

# CHROMIUM

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In 2000, the U.S. chromium supply (measured in contained chromium) was 139,000 metric tons (t) from recycled stainless steel scrap; 453,000 t from imports; and 924,000 t from Government and industry stocks. Supply distribution was 86,300 t to exports; 840,000 t to Government and industry stocks; and 589,000 t to apparent consumption. Chromium apparent consumption increased by 5.63% compared with that of 1999.

## Legislation and Government Programs

The Department of Health and Human Services (HHS) updated the toxicological profile for chromium. HHS revises and republishes toxicological profiles as necessary, but no less than once every 3 years. The profiles are prepared for health professionals and report toxicologic and health effect information (Syracuse Research Corp., 2000).

The Defense Logistics Agency (DLA) disposed of chromium materials under its fiscal year (FY) 2000 (October 1, 1999, through September 30, 2000) Annual Materials Plan (AMP). DLA's FY 2000 AMP (as revised in April) set maximum disposal goals for chromium materials at 90,700 t of chemical grade chromite ore, 227,000 t of metallurgical grade chromite ore, 90,700 t of refractory grade chromite ore, 136,000 t of chromium ferroalloys, and 454 t of chromium metal. DLA also developed its FY 2001 AMP, which set maximum disposal goals of 90,700 t of chemical grade chromite ore; 227,000 t of metallurgical grade chromite ore; 90,700 t of refractory grade

chromite ore; 136,000 t of chromium ferroalloys; and 454 t of chromium metal (U.S. Department of Defense, 2001, p. 8, 11).

## World Review

**Albania.**—The Government of Albania (GOA) studied the possibility of privatizing chromite ore mines and ferrochromium smelters (Ryan's Notes, 2000j). GOA contracted Darfo S.p.A. (Italy) to operate the Elbasan ferrochromium smelter. There are two 9 megavoltampere furnaces at the smelter, of which one is producing at the rate of 800 tons per month (t/mo) and the other is closed. Darfo planned to install a 13 megavoltampere and a 25 megavoltampere furnace at a cost of about \$15 million, raising the plant's annual production capacity to 40,000 t (Ryan's Notes, 2000a).

**Australia.**—Danelagh Resources Pty. Ltd. produced chromite at Coobina Chromite Deposit 57 kilometers (km) east-southeast of Newman, Western Australia. The Coobina Range consists of a central core of serpentine. An associated gabbro was formed by the serpentinization of layered peridotite, which contains minor amounts of chlorite, talc, carbonate, chromite, and magnetite. As of December 1997, resources were: measured, 39,000 t graded at 38.5% chromic oxide; indicated, 86,200 t graded at 39.7% chromic oxide; and inferred, 400,000 t of similar grade. Mining process is open cut, and run-of-mine ore is crushed and screened. Danelagh exercised its option to take ownership of the mine leaving Consolidated Minerals

## Chromium in the 20th Century

In 1900, "chromic iron ore" was used to describe what we now call chromite ore. Chromium was used as an alloying element, in chemical compounds, and in refractory materials. It played an important role in metallurgy as an alloying element. Chromium and tungsten were being alloyed with iron to make tool steels that permitted large increases in industrial productivity. Chromium was also used to make armor plating hard. These, along with the use of chromite ore as a refractory in steel-producing furnaces, made chromium a critical and strategic material during World War I. In 1900, the United States had resumed production of chromite ore and chromium after a hiatus from 1897 to 1899. Prior to that, the United States had produced 3,767 metric tons of chromite ore in 1890. Production picked up during World War I and again during World War II. In 1900, U.S. chromite ore production was 142 metric tons, which represented 0.27% of world production.

Chromium has played an important role in metallurgy as an

alloying element. It was not until 1910 to 1920 that the alloying role of chromium with iron to make stainless steel was developed in France, Germany, the United Kingdom, and the United States. Once this was understood, however, stainless steel became an integral part of the steel industry, accounting for more than 1% of steel production in 2000 and accounting for about 60% of chromium consumption. Stainless steel, which didn't even exist in 1900, accounted for most of the chromium consumed in 2000, and its share of steel production was growing. Chromium chemical use has grown since 1900; chromite refractory use, however, has been reduced because of technological developments. Superalloys, which are engineering alloys of chromium and nickel used in aggressive environments and were also nonexistent in 1900, were an important strategic use of chromium in 2000, because they were used to make the internal workings of jet engines.

Ltd.'s interest to a royalty. Chromite ore production was 6,000 t in 1996; 31,000 t in 1997; 130,000 t in 1998; and 85,000 t in 1999 (Resource Information Unit, 2000, p. 294-295). Danelagh planned to construct a beneficiation plant that would permit it to increase its recoverable resources and to produce more product grades. Danelagh reported proven reserves of 2.2 million tons (Mt) and probable reserves of 10 Mt. The mine produced chromite ore graded at 37% Cr<sub>2</sub>O<sub>3</sub> and from 6 millimeters (mm) to 150 mm in size (Ryan's Notes, 2001c).

Tata Iron and Steel Co. Ltd. (India) studied the possibility of constructing a ferrochromium smelter in Gladstone, Queensland. Tata produced chromite ore and ferrochromium in India; however, its ferrochromium production was limited by the availability and cost of electrical power in India. Electrical power was available at a lower cost in Australia than it was in India. A 120,000-ton-per-year (t/yr) capacity ferrochromium smelter with the potential to double that capacity would cost about \$50 million (Metal Bulletin, 2000o, 2001; Ryan's Notes, 2001b).

Dragon Mining NL studied the Range Well deposit 67 km northwest of Cue, Western Australia. Chromium occurs predominantly in the iron oxide minerals hematite and goethite. The Range Well laterite resource lies directly over part of a 5.5 km thick funnel-shaped layered ultramafic complex. As of June 1998, inferred resource was estimated at 36 Mt graded at 3.60% chromium (2% cutoff grade) (Resource Information Unit, 2000, p. 295).

**Brazil.**—Brazil reported production for use in the metallurgical and refractory industries. Brazil produced high- and low-carbon ferrochromium. Brazil reported 1999 chromite ore production of 420,000 t (45.2% Cr<sub>2</sub>O<sub>3</sub>), exported 194,000 t of chromite ore (53.1% Cr<sub>2</sub>O<sub>3</sub>), and imported 8,482 t (48.0% Cr<sub>2</sub>O<sub>3</sub>). In 1999, Brazil produced 91,000 t of chromium ferroalloys of which 71,000 t was high-carbon ferrochromium, 8,200 t was low-carbon ferrochromium, and the remainder was ferrochromium-silicon. Brazil imported 5,000 t of chromium ferroalloys and metal and exported 59 t of ferrochromium (Cesar, 2000).

Associação Brasileira dos Produtores de Ferroligas e de Silício Metálico reported ferrochromium production in 1999 to have been 71,291 t of high-carbon and 7,583 t of low-carbon ferrochromium. Brazil exported 59 t of high-carbon ferrochromium and 168 t of low-carbon ferrochromium. Brazil imported 2,144 t of high-carbon ferrochromium and 2,827 t of low-carbon ferrochromium (TEX Report, 2000r, s, t).

Villa Nova Mine, Amapa State, operated with an annual production capacity of 200,000 t of chromite concentrate from 400,000 t of run-of-mine chromite ore. Villa Nova operated a four-stage beneficiation process that it is replacing with a three-stage spiral separator process having a through-put of 100 metric tons per hour. The new process was expected to achieve a recovery rate of about 96% (Mining Weekly, 2000).

**Canada.**—Allican Resources planned to build a low-carbon ferrochromium smelter at Thetford Mines, Quebec. The project was estimated to cost about \$44.6 million for a 19,000-metric-ton-year smelter. Chromite ore would be supplied initially from imports followed by development of chromite ore deposits in the Thetford area. At this capacity, the plant could supply about one-half of North American low-carbon ferrochromium demand

(Ryan's Notes, 2000c).

**China.**—China reported its national chromium-material trade statistics for 1999. Chromite ore imports were 711,493 t in 1998; 816,229 t in 1999; and 1,112,838 t in 2000. High-carbon ferrochromium exports were 74,849 t in 1997; 65,576 t in 1998; 49,652 t in 1999; and 130,446 t in 2000. Low-carbon ferrochromium exports were 27,220 t in 1997; 36,508 t in 1998; 24,161 t in 1999; and 24,161 t in 2000 (TEX Report, 2000b, c, 2001a, b). Based on this reported trade, apparent consumption of chromium in China was 420,000 t.

The State Economic and Trade Commission of China embarked on a modernization program for the ferroalloys industry. Goals of the plan are to scrap old ferroalloy plants, prohibit construction of new plants, prevent environmental pollution, and promote technology. China operated about 1,600 ferroalloy furnaces of which about 1,000 had electrical power capacity under 3,000 kilovolt-amperes. Electrical furnaces rated under 1,800 kilovolt-amperes were to have been scrapped by the end of 2000; furnaces under 3,200 kilovolt-amperes by the end of 2001. New furnace construction was suspended until 2005 as were expansions. The modernization plan was expected to reduce high-carbon ferrochromium production in China; however, more low-carbon ferrochromium could be produced (TEX Report, 2000d).

**European Union.**—The European Union (EU) permits duty-free importation of ferrochromium from non-EU countries on a specified amount of material from all non-EU sources. Import duties are applied to imported materials in excess of the specified amount of material. The EU set the duty-free ferrochromium import quota at 1.035 Mt in January 2000 (Metal Bulletin, 2000a). The EU lifted antidumping duties imposed on Kazakhstani and Russian low-carbon ferrochromium producers in 1993 (Metal Bulletin, 2000b). Since the EU made a special trade deal with South Africa, it revised its 2000 duty-free import quota at 515,000 t for South Africa; 520,000 t for all other countries combined. EU left its 2001 duty-free quota for South Africa unchanged while reducing that for all other countries to 400,000 t (Ryan's Notes, 2001c).

