Chromium

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SUMMARY

In 1995, the world chromium industry pursued the expansion started in the previous year. Despite production disruptions at the Donskoy Combine in Kazakstan, and in Albania, Turkey and India, which caused tightness in chromite ore supplies, capacity for the production of chromium alloys was added to satisfy increased demand from the stainless steel industry. Through resumptions, furnace conversions from the production of manganese and silicon alloys to that of chromium alloys, and the development of new capacity, the world's production of chromium alloys increased by 36% compared to 1994, matching the peak reached in 1989.

The Western World's production of stainless steel, which accounts for about 80% of total demand for ferrochromium, is expected to have increased by 13% in 1995 compared to the previous year. Although this growth rate is divergent from the long-term compounded rate of 3.5%/y observed since 1970, it appears to point to a general increase in the growth rate since production in 1996 is expected to advance by 6%.

Prices for all chromium products reached historic highs, or at least highs unseen since the 1988-89 period. Spot chromium ore prices on the North American market increased by 200% for Transvaal ores and by 100% for Turkish ores and closed the year at those levels. Ferrochromium prices also increased significantly, but peaked in mid-year and decreased gradually thereafter. High-carbon ferrochromium closed the year at a price level 32% higher than its starting point but still falling, while the price for low-carbon ferrochromium stabilized at a level 48% above its starting point in the year.

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. In the short term, supplies of chromium ores and concentrates are expected to be tight with a corresponding pressure on prices, while supplies of chromium alloys are expected to remain in a delicate balance with demand. However, as new ferrochromium production capacity comes on stream, markets could become oversupplied before high-cost producers are forced out. In the short term, production in C.I.S. countries should not improve significantly, but in the medium and long term, developments in these countries will probably dictate the levels of operation in the rest of the world. Prices for ores and concentrates and chromium metal should remain at high levels in the short term on account of short supplies and strong demand, while prices for ferrochromium will decrease further before stabilizing.

USES

While many minerals contain chromium, chromite ($FeCr_2O_4$) is the only commercial ore mineral. 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 cutlery and decorative trim. Chromium is added to alloy and tool steels to increase their hardening ability and improve their mechanical properties such as yield strength. Superalloys containing chromium have a high degree of resistance to oxidation and corrosion at elevated temperatures and are used in jet engines, gas turbines and chemical process equipment. Chromium-containing castings are usually used in high-temperature applications.

The refractory industry uses chromite in the manufacture of refractory bricks, castables, mortars and ramming gun mixes. Chromite castables, mortars and gunning mixes are used for repairs to, and in the bonding and coating of, basic (versus acid) bricks. They are also used in areas where the separation of various types of bricks by a chemically neutral substance is desirable.

Refractories containing both chromite and magnesite are used in furnaces wherever basic slags and dust are encountered, such as in the ferrous and nonferrous metal industries. In the ferrous industry, a chromite-magnesite brick is used in electric arc furnaces, while basic oxygen furnaces, which operate at higher temperatures, require magnesite bricks. In general, refractory requirements in the steel industry have changed to a higher magnesite-content brick, thereby decreasing the consumption of chromite in this application. However, overall chromite refractory consumption in the steel industry is expected to stabilize in the next few years. In the nonferrous industry, chromite-magnesite bricks are used mainly in converters, while the glass industry uses a chromite-magnesite brick in the reheating chambers of glass furnaces. The kraft paper industry requires a dense chromite brick in recovery furnaces to resist chemical attack by spent liquors.

Chromium chemicals, which make up less than 5% by weight of the chromium products consumed in Canada, have a wide variety of applications in several industries. Most chromium chemicals are produced from sodium dichromate, which is manufactured directly from chemical-grade chromite. Chromium compounds are used as pigments, mordants and dyes in the textile industry; as tanning agents for all types of leather; and for chromium electroplating, anodizing, etching and dipping. Chromium compounds are also used as oxidants and catalysts in the manufacture of various products such as saccharin; in the bleaching and purification of oils, fats and chemicals; and as agents to promote the water insolubility of various products such as glues, inks and gels.

CANADIAN DEVELOPMENTS

Canada imports all of its chromium requirements, mostly as natural ores and concentrates, and as ferrochromium. Imports also include small quantities of chromium metal and chromium chemicals. In 1995, total imports of chromium-based products were valued at $101.4 million, an increase of 52% over 1994, while exports, consisting mostly of ferrochromium and chemicals, amounted to $0.9 million, down 64%.

During the year, imports of chromium ores and concentrates increased to 39 041 t compared to 20 232 t in 1994, exceeding by a large margin the last seven years' average yearly import of 24 943 t. Ferrochromium imports (including silicochromium) in 1995 were 15.2% higher than in 1994, and surpassed the past seven years' average yearly import of 48 657 t. However, imports of chromium metal in 1995 decreased by 28% to 332 t, but largely exceeded the past seven years' average import of 285 t/y. Meanwhile, treated as a whole, imports of chromium chemicals in 1995 slumped, registering a 15.6% reduction in volume.

The hike in imports of chromium ore and ferrochromium in 1995 reflects the vigorous state of the Canadian manufacturing industry. Specifically, increased imports of ferrochromium are an indication of the strength of the stainless steel and specialty steel industries, while the hike in imports of chromium ore reflect an increase in the production of refractories to service the healthier steel industry. The reduction in chromium chemical imports is restricted mostly to sodium dichromate (tonnage basis), the intermediate compound from which chromium chemicals are produced. Imports of chromium trioxide (chromic acid) used in the electroplating and wood preservative industries increased by 40% over 1994, while imports of chromium sulphates used in the leather tanning industry increased by 33% over 1994. Reductions of 37% on imports for sodium dichromate and 22% on imports of chromium oxide used in the pigment, refractories, and catalyst industry while imports of other chemicals increased may reflect a switch by producers from intermediate products to more direct-use ones.

Atlas Stainless Steels, a division of Sammi Atlas Inc. that operates two plants in Canada, is the country's largest consumer of ferrochromium. The plant in Tracy, Quebec, which uses a feed mix of 65% stainless steel scrap and 35% ferrochromium, produces stainless steel sheet and strip, while the Welland, Ontario, plant produces alloy and stainless steel ingots, billets and blooms. Production in 1995 was reportedly at capacity.

While no chromium ore is presently mined in Canada, there are occurrences of various grades of ore in most provinces. Limited commercial production occurred early in the century and during the second world war in the Eastern Townships, but the operations became uneconomic at the end of the hostilities. Beginning in 1986, renewed exploration drilling was undertaken due to a rise in ferrochromium prices and increased concerns about security of supply for North America. In more recent years, exploration work has been undertaken on occurrences located in the Bird River area of Manitoba, in the Big Trout Lake area of northwestern Ontario, in the Eastern Townships and the James Bay areas of Quebec, and in the Port au Port Bay area of Newfoundland.

The Bird River deposit occurs along about 43 km of the Bird River sill located in east-central Manitoba. The chromium-bearing zone, estimated to be about 60 m thick, consists of chromite crystals concentrated in very thin bands within layers of mafic and ultramafic rocks in igneous intrusions. Present reserve figures outlined for the sill are 7 Mt grading 6.9% Cr_2O_3, which incorporate mineralized material from four properties owned by as many companies or individuals.

Metallurgical tests done on a Bird River deposit bulk sample through the Canada Centre for Mineral and Energy Technology (CANMET), using heavy media separation, produced a concentrate grading 30% Cr_2O_3. The chromium-to-iron ratio of the ore, at 0.84:1.00, does not meet the current specifications of ferrochromium used by the Canadian steel industry. However, the concentrate could be used with nickel sulphide to produce a chromium-nickel-iron master alloy. A potential market would be the producers of stainless steel. Discussions between the various interested parties are ongoing, albeit very slowly.

The Big Trout Lake chromite mineralization in northern Ontario is hosted in a layered intrusion. Chromite crystals are concentrated in thin bands that appear to extend for several kilometres. Grades between 4% and 14% Cr_2O_3 have been intersected over significant intervals in exploratory drilling. The resource is not well delineated but the potential for a large tonnage is good. Recent work on this deposit dates back to 1989 when International Platinum Corp. carried out a diamond drilling program principally to assess the potential for platinum group elements.

In the Eastern Townships of Quebec, chromite occurs as thin veins concentrated in mineralized zones 10-50 m thick. These zones are podiform shaped, discontinuous, and hosted in ultramafic rocks of an ophiolitic complex. Exploration for chromium in the area is led by Coleraine Mining Resources Inc. (Coleraine) and Canchrome Mines Inc.

In the past nine years, Coleraine has been active on a number of properties in the area. The property with the most potential, the Coleraine property, has chromite reserves estimated at 1 032 574 t grading 4.5% Cr_2O_3, amenable to open-pit mining. Tests at the Centre de Recherche minérales du Québec have shown that the chromite ore can easily be processed to produce a concentrate of lumpy ore grading 51.7% Cr_2O_3 with a chromium-to-iron ratio of 2.5:1. Mannessmann Demag of Germany, a company that specializes in the fabrication of submerged electric arc furnaces that are used to produce ferrochromium, performed a production energy balance on a process proposed for the production of ferrochromium using a concentrate from Coleraine. The smelting tests produced an excellent quality high-carbon ferrochromium containing 63% chromium.

