4 455	18 083	15 598	31 021	19 297	5 607	15 356	14 927	124 344
1986	4 990	19 213	17 462	31 584	21 164	5 779	17 259	15 170	132 621
1987	4 816	18 615	19 770	35 329	22 129	6 252	18 398	16 358	141 667
1988	6 182	19 689	20 795	36 976	23 042	6 390	22 681	17 887	153 642
1989	5 407	23 006	22 591	36 707	25 626	7 076	24 639	20 099	165 151
1990	5 234	21 277	21 075	33 665	22 475	6 112	24 271	19 298	153 407
1991	5 081	18 667	19 885	30 348	21 912	5 246	23 092	16 770	141 001
1992[e]	4 907	18 174	18 654	24 329	26 202	5 300	23 997	17 505	139 067
1993[f]	5 213	17 195	17 760	22 397	21 977	5 466	24 397	19 869	134 274

Sources: Natural Resources Canada; Statistics Canada.
SIC: Standard Industrial Classification, 1980.
[e] Estimated; [f] Forecast.
[1] Total activity includes sales and head offices.
Note: Numbers may not add to totals due to rounding.

TABLE 41. CANADA, EMPLOYMENT, SALARIES AND WAGES IN THE MINERAL INDUSTRY,[1] 1984-91

	Unit	1984	1985	1986	1987	1988	1989	1990	1991
METALS									
Production and related workers	Number	39 181	36 618	34 941	34 329	36 140	37 451	33 895	31 168
Salaries and wages	$000	1 296 157	1 288 990	1 308 956	1 327 119	1 539 838	1 707 653	1 674 050	1 627 254
Annual average salary and wage	$	33 081	35 201	37 462	38 659	42 608	45 597	49 389	52 209
Administrative and office workers	Number	13 502	12 054	11 546	11 167	12 137	11 954	11 353	10 924
Salaries and wages	$000	518 644	487 398	489 402	489 609	561 205	600 238	603 486	626 302
Annual average salary and wage	$	38 412	40 435	42 387	43 844	46 239	50 212	53 157	57 333
Total metals									
Employees	Number	52 683	48 672	46 487	45 496	48 277	49 405	45 248	42 092
Salaries and wages	$000	1 814 801	1 776 388	1 798 358	1 816 728	2 101 043	2 307 891	2 277 536	2 253 556
Annual average salary and wage	$	34 448	36 497	38 685	39 932	43 521	46 714	50 335	53 539
INDUSTRIALS[2]									
Production and related workers	Number	13 008	12 535	12 376	12 989	12 969	12 976	12 702	11 699
Salaries and wages	$000	356 828	354 460	361 039	401 626	429 111	440 750	438 725	427 512
Annual average salary and wage	$	27 431	28 278	29 173	30 920	33 087	33 967	34 540	36 543
Administrative and office workers	Number	4 250	4 380	4 887	4 930	4 627	4 619	4 189	4 139
Salaries and wages	$000	138 012	148 090	169 237	183 979	189 650	191 558	181 420	186 909
Annual average salary and wage	$	32 473	33 811	34 630	37 318	40 988	41 472	43 309	45 158
Total industrials									
Employees	Number	17 258	16 915	17 263	17 919	17 596	17 595	16 891	15 838
Salaries and wages	$000	494 840	502 550	530 276	585 605	618 761	632 308	620 145	614 421
Annual average salary and wage	$	28 673	29 710	30 717	32 681	35 165	35 937	36 715	38 794
FUELS									
Production and related workers	Number	17 461	17 792	17 043	17 052	18 251	18 277	18 011r	17 977
Salaries and wages	$000	642 271	703 634	708 529	716 189	780 402	837 158	877 561	925 594
Annual average salary and wage	$	36 783	39 548	41 573	42 000	42 759	45 804	48 724	51 488
Administrative and office workers	Number	28 388	33 004	28 640	27 209	26 633	25 698	25 321	24 710
Salaries and wages	$000	1 154 137	1 438 982	1 408 406	1 330 835	1 376 003	1 455 629	1 415 378	1 569 740
Annual average salary and wage	$	40 656	43 600	49 176	48 912	51 665	56 644	55 897	63 527
Total fuels									
Employees	Number	45 849	50 796	45 683	44 261	44 884	43 975	43 332r	42 687
Salaries and wages	$000	1 796 408	2 142 616	2 116 935	2 047 024	2 156 405	2 292 787	2 292 939	2 495 334
Annual average salary and wage	$	39 181	42 181	46 340	46 249	48 044	52 138	52 916	58 457
TOTAL MINERAL INDUSTRY									
Production and related workers	Number	69 650	66 945	64 360	64 370	67 360	68 704	64 608r	60 844
Salaries and wages	$000	2 295 256	2 347 084	2 378 524	2 444 934	2 749 351	2 985 561	2 990 336	2 980 360
Annual average salary and wage	$	32 954	35 060	36 957	37 983	40 816	43 455	46 284	48 984
Administrative and office workers	Number	46 140	49 438	45 073	43 306	43 397	42 271	40 863	39 773
Salaries and wages	$000	1 810 793	2 074 470	2 067 045	2 004 423	2 126 857	2 247 425	2 200 284	2 382 951
Annual average salary and wage	$	39 246	41 961	45 860	46 285	49 009	53 167	53 845	59 914
Total mineral industry									
Employees	Number	115 790	116 383	109 433	107 676	110 757	110 975	105 471r	100 617
Salaries and wages	$000	4 106 049	4 421 553	4 445 569	4 449 357	4 876 209	5 232 986	5 190 620	5 363 311
Annual average salary and wage	$	35 461	37 991	40 624	41 322	44 026	47 155	49 214	53 304

Sources: Natural Resources Canada; Statistics Canada.
r Revised.
[1] Cement manufacturing, lime manufacturing, clay and clay products (domestic clays) are included in the mineral manufacturing industry. [2] Includes structural materials.
Note: Numbers may not add to totals due to rounding.

TABLE 42. CANADA, EMPLOYMENT, SALARIES AND WAGES IN THE MINERAL MANUFACTURING INDUSTRIES, 1984-91

	Unit	1984	1985	1986	1987	1988	1989	1990	1991
PRIMARY METAL INDUSTRIES									
Production and related workers	Number	92 336	92 695	90 035	. .	95 967	94 037	82 845	79 690
Salaries and wages	$000	2 818 413	2 940 777	2 924 986	. .	3 387 100	3 505 958	3 265 293	3 272 436
Annual average salary and wage	$	30 523	31 725	32 487	. .	35 294	37 283	39 414	41 065
Administrative and office workers	Number	30 826	29 467	28 738	. .	27 861	27 454	26 787	25 010
Salaries and wages	$000	1 131 842	1 159 060	1 182 287	. .	1 249 200	1 314 630	1 282 902	1 268 889
Annual average salary and wage	$	36 717	39 334	41 140	. .	44 837	47 885	47 893	50 735
Total primary metal industries[1]									
Employees	Number	123 162	122 162	118 773	119 372	123 828	121 491	109 632	104 700
Salaries and wages	$000	3 950 255	4 099 837	4 107 273	4 244 950	4 636 300	4 820 588	4 548 195	4 541 325
Annual average salary and wage	$	32 074	33 561	34 581	35 561	37 441	39 679	41 486	43 375
NONMETALLIC MINERAL PRODUCTS INDUSTRIES									
Production and related workers	Number	36 155	38 763	42 011	. .	45 974	46 019	43 482	38 756
Salaries and wages	$000	883 604	1 001 780	1 121 460	. .	1 309 458r	1 374 934	1 337 159	1 205 721
Annual average salary and wage	$	24 439	25 844	26 694	. .	28 483r	29 878	30 752	31 111
Administrative and office workers	Number	12 738	11 842	11 479	. .	11 863	11 298	11 123	10 578
Salaries and wages	$000	394 620	397 131	406 427	. .	464 835r	466 153	473 886	453 120
Annual average salary and wage	$	30 980	33 536	35 406	. .	39 184r	41 260	42 604	42 836
Total nonmetallic mineral products									
Employees	Number	48 893	50 605	53 490	56 822	57 837	57 317	54 605	49 334
Salaries and wages	$000	1 278 224	1 398 911	1 527 887	1 668 869	1 774 293r	1 841 087	1 811 045	1 658 841
Annual average salary and wage	$	26 143	27 644	28 564	29 370	30 677r	32 121	33 166	33 625
FABRICATED METAL PRODUCTS INDUSTRIES									
Production and related workers	Number	88 787	100 650	109 634	. .	129 187	141 465	127 585	117 317
Salaries and wages	$000	1 983 782	2 298 665	2 518 297	. .	3 172 110r	3 682 263	3 532 497	3 398 428
Annual average salary and wage	$	22 343	22 838	22 970	. .	24 554	26 029	27 687	28 968
Administrative and officer workers	Number	26 203	23 694	22 987	. .	24 455	23 686	26 272	23 684
Salaries and wages	$000	778 057	751 973	746 041	. .	882 671r	893 706	1 031 078	930 430
Annual average salary and wage	$	29 693	31 737	32 455	. .	36 094r	37 731	39 246	39 285
Total fabricated metal products industries									
Employees	Number	114 990	124 344	132 621	142 194r	153 642	165 151	153 857	141 001
Salaries and wages	$000	2 761 839	3 050 638	3 264 338	3 565 982r	4 054 781r	4 575 969	4 563 575	4 328 858
Annual average salary and wage	$	24 018	24 534	24 614	25 078r	26 391	27 708	29 661	30 701
PETROLEUM AND COAL PRODUCTS INDUSTRIES									
Production and related workers	Number	6 538	6 436	6 359	. .	6 837	6 973r	6 781	7 020
Salaries and wages	$000	262 827	265 859	265 156	. .	318 581r	329 984r	334 412	349 896
Annual average salary and wage	$	40 200	41 308	41 698	. .	46 597r	47 323r	49 316	49 843
Administrative and office workers	Number	10 726	10 303	8 707	. .	8 773	9 072r	9 087	7 623
Salaries and wages	$000	466 006	456 202	399 264	. .	407 084r	446 702r	464 798	409 932
Annual average salary and wage	$	43 446	44 279	45 856	. .	46 402r	49 240r	51 150	53 776
Total petroleum and coal products									
Employees	Number	17 264	16 739	15 066	15 148	15 610	16 045r	15 868	14 643
Salaries and wages	$000	728 833	722 061	664 420	708 309	725 665r	776 686r	799 210	759 828
Annual average salary and wage	$	42 217	43 136	44 101	46 759	46 487r	48 407r	50 366	51 890
TOTAL MINERAL MANUFACTURING INDUSTRIES									
Production and related workers	Number	223 816	238 544	248 039	. .	277 965	288 494r	260 693	242 783
Salaries and wages	$000	5 948 626	6 507 081	6 829 899	. .	8 187 249r	8 893 139r	8 469 361	8 226 481
Annual average salary and wage	$	26 578	27 278	27 536	. .	29 454r	30 826r	32 488	33 884
Administrative and office workers	Number	80 493	75 306	71 911	. .	72 952	71 510r	73 269	66 895
Salaries and wages	$000	2 770 525	2 764 366	2 734 019	. .	3 003 790r	3 121 191r	3 252 664	3 062 371
Annual average salary and wage	$	34 419	36 708	38 019	. .	41 175r	43 647r	44 393	45 779
Total mineral manufacturing industries									
Employees	Number	304 309	313 850	319 950	333 536r	350 917	360 004r	333 962	309 678
Salaries and wages	$000	8 719 151	9 271 447	9 563 918	10 188 110r	11 191 039r	12 014 330r	11 722 025	11 288 852
Annual average salary and wage	$	28 652	29 541	29 892	30 546r	31 891	33 373r	35 100	36 454

Source: Statistics Canada.
. . Not available; r Revised.
[1] Wire and wire products have been included in the Primary Metal Industries group.