**Finland.**—Outokumpu Polarit Oy planned to merge with Avesta Sheffield (Sweden, United Kingdom). See Sweden section. Outokumpu reported on its ferroalloys production process using preheated charge. Sintered pellets and other charge components are heated before being charged into the smelting furnace (called preheated) on a moving steel belt over which hot gasses from the closed smelting furnace are passed. The system was developed to process chromite ore from Kemi Mine. The process was developed to consume little electrical energy for smelting, have high on-line availability, good working conditions, and adequate environmental aspects (Nurmialo, 2000). Outokumpu planned the addition of a new melt shop and hot- and cold-rolling facilities that were expected to double output at Tornio works to 800,000 t in 2002.

**France.**—Delachaux Metals Division produced chromium metal by aluminothermic reduction. Delachaux reported that world demand for chromium metal in 2000 increased to 21,000 t from 20,000 t in 1999. The major end uses for chromium metal were the production of superalloys for use in gas turbine engines or petrochemical production. Delachaux estimated its

production in 2000 to be 5,500 t (Metal Bulletin Books, 1995, p. 42; TEX Report, 2000g).

**Germany.**—ThyssenKrupp Group made a purchase guarantee with SA Chrome and Alloys (South Africa), a startup ferrochromium producer. ThyssenKrupp committed to purchase 230,000 t/yr of high-carbon ferrochromium from SA Chrome and Alloys for 5 years.

**India.**—The Ministry of Commerce conducted a review of the antidumping duty imposed in January 1997 that found no evidence of injury to domestic industry by the import of low-carbon ferrochromium from Kazakhstan or Russia. Ferro Alloys Corp. Ltd., the only domestic low-carbon ferrochromium producer, has not produced the material for the past 2 years (Metal Bulletin, 2000h; Platt's Metals Week, 2000b).

Ferro Alloys Corp. Ltd. resumed production at Garividi and at Shreeram Nagar. The Garividi plant was closed for financial reasons. The Shreeram Nagar plant was closed over a labor dispute. Ferro Alloys Corp. Ltd. exported chromite ore for the first time. Ferro Alloys Corp. Ltd. reported annual ferrochromium production of 87,000 t in 1998 and 51,000 t in 1999. (Metal Bulletin, 2000d, n; TEX Report, 2000f).

Indian Metals and Ferroalloys Ltd. started opencast mining in the Sukinda Valley. Indian Metals and Ferroalloys received 190 hectares (ha) containing 21 Mt of chromite ore reserves when the Government redistributed Sukinda Valley resources in 1999. Chromite ore production reached 31,000 t/mo in May, enough to supply its ferroalloy plants. Indian Metals and Ferroalloys used that chromite ore to feed its ferrochromium smelters at Therubali and Choudwar. At Therubali, Indian Metals and Ferroalloys operated three furnaces electrically rated at 48 megavolt-amperes, 24 megavolt-amperes, and 10 megavolt-amperes. The plant's annual ferrochromium production capacity was 110,000 t; however, Indian Metals and Ferroalloys was producing ferrochromium at the rate of 30,000 t/yr from the 24 megavolt-ampere furnace. Indian Charge Chrome Ltd. was producing ferrochromium at the annual rate of 60,000 t from a 48 megavolt-ampere furnace at Choudwar. Indian Metals and Ferroalloys reported annual production of 56,000 t in 1998 and 67,000 t in 1999 (TEX Report, 2000h).

Jindal Strips Ltd., Ferro Alloys Division planned to exploit chromite ore resources allocated to it when the Government redistributed Sukinda Valley resources in 1999. Jindal planned to produce ferrochromium at the annual rate to 60,000 t at its plant in Andhra Pradesh State (TEX Report, 2000k).

Tata Iron and Steel Co. Ltd. reported 1999 ferrochromium production of 100,000 t and planned to increase that in 2000. Tata produced ferrochromium at its Bamnival plant in India and under agreements with five other domestic companies operating nine furnaces and five Chinese plants operating seven furnaces. Tata reported 1999 chromite ore production of 772,000 t with plans to increase that to 1,000,000 t by exploiting resources assigned to it when the Government redistributed Sukinda Valley resources in 1999; Tata also reported chromite ore concentrate production of 200,000 t with plans to increase that to 300,000 t. To meet ferrochromium expansion goals, Tata bid to buy Industrial Development Corp.'s ferroalloy plant. To reduce electrical energy cost and assure supply, Tata requested permission to build a powerplant in Orissa. Another plan by Tata to increase ferrochromium production while avoiding the

high cost of electrical energy was to build a ferrochromium plant in Australia that would use chromite ore mined by Tata in India (see Australia section) (Lobo, 2000; Metal Bulletin, 2000m, n, p; TEX Report, 2000x).

**Iran.**—Abdan Ferroalloy Refinery produced ferrochromium with an annual capacity of 15,000 t from a 12.5-megavolt-ampere furnace. The company also operated the Ne'Mat chromite ore mine. The mine's annual production capacity was 400,000 t, some of which was processed in its 120,000-t/yr concentrator.

Iran produced chromite ore in excess of its domestic needs. To increase value added exports, the Government planned to increase domestic annual ferrochromium production to 200,000 t by 2005. New production facilities were planned for the provinces Kerman and Fars. Baft Ferrochrome Industrial Company and Nahid Ehyan Sepahan contracted with ABB Engineering Company (Sweden, Switzerland) to build two plants, each with an annual ferrochromium production capacity of 25,000 t, for \$74 million. Construction was expected to take 2 years (Iran Daily, 2000; Ryan's Notes, 2000l).

**Japan.**—Japan imported 501,727 t of chromite ore; 714,531 t of high-carbon, and 61,796 t of low-carbon ferrochromium; and 3,202 t of chromium metal. Japan produced 131,759 t of high- and low-carbon ferrochromium. Stainless steel production was 3.447 Mt. Ferrochromium imports represented 85% of market share. Japan exported 2,541 t of ferrochromium and 1.162 Mt of stainless steel. Japan had stainless steel scrap imports of 211,581 t and exports to 70,676 t (TEX Report, 2001c, f, g, h, i, j, k).

Based on chromite ore, ferrochromium, chromium metal, and stainless steel scrap trade, chromium apparent consumption in Japan was 586,000 t contained chromium. Japan had a duty-free quota for the importation of ferrochromium amounting to 28,100 t in FY 2000. There was a preferential duty of 3.18% and a temporary duty of 5.3% imposed effective April 1, 2001 (April 1, 2000, through March 31, 2001) (TEX Report, 2001m).

The Ministry of International Trade and Industry reported its intent to review the goals of the rare metals stockpile, which included chromium metal, taking into account current political conditions, budget constraints, and rare metal demand. The rare metals stockpiling program has been active since 1984, at which time chromium was identified as one of the rare metals that would be stocked in the amount necessary to meet 60 days of demand (TEX Report, 2000o). A stockpile equivalent to 78.2% of the goal for chromium had been reached. The review found that the amount of chromium held in the stockpile could be reduced. J S Processing Co. Ltd. is a new business setup in Osaka to supply blended scrap to Nippon Steel Corp. The company is a joint venture among ELG Haniel Metals Corp. (40%), Mitsui and Co. Ltd. (19%), Mitsubishi Corp. (19%), Nippon Steel Trading Co. Ltd. (12%), Fujimoto Kinzoku (5%), and Sangyo Shinko (5%). The company anticipated handling 3,000 t/mo of scrap, of which 1,000 t would be blended (TEX Report, 2000i, j).

High-carbon ferrochromium producers and production in Japan in 2000 were: Nippon Denko Co. Ltd., 7,113 t; NKK Materials Co. Ltd., a subsidiary of NKK Corp., 31,948 t; and Shunan Denko K.K., a subsidiary of Showa Denko K.K.,

83,909 t (TEX Report, 2001c).

NKK Materials Co. Ltd. reported the development of a new product, 99.5% pure chromium metal. NKK Materials implemented its two-step electric furnace refining process followed by vacuum degasification at its Toyama plant. NKK expected the chromium metal to be used by master alloy producers for the aircraft industry, a market sector that NKK currently supplies with low-carbon ferrochromium. NKK planned to produce about 1,000 t/yr, developing its chromium metal production capacity to 3,000 t/yr (Metal Bulletin, 2000i; TEX Report, 2000n).

Japan houses about one-fifth of the world's stainless steel industry with a production capacity well in excess of its domestic demand. That industry has participated in the trend to make strategic alliances between ferrochromium consumers, that is themselves, and ferrochromium producers in South Africa. As no new alliances have originated over the past 2 years, that trend appears to have played out. The stainless steel industry itself is now undergoing changes in Japan. From 1961 through 2000, stainless steel production (excluding heat resisting grades) in Japan has grown from 199,462 t to 3,021,080 t, a compounded growth rate of 7.22%. The major stainless steel-producing companies that also operate blast furnaces, their stainless steel production locations, and production in 2000 were Kawasaki Steel Corp., Chiba, 683,858 t; Nippon Metal Industry, Kinuura, 318,888 t; Nippon Steel, Hikari and Yawata, 1,105,318 t; Nippon Yakin Kogyo Co. Ltd., Kawasaki, 337,840 t; Nisshin Steel Co., Shunan, 629,072 t; and Sumitomo Metal Mining Co. Ltd., Wakayama and Naoetsu, 551,672 t. Nippon Steel and Sumitomo agreed to specialize. Nippon Steel was to specialize in producing stainless steel coils; Sumitomo in pipes and shaped steels. Nippon Steel also reached an agreement with Nisshin Steel wherein Nippon Steel would specialize in austenitic (that is, chromium-nickel-containing) grades and Nisshin would specialize in ferritic (that is, chromium-containing) grades. By these agreements, each company expected to benefit economically by producing larger volumes of fewer products and permitting the elimination of excess production capacity (TEX Report, 2000e, 2001d, e). Japan has exported a substantial fraction of its stainless steel production. In recent years, stainless steel production capacity has been developed in Asia, namely in the Republic of Korea and Taiwan. Since new capacity has come into production faster than demand expansion, adjustments are necessary. Capacity reduction takes place where production is least efficient; that is, in older facilities. The older facilities in Asia are in Japan.