Following the cancellation of a joint venture between Coleraine and MG Ores and Alloys Corp. (MG) of New York for the construction of a vertically integrated ferrochromium project from which MG pulled out of during the due diligence study at the end of 1993, Coleraine refocused its efforts and was approached by a major European steel producer. By early 1995, a vertically integrated project for the production of 80 000 t/y of ferrochromium was being considered. However, because of tight chromite ore supplies on international markets from which the project would have had to source a substantial portion of its feed, the project was shelved.

Instead, Coleraine is proceeding with a bankable feasibility study for the development of a 20 000-t/y capacity mining operation for the production of a chromite concentrate. Groupe-Conseil Roche Ltée, a Quebec-based engineering firm, is expected to complete this study by March 1996. The project could be operational by the end of the year.

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 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, Environment Canada and Health Canada announced that chromium was deemed toxic under CEPA. Specifically, their conclusions were that hexavalent chromium (Chromium VI) compounds were toxic, while information was insufficient to conclude that trivalent forms of chromium (Chromium III) are toxic under CEPA.

As a result of these findings, management strategies for key sources of Chromium VI compounds were being developed during 1995 under the Strategic Options Process (SOP). Under these strategies, Environment Canada, through consultations with stakeholders, will consider the 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. SOP recommendations for the steel manufacturing, wood preservative, metal finishing, and electric power generation industries are expected in July, August, October and December 1996 respectively.

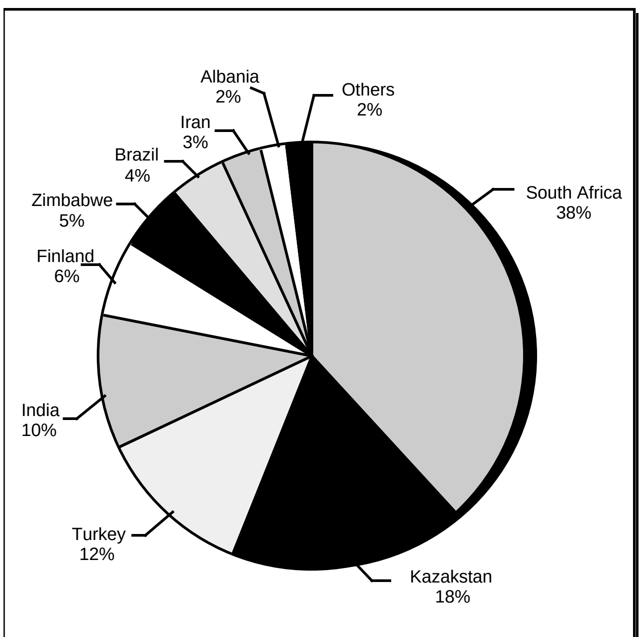
World Developments

The world's production of chromium ore, which is concentrated in only a few countries (Figure 1), is expected to reach 12.0 Mt in 1995, up 29% compared to 1994. The production increase results from the resumption of mining operations around the world that had closed during the past few years because of a reduction in consumption by ferrochromium producers brought about by a contraction in most of the world economies.

Despite this increase in production, the tightness in the chromium ore market is believed to be attributable to the combined effect of strong demand from the stainless steel industry and reduced exports from Kazakstan's Donskoy Combine following the establishment of the Kazchrome joint venture. Japanese consumers were reportedly importing Iranian chromium ore to cover the deficit.

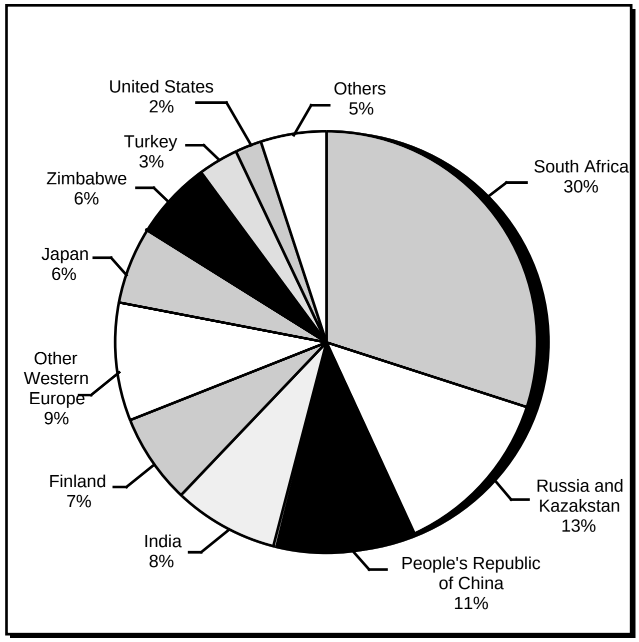
In 1995, the world production of ferrochromium, which is concentrated mostly in eight countries (Figure 2), is forecast at 4.02 Mt, an increase of 36% compared to 1994. This production level matches the all-time high reached in 1989. As with chromium ore, the increase in ferrochromium production in 1995 resulted from a hike in demand from stainless steel and specialty steel producers brought about by the expansion of world economies and a recent tightness in scrap availability, which decreased the replacement of ferrochromium by stainless steel scrap for chromium units.

Figure 1
World Chromite Ore Production, Share by Country, 1994



Source: International Chromium Development Association.

Figure 2
World Ferrochromium Production, Share by Country, 1994



Source: International Chromium Development Association.

Finally, the production of chromium metal in 1995 is expected to be significantly less than in 1994 because of the permanent closure of the Tosoh plant in Japan.

Albania

Albania was the world's fourth largest producer of chromite ore until 1991 when its Communist regime fell. Since then, as a result of domestic turmoil stemming from its transition to a market economy, the country's chromium ore output has dropped from over 1 Mt/y to a low of 236 700 t in 1994. In 1995 production is expected to increase slightly to 246 000 t.

Albchrome, the state body that controls Albania's producing and exporting industry, operates two ferrochromium plants, Burel and Elbasan, each equipped with three 9-MW furnaces for a total capacity of 75 000 t/y. Reports in 1995 mentioned that only four furnaces were operational, while the other two had been partially dismantled for spare parts. Nevertheless, ferrochromium production in 1995 was expected to exceed 46 000 t, 37% more than in 1994.

After evaluating submissions to its tender for the revitalization of its chromium industry, Albchrome reported in May the rejection of the last bid and that a new tender would be opened. Since Albania broke from its Chinese partner in 1978, the industry has slowly deteriorated because of reduced investments. Funding in the order of US$100 million is now

required over the next seven years to further develop the Bulqize mine and to open new mines at Vllahne and Qafe Baull, and also to refurbish closed furnaces and build two new plants in central and northeastern Albania. Because of the difficult political and economic situation in Albania, progress on the privatization is expected to be slow.

In the meantime, Albania's Ministry of Mineral Resources and Energy and the Japan International Cooperation Agency have agreed to carry out a three-year resource development project in an effort to boost chromium ore output.

Brazil

Companhia de Ferro Ligas de Bahia (Ferbasa), Brazil's largest producer of chromium ore and the country's only ferrochromium producer, based in the northeastern state of Salvador, was reportedly producing from four of its six furnaces and was expecting to produce about 88 000 t of high-carbon ferrochromium and 6000 t of low-carbon ferrochromium. About 80% of Ferbasa's production of high-carbon ferrochromium and all of its low-carbon ferrochromium is destined for the domestic market.

On account of the production expansion at Brazil's only stainless steel producer, Acesita - Cia Aços Especiais Itabira, Companhia Ferro-Ligas do Amapa was considering the conversion of its furnace, which currently produces manganese alloys, to the production of ferrochromium. If the switch goes ahead, the plant could produce 20 000 t/y of high-carbon ferrochromium using high-grade chromite ore (with a chromium-to-iron ratio of less than 2:1) currently produced by its parent company at the Vila Nova mine in Amapa State at a rate of 150 000 t/y.

China

The People's Republic of China, considered one of the world's largest consumers of high-grade chromium ore, depends in large part on imports for its requirements. In the first ten months of 1995, China imported 1 030 000 t of ore, mostly from India, Iran, Turkey and South Africa, up 111% from the same period last year. China's internal consumption of chromium ore is estimated at 500 000 t/y; however, higher imports are used mostly for toll smelting of chromium alloys with 80% of this production (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 of China's ferrochromium requirement is imported.

To help reduce its dependence on ore imports China opened the Norbusa mine, which was developed under the Eighth Five-Year Plan (1991-95). The mine, which is the country's largest, is located in Qusum County, Tibet, and has a capacity of 55 000 t/y of chromium in ore. Qusum County is reported to be rich in chromium deposits grading better than 57% Cr_2O_3.

In early 1995, because of higher winter power costs and high debt levels due to a tight credit policy enforced by the Government to rein in inflation, China's ferroalloy industry was forced to reduce its output. However, increasing demand from the domestic and international stainless steel industry, which forced prices up, prompted Chinese ferroalloy producers to boost their output of ferrochromium. This was done through the resumption of idled ferrochromium capacity and by converting some of the country's silicon and manganese alloy capacity to the production of ferrochromium. China is reported to have a total alloying capacity of 4.35 Mt in 14 large plants and over 1000 small- and medium-sized plants. The rapid increase in Chinese ore demand, combined with short supplies of high-quality ores from traditional international suppliers and difficulties in securing vessels to import the ore, forced temporary furnace shut-downs in the second quarter of 1995.