TABLE 47. CANADA, AVERAGE WEEKLY WAGES AND HOURS WORKED (INCLUDING OVERTIME) FOR HOURLY RATED EMPLOYEES IN MINING, MANUFACTURING AND CONSTRUCTION INDUSTRIES, 1987-92

	1987	1988	1989	1990	1991	1992
MINING, QUARRYING AND OIL WELLS						
Average hours per week	39.7	40.7	39.8	40.0	39.5	39.8
Average weekly wage ($)	645.01	700.67	730.35	764.82	812.25	847.11
METALS						
Average hours per week	38.7	39.5	39.7[r]	40.2	39.6	39.8
Average weekly wage ($)	664.12	735.17	777.06	824.66	887.30	926.11
MINERAL FUELS						
Coal Mines						
Average hours per week	40.8	42.4	41.6	42.0	41.2	41.5
Average weekly wage ($)	715.09	786.06[r]	809.58	843.30	868.98	904.30
Crude Petroleum and Natural Gas						
Average hours per week	45.3	45.3	44.0	45.9	42.3	41.3
Average weekly wage ($)	753.40	803.18	876.78[r]	934.65	970.19	943.41
NONMETALS						
Average hours per week	38.4	39.1	39.5	38.8	39.1	39.6
Average weekly wage ($)	591.05	624.90	653.84	680.65	712.13	752.10
MANUFACTURING						
Average hours per week	38.7	38.9	38.7	38.2	37.8	38.3
Average weekly wage ($)	479.10	500.39	523.93[r]	544.63	565.11	591.93
CONSTRUCTION						
Average hours per week	38.2	38.5	38.1	38.1	37.2	36.7
Average weekly wage ($)	557.99	577.24	610.92	644.42	653.29	646.90

Source: Statistics Canada.
[r] Revised.

TABLE 48. CANADA, INDUSTRIAL FATALITIES PER THOUSAND WORKERS BY INDUSTRY GROUP,[1] 1989-92

	Fatalities				Number of Workers				Rate per 1000 Workers			
	1989[r]	1990[r]	1991[r]	1992[p]	1989[r]	1990[r]	1991[r]	1992[p]	1989[r]	1990[r]	1991[r]	1992[p]
	(number)				(000)							
Agriculture	16	16	16	21	428	428	448	433	0.04	0.04	0.04	0.05
Forestry and fishing[2]	79	94	51	39	109	103	106	100	0.72	0.91	0.48	0.39
Mining[3]	119	113	107	96	179	180	174	157	0.66	0.63	0.61	0.61
Manufacturing	144	160	133	110	2 126	2 001	1 865	1 788	0.07	0.08	0.07	0.06
Construction	181	160	111	115	764	778	695	681	0.24	0.21	0.16	0.17
Transportation[4]	161	138	137	107	961	951	916	922	0.17	0.15	0.15	0.12
Trade	76	63	54	38	2 186	2 247	2 169	2 155	0.03	0.03	0.02	0.02
Finance[5]	8	10	6	3	733	755	760	763	0.01	0.01	0.01	0.00
Service[6]	100	162	131	107	4 159	4 299	4 376	4 408	0.02	0.04	0.03	0.02
Public administration[7]	35	35	31	13	841	831	832	834	0.04	0.04	0.04	0.02
Unknown	26	24	10	29	. .	. .	. .	. .	. .	. .	. .	. .
Total	945	975	787	678	12 486	12 573	12 341	12 241	0.08	0.08	0.06	0.06

Sources: Labour Canada; Statistics Canada.
. . Not available; [p] Preliminary; [r] Revised.
[1] Includes fatalities resulting from occupational chest illnesses such as silicosis, lung cancer, etc. [2] Includes trapping and hunting. [3] Includes quarrying and oil wells. [4] Includes storage, communication, electric power and water utilities, and highway maintenance. [5] Includes insurance and real estate. [6] Includes community, business and personal services. [7] Includes defence.

TABLE 49. CANADA, RATE OF INDUSTRIAL FATALITIES PER THOUSAND WORKERS BY INDUSTRY GROUP,[1] 1987-92

	1987r	1988r	1989r	1990r	1991r	1992p
Mining[3]	0.80	0.71	0.66	0.63	0.61	0.61
Forestry and fishing[2]	0.85	0.74	0.72	0.91	0.48	0.39
Construction	0.23	0.22	0.24	0.21	0.16	0.17
Transportation[4]	0.16	0.15	0.17	0.15	0.15	0.12
Manufacturing	0.08	0.09	0.07	0.08	0.07	0.06
Agriculture	0.04	0.03	0.04	0.04	0.04	0.05
Service[6]	0.03	0.03	0.02	0.04	0.03	0.02
Public administration[7]	0.02	0.03	0.04	0.04	0.04	0.02
Trade	0.04	0.03	0.03	0.03	0.02	0.02
Finance[5]	0.01	0.01	0.01	0.01	0.01	0.00
Total	0.08	0.08	0.08	0.08	0.06	0.06

Sources: Labour Canada; Statistics Canada.
p Preliminary; r Revised.
[1] Includes fatalities resulting from occupational chest illnesses such as silicosis, lung cancer, etc. [2] Includes trapping and hunting. [3] Includes quarrying and oil wells. [4] Includes storage, communication, electric power and water utilities, and highway maintenance. [5] Includes insurance and real estate. [6] Includes community, business and personal services. [7] Includes defence.

TABLE 50. CANADA, NUMBER OF STRIKES AND LOCKOUTS BY INDUSTRY, 1991-93

	1991			1992			1993p		
	Strikes and Lockouts	Workers Involved	Duration in Person-Days	Strikes and Lockouts	Workers Involved	Duration in Person-Days	Strikes and Lockouts	Workers Involved	Duration in Person-Days
Agriculture	–	–	–	–	–	–	2	108	810
Forestry	5	627	44 330	5r	144r	4 390r	3	50	1 410
Fishing and trapping	1	500	2 000	1	2 000r	2 000r	–	–	–
Mining	7	2 547	153 920	5	2 634	271 210	5	1 122	114 220
Manufacturing	163	18 667r	571 510r	152r	38 654r	840 620r	130	12 271	474 030
Construction	31	3 820	35 040	22	22 125	151 270	7	15 701	156 620
Transportation and utilities	53	96 364	321 060r	39r	5 993r	146 530r	24	3 446	92 360
Trade	54	4 357r	135 520r	66r	4 716r	115 120r	64	9 846	239 760
Finance, insurance and real estate	8	284	20 020	11r	250r	12 150r	20	1 105	36 050
Service	114	38 200r	467 070r	73r	51 968r	482 480r	105	51 678	392 740
Public administration	27	88 120	779 510	30r	21 067r	90 160	22	6 415	94 400
Total, all industries	463	253 486r	2 529 980r	404r	149 551r	2 115 930r	382	101 742	1 602 400

Source: Labour Canada.
– Nil; p Preliminary; r Revised.

TABLE 53. CANADA, SOURCE OF ORES HOISTED OR REMOVED FROM SELECTED TYPES OF MINES, 1989-91

Mines	1989			1990			1991		
	Underground	Open-Pit	Total	Underground	Open-Pit	Total	Underground	Open-Pit	Total
					(000 tonnes)				
Nickel-copper-zinc	27 070	99 099	126 169	27 156	102 545	129 701	27 534	91 020	118 554
Iron ore	1 310	98 652	99 962	758	91 388	92 146	977	97 202	98 179
Coal	4 015	83 668	87 683	4 951	84 511	89 462	5 559	53 462	59 021
Potash	34 494	. .	34 494	31 760	. .	31 760	32 578	. .	32 578
Gold	16 795	3 540	20 335	19 924	2 878	22 802	18 451	4 400	22 851
Miscellaneous metals	1 187	16 948	18 135	996	17 363	18 359	1 008	15 882	16 890
Asbestos	1 390	15 757	17 147	1 463	13 020	14 484	2 328	11 370	13 698
Silver-lead-zinc	7 736	5 049	12 785	11 487	189	11 677	12 346	226	12 572
Rock salt	8 560	–	8 560	11 226	–	11 226	11 035	–	11 035
Gypsum	1 572	7 927	9 499	1 202r	7 829r	9 031r	737	6 466	7 203
Uranium	5 797	607	6 404	4 781	1 107	5 888	1 853	455	2 308
Miscellaneous nonmetals	401	1 584	1 985	424	1 759	2 184	260	1 750	2 010
Total	110 327	332 831	443 159	116 128r	322 591r	438 719r	114 665	282 233	396 898
Percentage	24.9	75.1	100.0	26.5	73.5	100.0	28.9	71.1	100.0

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available; r Revised.
Note: Numbers may not add to totals due to rounding.

TABLE 54. CANADA, SOURCE OF MATERIAL HOISTED OR REMOVED FROM SELECTED TYPES OF MINES, 1991

	Underground		Open-Pit			
	Ore	Waste	Ore	Waste	Over-burden	Tailings
	(000 tonnes)					
Nickel-copper-zinc	27 534	5 094	91 020	111 990	3 022	117 790
Iron ore	977	–	97 202	53 794	19 303	57 386
Coal	5 559	. .	53 462	. .	. .	. .
Potash	32 578	20	. .	. .	. .	20 453
Gold	18 451	3 262	4 400	16 519	238	22 829
Miscellaneous metals	1 008	8	15 882	15 989	–	13 724
Asbestos	2 328	–	11 370	13 612	2 834	7 525
Silver-lead-zinc	12 346	271	226	986	–	10 894
Rock salt	11 035	–	–	–	–	1 381
Gypsum	737	61	6 466	1 915	4 262	506
Uranium	1 853	213	455	4 655	5 449	2 274
Miscellaneous nonmetals	260	10	1 750	1 151	154	547
Total	114 665	8 938	282 233	220 612	35 262	255 309

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available.
Note: Numbers may not add to totals due to rounding.

TABLE 55. CANADA, ORE MINED AND ROCK QUARRIED IN THE MINING INDUSTRY, 1985-91

	1985	1986	1987	1988	1989	1990	1991
				(000 tonnes)			
METALS							
Nickel-copper-zinc	117 169	126 658r	130 452	127 119	126 169	129 701	118 554
Iron	94 587	88 231	87 077	102 392	99 962	92 146	98 179
Gold	11 997	14 072	15 326	18 746	20 335	22 802	22 851
Silver-lead-zinc	9 970	12 084	15 147	12 758	12 785	11 677	12 572
Miscellaneous metals	4 067	8 360	11 787	14 747	18 135	18 359	16 890
Uranium	7 182	6 933	6 383	6 337	6 404	5 888	2 308
Total	244 972	256 339r	266 172	282 098	283 790	280 573	271 353
NONMETALS							
Potash	34 843	33 563	34 875	38 965	34 494	31 760	32 578
Asbestos	17 118	11 808	13 526	15 373	17 147	14 484	13 698
Gypsum	9 608	9 175	9 439	9 204	9 499	9 031r	7 203
Rock salt	7 101	8 460	7 091	7 960	8 560	11 226r	11 035
Miscellaneous nonmetals	3 036	3 397	3 564	1 737	1 985	2 184	2 010
Total	71 706	66 403	68 496	73 239	71 685	68 684r	66 523
STRUCTURAL MATERIALS							
Stone, all kinds quarried[1]	86 632	97 602r	113 291r	120 126r	119 335r	111 355r	87 807
Stone used to make cement	8 467	11 535	12 543	12 539	13 899	12 991	9 719
Stone used to make lime	5 137	3 556	3 134	2 346	2 162	2 367	2 354
Total	100 236	112 693r	128 969r	135 010r	135 395r	126 713r	99 879
FUELS							
Coal	76 667	72 736	77 452	89 256	87 683	89 462	59 021
Total ore mined and rock quarried	493 581	508 171r	541 088r	579 603r	578 554r	565 433r	496 777

Sources: Natural Resources Canada; Statistics Canada.
– Nil; r Revised.
[1] Excludes stone used to manufacture cement and lime in Canada.
Note: Numbers may not add to totals due to rounding.