**Kazakhstan.**—Kazchrome was co-owned by Trans World (Alloys) Inc. and the Government of Kazakhstan. A dispute arose in 1997 between Trans World and local company officials over who would control and manage the mine and ferrochromium smelters. The dispute was settled in 2000 when the Chodiev Group (also known as Kazakhstan Mineral Resource Corp.) bought Trans World's interest in the Kazchrome. Kazchrome owns the Donskoy Ore Dressing Complex and the Aksusky Ferroalloy Plant (Aksu) and Aktyubinsk Ferroalloy Plant. Kazchrome was owned by Kazakhstan Mineral Resource Corp. (28.75%), the Kazakhstani Government (31.3%), and holds its own stock (28.75%).

Kazakhstan's chromium industry includes Donskoy Ore

Dressing Complex, Aksu, and Aktyubinsk Ferroalloy Plant. Donskoy extracted chromite ore from the Poiskovy open pit and the Molodyonzhnaya underground mines (TEX Report, 2000m). Donskoy completed construction of equipment that will produce briquettes from chromite ore fines, with an annual capacity of 500,000 t (TEX Report, 2001l). Aksu installed a new 64-megavolt-ampere furnace manufactured by Mannesmann-Demag (Germany) that has a high-carbon ferrochromium production capacity of 102,000 t/yr. Aksu planned to add about 160,000 t of high-carbon ferrochromium production capacity in the form of two 50-megavolt-ampere or three 30-megavolt-ampere furnaces in 2002 (Ryan's Notes, 2000e; TEX Report, 2000l).

**Norway.**—Elkem ASA produced high-carbon ferrochromium containing 60% to 65% chromium from two closed furnaces at its ferrochromium plant in Rana. Annual production capacity was 160,000 t (Ryan's Notes, 2000h).

**Philippines.**—The four ferrochromium producers in the Philippines were reported to have ceased production several years ago (Bennet, Barrand, and Clarkson, 2000). Benguet Corporation mined foundry and refractory grades of chromite ore at Masinloc Chromite Operation in Zambales Province. Having developed a stockpile equivalent to 15 to 18 months of consumption, Benguet temporarily suspended production in 1999 to reduce stocks (Industrial Minerals, 1999). Having depleted its stockpile, Benguet started underground chromite ore mine production (Platt's Metals Week, 2000a).

**Russia.**—Serov Ferroalloy Plant reported production of 129,500 t of ferrochromium in 1999: 90,000 t of high-carbon ferrochromium; 18,500 t of medium-carbon ferrochromium; and 21,000 t of low-carbon ferrochromium. The plant is 359 km from Sverdlovsk. It uses locally mined and imported chromite ore. Serov was developing a new mine at Salechard, which it expected to yield chromite ore of higher grade than that currently available from local sources. Serov imported ore from Kazakhstan and Turkey (Metal Bulletin, 2000k).

Severonickel Combine, a subsidiary of RAO Norilsk Nickel, continued development of the Sopchezero chromite deposits. Norilsk sought a partner to develop the chromite ore mine and a ferrochromium smelter (Ryan's Notes, 2000b).

Chelyabinsk Electrometallurgical Integrated Plant produced low-carbon ferrochromium with an annual production capacity of 144,000 t. Chelyabinsk imported its chromite ore from Kazakhstan (Ryan's Notes, 2001a). Chelyabinsk planned to install a scrap recycling circuit (Ryan's Notes, 2000g).

**South Africa.**—The Minerals Bureau reported that, from a reserve base of 3,100 Mt of chromite ore, in 1999 South Africa produced 6,817,000 t of chromite ore from which it produced 2,155,000 t of ferrochromium and other products. South Africa exported 841,000 t of chromite ore and 1,897,100 t of ferrochromium in 1999 (Armitage, 2000). Based on chromite ore production and chromite ore and ferrochromium trade, 1999 South African chromium apparent consumption was 755,658 t, contained chromium. The Minerals Bureau reported chromite ore production in 2000 of 6,620,754 t and sales of 6,744,278 t. Eighty-five percent of sales was sold locally; the remaining 15% was exported (South African Minerals Bureau, 2001).

South Africa considered changing its mining law. Currently,

companies own mineral property rights. Draft legislation would change to government ownership of minerals and government licensing of mining for a specified period of time (Ryan's Notes, 2000h, k). Eskom, the South African power company, planned to change its billing structure for the ferrochromium industry, as their current 7-year contract with that industry comes to a close. The current contract adjusts the price of electrical energy between minimum and maximum rates based on the price of ferrochromium. The proposed system would be a fixed tariff rate of 12.2 cents per kilowatthour. Eskom was the fifth largest electrical power producer worldwide and planned to be privatized (Metal Bulletin, 2000l; Ryan's Notes, 2000f, 2001d). South African environmentalists made their desire for stricter pollution-control standards known at public hearings held to discuss the environmental impact of new plants or new furnaces (Ryan's Notes, 2000m).

ASA Metals (Pty.) Ltd. planned another furnace and an agglomeration facility for its ferrochromium plant near Burgersfort, Northern Province. ASA completed construction and started production at its ferrochromium plant last year. ASA had an annual ferrochromium production capacity of 60,000 t from a 33 megavolt-ampere furnace. ASA is a joint venture between Northern Province Development Corporation (40%) and East Asian Metals Investment Co. Ltd. (60%) (Lourens, 2000).

South Africa Chrome and Alloys Ltd. (SAChrome), formerly Southern Witwatersrand Exploration Co., studied the feasibility of constructing a ferrochromium plant. The plant was to use chromite ore from its Horizon and Chromeden mines. SAChrome planned to build a pelletizing and sintering plant with an annual capacity of 520,000 t and a ferrochromium plant with annual production capacity of 230,000 t. They planned two closed furnaces with electrical capacity of 54 megavolt-amperes each. The plant was to be located near Boshhoek at a rail siding about 40 km from the mine and about 650 km from Richards Bay. Plant cost was estimated at about \$100 million. SAChrome planned to use chromite ore from the UG-2 and LG-6 seams to produce ferrochromium containing 51% chromium. Thyssen Krupp Metallurgie contracted to take up to 250,000 t/yr of ferrochromium for 5 years from SAChrome (Graulich, 2000; Ryan's Notes, 2000d, m, 2001b).

Associated Manganese Mines of South Africa Ltd. (Assmang) started production at the Dwarsrivier chromite ore mine in Mpumalanga Province about 30 km from Steelpoort (Mining Journal, 2000b). The opencast mine and beneficiation plant located at the mine site had an annual production capacity of about 350,000 t/yr. Assmang planned to start underground mining in 2001, thereby bringing production capacity up to about 1 million tons per year. The LG-6 seam, which dips at 8 degrees to 14 degrees and has a thickness of about 180 centimeters, was being mined. Within the mine, ore was transported by conveyor belt from the pit to the beneficiation plant. From the plant, ore was trucked to the Steelpoort rail terminal from which it was carried by train the remaining 60 to 65 km to Feralloys, Assmang's ferrochromium plant at Machadodorp (<http://www.avmin.co.za/mediashop/pressreleas.asp?story=5>, downloaded April 13, 2000) (TEX Report, 2000a). Feralloys operated three furnaces and a metal-from-slag recovery process. The furnaces accounted for an

annual ferrochromium production capacity of about 125,000 t; the metal-from-slag recovery was 25,000 t. Two of their three furnaces had electrical capacity of 24 megavolt-amperes; the third furnace, 30 megavolt-amperes. The two 24-megavolt-ampere furnaces were upgraded to 30 megavolt-amperes, bringing Feralloys' ferrochromium production capacity up to 175,000 t/yr (Metal Bulletin, 2000g). A fourth furnace and pelletizing plant of Outokumpu technology was planned. The fourth furnace was planned to have an electrical capacity of 54 megavolt-amperes and ferrochromium production capacity of 130,000 t/yr. The pelletizing plant was planned to produce 350,000 t/yr of pellets (Metal Bulletin, 2000f).

Columbus Stainless Steel estimated its production of stainless steel flat products to have been 440,000 t in 2000, of which 105,000 t was sold domestically (Metal Bulletin, 2000c).

Hernic (Pty.) Ltd. brought its third furnace into production. The third furnace is supported by pelletizing and preheating operations manufactured by Outokumpu Oy (Finland). The system was installed at a cost of about 200 million Rand and increased Hernic's annual ferrochromium production capacity to 260,000 t (Venter, 2000b).

Samancor Ltd. planned a greenfield ferrochromium plant in the western belt of the Bushveld Complex near its Mooinooi Mine. Samancor planned to construct two closed furnaces to be fed by one pelletizing and sintering plant on a 50-ha site at a cost of 500 million Rand. Production technology is from Outokumpu Technology (Finland) that Samancor is using at its Ferrometals plant. This will be Samancor's first ferrochromium plant in the western belt of the Bushveld complex. The mine was expected to produce about 760,000 t/yr of chromite ore. The smelter was expected to produce 520,000 t/yr of preheated pellets, from which about 300,000 t/yr of ferrochromium would be produced. The plans were reported to have included the use of UG-2 chromite byproduct from platinum mining and iron and steel scrap (Venter, 2000a). Samancor anticipated proceeding with plant construction when market conditions indicated the need for this new plant (Gonsalves, 2000).

Xstrata S.A. (Pty.) Ltd. was developing the Townlans Mine in the Rustenburg area, western belt of Bushveld Complex. The mine was expected to start production in 2001 and have a production capacity of 480,000 t/yr. The new mine complements Xstrata's existing mines in the western belt: Waterval, 273,000 t/yr production capacity and Kroondal Mine, 663,000 t/yr; and the Thorncliffe Mine, 1,056,000 t/yr in the eastern belt (TEX Report, 2000y).

Samancor and Xstrata formed an equally owned joint venture to develop chromite ore mining and ferrochromium production in the Rustenburg area of the western belt of the Bushveld Complex. The joint venture will develop chromite ore reserves owned by Samancor that are accessible via Xstrata's Kroondal Mine and will expand Xstrata's Wonderkop smelter. The Wonderkop smelter near Rustenburg had an annual ferrochromium production capacity of about 300,000 t from four, 39 megavolt-ampere furnaces, two pelletizing lines, and a recovery plant. Wonderkop obtained its chromite ore supply primarily from the Kroondal Mine. Samancor and Xstrata planned to add two 45 megavolt-ampere furnaces, pelletizing and prereluction, and metal-from-slag recovery at a cost of

about \$40 million. The new production equipment will add 180,000 t/yr of ferrochromium to the plant's annual production capacity. Additional chromite ore supplies will come through development of the Kroondal Mine to exploit reserves owned by Samancor. Production was expected to start in 2001 (Metal Bulletin, 2000j; Mining Journal, 2000a; Platt's Metals Week, 2000c; Robinson, 2000b; Ryan's Notes, 2000i; TEX Report, 2000p).