Finland

Finland's chromium industry is fully integrated from the production of concentrates to that of stainless steel, and is controlled by Outokumpu Oy, a 57% state-owned company. Production of chromium concentrates comes from its Kemi open-pit mine, which is Europe's largest chromium resource, located just south of the Arctic Circle in Finnish Lapland. Current reserves of 150 Mt grading 26% Cr_2O_3 (chromium-to-iron ratio of 1.55:1) enable the production of 250 000 t/y of lumpy ore grading 36% Cr_2O_3 and 350 000 t/y of metallurgical-grade fine concentrate grading 44% Cr_2O_3. All of the mineral production is smelted close by at the 220 000-t/y Tornio ferrochromium smelter, where half of this production is sent to the adjoining stainless steel plant in liquid form while the rest is exported.

In 1995, the company was proceeding with the installation of a chromium converter to melt the stainless steel scrap that makes up part of the feed for stainless steel production. Using the energy stored in the molten ferrochromium to help melt the scrap, the company expects to expand its melt shop capacity by 23% to 540 000 t/y starting in 1996.

India

In recent years India has become one of the world's four largest producers of chromium ores. In 1995, because of production disruptions in Kazakstan and Turkey that reduced their output, India probably tied with Kazakstan in second place behind South Africa with production of about 1.2 Mt, an increase of 32% over 1994. Of this amount about 50% will be exported, mostly to China where India has conversion

contracts. In 1996, India's production of chromium ore is expected to increase to 1.3 Mt.

Most of India's chromite reserves are hosted in the Sukinda ultramafic complex located in the state of Orissa in eastern India. Production comes from over 45 mines, but two producers, Tata Iron and Steel Co. Ltd. (Tisco) and state-owned Orissa Mining Corp. (OMC), own major portions of the leases on which these reserves are located. Because these companies cannot develop the huge chromite resource optimally, four of India's other producing companies have asked the Indian government to reallocate the resource. A decision to that effect expected in August 1996, after two years of dispute, will probably result in a substantial increase in the country's ore production in the short term.

India's ferrochromium production consists mostly of high-carbon grade and charge chromium, given that domestic demand for low-carbon ferrochromium has fallen in recent years. In 1995, chromium alloy production is expected to reach 300 000 t, a 20% increase over 1994 that was brought about by production capacity resumptions and conversions from manganese alloy production to that of ferrochromium. However, regional power shortages during the year prevented the industry from attaining higher utilization of its 400 000-t/y production capacity. Among the country's producers, Indian Charge Chrome Ltd. restarted operations in early April at its 62 500-t/y Choudwar charge chromium plant after a 13-month shut-down. The plant had closed with the cancellation of its chromium ore supply agreement with Tisco. The company will now source its requirements from OMC and abroad, possibly from Turkey.

Tisco increased its 1995 production of ferrochromium to about 100 000 t, supplementing its production from the Bamnipal and Joda plants through conversion deals with Sandur Manganese and Iron Ore Co., Navchrome, and Hira Ferro Alloys.

Also on the strength of ferrochromium prices, Ispat Alloys Ltd. converted three of its five furnaces from silicomanganese to ferrochromium production before mid-year, bringing an additional production capacity of 30 000 t/y to the market. Ferro-Alloys Corp. (Facor), which operates the Boula, Ostapal and Kathpal chromite mines and was India's first ferrochromium producer, operated two plants in 1995. The 50 000-t/y D.P. Nagar charge chromium plant located in Orissa operated at close to capacity, while the 40 000-t/y Shreeramnagar high-carbon ferrochromium plant located in Madhya Pradesh State suffered production delays caused by power shortages.

Jindal Ferro Alloys, a subsidiary of India's largest stainless steel producer, announced its plans to build a 150 000-t/y high-carbon plant in Orissa, integrated with a 100-MW coal-based power plant as a captive source of electricity that would also feed a planned 500 000-t/y stainless steel plant. Construction of the alloy plant was scheduled to start by January 1996 and take two years to complete. However, the company's plans depend entirely on a stable procurement of chromium ore, and therefore on the settlement of the mining leases conflict.

Japan

In recent years, as a result of the appreciation of the yen on international markets, high domestic energy costs and severe environmental standards, Japan's chromium industry suffered a number of retrenchments, signalling the start of a downsizing of its chromium metal and ferrochromium production capacity. However, because of increased demand from the stainless steel industry, Japan's production of ferrochromium in 1995 is expected to reach 232 000 t, an increase of 10.9% over 1994. Japan Metals & Chemicals (JMC), the country's largest producer, announced its intention early in the year to produce at capacity at its 80 000-t/y high-carbon ferrochromium Kyushu plant.

Japanese stainless steel producers imported an estimated 837 000 t of ferrochromium in 1995, 37% more than in 1994, mostly from South Africa, China, India and Zimbabwe. These imports were highest in the first half of the year, but started decreasing in September as steel-makers lowered their steel production plans. This was mostly due to the slumping production of consumer durables destined for export which were affected by the high value of the Japanese currency and trade relation disruptions between Japan and North America. Japan was expected to produce over 3.2 Mt of stainless steel in 1995, with 68% destined for the domestic market and 32% for export. At the end of the year, Japanese stainless steel producers were reporting an average of two months' production needs of ferrochromium in stocks. These high stocks may put a downward pressure on Japan's imports in early 1996.

Tosoh Corp. closed its 3600-t/y electrolytic chromium metal plant located at Yamataga in northern Japan in March 1995 to make way for the city's urban development program. However, the company reported its stockpile could meet customer demand until March 1997. This leaves Nippon Denko Co. Ltd. as Japan's sole producer of chromium metal with a production capacity of 2000 t/y, although JMC was reportedly producing chromium metal at its 60-t/y Oguni plant, also in Yamataga prefecture. The production capacity closure could have a severe impact on the market since the world's production of chromium metal is only about 15 000 t/y. Increased exports from Russia's Polema electrolytic chromium metal plant in Tula, which produces 99.95% pure powder and flake, may help replace part of the lost production.

Kazakstan

Kazakstan, the former Soviet Union's main producer of chromium ore, currently operates two mines: one

open-pit and one underground, both located in the southern Ural mountain chain. In 1995, Donskoy Chrome Ore Mine & Dressing Combine (Donskoy Combine), which controls the country's production of chromium ore, was reported to have produced 1.2 Mt of ore, a decrease of about 29% compared to 1994. Exports of ore outside the Commonwealth of Independent States (C.I.S.) are forecast at under 100 000 t, compared to 231 000 t in 1994. The reduced output stems in large part from production delays caused by unstable rock conditions and ventilation problems at the Molodezhnaya underground mine, which lowered its production to 0.6 Mt instead of the planned 2.0 Mt. Production from the open-pit mine will gradually be phased out because of diminishing reserves and switched to the Molodezhnaya and Tsentralnaya mines, the latter hosting reserves of 250 Mt grading 47-51% Cr_2O_3.

Kazakstan's 1995 ferrochromium production, manufactured at the Yermak and Aktyubinsk ferroalloy plants, is estimated at 350 000 t, up 7% over 1994. Exports of ferrochromium are expected to reach 130 000 t, up from about 94 000 t in 1994, although International Chromium Development Association (ICDA) half-year data indicating a further annualized 170 000 t being exported from Estonia, Latvia and Lithuania are, in fact, re-exports from Kazakstan and Russia, pushing total C.I.S. exports to 540 000 t. The Yermavosky Ferro-Alloy Works was reported in June and September to be producing ferrochromium at about 30% of capacity, whereas a report in late January had mentioned that the plant was closed since November 1994 because of political infighting that had resulted in a chromium ore supply shortage at the plant. Its production capacity was last reported at 350 000 t/y of ferrochromium. However, plans were to convert idled ferrosilicon furnaces to boost to 750 000 t/y the ferrochromium production capacity which the plant can produce more competitively on account of the country's vast chromite reserves.

The lower production of chromium ore and ferrochromium in Kazakstan in 1995 is due to lower demand in the C.I.S., but it is also due to difficulties in maintaining the level of production (in 1992, the Donskoy Combine produced 3.5 Mt of ore) and political problems at Donskoy. Higher energy prices and transport costs, and shortages of metallurgical coal which is imported from Russia, are affecting the industry.

After liquidating the Kramds industrial group in mid-March, which had been incorporated to reorganize the country's chromium industry, the Government of Kazakstan announced in May that, as a first phase of its privatization program, it was transferring control of the Donskoy Combine and both the Yermak and Aktyubinsk Ferro-Alloy Works to the Japan Chrome Corporation (JCC). Set up by Mitsui & Co., Ltd., Unico International, and Trans-World Metals, JCC was designed to act as a managing company and work in cooperation with the transnational joint-stock company of the Kazakstan chromium industry, Kazchrome, to develop these resources and increase the vertical integration of the industry. As part of the second phase of the privatization, the government announced in November that JCC had purchased a 55% interest in Kazchrome.

The objectives of the reorganization program implemented by JCC are to: (1) stabilize chromium ore output at the 2.5-Mt/y level; (2) complete the construction and commissioning of the second concentrator circuit at the Donskoy Combine; (3) complete the development of facilities at the Tsentralnaya mine for a production capacity of 2 Mt/y (commissioning is expected in two years); and (4) increase the capacity utilization rate of the country's ferrochromium plants. In order to accomplish its last goal, JCC intends to end chromium ore exports and favour the supply of the two local ferrochromium producers.

The projects to develop a 200 000-t/y briquetting plant for chromium ore fines and a 700 000-t/y capacity pelletizing plant were discussed during the year, but no details on a timeframe were released.