TABLE 56. CANADA, EXPLORATION, DEVELOPMENT AND CAPITAL EXPENDITURES IN THE MINING INDUSTRY[1] BY PROVINCE AND TERRITORY, 1991-93

		Capital						Repair			
		Construction									
		On-Property Exploration	On-Property Development	Structures	Sub-total	Machinery and Equipment	Total Capital	Construction	Machinery and Equipment	Total Repair	Total Capital and Repair
		($ millions)									
Newfoundland	1991	x	x	x	46.2	63.8	110.0	8.6	144.8	153.4	263.4
	1992[p]	x	37.9	x	39.0	13.5	52.5	8.4	135.8	144.2	196.7
	1993[i]	x	31.5	x	31.9	26.6	58.5	8.0	135.5	143.5	202.0
Prince Edward Island	1991	–	–	–	–	–	–	–	–	–	–
	1992[p]	–	–	–	–	–	–	–	–	–	–
	1993[i]	–	–	–	–	–	–	–	–	–	–
Nova Scotia	1991	x	31.7	x	62.0	49.3	111.3	2.0	41.7	43.7	155.0
	1992[p]	–	8.1	2.4	10.5	41.5	52.0	2.6	36.6	39.2	91.2
	1993[i]	–	7.9	7.4	15.3	28.5	43.8	2.3	34.9	37.2	81.0
New Brunswick	1991	x	x	3.5	22.9	39.0	61.9	2.5	48.7	51.2	113.1
	1992[p]	x	19.7	x	33.0	19.8	52.8	13.6	95.9	109.5	162.3
	1993[i]	x	20.7	x	32.5	29.5	62.0	12.3	92.7	105.0	167.0
Quebec	1991	20.2	216.0	58.5	294.7	74.7	369.4	36.5	247.3	283.8	653.2
	1992[p]	19.3	159.2	24.5	203.0	57.2	260.2	36.3	244.3	280.6	540.8
	1993[i]	17.2	184.5	34.2	235.9	97.4	333.3	34.4	237.7	272.1	605.4
Ontario	1991	19.8	297.5	47.7	365.0	94.8	459.8	60.9	426.1	487.0	946.8
	1992[p]	20.2	183.3	32.9	236.4	120.9	357.3	68.5	343.7	412.2	769.5
	1993[i]	18.4	168.5	31.4	218.3	134.2	352.5	70.5	295.3	365.8	718.3
Manitoba	1991	x	x	x	70.6	46.8	117.4	2.4	27.4	29.8	147.2
	1992[p]	x	x	x	61.8	34.6	96.4	1.4	68.5	69.9	166.3
	1993[i]	x	x	x	61.8	32.7	94.5	1.3	69.7	71.0	165.5
Saskatchewan	1991	7.3	75.4	30.7	113.4	45.1	158.5	10.4	119.5	129.9	288.4
	1992[p]	11.5	72.3	21.4	105.2	49.2	154.4	15.1	136.2	151.3	305.7
	1993[i]	10.3	89.3	32.5	132.1	57.3	189.4	17.1	123.0	140.1	329.5
Alberta	1991	2.3	22.4	5.9	30.6	18.6	49.2	3.7	117.7	121.4	170.6
	1992[p]	x	13.0	x	15.2	29.6	44.8	3.7	108.1	111.8	156.6
	1993[i]	2.2	6.5	0.5	9.2	44.4	53.6	3.7	83.1	86.8	140.4
British Columbia	1991	5.0	240.4	24.3	269.7	106.6	376.3	32.3	480.4	512.7	889.0
	1992[p]	5.9	166.1	26.6	198.6	76.2	274.8	20.1	333.6	353.7	628.5
	1993[i]	4.8	184.1	13.6	202.5	63.6	266.1	24.0	295.1	319.1	585.2

Yukon	1991	x	x	x	35.5	32.2	67.7	4.1	21.4	25.5	93.2
	1992p	x	x	x	25.8	0.1	25.9	0.5	14.6	15.1	41.0
	1993i	x	x	x	31.3	1.3	32.6	0.3	13.0	13.3	45.9
Northwest Territories	1991	4.4	x	x	35.3	7.7	43.0	2.1	43.8	45.9	88.9
	1992p	x	34.0	x	38.5	16.3	54.8	2.9	43.1	46.0	100.8
	1993i	x	x	x	26.5	4.7	31.2	1.9	39.8	41.7	72.9
Canada	1991	68.4	1 056.6	221.2	1 346.2	578.6	1 924.8	165.4	1 718.8	1 884.2	3 809.0
	1992p	70.7	769.9	126.1	966.7	459.0	1 425.7	173.1	1 560.4	1 733.5	3 159.2
	1993i	64.3	798.0	135.0	997.3	520.2	1 517.5	175.8	1 419.8	1 595.6	3 113.1

Source: Statistics Canada, catalogue no. 61-216.

– Nil; i Intentions; p Preliminary actual; x Confidential, included in total.

1 Excludes crude oil and natural gas industries.

Notes: Numbers may not add to totals due to rounding. Capital and repair expenditures in this table are based on the 1970 Standard Industrial Classification (SIC).

TABLE 57. CANADA, EXPLORATION , DEVELOPMENT AND CAPITAL EXPENDITURES IN THE MINING INDUSTRY[1] BY TYPE OF MINING, 1991-93

		Capital						Repair			
		Construction									
		On-Property Exploration	On-Property Development	Structures	Sub-total	Machinery and Equipment	Total Capital	Construction	Machinery and Equipment	Total Repair	Total Capital and Repair
		($ millions)									
METAL MINES											
Copper-gold-silver	1991	12.6	115.2	28.1	155.9	63.5	219.4	22.3	234.5	256.8	476.2
	1992[p]	11.6	80.2	36.5	128.3	82.3	210.6	19.6	181.2	200.8	411.4
	1993[i]	12.9	111.7	38.7	163.3	84.7	248.0	20.5	173.9	194.4	442.4
Gold	1991	25.3	186.6	41.3	253.2	86.6	339.8	31.5	210.2	241.7	581.5
	1992[p]	22.5	139.6	22.5	184.6	73.2	257.8	33.9	176.9	210.8	468.6
	1993[i]	17.7	142.2	17.6	177.5	95.7	273.2	31.8	175.9	207.7	480.9
Iron	1991	x	x	x	164.7	59.4	224.1	21.4	217.7	239.1	463.2
	1992[p]	x	74.9	x	76.9	28.2	105.1	14.0	206.1	220.1	325.2
	1993[i]	x	58.4	x	61.4	27.7	89.1	13.6	195.1	208.7	297.8
Silver-lead-zinc	1991	8.6	60.2	18.7	87.5	46.3	133.8	6.7	85.3	92.0	225.8
	1992[p]	4.5	55.0	14.9	74.4	23.3	97.7	17.0	112.1	129.1	226.8
	1993[i]	x	59.7	x	76.4	22.0	98.4	14.3	99.7	114.0	212.4
Uranium	1991	x	x	x	35.6	9.4	45.0	4.7	73.3	78.0	123.0
	1992[p]	x	x	x	86.3	15.1	101.4	6.0	72.7	78.7	180.1
	1993[i]	x	63.1	x	95.3	8.4	103.7	5.6	34.8	40.4	144.1
Other metal mining[2]	1991	9.9	232.1	15.9	257.9	65.8	323.7	41.8	213.1	254.9	578.6
	1992[p]	x	112.6	x	147.6	57.7	205.3	45.2	187.2	232.4	437.7
	1993[i]	x	93.6	x	124.1	49.3	173.4	46.3	199.2	245.4	418.9
Total metal mining	1991	59.3	734.3	161.3	954.9	330.9	1 285.8	128.3	1 034.1	1 162.4	2 448.2
	1992[p]	60.1	525.4	112.5	698.0	279.9	977.9	135.8	936.3	1 072.1	2 050.0
	1993[i]	52.5	528.8	116.7	698.0	287.7	985.7	132.1	878.6	1 010.7	1 996.4
NONMETAL MINES											
Asbestos	1991	x	x	x	28.4	15.6	44.0	4.7	34.8	39.5	83.5
	1992[p]	x	x	x	59.5	1.3	60.8	5.1	53.0	58.1	118.9
	1993[i]	x	x	x	60.8	1.0	61.8	2.5	43.0	45.5	107.3
Coal mines	1991	3.9	222.2	44.6	270.7	120.3	391.0	15.2	400.5	415.7	806.7
	1992[p]	2.3	141.4	4.9	148.6	79.6	228.2	10.0	313.2	323.2	551.4
	1993[i]	2.9	162.3	7.9	173.1	93.8	266.9	16.7	261.6	278.3	545.2

NONMETAL MINES (cont'd)

Other nonmetal mining[3]	1991	x	x	x	92.1	111.7	203.8	17.2	249.4	266.6	470.4
	1992p	x	x	x	60.6	98.2	158.5	22.5	257.9	280.1	438.9
	1993i	x	x	x	65.4	137.7	203.1	24.5	236.6	261.1	464.2
Total nonmetal mining	1991	9.0	322.3	59.8	391.1	247.7	638.8	37.1	684.7	721.8	1 360.6
	1992p	10.6	244.5	13.6	268.7	179.1	447.8	37.3	624.1	661.4	1 109.2
	1993i	11.8	269.3	18.3	299.4	232.5	531.9	43.7	541.2	584.9	1 116.8
Total mining	1991	68.4	1 056.6	221.2	1 346.2	578.6	1 924.8	165.4	1 718.8	1 884.2	3 809.0
	1992p	70.7	769.9	126.1	966.7	459.0	1 425.7	173.1	1 560.4	1 733.5	3 159.2
	1993i	64.3	798.0	135.0	997.3	520.2	1 517.5	175.8	1 419.8	1 595.6	3 113.1

Source: Statistics Canada, catalogue no. 61-216.

– Nil; i Intentions; p Preliminary actual; x Confidential, included in total.

1 Excludes expenditures in the petroleum and natural gas industries. 2 Includes nickel-copper mines, silver-cobalt mines and other metal mines. 3 Includes gypsum mines, salt mines, potash mines, quarries, sand and gravel pits and other nonmetal mines.

Notes: Numbers may not add to totals due to rounding. Capital and repair expenditures in this table are based on the 1970 Standard Industrial Classification (SIC).

TABLE 58. CANADA, DIAMOND DRILLING IN THE MINING INDUSTRY BY MINING COMPANIES WITH OWN EQUIPMENT AND BY DRILLING CONTRACTORS, 1989-91

		1989			1990			1991		
		Exploration	Other	Total	Exploration	Other	Total	Exploration	Other	Total
						(metres)				
METAL MINES										
Gold	Own equipment	70 359	35 936	106 295	24 193	188 565	212 758	34 171	6 965	41 136
	Contractors	735 297	123 330	858 627	734 105	–	734 105	644 021	4 283	648 304
	Total	805 656	159 266	964 922	758 298	188 565	946 863	678 192	11 248	689 440
Nickel-copper-zinc	Own equipment	241 854	–	241 854	166 877	–	166 877	141 716	–	141 716
	Contractors	309 652	–	309 652	303 952	–	303 952	175 930	–	175 930
	Total	551 506	–	551 506	470 829	–	470 829	317 646	–	317 646
Iron	Own equipment	6 886	377 764	384 650	8 328	131 708	140 036	30 764	94 450	125 214
	Contractors	25 920	–	25 920	11 366	–	11 366	11 630	–	11 630
	Total	32 806	377 764	410 570	19 694	131 708	151 402	42 394	94 450	136 844
Silver-lead-zinc	Own equipment	51 287	–	51 287	23 717	–	23 717	14 894	–	14 894
	Contractors	47 866	–	47 866	12 100	–	12 100	11 296	–	11 296
	Total	99 153	–	99 153	35 817	–	35 817	26 190	–	26 190
Uranium	Own equipment	32 379	–	32 379	21 015	–	21 015	236	–	236
	Contractors	31 507	–	31 507	12 233	–	12 233	22 151	–	22 151
	Total	63 886	–	63 886	33 248	–	33 248	22 387	–	22 387
Miscellaneous metal mining	Own equipment	–	–	–	–	–	–	–	–	–
	Contractors	31 906	–	31 906	26 536	–	26 536	15 311	–	15 311
	Total	31 906	–	31 906	26 536	–	26 536	15 311	–	15 311
Total metal mining	Own equipment	402 765	413 700	816 465	244 130	320 273	564 403	221 781	101 415	323 196
	Contractors	1 182 148	123 330	1 305 478	1 100 292	–	1 100 292	880 339	4 283	884 622
	Total	1 584 913	537 030	2 121 943	1 344 422	320 273	1 664 695	1 102 120	105 698	1 207 818
NONMETAL MINES										
Potash	Own equipment	10 674	–	10 674	12 817	–	12 817	14 231	–	14 231
	Contractors	1 065	–	1 065	3 045	–	3 045	7 397	–	7 397
	Total	11 739	–	11 739	15 862	–	15 862	21 628	–	21 628
Asbestos	Own equipment	–	–	–	–	–	–	–	–	–
	Contractors	9 508	–	9 508	7 909	–	7 909	7 115	–	7 115
	Total	9 508	–	9 508	7 909	–	7 909	7 115	–	7 115
Gypsum	Own equipment	–	–	–	6 100	–	6 100	–	–	–
	Contractors	–	1 778	1 778	3 188	–	3 188	1 766	–	1 766
	Total	–	1 778	1 778	9 288	–	9 288	1 766	–	1 766
Other nonmetal mines	Own equipment	–	–	–	812	–	812	–	–	–
	Contractors	7 064	–	7 064	1 450	–	1 450	1 000	–	1 000
	Total	7 064	–	7 064	2 262	–	2 262	1 000	–	1 000
Total nonmetal mining	Own equipment	10 674	–	10 674	19 729	–	19 729	14 231	–	14 231
	Contractors	17 637	1 778	19 415	15 592	–	15 592	17 278	–	17 278
	Total	28 311	1 778	30 089	35 321	–	35 321	31 509	–	31 509
Total mining industry	Own equipment	413 439	413 700	827 139	263 859	320 273	584 132	236 012	101 415	337 427
	Contractors	1 199 785	125 108	1 324 893	1 115 884	–	1 115 84	897 617	4 283	901 900
	Total	1 613 224	538 808	2 152 032	1 379 743	320 273	1 7000 016	1 133 629	105 698	1 239 327

Sources: Natural Resources Canada; Statistics Canada, Catalogue nos. 26-223 and 26-224.
– Nil.
Note: Numbers may not add to totals due to rounding.