**Sweden.**—Vargön Alloys AB planned to purchase a recovery plant that would recover ferrochromium from slag. The plant was planned to process slag at the rate of 100 metric tons per hour. The equipment supplier was Apic Toll Treatment, a joint venture between Mintek and Bateman Titaco Company (Robinson, 2000a).

The European stainless steel producers Avesta Sheffield Ltd. (Sweden, United Kingdom) and Outokumpu Polarit Oy (Finland) merged to form AvestaPolarit Abp. Avesta Sheffield is the result of the merger of Avesta (Sweden) and British Stainless Steel (UK) in 1992. The merger was to be effected in 2001. The new company would have a stainless steel production capacity of 1.7 Mt. Other stainless steel producers in Europe include Acciai Speciali Terni SpA (Italy), Acerinox SA (Spain), ALZ NV (Belgium), Ugine SA (France), and Krupp-Thyssen Nirosta GmbH (Germany). Raw materials supply appears to favor Outokumpu Polarit's plant at Tornio because it is near to chromium and nickel supply (Metal Bulletin Books, 1995, p. 4, 18, 30, 48, 79, 96; Avesta Sheffield, 2000; TEX Report, 2000q).

**Taiwan.**—Taiwan reported production of ferrochromium to have been 296,297 t high carbon in 1998; 387,995 t high carbon in 1999; and 380,996 t high carbon, and 14,175 t low carbon in 2000 (TEX Report, 2001n, o). Taiwan reported stainless steel scrap imports of 20,789 t in 2000 (TEX Report, 2000v). Taiwan reported stainless steel scrap exports of 45,095 t in 1998 and 49,055 t in 1999 (TEX Report, 2000u).

Tang Eng Iron Works, Yieh United Steel, Walsin Carteck, and China Steel Corp. produced about 1.2 Mt of stainless steel in 2000 (TEX Report, 2000w).

**Turkey.**—Eskikaya and Aydinler (Eskikaya and Aydinler, 2000) reported that Turk Maadin A.S. operated the Dagardi, Kavak, Koycegiz, and Tavas chromite ore mines. The Kavak Mine had 2 Mt of reserves, and annual production was about 100,000 t. Eskikaya reported that mine performance was improved when they introduced new mining techniques and equipment. In particular, the improvements reduced accidents, manpower required, and timber consumption. These savings could extend the reserves and mine life by making low-grade ore production economical.

**Zimbabwe.**—Zimbabwe Alloys Ltd. reported production of 33,425 t of low-carbon ferrochromium in 1999. Zimbabwe Alloys renovated its Gweru plant. It converted one 28-megavolt-ampere furnace from the production of ferrochromium-silicon to the production of high-carbon ferrochromium. The conversion cost about \$3 million. The new furnace had a high-carbon ferrochromium production capacity of 35,000 t/yr. Zimbabwe Alloys will continue to produce low-carbon ferrochromium under a joint-venture agreement with Japan Metals and Chemicals Co. (Japan) (Ryan's Notes, 2000n).

## Current Research and Technology

Mintek found that dry milling of ferrochromium slag or chromite ore produces a buildup of chromium in the +6 valence state. Chromium in chromite ore is in the +3 valence state. Mintek found that longer duration milling resulted in higher concentration of chromium in the +6 valence state (Mintek Bulletin, 2000).

## Outlook

The outlook for chromium consumption in the United States and the rest of the world is about the same as that for stainless steel, which is the major end use for chromium worldwide. Thus, stainless steel industry performance largely determines chromium industry demand worldwide. (See the following section on stainless steel.)

Several trends are occurring simultaneously in the chromium industry. Chromite ore production is moving from independent producers to vertically integrated producers. In other words, chromite ore mines tend to be owned and operated by ferrochromium or chromium chemical producers. This trend is associated with the migration of ferrochromium production capacity from stainless steel-producing countries to chromite ore-producing countries. As ferrochromium-production capacity is rationalized in historically producing countries, which are usually stainless steel producing countries, new furnaces or plants are constructed in chromite ore producing areas. The electrical power capacity and production capacity of submerged-arc electric furnaces used to produce ferrochromium has been increasing. Production process improvements such as agglomeration of chromite ore, preheating and prereduction of furnace feed, and closed furnace technology have been retrofitted at major producer plants and are being incorporated into newly constructed plants. When ferrochromium plants started to be built, furnaces rated in the low kilovoltampere range were common. Furnaces built recently tend to approach the mid megavolt-ampere range. The introduction of post melting refining processes in the steel industry after 1960 started a shift in consumption from low-carbon ferrochromium to high-carbon ferrochromium causing a decline in low-carbon ferrochromium production that continues today. After years of ferrochromium production, slag stockpiles have built up. Recently developed processes efficiently recover ferrochromium from that slag. Equipment to use these processes was being installed at plant sites. In South Africa, the major chromite ore- and ferrochromium-producing country, two trends are emerging; ferrochromium plants are being developed in the western belt of the Bushveld Complex, and chromite ore byproduct from platinum operations are being accommodated by new production processes. After many years of stainless steel production, stainless steel scrap resources have accumulated. Stainless steel producers have been improving their production processes by reducing scrap generated during the production process and by increasing the amount of scrap used as feed material. As a result, the fraction of stainless steel scrap use as feed material has been increasing, especially from post consumer sources.

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TABLE 1  
SALIENT CHROMIUM STATISTICS 1/

(Metric tons, contained chromium, unless otherwise specified)

|  | 1996       | 1997         | 1998         | 1999         | 2000         |             |
|--|------------|--------------|--------------|--------------|--------------|-------------|
| <b>World production:</b>   |            |              |              |              |              |             |
| Chromite ore (mine) 2/   | 3,480,000  | 4,130,000 r/ | 4,040,000 r/ | 4,250,000 r/ | 4,320,000 e/ |             |
| Ferrochromium (smelter) 3/                                       | 2,250,000  | 2,760,000    | 2,710,000 r/ | 2,810,000 r/ | 2,930,000 e/ |             |
| Stainless steel 4/   | 2,750,000  | 2,960,000    | 2,920,000    | 2,940,000    | 3,110,000 e/ |             |
| <b>U.S. supply:</b>  |            |              |              |              |              |             |
| <b>Components of U.S. supply:</b>                                |            |              |              |              |              |             |
| Domestic mines   | --         | --           | --           | --           | --           |             |
| Secondary  | 98,400     | 120,000      | 104,000      | 118,000      | 139,000      |             |
| <b>Imports:</b>  |            |              |              |              |              |             |
| Chromite ore   | 79,200     | 96,600       | 117,000      | 85,000       | 86,200       |             |
| Chromium chemicals   | 7,060      | 6,430        | 9,070        | 10,400       | 12,500       |             |
| Chromium ferroalloys   | 267,000    | 237,000      | 249,000      | 371,000      | 344,000      |             |
| Chromium metal   | 8,730      | 9,800        | 9,520        | 9,030        | 9,940        |             |
| <b>Stocks, January 1:</b>  |            |              |              |              |              |             |
| Government   | 1,120,000  | 1,070,000    | 1,020,000    | 928,000      | 909,000      |             |
| Industry 5/  | 80,200 r/  | 73,800 r/    | 63,600 r/    | 59,300 r/    | 14,000       |             |
| Total  | 1,660,000  | 1,610,000    | 1,570,000 r/ | 1,580,000    | 1,520,000    |             |
| <b>Distribution of U.S. supply:</b>                              |            |              |              |              |              |             |
| <b>Exports:</b>  |            |              |              |              |              |             |
| Chromite ore   | 21,900     | 5,890        | 39,900       | 37,200       | 44,600       |             |
| Chromium chemicals   | 18,200     | 16,700       | 17,500       | 17,300       | 16,400       |             |
| Chromium ferroalloys and metal                                   | 10,800     | 7,710        | 5,000        | 5,790        | 25,400       |             |
| <b>Stocks, December 31:</b>                                      |            |              |              |              |              |             |
| Government   | 1,070,000  | 1,020,000    | 928,000      | 909,000      | 825,000      |             |
| Industry 5/  | 73,800 r/  | 70,900 r/    | 59,300 r/    | 54,000 r/    | 15,200       |             |
| Total  | 1,190,000  | 1,120,000    | 1,050,000    | 1,020,000    | 926,000      |             |
| Apparent consumption   | 468,000 r/ | 489,000 r/   | 524,000 r/   | 558,000      | 589,000      |             |
| <b>Reported production: 6/</b>                                   |            |              |              |              |              |             |
| <b>Chromium ferroalloy and metal net production:</b>             |            |              |              |              |              |             |
| Gross weight   | 36,800     | 60,700       | W            | W            | W            |             |
| Chromium content   | 26,400     | 40,900       | W            | W            | W            |             |
| Net shipments  | 38,800     | 56,300       | W            | W            | W            |             |
| <b>Reported consumption:</b>                                     |            |              |              |              |              |             |
| Chromite ore and concentrates (gross weight)                     | 282,000    | 350,000      | 269,000      | W            | W            |             |
| Chromite ore average Cr <sub>2</sub> O <sub>3</sub> (percentage) | 45         | 45           | 45           | 45           | 45           |             |
| Chromium ferroalloys (gross weight)                              | 329,000    | 385,000      | 332,000      | 385,000 r/   | 354,000      |             |
| Chromium ferroalloys (contained chromium)                        | 186,000    | 220,000      | 187,000      | 212,000      | 201,000      |             |
| Chromium metal (gross weight)                                    | 4,500 r/   | 4,970        | 4,670 r/     | 4,690        | 4,980        |             |
| <b>Stocks, December 31 (gross weight):</b>                       |            |              |              |              |              |             |
| <b>Government:</b>   |            |              |              |              |              |             |
| Chromite ore   | 1,190,000  | 1,090,000    | 885,000      | 820,000      | 636,000      |             |
| Chromium ferroalloys   | 1,050,000  | 1,020,000    | 974,000      | 973,000      | 919,000      |             |
| Chromium metal   | 7,720      | 7,720        | 7,720        | 7,720        | 7,550        |             |
| Industry, producer   | 6,450      | 10,900       | W            | W            | W            |             |
| <b>Industry, consumer:</b>                                       |            |              |              |              |              |             |
| Chromite ore   | 173,000    | 175,000      | 159,000      | 130,000      | W            |             |
| Chromium ferroalloys   | 27,400     | 16,700       | 17,300       | 25,000 r/    | 26,300       |             |
| Chromium metal   | 211 r/     | 227          | 195 r/       | 245          | 191          |             |
| <b>Prices, average annual:</b>                                   |            |              |              |              |              |             |
| Chromite ore, per ton gross weight 7/                            | \$75       | \$73         | \$68         | \$63         | NA           |             |
| Ferrochromium, per pound chromium content 8/                     | \$0.510    | \$0.480      | \$0.467      | \$0.366      | \$0.414      |             |
| Standard chromium metal, per pound gross weight 9/               | \$4.75     | \$5.20       | \$4.73       | \$4.43       | \$4.43       |             |
| Vacuum chromium metal, per pound gross weight 9/                 | \$5.27     | \$5.39       | \$5.38       | \$5.38       | \$5.42       |             |
| <b>Value of trade: 10/</b>                                       |            |              |              |              |              |             |
| Exports  | thousands  | \$111,000    | \$107,000    | \$102,000    | \$92,500     | \$110,000   |
| Imports  | do.        | \$463,000    | \$450,000    | \$421,000    | \$420,000    | \$427,000   |
| Net exports 11/  | do.        | (\$352,000)  | (\$343,000)  | (\$319,000)  | (\$327,000)  | (\$317,000) |
| <b>Stainless steel (gross weight):</b>                           |            |              |              |              |              |             |
| Production 12/   |            | 1,870,000    | 2,160,000    | 2,010,000    | 2,190,000    | 2,190,000   |
| Shipments 13/  |            | 1,730,000    | 1,880,000    | 1,850,000    | 1,890,000    | 1,930,000   |
| Exports  |            | 162,000      | 199,000      | 206,000      | 216,000      | 264,000     |
| Imports  |            | 781,000      | 774,000      | 862,000      | 941,000      | 989,000     |