Norway

Elkem Rana A/S, a subsidiary of Elkem A/S, is the country's sole producer of ferrochromium. Using chromite ores imported from Turkey and Kazakstan, the company had two of the Mo i Rana plant's four operating furnaces producing high-carbon ferrochromium at their combined 150 000-t/y capacity for most of 1995. However, a proposal was under consideration to refurbish for the production of ferrochromium one of two furnaces idled since 1989 that previously had produced pig iron. If the project goes ahead, production capacity of 75 000 t/y would be added by the second quarter of 1997.

Philippines

Because of electric power restrictions, ferrochromium production from the Philippines' Mindanao Island-based industry in recent years has only been a fraction of its 90 000-t/y capacity. Reduced rainfall in the 1991-94 period forced the government 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, combined with difficulties in sourcing chromium ores locally because of production disruptions caused by fighting between government and rebel forces, forced the shut-down of a major part of the industry's production capacity. Heavy rainfalls in the first half of 1995 and strong international demand prompted most companies to resume their operations during the year. However, a 20% appreciation in the local currency over 1994 rendered production susceptible to variations in prices and in the cost of entrants.

After a three-year shut-down, Metro Alloys re-opened its three 21 600-t/y furnaces in January, two of which are assigned to the production of high-carbon 60-65% ferrochromium and 50-55% charge chromium. Ferrochrome Philippines Inc., which was sold during the year to a local Philippines-Chinese consortium, resumed its operations in March and was reportedly producing high-carbon ferrochromium at a rate of 42 000 t/y. In addition, Integrated Chrome Corp. (Inchrome) re-opened its charge chromium production facilities for a short period of time in June, but had to close again temporarily because of a lack of ore. It resumed operating on July 29 at the reduced rate of 24 000 t/y.

Russia

Russia's sole producer of chromium ore, the Saranovskaya Shakhta Rudnaya mine located in the Perm region of the central Urals, produced an estimated 157 000 t in 1995, an increase of about 22% over 1994. However, the mine's production, which has a low chromium-to-iron ratio (lower than 1.88:1), fell short of the country's needs for ore. Kazakstan, Russia's traditional supplier of chromium ore, made up for part of the deficit, but reduced production at the Donskoy Combine forced Russian consumers to also import lumpy ore from Turkey.

Russia's production of ferrochromium comes from two plants with a combined capacity of over 450 000 t/y: the Serovsky Ferro-Alloy Works, and the Chelyabinsky Electro-metallurgical Works, both located in the central Urals. In 1995, Russia's ferrochromium plants were reported to be operating at about 60% of capacity, or 270 000 t/y, and were gradually being switched to the production of high-carbon material from that of low-carbon ferrochromium. Exports of chromium alloys in 1995 were expected to amount to 240 000 t.

In an effort to improve their competitiveness and solve some of their production problems, producers pushed for the realization of a few projects. These include the construction of a 300 000-kW gas-turbine power plant near the Chelyabinsky Works, which would significantly reduce its production costs. Also, the Serovsky ferrochromium plant was planning to build a 300 000-t/y briquetting plant that could briquette fines for use in the production of high-carbon ferrochromium. However, an investment tender for the 10% government holding in the company, which would have financed the briquetting plant, was cancelled in December due to a lack of interest. Serovsky has 18 furnaces for an overall nominal production capacity of 400 000 t/y, but was reported to be presently operating at only 337 000 t/y, or at about 60% of its capacity.

TDR International, a Belgian-based trading company, announced its intention to bring on stream a 140 000-t/y charge chromium facility in Tikhuin near St-Petersburg to take advantage of the area's cheap power costs. The North West project, as it is known, will involve the installation of four refurbished furnaces, two of which are scheduled for commissioning by the end of the second quarter with the rest to be operational by the end of 1996. The plant would be set up mostly as a toll converter, importing the ore feed and exporting the ferrochromium. Production in 1996 is expected to be 36 000 t.

South Africa

In 1995, South Africa produced 5.49 Mt of chromium ore, 53% more than in 1994 and about 46% of the world's production, while it produced about 1.5 Mt of ferrochromium, an increase of 32% over the previous year.

South Africa's chromium industry is dominated by two major companies, Samancor Ltd. (Samancor), owned principally by Gencor Ltd. and Anglo American Corporation of South Africa Ltd., 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, which owns the second largest 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. In 1995, Samancor operated nine chromite mines located within the Bushveld igneous complex in the Western Transvaal and in the Steelpoort Valley of the Eastern Transvaal, for a combined production of about 3.1 Mt, an increase of 30% over 1994. Similarly for ferrochromium, Samancor operated five fully integrated alloy plants for a total production capacity of 1.02 Mt/y, making it the country's largest ferrochromium producer. These plants are: Ferrometals Ltd., Tubatse Ferrochrome, Middelburg Ferrochrome, Palmiet Ferrochrome, and Batlhako Ferrochrome. Their combined ferrochromium production in 1995 was an estimated 833 000 t, 43% higher than in 1994.

CMI, the second largest producer of ferrochromium in South Africa, was reportedly operating at full capacity starting in February 1995 with the resumption of production from its second furnace at its Rustenburg plant. Combined with production from the three furnaces at its Lydenburg plant, the company produced 340 000 t in 1995. The company was considering the development of the Thorncliff mine in the Steelpoort area, but had not committed itself by the end of the year. However, it finalized an agreement with Mitsui & Co., Ltd. in late March for the purchase by the latter of a 12.5% stake in CMI's 240 000-t/y Lydenburg ferrochromium plant. Through this deal Mitsui gains access to a 60 000-t/y supply of alloy.

South Africa's third largest ferrochromium producer, Chromecorp Technology (CCT), commissioned its new fourth furnace in February, raising its production

capacity to 260 000 t/y of charge chromium while also recovering 24 000 t/y of ferrochromium from slags. The company announced the development by August 1996 of the Wonderkop integrated project at Kroondal near Rustenburg, which will include an underground mining operation, a pelletizing plant, a chromium recovery unit, and two charge chromium furnaces with a combined capacity of 160 000 t/y. The company is also committed to the development, by the first quarter of 1997, of a 170 000-t/y charge chromium facility in Pretoria to supply liquid ferro-chromium to Iscor Ltd.'s newly converted 480 000-t/y stainless steel plant.

Ferralloys Ltd., the country's fourth largest ferro-chromium producer, was reportedly operating at capacity at its 120 000-t/y Machadodorp plant in Transvaal State after production resumed at the plant's second and third furnaces in March and May respectively. It had operated only one furnace in 1994.

South Africa's Columbus Joint Venture (CJV), the stainless steel expansion project equally owned by Samancor, Highveld Steel and Vanadium Corporation Limited, and the state-owned Industrial Development Corp., was expected to be commissioned by the end of 1995 and to be operating at full capacity in 1997. Located in the Middleburg District in Eastern Transvaal, the 600 000-t/y Columbus plant will make South Africa the world's sixth largest producer of stainless steel and will bring 510 000 t/y of stainless steel onto the international market as 85% of the plant's production is slated for export. The plant's production in 1995 amounted to about 250 000 t of stainless steel, and is expected to reach 450 000 t in 1996. In anticipation of the plant's needs for ferrochromium, Samancor proceeded in 1995 with the construction of a 100 000-t/y DC plasma furnace at its Middelburg plant which adjoins the Columbus stainless steel plant. The furnace, expected to be completed in the second half of 1996, will contribute hot, liquid ferrochromium to the Columbus plant.

The increased demand for chromium products prompted a surge of projects for the development of additional chromium ore and alloy production capacity in South Africa. Aside from capacity resumptions and conversions, a number of companies announced the start of new projects including, in addition to those mentioned above, the Samancor-Showa Denko-Marubeni Corp. joint venture for the production capacity expansion of the Middelburg Technochrome plant to produce 36 000 t/y of low-carbon ferro-chromium and 24 000 t/y of silicochromium. In relation to this deal Showa will close its 20 000-t/y Chichibu plant in Japan by the end of 1997. In 1995 Samancor proceeded with the installation of new equipment to recover ferrochromium from slags, which will boost production by 40 000 t/y at its Tubatse plant and initiate the production of 50 000 t/y at its Ferrometals plant. In March, the company also commissioned a sixth 55 000-t/y charge chromium furnace at its Tubatse plant.

Eastern Asia Metal Investment Co. Ltd., a subsidiary of state-run China Iron and Steel Industry and Trade Group Corp. and Jilin Ferroalloy Works, formed a joint venture with Northern Transvaal Development Corp. to operate the latter company's 400 000-t/y Dilokong chromite mine and build a 100 000-t/y charge chromium plant.

Also, Hernic Ferrochrome (Pty) Ltd. proceeded in April with its integrated 130 000-t/y ferrochromium project located in the Brits District of Transvaal State. The plant is expected to come on stream in June 1996 with one 65 000-t/y furnace; a second furnace would be added later on.

However, with all of the projects for additional capacity competing in the same market, and with prices showing signs of weakness in the last quarter of 1995, some of these projects are bound to be shelved temporarily. Already, Rhoex Ltd. has postponed its plans to establish a 130 000-t/y ferrochromium plant at the Buffelsfontein mine near Rustenburg, which was expected to come on stream by mid-1997. Another sign of the market slowing was Samancor's announcement near the end of 1995 that it had switched back to the production of silicomanganese two of its furnaces at the Krugersdorp plant in Gauteng State that had been converted to charge chromium production in July 1994.