TABLE 59. CANADA, ORE MINED AND ROCK QUARRIED IN THE MINING INDUSTRY, 1960-91

	Metals	Industrial[1]	Coal	Total
	(million tonnes)			
1960	92.1	88.7	. .	180.8
1961	90.1	96.7	. .	186.8
1962	103.6	103.8	. .	207.4
1963	112.7	120.4	. .	233.1
1964	128.0	134.1	. .	262.1
1965	151.0	146.5	. .	297.5
1966	147.6	171.8	. .	319.4
1967	169.1	177.5	. .	346.6
1968	186.9	172.7	. .	359.6
1969	172.0	178.8	. .	350.8
1970	213.0	179.1	. .	392.1
1971	211.5	185.8	. .	397.3
1972	206.0	189.7	. .	395.7
1973	274.9	162.6	. .	437.4
1974	278.7	178.8	. .	457.5
1975	264.2	158.7	. .	422.9
1976	296.5	167.1	. .	463.6
1977	299.5	205.2	33.8	538.5
1978	248.1	205.5	36.3	489.9
1979	274.8	200.1	39.8	514.6
1980	290.1	193.5	43.9	527.5
1981	301.5	172.5	48.2	522.2
1982	238.4	121.2	53.0	412.5
1983	219.0	137.0	54.8	410.8
1984	246.4	167.8	71.2	485.4
1985	245.0	171.9	76.7	493.6
1986	256.3r	179.1r	72.7	508.2r
1987	266.2	197.5r	77.5	541.1r
1988	282.1	208.2r	89.3	579.6r
1989	283.8	207.1r	87.7	578.6r
1990	280.6	195.4r	89.5	565.4r
1991	271.4	166.4	59.0	496.8

Sources: Natural Resources Canada; Statistics Canada.
. . Not available; r Revised.
[1] Includes nonmetallic mineral mining and all stone quarried, including stone used to make cement and lime. From 1979 onwards, coverage includes miscellaneous nonmetal mines previously excluded.
Note: Numbers may not add to totals due to rounding.

TABLE 60. CANADA, TOTAL DIAMOND DRILLING, METAL DEPOSITS, 1960-91

	Gold Deposits	Copper-Zinc and Nickel-Copper Deposits	Silver-Lead-Zinc Deposits	Other Metal-Bearing Deposits[1]	Total Metal Deposits
			(metres)		
1960	628 016	1 267 792	226 027	315 067	2 436 902
1961	595 180	1 128 091	255 101	221 079	2 199 451
1962	902 288	1 025 048	350 180	358 679	2 636 195
1963	529 958	977 257	288 204	148 703	1 944 122
1964	458 933	709 588	401 099	104 738	1 674 358
1965	440 020	779 536	331 294	275 917	1 826 767
1966	442 447	729 148	292 223	164 253	1 628 071
1967	391 347	947 955	230 182	120 350	1 689 834
1968	375 263	935 716	198 038	56 780	1 565 797
1969	274 410	923 452	197 670	109 592	1 505 124
1970	214 717	1 132 915	375 019	99 373	1 822 024
1971	193 291	1 089 103	308 798	83 851	1 675 043
1972	229 771	967 640	240 195	50 225	1 487 831
1973	243 708	713 134	185 946	57 730	1 200 518
1974	250 248	798 564	197 322	83 484	1 329 618
1975	216 158	532 991	184 203	97 971	1 031 323
1976	156 030	507 620	166 366	97 735	927 751
1977	175 643	515 780	213 279	124 329	1 029 031
1978	209 335	346 722	490 489	135 197	1 181 743
1979	198 955	437 562	131 032	150 018	917 567
1980	187 635	566 610	259 877	173 945	1 188 067
1981	306 197	675 712	478 754	170 369	1 631 032
1982	288 421	386 940	424 218	164 742	1 264 321
1983	352 218	512 745	269 659	97 661	1 232 283
1984	406 060	830 536	273 238	281 661	1 791 495
1985	429 565	475 582	152 692	286 764	1 344 603
1986	774 896	434 325	163 756	278 642	1 651 619
1987	650 688	503 509	125 291	359 011	1 638 499
1988	736 370	370 282	133 138	433 464	1 673 254
1989	964 922	551 506	99 153	506 362	2 121 943
1990	946 863	470 829	35 817	211 186	1 664 695
1991	689 440	317 646	26 190	174 542	1 207 818

Sources: Natural Resources Canada; Statistics Canada, Catalogue no. 26-223.
[1] Includes iron, titanium, uranium, molybdenum and other metal deposits.

TABLE 61. CANADA, EXPLORATION DIAMOND DRILLING, METAL DEPOSITS, 1960-91

	Mining Companies with Own Personnel and Equipment	Diamond Drilling Contractors	Total
		(metres)	
1960	268 381	1 409 416	1 677 797
1961	302 696	1 337 173	1 639 869
1962	167 214	1 748 023	1 915 237
1963	361 180	1 169 292	1 530 472
1964	143 013	1 072 985	1 215 998
1965	209 002	1 176 996	1 385 998
1966	163 379	1 044 860	1 208 239
1967	93 164	1 123 137	1 216 301
1968	159 341	990 690	1 150 031
1969	135 311	1 072 328	1 207 639
1970	62 147	1 228 061	1 290 208
1971	86 838	1 053 330	1 140 168
1972	251 651	839 753	1 091 404
1973	321 333	742 899	1 064 232
1974	357 823	892 557	1 250 380
1975	346 770	618 161	964 931
1976	335 919	532 036	867 955
1977	327 241	638 327	965 568
1978	237 250	534 557	771 807
1979	311 221	571 721	882 942
1980	347 829	747 566	1 095 395
1981	460 687	917 566	1 378 253
1982	289 901	713 413	1 003 314
1983	324 383	707 343	1 031 726
1984	357 680	936 459	1 294 139
1985	382 490	725 310	1 107 800
1986	347 154	915 809	1 262 963
1987	290 510	1 022 446	1 312 956
1988	272 116	1 003 074	1 275 190
1989	402 765	1 182 148	1 584 913
1990	244 130	1 100 292	1 344 422
1991	221 781	880 339	1 102 120

Sources: Natural Resources Canada; Statistics Canada, Catalogue no. 26-223.

TABLE 62. CANADA, DIAMOND DRILLING, OTHER THAN FOR EXPLORATION, METAL DEPOSITS, 1960-91

	Mining Companies with Own Personnel and Equipment	Diamond Drilling Contractors	Total
		(metres)	
1960	450 246	308 860	759 106
1961	384 432	175 149	559 581
1962	528 700	192 259	720 959
1963	388 228	25 422	413 650
1964	385 765	72 594	458 359
1965	393 947	46 822	440 769
1966	227 968	191 863	419 831
1967	186 463	287 071	473 534
1968	122 851	292 914	415 765
1969	87 552	209 933	297 485
1970	290 363	241 453	531 816
1971	295 966	238 910	534 876
1972	304 523	91 903	396 426
1973	77 162	59 124	136 286
1974	54 353	24 885	79 238
1975	31 917	34 475	66 392
1976	31 413	28 383	59 796
1977	24 303	39 160	63 463
1978	351 344	58 592	409 936
1979	4 090	30 535	34 625
1980	20 545	72 127	92 672
1981	200 898	51 881	252 779
1982	188 674	72 333	261 007
1983	81 138	119 419	200 557
1984	492 939	4 417	497 356
1985	230 501	6 302	236 803
1986	378 823	9 833	388 656
1987	325 543	–	325 543
1988	389 064	9 000	398 064
1989	413 700	123 330	537 030
1990	320 273	–	320 273
1991	101 415	4 283	105 698

Sources: Natural Resources Canada; Statistics Canada, Catalogue no. 26-223.
– Nil.
Note: Non-producing companies excluded since 1964.

TABLE 63. CANADA, CRUDE MINERALS TRANSPORTED BY CANADIAN RAILWAYS, 1989-91

	1989	1990	1991
		(000 tonnes)	
METALLIC MINERALS			
Iron ores and concentrates	41 594	35 801	38 602
Alumina and bauxite	3 841	3 909	4 236
Nickel-copper ores and concentrates	2 961	3 262r	3 377
Copper ores and concentrates	955	1 049r	1 040
Zinc ores and concentrates	1 231	973	886
Lead ores and concentrates	465	192	122
Metallic ores and concentrates, n.e.s.	80	46	22
Nickel ores and concentrates	–	7	14
Total	51 127	45 239r	48 296
NONMETALLIC MINERALS			
Potash (KCl)	10 559	11 317r	10 740
Sulphur, n.e.s.	4 227	4 925	4 893
Gypsum	5 621	5 258	4 227
Sulphur, liquid	1 016	568	1 235
Limestone, n.e.s.	2 939	1 955	1 191
Phosphate rock	1 275	1 040	950
Salt, rock	828	934r	637
Sodium carbonate	631	531	457
Nepheline syenite	321	294	296
Sodium sulphate	291	519	264
Limestone, industrial	368	173	253
Sand, industrial	854	275	185
Clay	786	109	102
Nonmetallic minerals, n.e.s.	270	105	88
Salt, n.e.s.	137	77	71
Stone, n.e.s.	94	46	35
Barite	11	14	20
Abrasives, natural	27	9	5
Asbestos	3	3	3
Limestone, agricultural	55	6	3
Silica	19	2	1
Sand, n.e.s.	4	2	1
Peat and other mosses	2	2	1
Total	30 338	28 164r	25 658
MINERAL FUELS			
Coal, bituminous	38 856	36 861r	39 120
Coal, lignite	1 856	1 757	1 298
Natural gas and other crude bituminous substances	87	70	42
Oil, crude	12	8	6
Coal, n.e.s.	2	5	–
Total	40 813	38 701r	40 465
Total crude minerals	122 278	112 104r	114 419
Total revenue freight[1] moved by Canadian railways	247 041	226 338	233 290
Crude minerals as a percentage of total revenue freight	49.5	49.5r	49.0

Source: Statistics Canada.
– Nil; n.e.s. Not elsewhere specified; r Revised.
[1] Revenue freight refers to a local or interline shipment from which earnings accrue to a carrier.
Note: Numbers may not add to totals due to rounding.