See footnotes the at end of table.

TABLE 1--Continued  
SALIENT CHROMIUM STATISTICS 1/

(Metric tons, contained chromium, unless otherwise specified)

|  | 1996      | 1997          | 1998        | 1999        | 2000        |             |
|--|-----------|---------------|-------------|-------------|-------------|-------------|
| Stainless steel (gross weight)--Continued: |           |               |             |             |             |             |
| Scrap:                                     |           |               |             |             |             |             |
| Receipts                                   | 579,000   | 705,000 r/    | 610,000 r/  | 694,000 r/  | 817,000     |             |
| Consumption                                | 1,040,000 | 1,140,000     | 1,040,000   | 1,140,000   | 1,220,000   |             |
| Exports                                    | 303,000   | 370,000       | 298,000     | 260,000     | 468,000     |             |
| Imports                                    | 50,500    | 64,100        | 57,200      | 66,100      | 56,200      |             |
| Value of trade:                            |           |               |             |             |             |             |
| Exports                                    | thousands | \$583,000     | \$653,000   | \$622,000   | \$628,000   | \$782,000   |
| Imports                                    | do.       | \$1,880,000   | \$1,720,000 | \$1,680,000 | \$1,560,000 | \$2,010,000 |
| Scrap exports                              | do.       | \$234,000     | \$231,000   | \$176,000   | \$151,000   | \$310,000   |
| Scrap imports                              | do.       | \$28,500      | \$33,700    | \$21,600    | \$27,700    | \$35,500    |
| Net exports 11/ 14/                        | do.       | (\$1,090,000) | (\$870,000) | (\$903,000) | (\$811,000) | (\$955,000) |

e/ Estimated. r/ Revised. NA Not available. W Withheld to avoid disclosing company proprietary data. -- Zero.

1/ Data are rounded to no more than three significant digits; may not add to totals shown.

2/ Calculated assuming chromite ore to average 44% Cr<sub>2</sub>O<sub>3</sub>, which is 68.42% chromium.

3/ Calculated assuming chromium content of ferrochromium to average 57%.

4/ Calculated assuming chromium content of stainless steel to average 17%.

5/ Industry stocks include chromium ferroalloy and metal producer stocks before 1998; and chromite ore consumer stocks before 2000.

6/ Includes chromium ferroalloys and metal and other chromium materials in the United States.

7/ Time-weighted average price of South African chromite ore, as reported in Platt's Metals Week.

8/ Time-weighted average price of imported high-carbon chromium that contains 50% to 55% chromium, as reported in Platt's Metals Week.

9/ Time-weighted average price of electrolytic chromium metal, as reported in American Metal Market.

10/ Includes chromite ore and chromium ferroalloys, metal, and chemicals.

11/ Data indicate that imports are greater than exports.

12/ Data on stainless steel production from American Iron and Steel Institute Annual Reports and quarterly production of stainless and heat-resisting raw steel.

13/ Data on stainless steel shipments from American Iron and Steel Institute Annual Reports.

14/ Includes stainless steel and stainless steel scrap.

TABLE 2  
PRINCIPAL U.S. PRODUCERS OF CHROMIUM PRODUCTS IN 2000, BY INDUSTRY

| Industry and company                     | Plant                                 |
|--|---------------------------------------|
| Metallurgical:                           |                                       |
| Eramet Marietta Inc.                     | Marietta, OH.                         |
| JMC (USA) Inc.                           | Research Triangle Park, NC.           |
| Refractory:                              |                                       |
| National Refractories and Minerals Corp. | Moss Landing, CA, and Columbiana, OH. |
| RHI Refractories America Inc.            | Womelsdorf, PA.                       |
| Chemical:                                |                                       |
| Elementis Chromium LP                    | Corpus Christi, TX.                   |
| Occidental Chemical Corp.                | Castle Hayne, NC.                     |

TABLE 3  
U.S. CONSUMPTION OF CHROMIUM FERROALLOYS AND METAL, BY END USE 1/

(Metric tons, gross weight, unless noted)

| End use                            | Ferrochromium |                | Ferrochromium silicon | Other | Total    |
|------------------------------------|---------------|----------------|-----------------------|-------|----------|
|                                    | Low-carbon 2/ | High-carbon 3/ |                       |       |          |
| 1998:                              |               |                |                       |       |          |
| Steel:                             |               |                |                       |       |          |
| Carbon                             | 4,440         | 7,950          | 138                   | W     | 12,500   |
| Stainless and heat-resisting       | 7,230         | 226,000        | W                     | W     | 233,000  |
| Full-alloy                         | 4,050         | 22,300         | 1,530                 | 34 r/ | 28,000   |
| High-strength, low-alloy, electric | 2,170         | 1,790          | W                     | W     | 3,960 r/ |
| Tool                               | (4)           | W              | W                     | W     | W        |
| Cast irons                         | (4)           | 2,510          | W                     | W     | 2,510    |
| Superalloys                        | 2,470         | W              | W                     | 4,050 | 6,520    |
| Welding materials 5/               | 161           | 249            | W                     | W     | 409      |
| Other alloys 6/                    | 480           | 1,200          | --                    | 1,310 | 2,990 r/ |

See footnotes at end of table.

TABLE 3--Continued  
U.S. CONSUMPTION OF CHROMIUM FERROALLOYS AND METAL, BY END USE 1/

(Metric tons, gross weight, unless noted)

| End use                            | Ferrochromium |                | Ferrochromium silicon | Other       | Total      |
|------------------------------------|---------------|----------------|-----------------------|-------------|------------|
|                                    | Low-carbon 2/ | High-carbon 3/ |                       |             |            |
| 1998--Continued:                   |               |                |                       |             |            |
| Miscellaneous and unspecified      | (4/)          | 6,540 r/       | 36,700 r/             | 3,190 r/    | 46,400 r/  |
| Total 7/                           | 21,000        | 268,000        | 38,300                | 8,580 r/ 8/ | 336,000    |
| Chromium content                   | 14,200        | 157,000        | 13,800                | 6,450 r/    | 192,000    |
| Stocks, December 31, 1998          | 2,460         | 13,900         | 730                   | 461 r/ 9/   | 17,500     |
| 1999:                              |               |                |                       |             |            |
| Steel:                             |               |                |                       |             |            |
| Carbon                             | 4,100         | 6,330          | 165 r/                | W           | 10,600     |
| Stainless and heat-resisting       | 9,930 r/      | 274,000        | W                     | W           | 284,000    |
| Full-alloy                         | 3,830         | 20,900 r/      | 1,410 r/              | W           | 26,100 r/  |
| High-strength, low-alloy, electric | 2,130         | 2,300          | W                     | W           | 4,430      |
| Tool                               | (4/)          | W              | --                    | W           | W          |
| Cast irons                         | (4/)          | 1,720 r/       | W                     | W           | 1,710      |
| Superalloys                        | 1,730         | 3,820          | W                     | 3,720       | 9,280      |
| Welding materials 5/               | 219           | 232            | 1                     | 363         | 815        |
| Other alloys 6/                    | 412           | W              | --                    | 1,710       | 2,120 r/   |
| Miscellaneous and unspecified      | (4/)          | 2,010          | 44,800                | 3,240       | 50,000     |
| Total 7/                           | 22,300        | 312,000 r/     | 46,300                | 9,040 10/   | 390,000 r/ |
| Chromium content                   | 15,000        | 179,000 r/     | 16,300                | 6,720       | 217,000 r/ |
| Stocks, December 31, 1999          | 2,200 r/      | 21,700 r/      | 769 r/                | 545 11/     | 25,200 r/  |
| 2000:                              |               |                |                       |             |            |
| Steel:                             |               |                |                       |             |            |
| Carbon                             | 4,200         | 7,170          | 127                   | W           | 11,500     |
| Stainless and heat-resisting       | 9,660         | 252,000        | 27,800                | W           | 290,000    |
| Full-alloy                         | 4,230         | 22,100         | 1,640                 | 50          | 28,000     |
| High-strength, low-alloy, electric | 2,730         | 9,880          | (4/)                  | W           | 12,600     |
| Tool                               | (4/)          | W              | (4/)                  | W           | W          |
| Cast irons                         | (4/)          | 2,090          | (4/)                  | 57          | 2,150      |
| Superalloys                        | 1,380         | W              | 297                   | 3,730       | 5,400      |
| Welding materials 5/               | 203           | 243            | 1                     | W           | 447        |
| Other alloys 6/                    | (4/)          | W              | --                    | 1,550       | 1,550      |
| Miscellaneous and unspecified      | (4/)          | 5,370          | (4/)                  | 2,260       | 7,630      |
| Total 7/                           | 22,400        | 299,000        | 29,900                | 7,650 12/   | 359,000    |
| Chromium content                   | 15,200        | 174,000        | 10,200                | 6,470       | 206,000    |
| Stocks, December 31, 2000          | 2,160         | 23,300         | 713                   | 451 13/     | 26,600     |

r/ Revised. W Withheld to avoid disclosing company proprietary data; included with "Miscellaneous and unspecified." -- Zero.