Turkey

Turkey, one of the world's four major chromium ore producers, was estimated to have produced 900 000 t during the year, down 20% from 1994, of which about 70% was exported. Meanwhile, the country's sole ferrochromium producer, state-owned Etibank, was reportedly producing at capacity during the year. However, a 37-day strike in the fourth quarter was estimated to have limited its production of high-carbon ferrochromium to 83 000 t, down 6.7% from 1994, while production of low-carbon ferrochromium was estimated at 10 500 t, up 10% from 1994. In 1996, Turkey's production of chromium ore is expected to exceed 1 Mt, while its production of ferro-chromium is expected to reach 125 000 t. In the longer term, Turkey's exports of ore may decrease in favour of increased local conversion to ferrochromium if improvements proposed for the state-owned power generation system lead to a more stable energy supply.

United States

The sole ferrochromium producer in the United States, Macalloy Corp., completed its 10-year contract with the U.S. Defense Logistics Agency (DLA) to upgrade chromite ore to generate over 527 500 t of high-carbon ferrochromium for the U.S. stockpile. The upgrading program had been required by legislation to support the only domestic converter of chromite ore to ferrochromium. In fiscal year 1995,

Macalloy's Charleston, South Carolina plant, which is equipped with two 45-kVA furnaces for a capacity of 90 000 t/y, produced about 70 000 t of ferrochromium. With the completion of the contract, Macalloy continued the production of ferrochromium with one furnace by processing material from the U.S. stockpile that the DLA is liquidating. However, the company was reportedly negotiating with two companies to establish a conversion arrangement that would enable the restart of the second furnace that has been closed since 1990. To improve its competitiveness, the company also began construction of a 150 000-t/y briquetting facility at its plant to process fine ores in its furnaces. The plant was expected to be operational in early 1996.

In fiscal year 1995 (i.e., from October 1, 1994 to September 30, 1995), the DLA sold the total amount authorized under the Annual Materials Plan (AMP) of 317 600 t of metallurgical-grade chromite ore. In fiscal year 1996, the DLA has authority to dispose of 45 370 t of chemical-grade, 90 740 t of refractory-grade and 317 600 t of metallurgical-grade chromite ore, as well as 22 685 t of ferrochromium. However, a proposed revision to the 1996 AMP could double the amount of ferrochromium released and introduce the sale of 454 t of electrolytic chromium.

Zimbabwe

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 as well as 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. Anglo-American Corp. Zimbabwe Ltd.-owned Zimbabwe Alloys Ltd. (Zimalloys) announced the development of a new US$4 million open-pit project at its Inyala chromium mine to make up for poor production at its underground operations.

Zimbabwe's ferrochromium industry, which had been hit in the past few years 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, returned to higher production levels in 1994 and was reportedly producing at capacity in 1995. Zimalloys, the country's sole producer of low-carbon ferrochromium, re-opened a furnace at its Gweru plant. Closed since July 1993, this 15 000-t/y furnace will now be assigned to the production of silicochromium with a major portion of the production destined to supply Japan Metals and Chemicals Co. Ltd. (JMC), which closed its Oguni silicochromium plant earlier in the year. Also, a joint venture between Zimalloys (50%), Mitsui & Co., Ltd. (25%) and JMC (25%) has been arranged whereby a new 14 000-t/y furnace for the production of low-carbon ferrochromium will be installed at its existing plant. The additional capacity will supply the Japanese companies in replacement of domestic production from the Kokuni plant which will close when the new plant is operational. Finally, trial production at a new plant located at the Gweru site, designed to recover 16 000 t/y of low-carbon ferrochromium by processing the slags of previous production using heavy media separation, was reported to be experiencing problems late in the year. Zimalloys expected to produce 95 000 t of chromium alloys, 40 000 t of low-carbon ferrochromium and 55 000 t of silicochromium in 1995.

The country's other producer, Zimbabwe Mining and Smelting Co. Ltd. (Zimasco), owned since 1994 by South Africa's Exultate, is expected to produce at its 220 000-t/y capacity of high-carbon ferrochromium from 580 000 t of ore in 1995.

Other Developments

Derwent Mining Co. began producing lumpy ore grading 46-48% Cr_2O_3 at a rate of 200 000 t/y in the United Arab Emirates in 1994. In 1995, Madagascar's Kraomita Malagasy was expected to produce 150 000 t of chromium ore, about 83% of capacity, split 60% lumpy and 40% concentrates. Officials also reported the development of additional production capacity in 1996 with the opening of the Bemanevika mine.

MARKETS

In 1995 the chromium market was unstable because of a tightness in supply caused by an increase in demand for chromium products by the stainless steel industry, while chromium ores were in short supply largely due to production disturbances at Kazakstan's Donskoy Combine. As a result, prices for chromium products reached highs unseen since the 1988-89 period (Figures 3 and 4). However, excluding chromium ore and chromium metal products for which supplies were still believed to be unstable, a market correction was observed in the second half of the year in reaction to a downward pressure on prices caused by the increased availability of chromium alloys.

Contrary to what happened in the past few years when exports from Kazakstan entering the spot market at distress prices triggered the downfall of the market, a lack of chromium ore exports from the same country caused a shortage to develop and sent prices up. On the consumption side, exacerbating the ore supply shortage, the Western World's stainless steel production reached a record level of 14.8 Mt, an increase of over 13% compared to 1994.

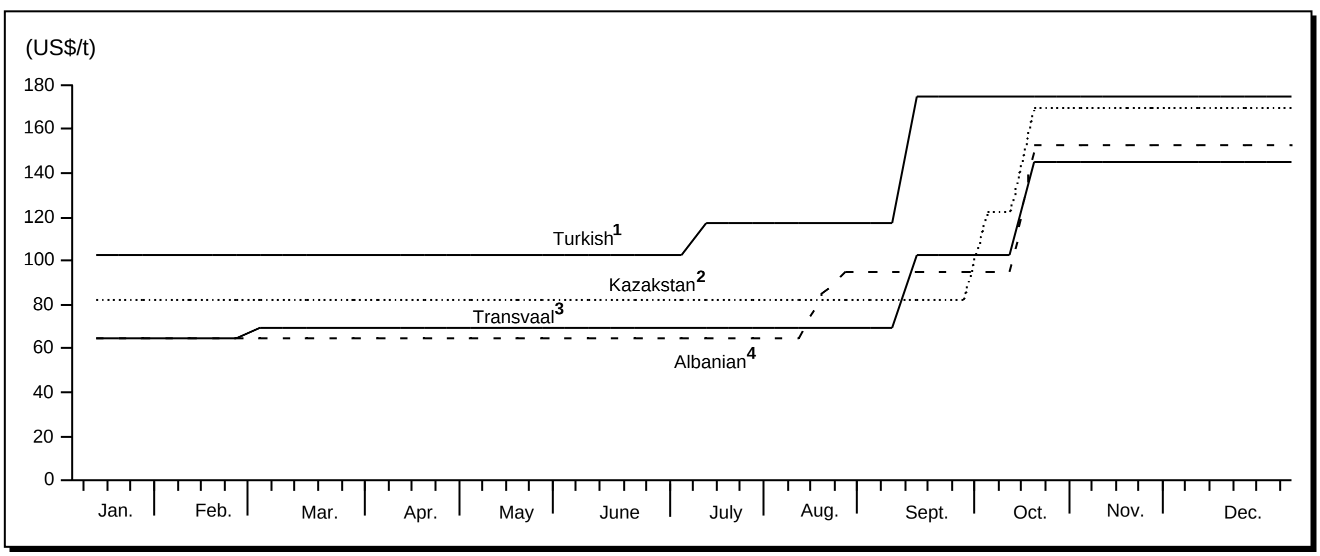
Reduced output at the Donskoy mines, compounded by export restrictions to favour the supply of C.I.S. alloy producers, forced consumers to rely on ore production from South Africa, India and Turkey to source their supplies. However, shipment disturbances on Turkish and Indian material caused by strikes, weather problems and the difficulty in securing vessels because of increased world trade created additional difficulties. The South African Transvaal ore price, which had been stable in the range of US$63-$67/t since 1993, first increased to US$65-$75/t in late February, and then pushed on to US$95-$110/t in early September and to US$140-$150/t in early October, where it remained until the end of the year. Turkish high-grade concentrate prices followed the same pattern trading in the US$100-$105/t range at the start of the year and increasing to stabilize at US$170-$180/t from early September until the end of 1995 (see price table and Figure 3).

Because of an increased tightness in the market, customers were prepared to take lower-grade ores than in the past; where it was hard to sell material grading less than 38% Cr_2O_3 in 1994, even 32% material was in demand in 1995.

With respect to ferrochromium prices on the North American market, prices for spot charge chromium 60-65% "imported" started the year continuing the rally begun in early 1994. From a range of US47¢-49¢/lb, prices gradually climbed to US79.5¢-83.0¢/lb where the market peaked in June. Prices weakened afterwards, gradually falling to reach US62¢-65¢/lb at the end of the year, still looking for a resistance level (see price table and Figures 5 and 6). Lagging behind charge chromium, the price for low-carbon ferrochromium finally started firming up in mid-January 1995 from the recent low of US81¢-83¢/lb where it had stagnated throughout the last quarter of 1994. It gradually increased to US125¢-130¢/lb where it peaked in mid-August, and then pulled back to the US119¢-123¢/lb range where it stabilized in the last quarter, again lagging charge chromium prices which had already started eroding. The weakness developing in the second half of the year was probably caused by the increased availability of ferrochromium on the market, while the announcement of the development of additional capacity reinforced the consumer's security of supply in the longer term.