TABLE 64. CANADA, FABRICATED MINERAL PRODUCTS TRANSPORTED BY CANADIAN RAILWAYS, 1989-91

	1989	1990	1991
		(000 tonnes)	
METALLIC MINERAL PRODUCTS			
Ferrous mineral products			
Iron and steel scrap	2 254	1 251r	1 049
Sheets and strips, steel	1 196	1 053	957
Ingots, blooms, billets, slabs of iron and steel	818	658	553
Bars and rods, steel	654	571	449
Pipes and tubes, iron and steel	459	265	407
Structural shapes and sheet piling, iron and steel	453	239	212
Plates, steel	260	193	168
Castings and forgings, iron and steel	62	53	45
Rails and railway track material	191	68	42
Pig iron	55	40	22
Ferroalloys	20	17	9
Other primary iron and steel	10	6	4
Wire, iron or steel	4	2	1
Total ferrous mineral products	6 436	4 416r	3 919
Nonferrous mineral products			
Aluminum and aluminum alloy fabricated material, n.e.s.	822	703r	777
Copper and alloys, n.e.s.	373	381	396
Zinc and alloys	492	389	383
Aluminum paste, powder, pigs, ingots, shot	191	377	378
Lead and alloys	134	87	114
Other nonferrous base metals and alloys	150	120	104
Slag, dross, etc.	99	51	63
Nonferrous metal scrap	107	56	52
Copper matte and precipitates	22	1	2
Total nonferrous mineral products	2 390	2 165r	2 269
Total metallic mineral products	8 826	6 581r	6 188
NONMETALLIC MINERAL PRODUCTS			
Fertilizers and fertilizer materials, n.e.s.	2 283	2 143	2 285
Sulphuric acid	1 767	2 102	1 990
Portland cement, standard	1 716	1 559	1 400
Lime, hydrated and quick	168	181	181
Cement and concrete basic products, n.e.s.	187	189	163
Nonmetallic mineral basic products, n.e.s.	178	159	128
Natural stone basic products, chiefly structural	152	115	123
Asbestos and asbestos-cement basic products	20	25	20
Gypsum basic products, n.e.s.	248	45	17
Dolomite and magnesite, calcined	51	15	16
Refractories, n.e.s.	3	4	8
Glass basic products	36	3	7
Fire brick and similar shapes	21	6	6
Plaster	9	2	4
Bricks and tiles, clay	50	3	–
Total nonmetallic mineral products	6 889	6 551	6 347
MINERAL FUEL PRODUCTS			
Refined and manufactured gases, fuel type	2 744	2 377	2 416
Fuel oil, n.e.s.	802	1 185r	1 235
Diesel fuel	1 397	1 349	896
Gasoline	612	531	511
Other petroleum and coal products	509	442	367
Coke, n.e.s.	459	355	363
Petroleum coke	340	266	333
Asphalts and road oils	211	191	214
Lubricating oils and greases	331	267	213
Total mineral fuel products	7 405	6 963r	6 547
Total fabricated mineral products	23 120	20 095r	19 081
Total revenue freight[1] moved by Canadian railways	247 041	226 338	233 290
Fabricated mineral products as a percentage of total revenue freight	9.4	8.9	8.2

Source: Statistics Canada.
– Nil; n.e.s. Not elsewhere specified; r Revised.
[1] Revenue freight refers to a local or interline shipment from which earnings accrue to a carrier.
Note: Numbers may not add to totals due to rounding.

TABLE 65. CANADA, CRUDE MINERALS AND FABRICATED MINERAL PRODUCTS TRANSPORTED BY CANADIAN RAILWAYS, 1960-91

	Total Revenue Freight[1]	Total Crude Minerals	Total Fabricated Mineral Products	Total Crude and Fabricated Minerals	Crude and Fabricated Minerals as Percent of Revenue Freight
	(million tonnes)				
1960	142.8	57.1	14.5	71.6	50.1
1961	138.9	54.1	13.6	67.7	48.7
1962	146.0	60.3	13.8	74.1	50.8
1963	154.6	62.9	15.5	78.4	50.6
1964	180.0	74.6	15.9	90.5	50.3
1965	186.2	80.9	17.3	98.2	52.7
1966	194.5	80.6	17.8	94.8	50.6
1967	190.0	81.2	17.7	98.9	52.1
1968	195.4	86.7	18.8	105.5	54.0
1969	189.0	81.9	27.6	109.5	57.9
1970	211.6	97.5	28.4	125.9	59.5
1971	214.5	95.6	27.4	123.0	57.3
1972	215.8	89.4	27.6	117.0	54.2
1973	241.2	113.1	29.1	142.2	59.0
1974	246.3	115.3	30.9	146.2	59.4
1975	226.0	110.6	26.6	137.2	60.7
1976	238.5	116.6	25.5	142.1	59.6
1977	247.2	121.1	25.7	146.8	59.4
1978	238.8	107.7	26.2	133.9	56.1
1979	257.9	127.2	26.6	153.8	59.6
1980	254.4	124.8	24.6	149.4	58.7
1981	246.6	120.7	26.4	147.1	59.7
1982	212.5	95.7	21.0	116.7	54.9
1983	222.8	95.3	22.7	118.0	53.0
1984	254.6	121.1	25.1	146.2	57.4
1985	250.6	125.2	24.3	149.5	59.7
1986	249.8	121.2	23.0	144.2	57.7
1987	261.4	122.2	22.7	144.9	55.4
1988	269.4	134.9	23.2	158.1	58.7
1989	247.0	122.3	23.1	145.4	58.9
1990	226.3	112.1r	20.1	132.2r	58.4r
1991	233.3	114.4	19.1	133.5	57.2

Source: Statistics Canada.
r Revised.
1 Revenue freight refers to a local or interline shipment from which earnings accrue to a carrier.

TABLE 66. CANADA, CRUDE MINERALS LOADED AND UNLOADED IN COASTWISE SHIPPING, 1992

	Loaded					Unloaded				
	Atlantic	St. Lawrence	Great Lakes	Pacific	Total	Atlantic	St. Lawrence	Great Lakes	Pacific	Total
	(tonnes)									
METALLIC MINERALS										
Iron ore and concentrates	9 699	6 738 134	26 971	–	6 774 804	9 699	773 464	5 991 641	–	6 774 804
Aluminum ores and concentrates	–	18 495	–	–	18 495	–	–	18 495	–	18 495
Other ores and concentrates	–	2 703 383	322 528	–	3 025 911	–	2 697 411	328 500	–	3 025 911
Total metallic minerals	9 699	9 460 012	349 499	–	9 819 210	9 699	3 470 875	6 338 636	–	9 819 210
NONMETALLIC MINERALS										
Salt	1 396 861	–	1 766 621	454	3 163 935	281 503	1 707 171	1 174 808	454	3 163 935
Limestone	30 041	367	1 642 461	65 589	1 738 459	30 367	23 992	1 637 651	46 448	1 738 459
Sand and gravel	107 381	–	154 564	752 275	1 014 220	107 381	–	154 564	752 275	1 014 220
Gypsum	612 505	25 997	–	–	638 502	29 559	475 477	133 466	–	638 502
Potash	–	–	99 855	–	99 855	–	25 401	74 454	–	99 855
Sulphur	–	81	–	1 498	1 579	–	81	–	1 498	1 579
Other mineral products (including clays, coal briquettes, greases and asphalt)	913 548	306 413	1 706 950	137 769	3 064 680	809 274	720 636	1 396 609	138 161	3 064 680
Total nonmetallic minerals	3 060 336	332 858	5 370 451	957 585	9 721 230	1 258 084	2 952 758	4 571 552	938 836	9 721 230
MINERAL FUELS										
Coal and coke	34 398	31 808	2 429 122	19 051	2 514 379	24 129	42 077	2 429 122	19 051	2 514 379
Crude petroleum	62 466	7 905	–	–	70 371	–	62 466	7 905	–	70 371
Total mineral fuels	96 864	39 713	2 429 122	19 051	2 584 750	24 129	104 543	2 437 027	19 051	2 584 750
Total crude minerals	3 166 899	9 832 583	8 149 072	976 636	22 125 190	1 291 912	6 528 176	13 347 215	957 887	22 125 190
Total all commodities[1]	6 654 922	13 869 202	17 634 579	14 102 865	52 261 568	5 277 166	16 674 314	16 227 826	14 082 262	52 261 568
Crude minerals as a percentage of all products	47.6	70.9	46.2	6.9	42.3	24.5	39.2	82.2	6.8	42.3

Source: Statistics Canada.
– Nil.
1 Includes metallic minerals, nonmetallic minerals and mineral fuels, along with all other cargo loaded and unloaded in coastwise shipping.
Notes: Numbers may not add to totals due to rounding.

TABLE 67. CANADA, FABRICATED MINERALS LOADED AND UNLOADED IN COASTWISE SHIPPING, 1992

	Loaded					Unloaded				
	Atlantic	St. Lawrence	Great Lakes	Pacific	Total	Atlantic	St. Lawrence	Great Lakes	Pacific	Total
	(tonnes)									
METALLIC MINERAL PRODUCTS										
Iron, steel and alloys	1 080	10 845	5 442	4 043	21 410	8 011	1 358	7 999	4 043	21 410
Aluminum and aluminum products	–	201 755	–	–	201 755	–	201 755	–	–	201 755
Other base-metal products	16 167	60 509	–	–	76 675	28 181	48 495	–	–	76 675
Total metallic mineral products	17 247	273 109	5 442	4 043	299 841	36 192	251 608	7 999	4 043	299 841
NONMETALLIC MINERAL PRODUCTS										
Cement and related products	529	70	483 426	–	484 026	600	119 493	363 933	–	484 026
Other fabricated nonmetallic minerals, n.e.s.	5 641	27 177	156 573	253 145	442 538	31 282	41 264	116 846	253 145	442 538
Total nonmetallic mineral products	6 170	27 247	639 999	253 145	926 564	31 882	160 757	480 779	253 145	926 564
MINERAL FUEL PRODUCTS										
Gasoline	1 165 315	1 068 439	330 358	582 999	3 147 111	1 062 364	1 074 515	427 233	582 999	3 147 111
Petroleum coke	–	–	12 680	–	12 680	–	–	12 680	–	12 680
Other fabricated mineral fuels, n.e.s.	1 829 038	1 752 334	647 158	709 837	4 938 369	1 839 873	1 812 746	577 716	708 033	4 938 369
Total mineral fuel products	2 994 353	2 820 773	990 196	1 292 836	8 098 160	2 902 237	2 887 261	1 017 629	1 291 032	8 098 160
Total fabricated mineral products	3 017 770	3 121 129	1 635 637	1 550 024	9 324 565	2 970 311	3 299 626	1 506 407	1 548 220	9 324 565
Total all commodities[1]	6 654 922	13 869 202	17 634 579	14 102 865	52 261 568	5 277 166	16 674 314	16 227 826	14 082 262	52 261 568
Fabricated minerals as a percentage of all commodities	45.3	22.5	9.3	11.0	17.8	56.3	19.8	9.3	11.0	17.8

Source: Statistics Canada.
– Nil; n.e.s. Not elsewhere specified.
[1] Includes metallic mineral products, nonmetallic mineral products and mineral fuel products, along with all other cargo loaded and unloaded in coastwise shipping.
Notes: Numbers may not add to totals due to rounding.

TABLE 68. CANADA, CRUDE AND FABRICATED MINERALS LOADED AT CANADIAN PORTS IN COASTWISE SHIPPING, 1960-92

	Total All Commodities[1]	Total Crude Minerals	Total Fabricated Minerals	Crude and Fabricated Minerals as Percentage of All Products
		(000 tonnes)		
1960	37 058	8 786	8 229	45.9
1961	41 861	9 527	8 857	43.9
1962	39 763	8 361	9 768	45.6
1963	40 328	7 998	9 942	44.5
1964	47 171	8 522	11 194	41.8
1965	48 200	9 183	11 766	43.5
1966	55 122	10 155	12 653	41.4
1967	49 799	11 509	12 207	47.6
1968	50 921	13 698	13 245	52.9
1969	51 890	12 746	14 181	51.9
1970	57 301	14 415	14 818	51.0
1971	55 128	14 783	15 374	54.7
1972	55 326	14 197	15 290	53.3
1973	55 314	16 573	15 615	58.2
1974	53 633	11 723	16 575	52.8
1975	54 373	15 687	17 510	61.1
1976	53 882	15 924	16 208	59.6
1977	58 309	18 131	17 435	61.0
1978	60 668	18 318	16 619	57.6
1979	79 950	22 130	17 486	49.6
1980	82 761	22 947	17 134	48.4
1981	71 271	17 849	16 669	48.4
1982	65 881	16 473	13 214	45.1
1983	67 598	21 248	12 025	49.2
1984	68 698	22 798	11 909	50.5
1985	61 717	19 867	10 291	48.9
1986	60 506	19 901	10 264	49.9
1987	67 572	20 969	11 118	47.5
1988	69 974	23 325	11 676	50.0
1989	62 016r	22 963	11 825	56.1r
1990	60 360	22 430	16 096	63.8
1991	58 430	19 624	10 370	51.3
1992	52 262	22 125	9 325	60.2

Source: Statistics Canada.
r Revised.
1 Includes metallic mineral products, nonmetallic mineral products and mineral fuel products, along with all other cargo loaded and unloaded in coastwise shipping.