1/ Data are rounded to no more than three significant digits; may not add to totals shown.

2/ Contains less than 3% carbon.

3/ Contains 3% or more carbon.

4/ Withheld to avoid disclosing company proprietary data.

5/ Includes structural and hard-facing welding material.

6/ Includes cutting materials and magnetic, aluminum, copper, nickel, and other alloys.

7/ Includes estimates.

8/ Includes 4,670 tons of chromium metal.

9/ Includes 195 tons of chromium metal.

10/ Includes 4,690 tons of chromium metal.

11/ Includes 245 tons of chromium metal.

12/ Includes 4,980 tons of chromium metal.

13/ Includes 191 tons of chromium metal.

TABLE 4  
U.S. GOVERNMENT STOCKPILE YEAREND INVENTORIES AND CHANGE FOR CHROMIUM-CONTAINING MATERIALS 1

(Metric tons, gross weight)

| Material      | 1999    | 2000    | Change    |               |
|---------------|---------|---------|-----------|---------------|
|               |         |         | Quantity  | Percentage 3/ |
| Chromite ore: |         |         |           |               |
| Chemical      | 205,000 | 203,000 | (2,630)   | (1)           |
| Metallurgical | 340,000 | 193,000 | (147,000) | (43)          |
| Refractory    | 274,000 | 241,000 | (33,900)  | (12)          |

See footnotes at end of table.

TABLE 4--Continued  
U.S. GOVERNMENT STOCKPILE YEAREND INVENTORIES AND CHANGE FOR CHROMIUM-CONTAINING MATERIALS 1

(Metric tons, gross weight)

| Material                  | 1999    | 2000    | Change   |               |
|---------------------------|---------|---------|----------|---------------|
|                           |         |         | Quantity | Percentage 3/ |
| Chromium ferroalloys:     |         |         |          |               |
| Ferrochromium-silicon     | 50,700  | 34,200  | (16,400) | (32)          |
| High-carbon ferrochromium | 645,000 | 615,000 | (29,500) | (5)           |
| Low-carbon ferrochromium  | 278,000 | 270,000 | (7,760)  | (3)           |
| Chromium metal:           |         |         |          |               |
| Aluminothermic            | 2,670   | 2,500   | (169)    | (6)           |
| Electrolytic              | 5,050   | 5,050   | --       | --            |

-- Zero.

1/ Includes specification- and nonspecification-grade materials.

2/ Data are rounded to no more than three significant digits.

3/ Quantity change as a percentage of stocks in earlier year.

Source: Defense Logistics Agency, Defense National Stockpile Center.

TABLE 5  
TIME-VALUE RELATIONS FOR CHROMITE ORE, FERROCHROMIUM, AND CHROMIUM METAL 1/ 2.

(Annual average value, dollars per metric ton)

| Material                                       | 1999               |              | 2000               |              |
|--|--------------------|--------------|--------------------|--------------|
|  | Contained chromium | Gross weight | Contained chromium | Gross weight |
| Chromite ore:                                  |                    |              |                    |              |
| Not more than 40% chromic oxide                | 215                | 65           | 841                | 210          |
| More than 40%, but less than 46% chromic oxide | 866                | 266          | 178                | 56           |
| 46% or more chromic oxide                      | 181                | 62           | 191                | 62           |
| Average 3/                                     | 184                | 62           | 198                | 64           |
| Ferrochromium:                                 |                    |              |                    |              |
| Not more than 3% carbon:                       |                    |              |                    |              |
| Not more than 0.5% carbon                      | XX                 | XX           | 1,090              | 707          |
| More than 0.5%, but not more than 3% carbon    | XX                 | XX           | 1,540              | 1,000        |
| Average 3/                                     | 1,560              | 1,040        | 1,470              | 956          |
| More than 3%, but not more than 4% carbon      | 572                | 372          | --                 | --           |
| More than 4% carbon                            | 658                | 387          | 710                | 409          |
| Average 3/                                     | 723                | 429          | 797                | 466          |
| Chromium metal                                 | XX                 | 6,270        | XX                 | 5,980        |

XX Not applicable. -- Zero.

1/ Based on Customs value of chromium contained in imported material.

2/ Data are rounded to no more than three significant digits; may not add to totals shown.

3/ Mass-weighted average.

TABLE 6  
PRICE QUOTATIONS FOR CHROMIUM MATERIALS AT BEGINNING AND END OF 2000 1/

| Material                             | January     | December    | Year average 2/ |
|--------------------------------------|-------------|-------------|-----------------|
| Chromite ore:                        |             |             |                 |
| South Africa                         | 60- 65      | NA          | NA              |
| Turkey                               | 140-150     | NA          | NA              |
| High-carbon ferrochromium, imported: |             |             |                 |
| 50% to 55% chromium                  | 37.00-40.00 | 39.00-41.00 | 41.44           |
| 60% to 65% chromium                  | 38.00-40.50 | 37.00-39.00 | 40.13           |
| Low-carbon ferrochromium, imported:  |             |             |                 |
| 0.05% carbon                         | 67-70       | 60-65       | 69              |
| 0.10% carbon                         | 53-54       | 47-50       | 57              |
| Chromium metal, domestic:            |             |             |                 |
| Electrolytic, standard               | 415-470     | 435-445     | 443             |
| Electrolytic, vacuum                 | 525-550     | 520-565     | 542             |

NA Not available.

1/ Sources: chromite ore and ferrochromium prices--Platt's Metals Week; chromium metal prices--American Metal Market.

2/ Time-weighted average.

TABLE 7  
U.S. EXPORTS OF CHROMIUM MATERIALS, BY TYPE 1/

| HTSUSA 2/                                     | Type   | 1999                 |                   | 2000                 |                   | Principal destinations, 2000   |
|---|--|----------------------|-------------------|----------------------|-------------------|--|
|   |  | Quantity (kilograms) | Value (thousands) | Quantity (kilograms) | Value (thousands) |  |
| 2610.00.0000                                  | Chromite ore and concentrate, gross weight         | 110,000,000          | \$8,580           | 138,000,000          | \$10,200          | Sweden (92%); Canada (3%); Mexico (3%).  |
| 8112.20.0000                                  | Metals and alloys, chromium metal, gross weight 3/ | 2,370,000            | 17,100            | 1,260,000            | 13,100            | Japan (48%); Canada (26%); Germany (8%); Netherlands (4%); Mexico (3%); Australia (2%); Brazil (2%); Hong Kong (2%); Belgium (1%).   |
| Chromium ferroalloys:                         |  |                      |                   |                      |                   |  |
| 7202.41.0000                                  | High-carbon ferrochromium, gross weight 4/         | 4,250,000            | 3,180             | 33,500,000           | 17,500            | Switzerland (57%); Slovenia (30%); Canada (6%); Mexico (5%); Australia (2%).   |
| 7202.41.0000                                  | High-carbon ferrochromium, contained weight 4/     | 2,550,000            | --                | 22,200,000           | --                |  |
| 7202.49.0000                                  | Low-carbon ferrochromium, gross weight 5/          | 1,290,000            | 1,560             | 1,570,000            | 2,180             | Canada (41%); Mexico (40%); France (9%); United Kingdom (3%); India (2%); Sweden (2%); Venezuela (1%).   |
| 7202.49.0000                                  | Low-carbon ferrochromium, contained weight 5/      | 776,000              | --                | 945,000              | --                |  |
| 7202.50.0000                                  | Ferrochromium-silicon, gross weight                | 250,000              | 243               | 2,700,000            | 1,490             | Netherlands (98%); Canada (2%).  |
| 7202.50.0000                                  | Ferrochromium-silicon, contained weight            | 87,700               | --                | 946,000              | --                |  |
|   | Total ferroalloys, gross weight                    | 5,790,000            | 4,980             | 37,700,000           | 21,200            |  |
|   | Total ferroalloys, contained weight                | 3,420,000            | --                | 24,100,000           | --                |  |
| Chemicals, gross weight:                      |  |                      |                   |                      |                   |  |
| Chromium oxides:                              |  |                      |                   |                      |                   |  |
| 2819.10.0000                                  | Chromium trioxide                                  | 11,100,000           | 21,800            | 11,600,000           | 22,800            | Canada (35%); Korea, Republic of (9%); Australia (6%); Japan (6%); Mexico (6%); Taiwan (6%); Brazil (5%); Germany (4%); New Zealand (4%); Indonesia (3%); Hong Kong (2%); Peru (2%); Singapore (2%); Thailand (2%); Chile (1%); Philippines (1%); South Africa (1%). |
| 2819.90.0000                                  | Other  | 3,310,000            | 13,400            | 5,170,000            | 20,300            | Germany (40%); Canada (19%); United Kingdom (13%); Belgium (6%); Guinea (3%); Guatemala (3%); Taiwan (3%); China (2%); Malaysia (2%); Mexico (2%); Australia (1%); Japan (1%); Netherlands (1%).   |
| 2833.23.0000                                  | Chromium sulfates                                  | 14,000               | 69                | 23,500               | 32                | Canada (85%); Germany (15%).   |
| Salts of oxometallic or peroxometallic acids: |  |                      |                   |                      |                   |  |
| 2841.20.0000                                  | Zinc and lead chromate                             | 523,000              | 1,830             | 287,000              | 620               | Mexico (42%); Canada (30%); India (13%); Dominican Republic (7%); Argentina (4%); Korea, Republic of (1%).   |
| 2841.30.0000                                  | Sodium dichromate                                  | 26,500,000           | 17,500            | 19,400,000           | 14,400            | Mexico (53%); Thailand (16%); Uruguay (8%); Panama (4%); Argentina (3%); Belgium (3%); Colombia (3%); Canada (1%); Germany (1%).   |
| 2841.40.0000                                  | Potassium dichromate                               | 82,600               | 151               | 95,400               | 144               | Indonesia (79%); Canada (11%); South Africa (6%); Italy (2%); Dominican Republic (1%).   |
| 2841.50.0000                                  | Other chromates, dichromates, and peroxochromates  | 297,000              | 893               | 639,000              | 2,140             | Canada (55%); Korea, Republic of (23%); Mexico (8%); Malaysia (5%); Italy (4%); United Kingdom (2%).   |
| 3206.20.0000                                  | Pigments and preparations, gross weight            | 1,470,000            | 6,200             | 1,040,000            | 5,340             | Mexico (41%); Canada (33%); Costa Rica (5%); Trinidad and Tobago (3%); Belgium (2%); Colombia (2%); Nigeria (2%); Singapore (2%); Taiwan (2%); Brazil (1%); Venezuela (1%).  |

-- Zero.