Prices for electrolytic chromium metal remained stable until late February at the price level of US$3.20-$3.60/lb established in March 1994. Prices then started increasing, slowly at first, moving in the range of US$3.40-$3.75/lb until the end of June when the range widened to US$3.75-$4.30/lb. However, price movements accelerated in mid-October and closed the year in the range of US$5.60-$6.00/lb when they were still rising. The price hike observed in 1995 was caused by the closure in March 1995 of the Tosoh plant in Japan, which will only leave Elkem-USA and a Russian producer to supply the market for that grade, and by increasing demand from the superalloy industry (see price table and Figures 7 and 8).

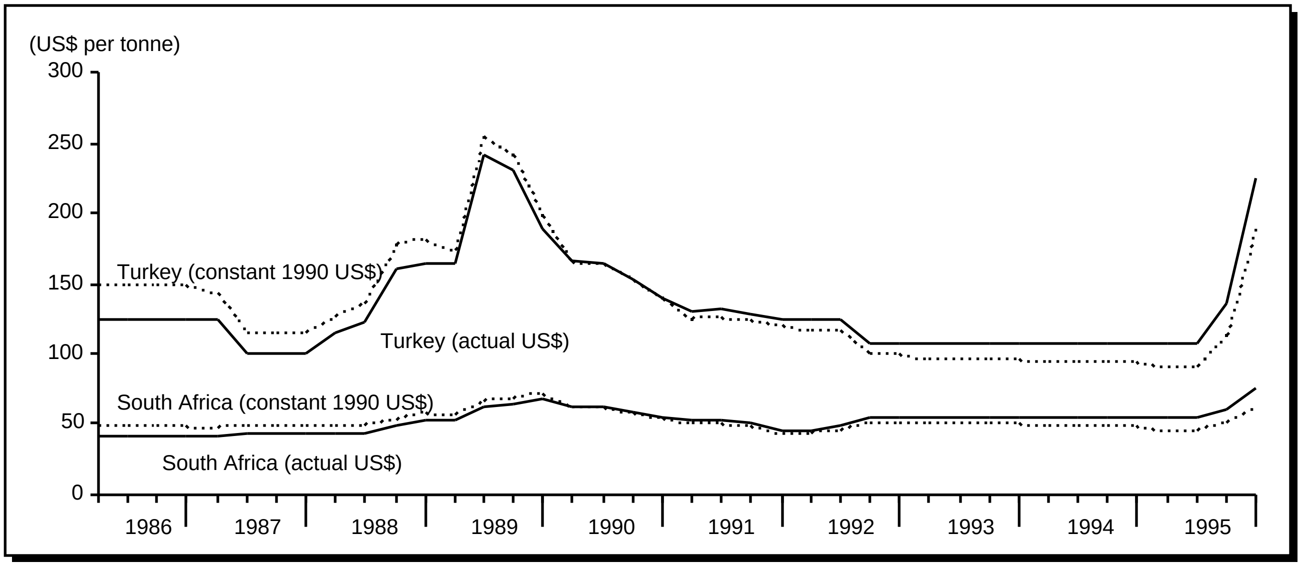
Figure 3
Chromite Ore Prices, 1995



Source: Metal Bulletin.

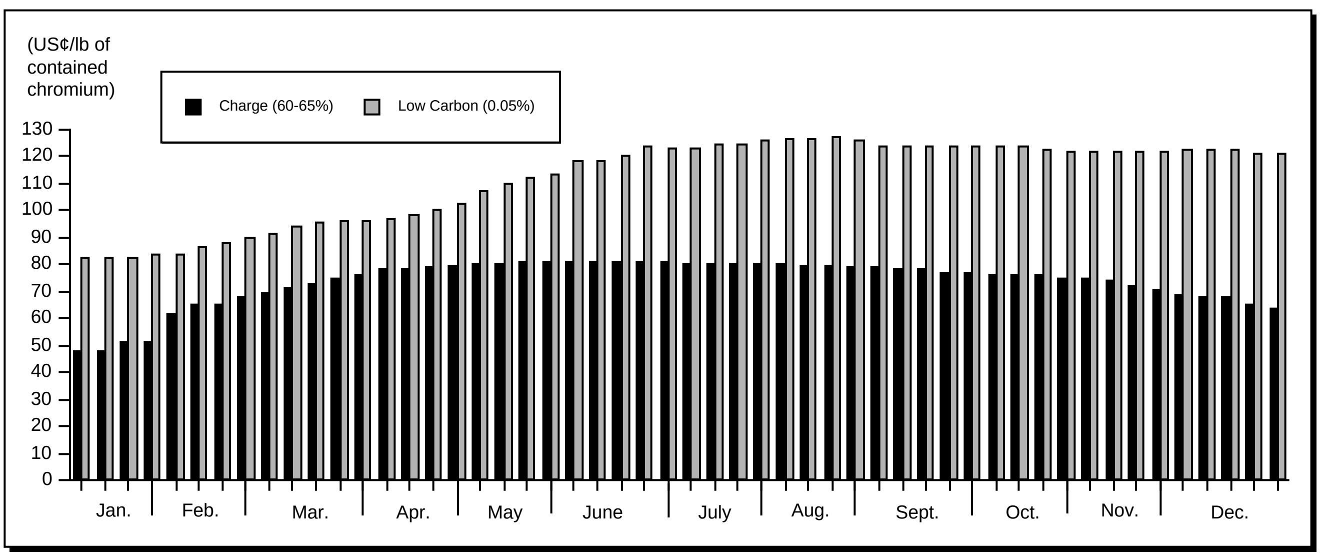
[1] Concentrates, 48% Cr_2O_3 minimum, f.o.b.
[2] 48% Cr_2O_3 minimum, f.o.b.
[3] Friably lumpy, basis 40% Cr_2O_3, f.o.b.
[4] Lumpy 42-47% Cr_2O_3 minimum, f.o.b.