TABLE 69. CANADA, CRUDE MINERALS LOADED AND UNLOADED AT CANADIAN PORTS IN INTERNATIONAL SHIPPING TRADE,[1] 1990-92

	1990		1991		1992	
	Loaded	Unloaded	Loaded	Unloaded	Loaded	Unloaded
	(tonnes)					
METALLIC MINERALS						
Iron ore and concentrates	29 227 639	4 590 480	28 842 400	5 530 400	26 181 230	5 401 658
Aluminum ores and concentrates	19 162	4 251 610	755	2 506 141	206	2 597 421
Lead and zinc ores and concentrates	895 731	138 419	620 254	302 976	630 641	369 808
Copper and nickel ores and concentrates	1 223 635	97 430	1 196 012	97 223	1 055 909	127 739
Other ores and base-metal products	1 365 310	222 720	1 074 545	78 048	1 001 411	277 730
Total metallic minerals	32 731 477	9 300 659	31 733 966	8 514 788	28 869 397	8 774 356
NONMETALLIC MINERALS						
Limestone	1 153 471	484 877	1 238 636	417 760	1 525 801	2 007 454
Sand and gravel	485 993	1 379 781	494 771	1 348 947	584 135	1 346 022
Salt	1 962 923	1 507 466	2 564 940	677 604	2 363 201	772 021
Gypsum	5 307 978	408 273	4 779 328	260 324	4 934 822	266 173
Potash	6 411 306	112 629	6 079 029	30 068	5 069 877	109
Sulphur	4 913 004	178	4 544 358	2 234	3 706 559	14
Other mineral products (including clays, coal briquettes, greases and asphalts)	3 291 966	5 012 974	4 490 644	2 928 547	2 813 131	2 619 601
Total nonmetallic minerals	23 526 641	8 906 178	24 191 706	5 665 484	20 997 526	7 011 394
MINERAL FUELS						
Coal and coke	30 929 789	14 097 683	32 750 231	11 362 713	27 606 538	12 882 982
Crude petroleum	1 315 721	19 392 330	1 489 166	18 018 389	1 126 694	16 488 431
Other mineral fuels	194	238	–	–	–	–
Total mineral fuels	32 245 704	33 490 251	34 239 397	29 381 102	28 733 232	29 371 413
Total crude minerals	88 503 822	51 697 088	90 165 069	43 561 374	78 600 155	45 157 163
Total all commodities[1]	159 039 270	73 296 005	168 030 334r	65 863 148r	153 786 355	69 369 223
Crude minerals as a percentage of all commodities	55.6	70.5	53.7	66.1	51.1	65.1

Source: Statistics Canada.
– Nil; n.e.s. Not elsewhere specified; r Revised.
1 Includes metallic minerals, nonmetallic minerals and mineral fuels, along with all other cargo loaded and unloaded at Canadian ports.
Note: Numbers may not add to totals due to rounding.

TABLE 70. CANADA, FABRICATED MINERAL PRODUCTS LOADED AND UNLOADED AT CANADIAN PORTS IN INTERNATIONAL SHIPPING TRADE,[1] 1990-92

	1990		1991		1992	
	Loaded	Unloaded	Loaded	Unloaded	Loaded	Unloaded
	(tonnes)					
METALLIC MINERALS						
Iron, steel and alloys	2 494 124	1 769 750	2 745 360	1 309 350	2 186 859	1 220 731
Nonferrous metals, n.e.s.	1 046 627	484 174	1 194 058	2 940 088	1 138 551	3 503 298
Total metallic minerals	3 540 751	2 253 924	3 939 418	4 249 438	3 325 410	4 724 029
NONMETALLIC MINERALS						
Cement and related products	1 164 806	473 564	1 552 827	396 660	1 663 864	283 935
Other nonmetallic minerals, n.e.s.	1 167 413	879 879	1 666 767	1 532 368	1 456 179	1 060 617
Total nonmetallic minerals	2 332 219	1 353 443	3 219 594	1 929 028	3 120 043	1 344 552
MINERAL FUELS						
Fuel oil	4 054 455	3 973 134	4 486 712	4 293 526	3 825 015	4 209 834
Gasoline	2 596 345	841 980	2 743 888	628 298	2 471 471	975 292
Coke, petroleum and coal products	232 225	1 067 483	311 138	684 225	245 481	852 349
Other mineral fuels, n.e.s.	2 350 898	2 569 567	1 437 542	1 202 321	1 655 145	1 296 153
Total mineral fuels	9 233 923	8 452 164	8 979 280	6 808 370	8 197 112	7 333 628
Total fabricated mineral products	15 106 893	12 059 531	16 138 292	12 986 836	14 642 565	13 402 209
Total all commodities[1]	159 039 270	73 296 005	168 030 334r	65 863 148r	153 786 355	69 369 223
Fabricated minerals as a percentage of all commodities	9.5	16.5	9.6r	19.7r	9.5	19.3

Source: Statistics Canada.
. . Not available; n.e.s. Not elsewhere specified; r Revised.
[1] Includes metallic mineral products, nonmetallic mineral products and mineral fuel products, along with all other cargo loaded and unloaded at Canadian ports.
Note: Numbers may not add to totals due to rounding.

TABLE 71. CANADA, CRUDE MINERALS AND FABRICATED MINERAL PRODUCTS LOADED AT CANADIAN PORTS IN INTERNATIONAL SHIPPING TRADE, 1960-92

	Total All Commodities[1]	Total Crude Minerals	Total Fabricated Minerals	Crude and Fabricated Minerals as Percentage of All Products
		(000 tonnes)		
1960	45 872	24 671	2 039	58.2
1961	48 771	23 241	2 133	52.0
1962	54 676	30 446	2 296	59.9
1963	62 031	32 214	2 503	56.0
1964	75 760	42 087	2 602	59.0
1965	74 521	41 338	2 746	59.2
1966	76 192	41 374	3 350	58.7
1967	72 598	42 704	3 701	63.9
1968	78 663	48 680	2 960	65.6
1969	70 432	42 442	3 456	65.2
1970	95 807	55 849	4 965	63.5
1971	95 887	53 245	5 022	60.8
1972	98 988	51 912	9 091	61.6
1973	112 434	64 195	10 103	66.1
1974	106 110	64 093	9 041	68.9
1975	102 444	61 970	7 495	67.8
1976	114 815	71 527	6 108	67.6
1977	119 770	70 257	5 979	63.7
1978	116 522	62 291	7 556	59.9
1979	134 639	79 685	8 901	65.8
1980	138 161	67 898	11 770	57.7
1981	145 445	83 007	9 022	63.3
1982	125 282	65 594	7 115	58.0
1983	129 490	67 152	6 197	56.6
1984	145 322	82 752	7 986	62.4
1985	143 421	83 878	10 814	66.0
1986	144 561	84 720	8 303	64.3
1987	158 994	86 085	10 488	60.7
1988	171 064	98 934	12 227	65.0
1989	159 069r	90 807	13 624	65.7r
1990	159 039	88 504	15 107	65.1
1991	168 030r	90 165	16 138	63.3
1992p	153 786	78 600	14 643	60.6

Source: Statistics Canada.
p Preliminary; r Revised.
1 Includes metallic mineral products, nonmetallic mineral products and mineral fuel products, along with all other cargo loaded and unloaded at Canadian ports.

TABLE 72. CANADA, CAPITAL AND REPAIR EXPENDITURES BY SELECTED INDUSTRIAL SECTOR, 1991-93

		Capital Expenditures			Repair Expenditures			Capital and Repair Expenditures		
		Construction	Machinery and Equipment	Total	Construction	Machinery and Equipment	Total	Construction	Machinery and Equipment	Total
		($ millions)								
Agriculture and related service industries	1991	861.1	1 571.0	2 432.1	447.4	1 532.6	1 980.0	1 308.5	3 103.6	4 412.1
	1992[p]	861.1	1 759.5	2 620.6	463.6	1 530.7	1 994.3	1 324.7	3 290.2	4 614.9
	1993[I]	844.2	1 790.0	2 634.2	476.6	1 592.0	2 068.6	1 320.8	3 382.0	4 702.8
Communications and other utilities	1991	10 121.2	9 571.6	19 692.8	1 308.9	3 224.1	4 533.0	11 430.1	12 795.7	24 225.8
	1992[p]	10 662.9	9 793.4	20 456.3	1 511.6	3 100.7	4 612.2	12 174.4	12 894.1	25 068.5
	1993[I]	10 537.2	8 629.7	19 166.9	1 573.8	3 212.1	4 785.8	12 111.0	11 841.8	23 952.8
Construction	1991	273.8	1 419.5	1 693.3	67.0	1 035.6	1 102.6	340.8	2 455.1	2 795.9
	1992[p]	289.7	1 500.6	1 790.3	67.9	1 115.9	1 183.8	357.6	2 616.5	2 974.1
	1993[I]	288.4	1 495.2	1 783.6	67.1	1 104.6	1 171.7	355.5	2 599.8	2 955.3
Fishing and trapping	1991	64.6	80.5	145.1	39.3	154.7	194.0	103.9	235.2	339.1
	1992[p]	64.4	79.5	143.9	39.5	156.6	196.1	103.9	236.1	340.0
	1993[I]	63.5	79.9	143.4	40.5	162.1	202.6	104.0	242.0	346.0
Housing	1991	30 903.5	–	30 903.5	3 864.4	–	3 864.4	34 767.9	–	34 767.9
	1992[p]	33 246.0	–	33 246.0	4 068.7	–	4 068.7	37 314.7	–	37 314.7
	1993[I]	34 274.2	–	34 274.2	3 711.5	–	3 711.5	37 985.7	–	37 985.7
Logging and forestry	1991	65.2	36.6	101.8	51.5	132.4	183.9	116.8	169.0	285.8
	1992[p]	80.4	40.2	120.6	52.7	129.5	182.2	133.1	169.7	302.8
	1993[I]	111.5	56.0	167.5	49.8	113.1	162.9	161.3	169.1	330.4
Manufacturing	1991	3 415.0	14 108.3	17 523.3	1 164.8	7 902.9	9 067.7	4 579.8	22 011.2	26 590.0
	1992[p]	2 271.9	12 074.0	14 345.9	1 103.4	7 195.4	8 298.8	3 375.3	19 269.4	22 644.7
	1993[I]	1 813.1	12 630.7	14 443.8	1 183.5	7 372.0	8 555.5	2 996.6	20 002.8	22 999.4
Mining[1]	1991	7 108.4	897.5	8 005.9	503.3	2 146.7	2 650.0	7 611.7	3 044.2	10 655.9
	1992[p]	5 269.4	715.8	5 985.3	455.8	2 225.1	2 680.8	5 725.2	2 940.9	8 666.1
	1993[I]	6 174.2	1 090.7	7 264.9	490.4	2 294.6	2 785.0	6 664.6	3 385.3	10 050.0
Transportation and storage	1991	3 393.6	3 298.3	6 691.9	1 613.0	4 056.1	5 669.1	5 006.6	7 354.4	12 361.0
	1992[p]	3 311.2	2 431.6	5 742.8	1 702.6	3 840.8	5 543.4	5 013.8	6 272.3	11 286.2
	1993[I]	3 047.3	2 310.2	5 357.5	1 722.5	3 704.1	5 426.6	4 769.8	6 014.3	10 784.1
Wholesale and retail trade	1991	1 559.2	3 610.3	5 169.5	757.5	1 036.1	1 793.6	2 316.7	4 646.4	6 963.1
	1992[p]	1 336.7	3 232.1	4 568.8	613.6	961.6	1 575.1	1 950.2	4 193.7	6 144.0
	1993[I]	1 392.5	3 408.1	4 800.4	649.3	972.4	1 621.6	2 041.6	4 380.5	6 422.2
Other[2]	1991	21 902.2	13 748.7	35 650.9	6 555.4	2 932.4	9 487.8	28 457.6	16 681.1	45 138.7
	1992[p]	19 708.1	13 576.3	33 284.4	6 770.6	3 037.2	9 807.8	26 478.7	16 613.5	43 092.2
	1993[I]	19 427.0	14 823.0	34 250.0	6 666.0	3 037.6	9 703.6	26 093.0	17 860.6	43 953.6
Total	1991	79 667.6	48 342.3	128 010.0	16 372.5	24 153.5	40 526.0	96 040.2	72 495.8	168 536.0
	1992[p]	77 101.8	45 203.1	122 305.0	16 849.9	23 293.4	40 143.2	93 951.7	68 496.5	162 448.2
	1993[I]	77 973.2	46 313.3	124 286.5	16 630.9	23 564.6	40 195.5	94 604.1	69 877.9	164 482.0
Mining as a percentage of total	1991	8.9	1.9	6.3	3.1	8.9	6.5	7.9	4.2	6.3
	1992[p]	6.8	1.6	4.9	2.7	9.6	6.7	6.1	4.3	5.3
	1993[I]	7.9	2.4	5.8	2.9	9.7	6.9	7.0	4.8	6.1