1/ Data are rounded to no more than three significant digits; may not add to totals shown.

2/ Harmonized Tariff Schedule of the United States of America code.

3/ Articles thereof and waste and scrap.

4/ More than 4% carbon.

5/ Not more than 4% carbon.

Source: U.S. Census Bureau.

TABLE 8  
U.S. IMPORTS FOR CONSUMPTION OF CHROMITE ORE, BY COUNTRY 1/

| Country      | Not more than 40% Cr <sub>2</sub> O <sub>3</sub><br>(HTS 2610.00.0020) 2/ |   |                              | More than 40%, but less<br>than 46% Cr <sub>2</sub> O <sub>3</sub><br>(HTS 2610.00.0040) 2/ |   |                              | 46% or more Cr <sub>2</sub> O <sub>3</sub><br>(HTS 2610.00.0060) 2/ |   |                              | Total                               |   |                              |
|--------------|---|---|------------------------------|---|---|------------------------------|---|---|------------------------------|-------------------------------------|---|------------------------------|
|              | Gross<br>weight<br>(metric<br>tons)                                       | Cr <sub>2</sub> O <sub>3</sub><br>content<br>(metric<br>tons) | Value 3/<br>(thou-<br>sands) | Gross<br>weight<br>(metric<br>tons)   | Cr <sub>2</sub> O <sub>3</sub><br>content<br>(metric<br>tons) | Value 3/<br>(thou-<br>sands) | Gross<br>weight<br>(metric<br>tons)                                 | Cr <sub>2</sub> O <sub>3</sub><br>content<br>(metric<br>tons) | Value 3/<br>(thou-<br>sands) | Gross<br>weight<br>(metric<br>tons) | Cr <sub>2</sub> O <sub>3</sub><br>content<br>(metric<br>tons) | Value 3/<br>(thou-<br>sands) |
|              | <b>1999:</b>  |   |                              |   |   |                              |   |   |                              |                                     |   |                              |
| Canada       | 380   | 146   | \$168                        | 40  | 19  | \$11                         | 57  | 18  | \$10                         | 477                                 | 183   | \$189                        |
| Philippines  | 4,000   | 1,320   | 456                          | --  | --  | --                           | --  | --  | --                           | 4,000                               | 1,320   | 456                          |
| South Africa | 21,100  | 9,710   | 1,020                        | 49  | 21  | 12                           | 226,000   | 113,000   | 14,000                       | 247,000                             | 123,000   | 15,000                       |
| Total        | 25,500  | 11,200  | 1,650                        | 89  | 40  | 24                           | 226,000   | 113,000   | 14,000                       | 252,000                             | 124,000   | 15,700                       |
| <b>2000:</b> |   |   |                              |   |   |                              |   |   |                              |                                     |   |                              |
| Canada       | 1,130   | 440   | 541                          | 68  | 29  | 36                           | 86  | 43  | 14                           | 1,290                               | 512   | 592                          |
| Italy        | --  | --  | --                           | --  | --  | --                           | 32  | 15  | 6                            | 32                                  | 15  | 6                            |
| Philippines  | 3,390   | 1,210   | 409                          | --  | --  | --                           | --  | --  | --                           | 3,390                               | 1,210   | 409                          |
| South Africa | --  | --  | --                           | 33,100  | 15,100  | 1,810                        | 230,000   | 109,000   | 14,300                       | 263,000                             | 125,000   | 16,100                       |
| Total        | 4,520   | 1,650   | 950                          | 33,100  | 15,100  | 1,840                        | 230,000   | 109,000   | 14,300                       | 268,000                             | 126,000   | 17,100                       |

-- Zero.

1/ Data are rounded to no more than three significant digits; may not add to totals shown.

2/ Harmonized Tariff Schedule of the United States of America code.

3/ Customs import value generally represents a value in the foreign country and therefore excludes U.S. import duties, freight, insurance and other charges incurred in bringing the merchandise to the United States.

Source: U.S. Census Bureau.

TABLE 9  
U.S. IMPORTS FOR CONSUMPTION OF FERROCHROMIUM, BY COUNTRY 1/

| Country        | Not more than 3% carbon<br>(HTS 7202.49.5000) 2/ |   |                           | More than 3% carbon, but<br>not more than 4% carbon<br>(HTS 7202.49.1000) 2/ |   |                           | More than 4% carbon<br>(HTS 7202.41.0000) 2/ |   |                           | Total<br>(all grades)               |   |                           |
|----------------|--|---|---------------------------|--|---|---------------------------|--|---|---------------------------|-------------------------------------|---|---------------------------|
|                | Gross<br>weight<br>(metric<br>tons)              | Chromium<br>content<br>(metric<br>tons) | Value<br>(thou-<br>sands) | Gross<br>weight<br>(metric<br>tons)  | Chromium<br>content<br>(metric<br>tons) | Value<br>(thou-<br>sands) | Gross<br>weight<br>(metric<br>tons)          | Chromium<br>content<br>(metric<br>tons) | Value<br>(thou-<br>sands) | Gross<br>weight<br>(metric<br>tons) | Chromium<br>content<br>(metric<br>tons) | Value<br>(thou-<br>sands) |
| 1999:          |  |   |                           |  |   |                           |  |   |                           |                                     |   |                           |
| Albania        | --   | --                                      | --                        | --   | --                                      | --                        | 3,750  | 2,360                                   | \$1,780                   | 3,750                               | 2,360                                   | \$1,780                   |
| China          | 758  | 511                                     | \$927                     | --   | --                                      | --                        | 4,360  | 2,590                                   | 2,380                     | 5,120                               | 3,100                                   | 3,310                     |
| Finland        | --   | --                                      | --                        | --   | --                                      | --                        | 5,060  | 2,780                                   | 1,940                     | 5,060                               | 2,780                                   | 1,940                     |
| France         | --   | --                                      | --                        | --   | --                                      | --                        | 6  | 4                                       | 7                         | 6                                   | 4                                       | 7                         |
| Germany        | 6,840  | 4,780                                   | 14,000                    | --   | --                                      | --                        | --   | --                                      | --                        | 6,840                               | 4,780                                   | 14,000                    |
| India          | --   | --                                      | --                        | --   | --                                      | --                        | 5,010  | 3,090                                   | 1,930                     | 5,010                               | 3,090                                   | 1,930                     |
| Japan          | 1,010  | 697                                     | 2,330                     | --   | --                                      | --                        | --   | --                                      | --                        | 1,010                               | 697                                     | 2,330                     |
| Kazakhstan     | 3,960  | 2,770                                   | 3,060                     | --   | --                                      | --                        | 154,000                                      | 106,000                                 | 68,500                    | 158,000                             | 108,000                                 | 71,500                    |
| Russia         | 16,800   | 11,500                                  | 13,200                    | --   | --                                      | --                        | 7,830  | 5,230                                   | 5,070                     | 24,600                              | 16,700                                  | 18,300                    |
| South Africa   | 5,950  | 3,440                                   | 3,970                     | --   | --                                      | --                        | 229,000                                      | 114,000                                 | 69,900                    | 235,000                             | 117,000                                 | 73,900                    |
| Sweden         | 34   | 24                                      | 74                        | --   | --                                      | --                        | --   | --                                      | --                        | 34                                  | 24                                      | 74                        |
| Turkey         | --   | --                                      | --                        | --   | --                                      | --                        | 83,700                                       | 52,500                                  | 31,900                    | 83,700                              | 52,500                                  | 31,900                    |
| United Kingdom | 61   | 43                                      | 131                       | 3,000  | 1,950                                   | \$1,120                   | 2  | 1                                       | 2                         | 3,060                               | 1,990                                   | 1,250                     |
| United States  | --   | --                                      | --                        | --   | --                                      | --                        | 4  | 3                                       | 12                        | 4                                   | 3                                       | 11                        |
| Zimbabwe       | 3,590  | 2,380                                   | 2,900                     | --   | --                                      | --                        | 68,400                                       | 42,300                                  | 34,100                    | 72,000                              | 44,700                                  | 37,000                    |
| Total          | 39,000   | 26,100                                  | 40,700                    | 3,000  | 1,950                                   | 1,120                     | 562,000                                      | 331,000                                 | 218,000                   | 604,000                             | 359,000                                 | 259,000                   |
| 2000:          |  |   |                           |  |   |                           |  |   |                           |                                     |   |                           |
| Brazil         | 40   | 25                                      | \$90                      | --   | --                                      | --                        | --   | --                                      | --                        | 40                                  | 25                                      | \$90                      |
| China          | 159  | 111                                     | 236                       | 60   | 42                                      | \$73                      | 192  | 126                                     | \$147                     | 411                                 | 279                                     | 456                       |
| Croatia        | --   | --                                      | --                        | --   | --                                      | --                        | 8,450  | 5,300                                   | 3,630                     | 8,450                               | 5,300                                   | 3,630                     |
| Georgia        | 130  | 91                                      | 213                       | --   | --                                      | --                        | --   | --                                      | --                        | 130                                 | 91                                      | 213                       |
| Germany        | 7,520  | 5,090                                   | 14,400                    | 23   | 16                                      | 74                        | --   | --                                      | --                        | 7,540                               | 5,110                                   | 14,500                    |
| India          | --   | --                                      | --                        | --   | --                                      | --                        | 3,850  | 2,260                                   | 1,610                     | 3,850                               | 2,260                                   | 1,610                     |
| Japan          | 1,940  | 1,330                                   | 4,320                     | 114  | 79                                      | 266                       | --   | --                                      | --                        | 2,060                               | 1,410                                   | 4,590                     |
| Kazakhstan     | 4,620  | 3,210                                   | 3,300                     | 1,850  | 1,300                                   | 1,250                     | 131,000                                      | 89,900                                  | 60,500                    | 138,000                             | 94,400                                  | 65,000                    |
| Russia         | 32,200   | 20,300                                  | 24,700                    | 2,690  | 1,840                                   | 1,890                     | 7,040  | 4,630                                   | 4,110                     | 41,900                              | 26,700                                  | 30,700                    |
| South Africa   | 451  | 293                                     | 662                       | 2,960  | 1,680                                   | 1,760                     | 260,000                                      | 131,000                                 | 91,700                    | 264,000                             | 133,000                                 | 94,100                    |
| Sweden         | 39   | 28                                      | 87                        | 133  | 95                                      | 282                       | --   | --                                      | --                        | 172                                 | 123                                     | 369                       |
| Turkey         | 2,960  | 2,140                                   | 2,190                     | --   | --                                      | --                        | 45,800                                       | 28,400                                  | 20,500                    | 48,800                              | 30,500                                  | 22,700                    |
| United Kingdom | 23   | 16                                      | 23                        | --   | --                                      | --                        | --   | --                                      | --                        | 23                                  | 16                                      | 23                        |
| Zimbabwe       | 220  | 148                                     | 145                       | 1,320  | 881                                     | 877                       | 60,400                                       | 36,800                                  | 29,500                    | 61,900                              | 37,800                                  | 30,500                    |
| Total          | 50,300   | 32,700                                  | 50,400                    | 9,150  | 5,930                                   | 6,470                     | 517,000                                      | 298,000                                 | 212,000                   | 577,000                             | 337,000                                 | 269,000                   |