Figure 4
Chromite Ore, Average Quarterly Price, 1986-95
Free on Board



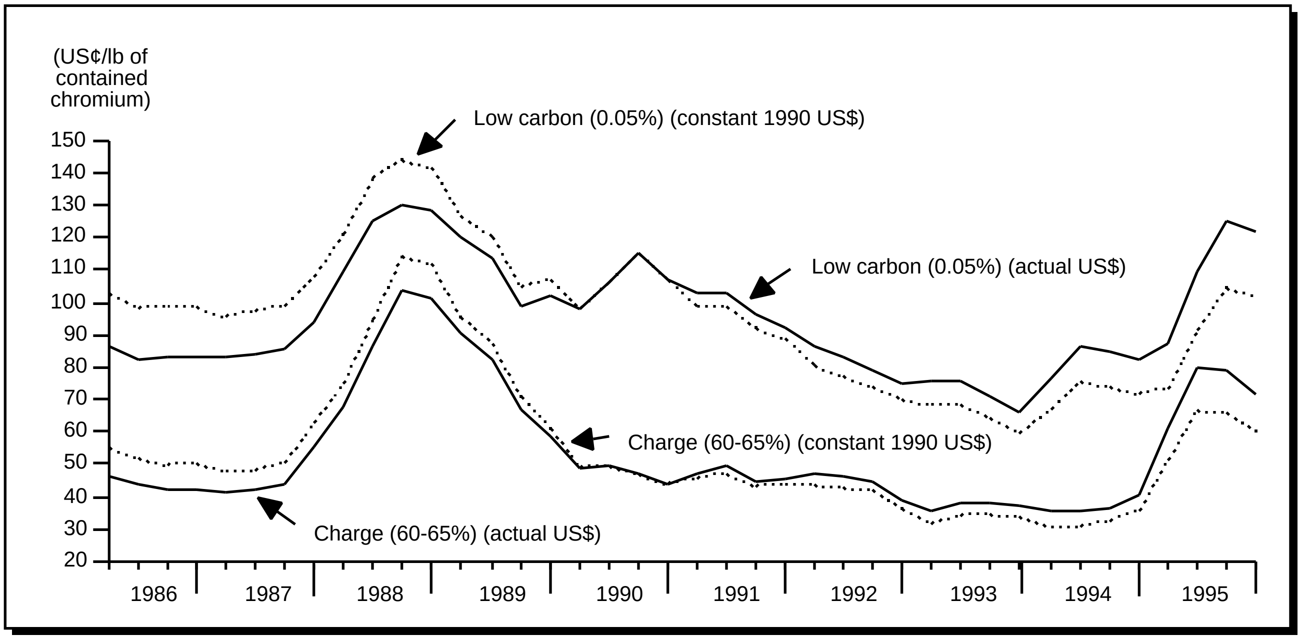
Source: *Metals Week.*

Figure 5
U.S. Imported Ferrochromium, Average Weekly Prices, 1995
Free on Board



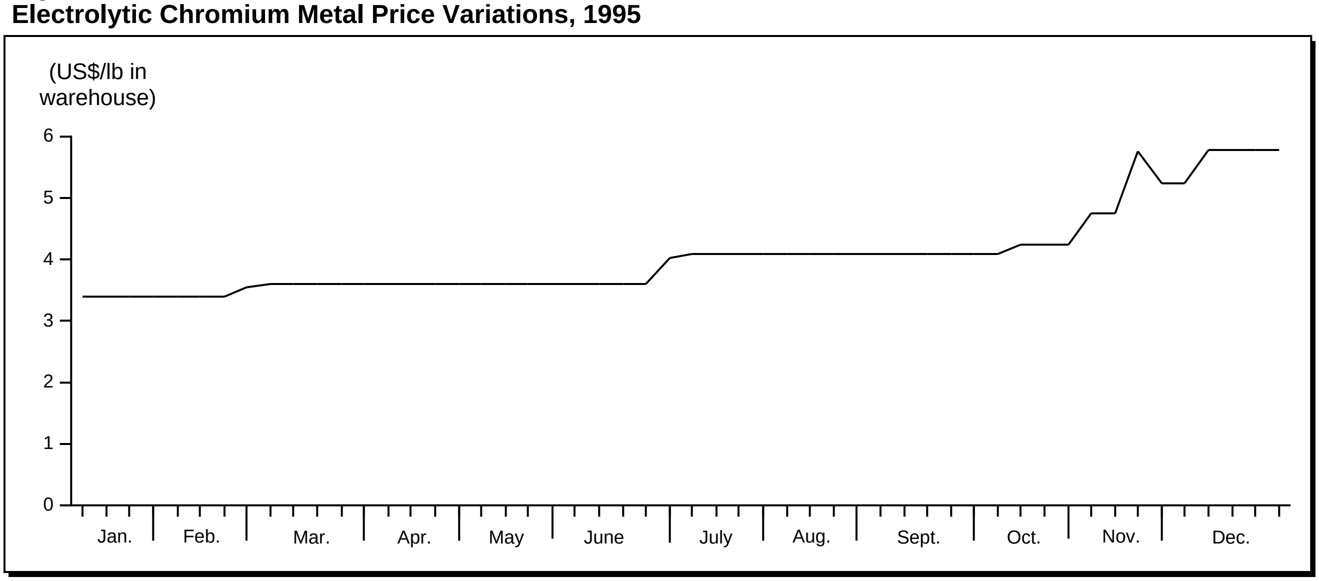
Source: *Metals Week.*

Figure 6
U.S. Imported Ferrochromium, Average Quarterly Prices, 1986-95
Free on Board



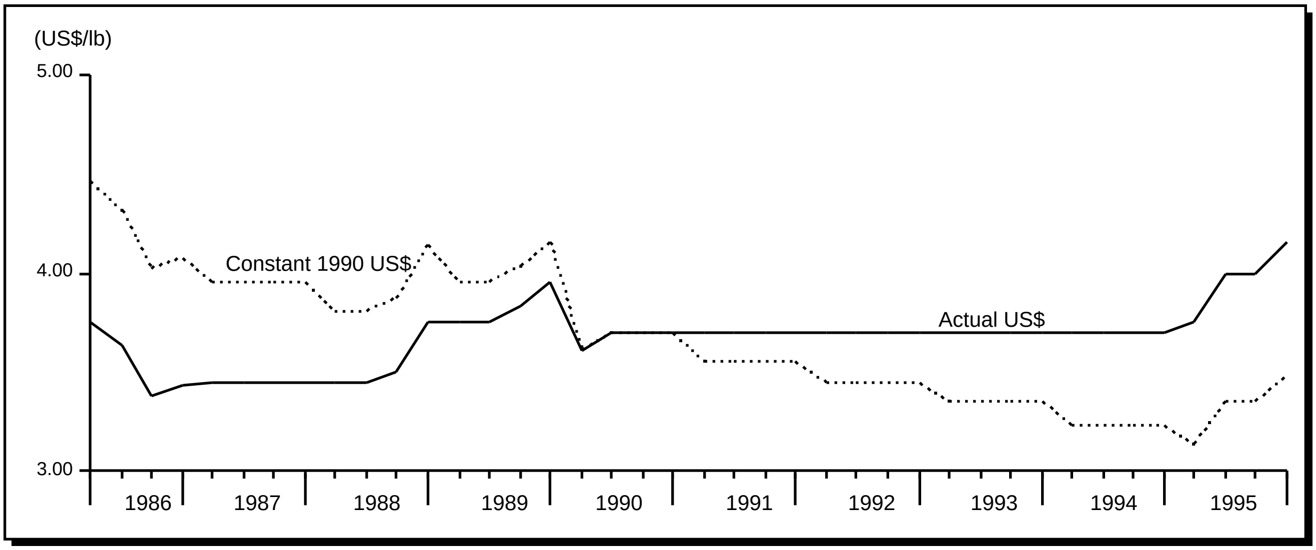
Source: *Metals Week.*

Figure 7
Electrolytic Chromium Metal Price Variations, 1995



Source: *Metal Bulletin* (free market).

Figure 8
U.S. Electrolytic Chromium Metal, Average Quarterly Price, 1986-95
Free on Board



Source: *Metals Week.*

In the short term, chromium ore prices are expected to increase by about 10% and to remain at the high levels experienced in 1995 on the strength of demand from the stainless steel industry and the slow development of new mining projects. On the other hand, because of increased ferrochromium production capacity in 1995, chromium alloy prices are expected to have peaked in mid-1995 and to have levelled out in the last quarter of 1995, with this trend continuing in the first quarter of 1996. Later in the year, prices are expected to reach a resistance level that is substantially higher than the troughs of past cycles. Finally, chromium metal prices could still increase in early 1996 before stabilizing at the higher level for a while. However, prices could be volatile on account of an increase in demand for superalloys by the aerospace industry where orders for commercial aircrafts increased substantially in the second half of 1995.

OUTLOOK

In 1995, because of a 13% production increase over 1994 in the chromium industry's major consuming sector, stainless steel, demand for chromium ore and ferrochromium increased significantly during the year. World producers of chromium alloys were quick to respond to market demand and increased their production capacity through the resumption of idled capacity, the conversion of furnaces from the production of manganese or silicon alloys to that of chromium alloys, or the commissioning of additional production capacity. However, production from these facilities was hampered by tight world supplies of chromium ore largely because of reduced production at Kazakstan's Donskoy Combine which previously had supplied about 20% of the market's need.

In the short term, supplies of chromium ore will remain tight with producers in South Africa, Turkey, India and Zimbabwe trying to make up for lower exports from the C.I.S. and waiting for new production capacity in Canada, Iran, Madagascar, the Philippines, the United Arab Emirates, and Zimbabwe to come on line. However, the situation largely depends on how long it takes JCC to reorganize Kazakstan's mining operations to boost production back to previous levels, and on the enforcement of its policy concerning restrictions of ore exports.

Consumption in the chromium industry in the short term is expected to increase following the growth of the global stainless steel industry, which is characterized by greater domestic demand in China and a 6% growth in the Western World's production in 1996. Following this line of thought, the consumption of chromium products in the medium to long term is expected to increase at a rate of between 2.5% and 5.0% annually. However, this could be affected by the pace of reforms in the C.I.S., which will cause the economies of these countries to expand and start consuming again.

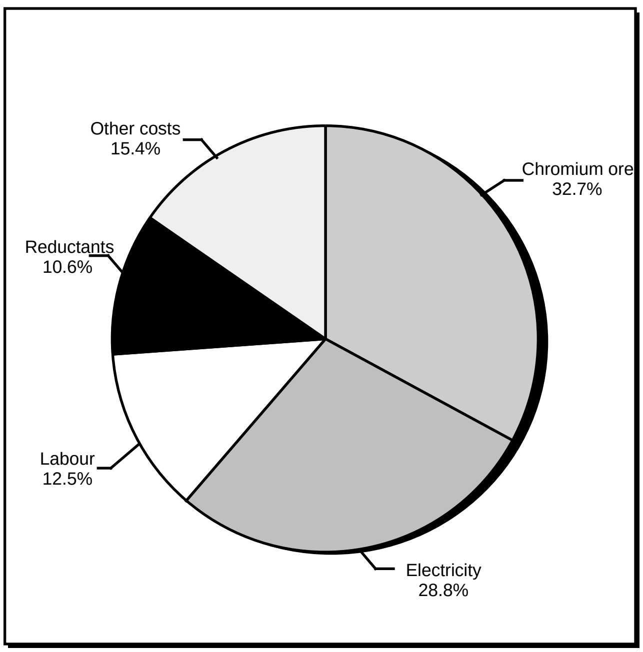
In the short term, production of ferrochromium is expected to decrease somewhat. In an effort to prevent a collapse in prices because of oversupplied markets, a number of producers were either switching back some of their ferrochromium capacity to the production of manganese and silicon alloys, like at Samancor's Krugersdorp plant, or planning

maintenance shut-downs on part of their facilities. Other producers, such as Russia's Chelyabinsky plant, which reportly had halted its production of chromium alloys in early January 1996 because of a lack of ore supplies, may have to close higher-cost or non-integrated facilities on account of new capacity coming on stream in countries with a lower cost base and captive ore supplies.

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 excess supply, and with the trend that is seeing ferrochromium production moving towards integrated producers with dedicated chromium ore deposits, Canadian ferrochromium projects will be developed very slowly. Nevertheless, on account of the strong demand for high-grade lumpy chromium concentrates, Coleraine's mining project in Quebec could find a window of opportunity in 1996.

Note: Information in this review was current as of January 26, 1996.

Figure 9
Cost Breakdown for the Production of High-Carbon Ferrochromium (Western World Producers' Average), 1993



Source: CRU International.