Source: Statistics Canada.
– Nil; [I] Revised intentions; [p] Preliminary actual.
[1] Includes mines, quarries and oil wells. [2] Includes finance, real estate, insurance, commercial services, institutions and government departments.
Notes: Numbers may not add to totals due to rounding. Capital and repair expenditures are now based on the 1980 Standard Industrial Classification (SIC). Previous data were released on a 1970 SIC basis.

TABLE 73. CANADA, CAPITAL AND REPAIR EXPENDITURES IN MINING[1] BY PROVINCE AND TERRITORY, 1991-93[2]

		Capital Expenditures			Repair Expenditures			Capital and Repair Expenditures		
		Construction	Machinery and Equipment	Total	Construction	Machinery and Equipment	Total	Construction	Machinery and Equipment	Total
		($ millions)								
Newfoundland	1991	x	x	x	x	x	x	504.1	208.0	712.1
	1992[p]	637.6	13.0	650.7	x	x	x	x	x	x
	1993[i]	955.8	26.4	982.1	x	x	x	x	x	x
Nova Scotia	1991	315.8	48.1	363.9	1.8	40.8	42.7	317.6	88.9	406.5
	1992[p]	110.8	39.8	150.5	2.6	36.0	38.6	113.3	75.8	189.1
	1993[i]	51.6	31.0	82.5	2.4	40.6	43.1	54.0	71.6	125.6
New Brunswick	1991	x	x	x	x	x	x	x	x	x
	1992[p]	x	x	x	x	x	x	x	x	x
	1993[i]	x	x	x	x	x	x	x	x	x
Quebec	1991	293.7	65.3	358.9	34.4	226.8	261.2	328.1	292.1	620.2
	1992[p]	208.0	52.3	260.3	35.7	232.9	268.6	243.7	285.2	528.9
	1993[i]	239.0	67.4	306.3	34.1	228.1	262.2	273.0	295.5	568.5
Ontario	1991	380.9	83.6	464.5	61.4	396.1	457.5	442.3	479.6	921.9
	1992[p]	248.0	113.6	361.5	67.6	284.2	351.8	315.6	397.7	713.4
	1993[i]	270.0	186.9	456.9	71.0	276.7	347.7	341.0	463.6	804.6
Manitoba	1991	x	x	136.7	x	x	35.5	92.0	80.3	172.3
	1992[p]	x	x	110.1	x	x	71.1	77.9	103.3	181.2
	1993[i]	63.0	52.2	115.2	1.6	72.6	74.2	64.6	124.8	189.4
Saskatchewan	1991	456.5	67.4	523.9	30.7	157.8	188.4	487.2	225.1	712.3
	1992[p]	350.7	53.5	404.2	29.6	153.4	183.0	380.3	206.9	587.2
	1993[i]	489.2	66.0	555.3	31.1	149.8	180.9	520.3	215.8	736.2
Alberta	1991	4 142.8	334.1	4 476.9	267.5	538.9	806.4	4 410.3	873.0	5 283.3
	1992[p]	3 038.8	293.4	3 332.1	203.7	818.6	1 022.3	3 242.5	1 111.9	4 354.4
	1993[i]	3 509.1	458.4	3 967.5	227.0	891.1	1 118.1	3 736.1	1 349.4	5 085.6
British Columbia	1991	778.5	107.3	885.8	87.3	491.7	579.0	865.8	599.0	1 464.8
	1992[p]	475.7	76.9	552.7	89.2	340.4	429.7	565.0	417.3	982.3
	1993[i]	489.8	165.3	655.0	99.6	347.9	447.5	589.3	513.2	1 102.5
Yukon	1991	x	x	x	x	x	x	x	x	x
	1992[p]	x	x	x	x	x	x	x	x	x
	1993[i]	x	x	x	x	x	x	x	x	x
Northwest Territories	1991	98.3	11.7	110.0	3.0	47.2	50.2	101.3	58.9	160.2
	1992[p]	64.6	21.0	85.6	3.5	42.8	46.3	68.1	63.8	131.9
	1993[i]	52.3	7.8	60.1	3.0	45.2	48.2	55.3	53.0	108.3
Total Canada	1991	7 108.4	897.5	8 005.9	503.3	2 146.7	2 650.0	7 611.7	3 044.2	10 655.9
	1992[p]	5 269.4	715.8	5 985.3	455.8	2 225.1	2 680.8	5 725.2	2 940.9	8 666.1
	1993[i]	6 174.2	1 090.7	7 264.9	490.4	2 294.6	2 785.0	6 664.6	3 385.3	10 050.0

Source: Statistics Canada.
p Preliminary Actual ; i Revised Intentions.
1 Includes mines, quarries and oil wells. 2 Capital and repair expenditures for 1991-1993 are now based on the 1980 Standard Industrial Classification (SIC). Previous data were released on a 1970 SIC basis.
Note: Numbers may not add to totals due to rounding.

TABLE 74. CANADA, CAPITAL AND REPAIR EXPENDITURES IN MINING[1] AND MINERAL MANUFACTURING INDUSTRIES,[5] 1991-93

	1991			1992p			1993i		
	Capital	Repair	Total	Capital	Repair	Total	Capital	Repair	Total
					($ millions)				
MINING									
Metal mines									
Copper and copper-zinc	218.6	252.1	470.7	211.1	200.6	411.7	245.4	193.8	439.2
Gold	328.5	220.8	549.3	257.6	193.7	451.3	273.2	209.2	482.5
Iron	224.0	239.1	463.1	105.1	220.1	325.2	73.5	208.7	282.3
Silver-lead-zinc	133.5	91.0	224.5	96.2	123.7	219.9	89.4	114.0	203.4
Uranium	45.0	78.0	123.0	101.4	x	x	x	x	152.5
Other metal mines[2]	323.8	254.4	578.2	203.0	x	x	x	x	496.3
Total	1 273.4	1 135.4	2 408.7	974.4	1 020.5	1 994.9	1 044.5	1 011.7	2 056.2
Nonmetal mines									
Asbestos	x	x	x	x	x	x	x	x	x
Gypsum	10.2	15.9	26.1	13.0	17.2	30.2	17.1	16.8	33.9
Peat	5.5	3.2	8.7	4.2	2.9	7.1	7.6	1.4	9.0
Potash	101.8	125.1	226.9	77.5	131.0	208.4	98.7	130.0	228.7
Salt	25.2	23.4	48.6	18.1	29.9	48.0	25.0	30.0	55.0
Other nonmetal mines[3]	x	x	x	x	x	x	x	x	x
Total	190.9	213.1	404.1	175.9	230.6	406.5	224.8	226.7	451.5
Quarries and sand pits	25.8	37.8	63.6	22.9	43.0	65.9	33.8	42.4	76.1
Mineral fuels									
Coal	390.8	417.6	808.4	225.6	308.2	533.8	257.3	333.5	590.8
Petroleum and natural gas[4]	6 084.4	775.5	6 859.9	4 560.6	1 031.8	5 592.5	5 686.6	1 121.6	6 808.2
Total mineral fuels	6 475.2	1 193.1	7 668.3	4 786.2	1 340.0	6 126.3	5 943.9	1 455.1	7 399.0
Service industries incidental to mineral extraction	40.6	70.5	111.2	25.9	46.7	72.6	18.1	49.2	67.2
Total mining industries	8 005.9	2 650.0	10 655.9	5 985.3	2 680.8	8 666.1	7 264.9	2 785.0	10 050.0
MINERAL MANUFACTURING									
Primary metal industries									
Aluminum rolling, casting and extruding	69.4	63.0	132.4	55.5	74.6	130.1	68.2	74.5	142.7
Copper and copper alloy, rolling, casting and extruding	4.5	8.5	13.0	7.6	8.6	16.2	12.5	7.8	20.3
Primary steel	589.4	838.1	1 427.5	366.7	714.5	1 081.2	294.3	712.1	1 006.4
Iron foundries	38.7	65.4	104.2	29.5	45.9	75.4	102.2	50.5	152.7
Metal rolling, casting and extruding	32.2	36.6	68.8	32.5	32.5	65.0	53.8	30.3	84.0
Smelting and refining	2 001.9	550.9	2 552.8	907.2	613.7	1 520.9	561.8	631.2	1 193.1
Steel pipe and tube mills	65.0	97.2	162.2	43.5	70.0	113.4	59.3	78.0	137.4
Total	2 801.2	1 659.6	4 460.9	1 442.5	1 559.8	3 002.3	1 152.2	1 584.3	2 736.5
Nonmetallic mineral products									
Abrasives	7.9	13.5	21.5	8.0	15.9	24.0	6.4	15.9	22.3
Cement	100.1	110.6	210.7	50.2	99.5	149.6	40.2	84.3	124.4
Clay products	10.4	7.0	17.5	11.2	8.4	19.7	9.4	7.4	16.8
Concrete products	40.2	50.4	90.7	23.1	36.5	59.5	18.7	31.3	50.0
Glass and glass products	69.5	38.9	108.4	37.1	24.4	61.5	85.1	29.0	114.1
Lime	13.3	18.0	31.4	6.8	17.0	23.8	7.9	17.1	25.0
Ready-mix concrete	78.8	117.6	196.4	56.2	105.0	161.2	39.9	77.4	117.3
Other nonmetallic mineral products	56.8	67.3	124.1	55.2	63.7	118.9	43.0	57.0	100.0
Total	377.1	423.4	800.5	247.8	370.4	618.2	250.6	319.3	570.0

TABLE 74 (cont'd)

	1991			1992p			1993r		
	Capital	Repair	Total	Capital	Repair	Total	Capital	Repair	Total
					($ millions)				
Metal-fabricating industries									
Power boiler and heat exchanger	10.5	6.7	17.1	11.1	5.8	16.9	17.4	5.5	22.9
Fabricated structural metal	43.7	25.8	69.5	33.4	17.5	50.9	20.7	16.8	37.5
Hardware, tool and cutlery	51.0	38.0	88.9	71.3	42.7	114.0	64.8	47.6	112.5
Heating equipment	8.1	7.3	15.4	8.9	7.0	15.8	17.7	7.5	25.2
Machine shops	34.1	15.9	50.0	26.8	17.3	44.1	27.8	11.4	39.2
Metal stamping, pressing and coating	97.6	69.0	166.6	106.1	62.8	168.9	86.4	60.5	146.9
Miscellaneous metal fabricating	51.9	23.1	75.0	44.7	18.8	63.5	52.9	15.4	68.3
Ornamental and architectural metal	17.7	15.6	33.3	18.1	16.3	34.4	30.1	17.9	48.0
Wire and wire products	62.9	47.7	110.6	44.0	54.4	98.4	69.2	56.1	125.3
Total	377.6	249.0	626.6	364.4	242.5	606.9	387.0	238.6	625.6
Petroleum and coal products									
Petroleum and coal products	7.1	20.0	27.0	7.5	23.5	31.0	9.0	7.0	16.0
Refined petroleum products	1 022.7	414.3	1 437.0	677.9	328.6	1 006.6	465.8	384.6	850.4
Total	1 029.8	434.3	1 464.1	685.4	352.2	1 037.6	474.8	391.6	866.5
Total mineral manufacturing industries	4 585.7	2 766.3	7 352.1	2 740.1	2 524.9	5 265.0	2 264.6	2 533.8	4 798.6
Total mining and mineral manufacturing industries	12 591.6	5 416.3	18 008.0	8 725.4	5 205.7	13 931.1	9 529.5	5 318.8	14 848.6

Source: Statistics Canada.
r Revised intentions; p Preliminary actual; x Confidential.
[1] Does not include cement, lime and clay products (domestic clay) manufacturing, smelting and refining. [2] Includes nickel-copper mines and miscellaneous metal mines. [3] Includes miscellaneous nonmetal mines. [4] The total of capital expenditures shown under "Petroleum and Natural Gas" is equal to the total capital expenditure under the columns entitled "Petroleum and Natural Gas Extraction," "Natural Gas Processing Plants" and "Service Industries Incidental to Mineral Extraction" of Table 77. [5] Capital and repair expenditures for 1991-93 are now based on the 1980 Standard Industrial Classification (SIC). Previous data were released on a 1970 SIC basis.
Note: Numbers may not add to totals due to rounding.

TABLE 75. CANADA, CAPITAL AND REPAIR EXPENDITURES IN THE MINING INDUSTRY,[1] 1987-93[3]

	1987	1988	1989	1990	1991	1992p	1993r
				($ million)			
METAL MINES							
Capital							
Construction	1 328.2	1 609.0	1 356.4	1 358.7	946.0	695.7	688.3
Machinery	372.9	566.5	578.6	420.9	327.4	278.6	356.1
Subtotal	1 701.1	2 175.5	1 935.0	1 779.6	1 273.4	974.4	1 044.5
Repair							
Construction	109.8	123.2	153.0	140.9	126.8	131.6	132.3
Machinery	880.8	1 033.6	1 062.1	1 139.0	1 008.5	888.9	879.4
Subtotal	990.6	1 156.8	1 215.1	1 279.9	1 135.4	1 020.5	1 011.7
Total capital and repair	2 691.7	3 332.3	3 150.1	3 059.5	2 408.7	1 994.9	2 056.2
NONMETAL MINES[2]							
Capital							
Construction	421.7	432.9	417.1	408.4	x	x	204.9
Machinery	251.6	263.4	270.1	263.5	x	x	310.9
Subtotal	673.3	696.3	687.2	671.9	607.5	424.4	515.9
Repair							
Construction	23.2	38.3	40.7	47.8	x	x	42.7
Machinery	608.8	634.6	682.4	734.2	x	x	559.7
Subtotal	632.0	672.9	723.1	782.0	668.5	581.8	602.6
Total capital and repair	1 305.3	1 369.2	1 410.3	1 453.9	1 276.0	1 006.2	1 118.5
MINERAL FUELS							
Capital							
Construction	4 096.0	5 134.4	4 444.9	4 935.8	5 771.4	4 297.6	5 280.3
Machinery	505.8	744.2	306.1	272.3	313.0	263.1	406.3
Subtotal	4 601.8	5 878.6	4 751.0	5 208.1	6 084.4	4 560.6	5 686.6
Repair							
Construction	307.0	241.8	235.2	329.1	340.0	289.3	314.0
Machinery	673.9	761.5	788.3	824.7	435.5	742.5	807.6
Subtotal	980.9	1 003.3	1 023.5	1 153.8	775.5	1 031.8	1 121.6
Total capital and repair	5 582.7	6 881.9	5 774.5	6 361.9	6 859.9	5 592.5	6 808.2
SERVICE INDUSTRIES INCIDENTAL TO MINERAL EXTRACTION							
Capital							
Construction	..	..	..	..	x	x	0.7
Machinery	..	..	..	..	x	x	17.4
Subtotal	..	..	..	..	40.6	25.9	18.1
Repair							
Construction	..	..	..	..	x	x	1.3
Machinery	..	..	..	..	x	x	47.8
Subtotal	..	..	..	..	70.5	46.7	49.2
Total capital and repair	..	..	..	..	111.2	72.6	67.2
TOTAL MINING							
Capital							
Construction	5 845.9	7 176.3	6 218.4	6 702.9	7 108.4	5 269.4	6 174.2
Machinery	1 130.3	1 574.1	1 154.8	956.7	897.5	715.8	1 090.7
Subtotal	6 976.2	8 750.4	7 373.2	7 659.6	8 005.9	5 985.3	7 264.9
Repair							
Construction	440.0	403.3	428.9	517.8	503.3	455.8	490.4
Machinery	2 163.5	2 429.7	2 532.8	2 697.9	2 146.7	2 225.1	2 294.6
Subtotal	2 603.5	2 833.0	2 961.7	3 215.7	2 650.0	2 680.8	2 785.0
Total capital and repair	9 579.7	11 583.4	10 334.9	10 875.3	10 655.9	8 666.1	10 050.0

Source: Statistics Canada.
.. Not available; r Revised intentions; p Preliminary actual; x Confidential.
[1] Does not include cement, lime and clay products (domestic clays) manufacturing, smelting and refining. [2] Includes coal mines, asbestos, gypsum, peat, salt, potash, miscellaneous nonmetals, quarrying and sand pits. [3] Capital and repair expenditures from 1991 to 1993 are now based on the 1980 Standard Industrial Classification (SIC). Data previous to 1991 were released on a 1970 SIC basis.
Note: Numbers may not add to totals due to rounding.

TABLE 76. CANADA, CAPITAL AND REPAIR EXPENDITURES IN THE MINERAL MANUFACTURING INDUSTRIES,[1] 1987-93

	1987	1988	1989	1990	1991	1992p	1993r
				($ millions)			
PRIMARY METAL INDUSTRIES[2]							
Capital							
Construction	265.7	287.3	611.7	1 110.0	498.5	139.4	129.1
Machinery	1 223.2	1 242.8	1 729.4	1 793.3	2 302.7	1 303.1	1 023.1
Subtotal	1 488.9	1 530.1	2 341.1	2 903.3	2 801.2	1 442.5	1 152.2
Repair							
Construction	119.0	134.0	186.4	166.4	143.0	123.1	124.6
Machinery	1 409.4	1 616.8	1 721.3	1 802.6	1 516.6	1 436.7	1 459.8
Subtotal	1 528.4	1 750.8	1 907.7	1 969.0	1 659.6	1 559.8	1 584.3
Total capital and repair	3 017.3	3 280.9	4 248.8	4 872.3	4 460.9	3 002.3	2 736.5
NONMETALLIC MINERAL PRODUCTS[3]							
Capital							
Construction	73.5	88.1	120.5	69.8	44.3	18.8	20.0
Machinery	282.6	352.5	447.6	471.1	332.8	229.0	230.7
Subtotal	356.1	440.6	568.1	540.9	377.1	247.8	250.6
Repair							
Construction	23.3	24.0	23.1	27.8	25.9	21.5	14.5
Machinery	277.5	313.9	339.1	365.7	397.6	348.9	304.8
Subtotal	300.8	337.9	362.2	393.5	423.4	370.4	319.3
Total capital and repair	656.9	778.5	930.3	934.4	800.5	618.2	570.0
METAL-FABRICATING INDUSTRIES							
Capital							
Construction	107.1	112.2	84.5	70.6	53.6	62.9	45.7
Machinery	356.3	355.2	340.6	257.9	324.0	301.5	341.3
Subtotal	463.4	467.4	425.1	328.5	377.6	364.4	387.0
Repair							
Construction	24.2	27.8	29.6	27.7	29.3	35.3	24.9
Machinery	194.7	197.1	201.1	204.3	219.7	207.2	213.7
Subtotal	218.9	224.9	230.7	232.0	249.0	242.5	238.6
Total capital and repair	682.3	692.3	655.8	560.5	626.6	606.9	625.6
PETROLEUM AND COAL PRODUCTS							
Capital							
Construction	464.9	437.9	626.0	665.3	677.0	487.5	329.6
Machinery	205.0	261.0	335.1	343.6	352.8	197.9	145.3
Subtotal	669.9	698.9	961.1	1 008.9	1 029.8	685.4	474.8
Repair							
Construction	252.8	255.6	274.3	335.3	264.3	247.0	289.0
Machinery	112.8	115.7	129.7	165.4	170.0	105.1	102.6
Subtotal	365.6	371.3	404.0	500.7	434.3	352.2	391.6
Total capital and repair	1 035.5	1 070.2	1 365.1	1 509.6	1 464.1	1 037.6	866.5
TOTAL MINERAL MANUFACTURING INDUSTRIES							
Capital							
Construction	911.2	925.5	1 442.7	1 915.7	1 273.4	708.6	524.4
Machinery	2 067.1	2 211.5	2 852.7	2 865.9	3 312.3	2 031.5	1 740.4
Subtotal	2 978.3	3 137.0	4 295.4	4 781.6	4 585.7	2 740.1	2 264.6
Repair							
Construction	419.3	441.4	513.4	557.2	462.5	426.9	453.0
Machinery	1 994.4	2 243.5	2 391.2	2 538.0	2 303.9	2 097.9	2 080.9
Subtotal	2 413.7	2 684.9	2 904.6	3 095.2	2 766.3	2 524.9	2 533.8
Total capital and repair	5 392.0	5 821.9	7 200.0	7 876.8	7 352.1	5 265.0	4 798.6

Source: Statistics Canada.
r Revised intentions; p Preliminary actual.
[1] Capital and repair expenditures from 1991 to 1993 are now based on the 1980 Standard Industrial Classification (SIC). Data previous to 1991 were released on a 1970 SIC basis. [2] Includes smelting and refining. [3] Includes cement, lime and clay products manufacturing.
Note: Numbers may not add to totals due to rounding.

TABLE 77. CANADA, CAPITAL EXPENDITURES IN THE PETROLEUM, NATURAL GAS AND ALLIED INDUSTRIES,[1] 1983-93

	Petroleum and Natural Gas Extraction	Transportation (Pipelines)	Marketing (Chiefly Outlets of Oil Companies)	Natural Gas Distribution	Petroleum and Coal Products Industries	Natural Gas Processing Plants	Service Industries Incidental to Mineral Extraction [2]	Total Capital Expenditures
				($ millions)				
1983	6 563.5	660.5	374.5	516.8	840.8	195.8	155.4	9 307.3
1984	6 946.4	795.4	422.9	604.1	432.4	340.0	43.8	9 585.0
1985	8 187.6	664.2	356.8	603.5	335.7	337.7	80.1	10 565.6
1986	5 401.1	586.9	344.9	573.9	398.2	207.8	29.9	7 542.7
1987	4 414.6	503.0	412.4	571.8	669.9	174.1	13.1	6 758.9
1988	5 589.9	828.9	478.4	602.8	698.9	271.8	16.9	8 487.6
1989	4 309.7	1 520.7	501.7	570.4	961.1	427.4	14.0	8 305.0
1990	4 750.8	1 817.2	380.2	666.9	1 008.9	445.3	12.1	9 081.4
1991	5 322.3	2 546.2	. .	775.0	1 029.8	762.1	40.6	10 476.0
1992p	4 109.4	2 516.1	. .	883.3	685.4	451.2	25.9	8 671.3
1993i	5 396.5	2 050.9	. .	976.9	474.8	290.1	18.1	9 207.3

Source: Statistics Canada.
i Revised intentions; p Preliminary actual; . . Not available.
1 The petroleum and natural gas industries in this table include all companies engaged in whole or in part in oil and gas activities.
2 Previous to 1991 this heading was entitled "Oil and Gas Drilling Contractors."
Notes: Numbers may not add to totals due to rounding. Capital and repair expenditures from 1991 to 1993 are now based on the 1980 Standard Industrial Classification (SIC). Data previous to 1991 were released on a 1970 SIC basis.