PRICES

	December 24, 1993	December 23, 1994	December 22, 1995
		(US$)	
Chrome ore, dry basis, f.o.b. shipping point			
Transvaal 44% Cr_2O_3, no ratio (per tonne)	50.00-60.00	50.00-60.00	70.00-80.00
Turkish 48% Cr_2O_3, 3:1 ratio (per tonne)	105.00-110.00	105.00-110.00	220.00-230.00
Chromium metal			
Electrolytic 99.1% Cr, f.o.b. shipping point (per kg)	8.15	8.15	9.15
		(US¢)	
Ferrochromium, f.o.b. shipping point (per kg Cr content)			
Imported 50-55% charge chrome	78.24-83.75	88.16-92.57	136.65-141.05
Imported 60-65% charge chrome	77.14-79.34	102.49-106.89	140.51-144.91
MW, imported, low carbon, 0.05% C	156.48-160.89	178.52-182.93	262.28-271.09

Source: *Metals Week.*
f.o.b. Free on board.

TARIFFS

Item No.	Description	Canada MFN	Canada GPT	Canada USA	United States Canada	EU 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	3.5%	3%	Free	Free	12.6%	3.8%
2819.90	Other	3.5%	3%	Free	Free	12.6%	3.8%
2833.23	Sulphates; alums; peroxosulphates (persulphates) of chromium						
2833.23.10	Chromium sulphate, basic	Free	Free	Free	Free	8.3%	Free
2833.23.90	Other chromium sulphates	3.5%	3%	Free	Free	8.3%	Free
2841.30	Sodium dichromate	Free	Free	Free	Free	11.7%	4.6%
	Ferrochromium						
7202.41	Containing by weight more than 4% of carbon	Free	Free	Free	Free	7.2%	7.5%
7202.49	Other	Free	Free	Free	Free	7.8%[a]	7.5%
7202.50	Ferro-silico-chromium	8.8%	5%	Free	Free	4.5%	3.5%
8112.20	Chromium						
8112.20.10	Unwrought chromium, not alloyed; powders, not alloyed	Free	Free	Free	Free	Free-4.6%	4.7-5.8%
8112.20.20	Unwrought chromium, alloyed; waste and scrap; powders, alloyed; articles of chromium	Free	Free	Free	Free	Free-6.6%	4.7-5.8%

Sources: Customs Tariff, effective January 1996, Revenue Canada, Customs and Excise; Harmonized Tariff Schedule of the United States, 1996; The "Bulletin International des Douanes," Journal No. 14 (17th edition), European Union, 1994-1995, "Conventional" column; Customs Tariff Schedules of Japan, 1995.
[a] Exemptions may apply circumstantially.
[1] GATT rate is shown; lower tariff rates may apply circumstantially.

TABLE 1. CANADA, CHROMIUM TRADE, 1993-95

Item No.		1993		1994		1995p	
		(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
IMPORTS							
2610.00.00.10	Chromium ores and concentrates, refractory grade (gross weight)						
	Cuba	4 290	643	–	–	5 016	1 670
	Philippines	7 319	1 513	3 890	963	2 458	611
	South Africa	4 149	553	3 802	569	3 859	600
	Other countries	959	364	808	251	1 960	3 418
	Total	16 717	3 074	8 500	1 783	13 292	6 299
2610.00.00.90	Chromium ores and concentrates, except refractory grade (chromium content)						
	United States	4 222	1 041	7 432	1 750	11 349	2 504
	South Africa	4 236	455	2 880	538	8 307	1 045
	Philippines	268	90	976	315	3 929	840
	Other countries	–	–	444	157	114	22
	Total	8 726	1 586	11 732	2 764	23 699	4 414
2819.10	Chromium trioxide						
	United States	1 409	3 084	1 796	4 653	2 671	6 883
	Germany	516	1 363	789	2 053	829	2 196
	Italy	79	183	58	136	90	246
	Other countries	41	149	30	99	46	146
	Total	2 045	4 782	2 673	6 943	3 635	9 473
2819.90	Chromium oxides n.e.s.; chromium hydroxides						
	United States	764	2 541	943	3 688	928	4 037
	People's Republic of China	52	199	97	370	100	401
	Other countries	17	83	45	214	37	196
	Total	833	2 825	1 085	4 274	1 065	4 635
2833.23	Chromium sulphates						
	Germany	657	519	616	518	617	587
	United States	4	4	2	2	179	145
	Other countries	–	–	21	15	1	1
	Total	661	523	639	537	797	735
2841.30	Sodium dichromate						
	United Kingdom	5 136	3 743	6 869r	5 234	3 776	5 552
	United States	457	567	561	793	271	402
	Argentina	–	–	178	193	200	231
	Other countries	442	485	251	247	313	354
	Total	6 035	4 798	7 859r	6 469	4 559	6 543
7202.41	Ferrochromium containing by weight more than 4% carbon						
	South Africa	20 893	11 936	31 310r	17 462r	21 390	19 381
	Turkey	–	–	492	422	2 517	4 145
	Philippines	–	–	–	–	3 124	3 686
	Croatia	–	–	–	–	2 405	3 505
	United States	6 888r	6 096r	3 797	3 734	2 203	2 952
	Other countries	12 057	8 619	8 384	6 247	2 381	3 839
	Total	39 838r	26 656r	43 983r	27 870r	34 020	37 517
7202.49	Ferrochromium n.e.s.						
	South Africa	3 064	2 669	4 770r	4 320r	24 318	23 748
	Turkey	–	–	1 625	1 348	2 423	2 347
	Russia	21	21	676	1 060	911	1 976
	United States	1 701	2 348	3 086	3 182	642	1 373
	Other countries	654	1 461	1 005	1 902	393	1 093
	Total	5 440	6 501	11 162r	11 814r	28 687	30 542
7202.50	Ferro-silico-chromium						
	United States	723	853	469	668	644	1 041
	Turkey	20	27	224	344	127	197
	Russia	–	–	10	13	60	96
	South Africa	278	240	723	665	–	–
	Other countries	–	–	48	83	54	93
	Total	1 021	1 121	1 474	1 775	886	1 428

TABLE 1 (cont'd)

Item No.		1993		1994		1995p	
		(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
IMPORTS (cont'd)							
8112.20.10	Unwrought chromium, not alloyed; powders, not alloyed						
	United States	93	847	90	922	85	921
	United Kingdom	37	346	30	235	51	468
	Japan	67	587	91	831	41	413
	Other countries	2	56	6	179	16	171
	Total	199	1 837	217	2 169	193	1 976
8112.20.20.10	Unwrought chromium, alloyed; powders, alloyed; articles of chromium, n.e.s.						
	United States	152	1 309	143	1 448	77	965
	United Kingdom	13	101	85	771	47	413
	France	–	–	...	1	40	376
	Other countries	6	95	16	228	8	95
	Total	171	1 509	244	2 450	172	1 853
8112.20.20.20	Chromium waste and scrap						
	United States	–	–	1	14	...	...
	Total	–	–	1	14	...	...
EXPORTS							
2610.00	Chromium ores and concentrates						
	United States	–	–	–	–	39	12
	Japan	–	–	40	35	–	–
	Total	–	–	40	35	39	12
2819.10	Chromium trioxide						
	Netherlands	–	–	–	–	60	170
	United States	1	2	1	2	–	–
	South Korea	...	2	–	–	–	–
	Total	1	4	1	2	60	170
2819.90	Chromium oxides n.e.s.; chromium hydroxides						
	United States	102	818	1 022	1 881	178	254
	Other countries	20	53	–	–	141	114
	Total	122	872	1 022	1 881	318	369
2833.23	Chromium sulphates						
	South Korea	–	–	54	56	–	–
	Total	–	–	54	56	–	–
2841.30	Sodium dichromate						
	United States	391	413	469	485	132	149
	Total	391	413	469	485	132	149
7202.41	Ferrochromium containing by weight more than 4% of carbon						
	United States	–	–	–	–	19	31
	Philippines	–	–	5	17	–	–
	Total	–	–	5	17	19	31
7202.49	Ferrochromium, n.e.s.						
	Italy	–	–	–	–	284	122
	Philippines	–	–	5	17	86	90
	Total	–	–	5	17	370	213
8112.20	Chromium and articles thereof, including waste, scrap and powders						
	United States	19	100	1r	10r	...	17
	Germany	...	17	83	27	–	–
	Other countries	...	2	...	1	–	–
	Total	19	120	83r	39r	...	17

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 1985-95

	Imports			
	Chromium Ores and Concentrates, Refractory Grade (Gross Weight)	Chromium Ores and Concentrates, Except Refractory Grade (Chromium Content)	Ferrochromium	Chromium Metal[1]
	(tonnes)			
1975	..	..	41 109	..
1980	..	..	41 369	..
1985	..	..	28 271	..
1986	..	..	39 045	..
1987	..	..	44 121	..
1988	18 633	10 342	50 181	257 r
1989	24 363	9 479	48 551	149
1990	16 643	4 667	43 245	214
1991	13 375	7 582	46 292	273
1992	9 794	3 981	34 368 r	194
1993	16 717	8 726	45 278 r	370
1994	8 500	11 732	55 145 r	462
1995 p	13 292	23 699	62 707	365

Source: Statistics Canada.
. . Not available; p Preliminary; r Revised.
[1] Data include HS codes 8112.20.10, 8112.20.20.10 and 8112.20.20.20.

TABLE 3. CANADA, CHROMIUM CONSUMPTION, 1970, 1975 AND 1980-94

	Consumption[1]	
	Chromite	Ferrochromium[2]
	(tonnes)	
1970	56 212	28 356
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	40 174 r
1992	10 752	36 832
1993	11 398	40 304 r
1994 p	9 843	48 278

Source: Natural Resources Canada.
p Preliminary; r Revised.
[1] Available data as reported by consumers.
[2] Gross weight.