-- Zero.

1/ Data are rounded to no more than three significant digits; may not add to totals shown.

2/ Harmonized Tariff Schedule of the United States of America code.

Source: U.S. Census Bureau.

TABLE 10  
U.S. IMPORTS FOR CONSUMPTION OF CHROMIUM MATERIALS, BY TYPE 1/

| HTS 2/  | Type   | 1999                 |                   | 2000                 |                   | Principal sources, 2000   |
|---|--|----------------------|-------------------|----------------------|-------------------|---|
|   |  | Quantity (kilograms) | Value (thousands) | Quantity (kilograms) | Value (thousands) |   |
| Metals and alloys:  |  |                      |                   |                      |                   |   |
| Chromium metal:   |  |                      |                   |                      |                   |   |
| 8112.20.3000  | Waste and scrap, gross weight                    | 17,800               | \$150             | 40,700               | \$598             | Russia (30%); United Kingdom (26%); Netherlands (13%); China (12%); Germany (12%); Singapore (5%); Mexico (1%).   |
| 8112.20.6000  | Other than waste and scrap, gross weight         | 9,010,000            | 56,400            | 9,900,000            | 58,800            | China (25%); Russia (25%); France (24%); United Kingdom (21%); Kazakhstan (2%); Germany (1%).   |
| 7202.50.0000  | Ferrochromium-silicon, gross weight              | 36,000,000           | 18,700            | 20,700,000           | 10,300            | Kazakhstan (46%); Russia (30%); Zimbabwe (18%); South Africa (6%).  |
| 7202.50.0000  | Ferrochromium-silicon, contained weight          | 12,700,000           | --                | 7,670,000            | --                |   |
| Chemicals (gross weight):                                   |  |                      |                   |                      |                   |   |
| Chromium oxides and hydroxides:                             |  |                      |                   |                      |                   |   |
| 2819.10.0000  | Chromium trioxide                                | 6,730,000            | 12,000            | 8,030,000            | 13,700            | Kazakhstan (68%); China (11%); Turkey (10%); Italy (5%); Poland (2%); Japan (1%); United Kingdom (1%).  |
| 2819.90.0000  | Other  | 4,300,000            | 14,800            | 3,220,000            | 12,100            | Japan (28%); China (25%); Germany (25%); United Kingdom (10%); Poland (4%); Netherlands (3%); Austria (2%); Belgium (1%); Colombia (1%); France (1%); Turkey (1%).  |
| 2833.23.0000  | Sulfates of chromium                             | 391,000              | 386               | 239,000              | 227               | United Kingdom (46%); Mexico (30%); Poland (15%); Argentina (8%); Germany (1%).   |
| Salts of oxometallic or peroxometallic acids:               |  |                      |                   |                      |                   |   |
| 2841.20.0000  | Chromates of lead and zinc                       | 159,000              | 355               | 289,000              | 563               | Norway (38%); Canada (23%); Korea, Republic of (21%); China (9%); United Kingdom (6%); Japan (3%).  |
| 2841.30.0000  | Sodium dichromate                                | 10,400,000           | 7,770             | 16,900,000           | 10,500            | United Kingdom (98%); China (2%).   |
| 2841.40.0000  | Potassium dichromate                             | 177,000              | 329               | 205,000              | 392               | United Kingdom (45%); India (20%); Kazakhstan (20%); Netherlands (10%); Canada (5%); Japan (1%).  |
| 2841.50.0000  | Other chromates and dichromates; peroxochromates | 471,000              | 1,050             | 56,900               | 183               | Korea, Republic of (49%); Austria (30%); United Kingdom (20%); India (2%).  |
| 2849.90.2000  | Chromium carbide                                 | 252,000              | 2,870             | 182,000              | 2,010             | Japan (48%); Germany (37%); United Kingdom (12%); Canada (2%); Austria (1%).  |
| Pigments and preparations based on chromium (gross weight): |  |                      |                   |                      |                   |   |
| 3206.20.0010  | Chrome yellow                                    | 6,760,000            | 19,000            | 7,000,000            | 18,700            | Canada (54%); Korea, Republic of (11%); Mexico (11%); Hungary (9%); China (8%); Colombia (4%); Japan (1%).  |
| 3206.20.0020  | Molybdenum orange                                | 1,550,000            | 6,600             | 1,620,000            | 7,110             | Canada (87%); Mexico (6%); Philippines (3%); China (1%); Colombia (1%); Germany (1%); Hungary (1%); Japan (1%).   |
| 3206.20.0030  | Zinc yellow                                      | 34,000               | 32                | 19,000               | 21                | Brazil (89%); Colombia (5%); Italy (5%).  |
| 3206.20.0050  | Other  | 1,250,000            | 4,330             | 1,530,000            | 6,290             | China (39%); France (39%); Germany (10%); Canada (4%); Poland (2%); Belgium (1%); Japan (1%); Korea, Republic of (1%); Switzerland (1%); United Arab Emirates (1%). |

-- Zero.

1/ Data are rounded to no more than three significant digits; may not add to totals shown.

2/ Harmonized Tariff Schedule of the United States of America code.

Source: U.S. Census Bureau.



TABLE 11  
PRINCIPAL WORLD CHROMITE ORE PRODUCERS, 2000

| Country 1/   | Company   | Country 1/              | Company   |
|--------------|---|-------------------------|---|
| Albania      | Albkrom (Government owned).   | South Africa--Continued | Canadian Gold S.A. (Pty.) Ltd.  |
| Brazil       | Cia. de Ferro Ligas da Bahia S.A.<br>Elkem ASA (Norway).<br>Mineração Vila Nova Ltda.<br>Magnesita S.A.   |                         | Goudini Chrome (Pty.) Ltd.<br>Hernic Ferrochrome (Pty.) Ltd.<br>National Manganese Mines Pty. Ltd.<br>Pilanesberg Chrome (Pty.) Ltd.<br>Rooderand Chrome Mine (Pty.) Ltd.<br>South Africa Chrome and Alloys Ltd.<br>Chromden Mine.<br>Horizon Chrome Mine.<br>Samancor Ltd.<br>Eastern Chrome Mines.<br>Western Chrome Mines.<br>Vereeniging Refractories Ltd.<br>Bophuthatswana Chrome Co. (Pty.) Ltd.<br>Marico Chrome Corp. (Pty.) Ltd.<br>Xstrata A.G. (Switzerland).<br>Xstrata S.A. (Pty.) Ltd.<br>Chromecorp (Pty.) Ltd.<br>Consolidated Metallurgical Industries Ltd. |
| China        | Huazang Smelter.<br>Shashen.<br>Xizang Kangjinla.<br>Xinjiang Karamay Gold Mine.<br>Xinjiang Nonferrous Metals Industry Co.   |                         |   |
| Finland      | Outokumpu Oy;<br>Outokumpu Steel Oy;<br>Outokumpu Chrome Oy.  |                         |   |
| India        | Ferro Alloys Corp. Ltd.<br>Indian Metals and Ferroalloys Ltd.<br>Indian Charge Chrome Ltd.<br>Misrilall Mines Ltd.<br>Mysore Mineral Ltd.<br>Orissa Mining Corp. Ltd.<br>Tata Iron and Steel Co. Ltd.               |                         |   |
| Indonesia    | PT. Palabim Mining-PT. Bituminusa.  | Sudan                   | Advanced Mining Works Co. Ltd.  |
| Iran         | Faryab Mining Co.   | Turkey                  | Aycan Madencilik Ltd. Sti.<br>Bilfer Madencilik A.S.<br>Birlik Madencilik Dis Tic. Insaat San. ve Tic. A.S.<br>Cevher Madencilik ve Ticaret A.S.<br>Dedeman Madencilik Sanayi ve Ticaret A.S.<br>Eti Holdings A.S.<br>Hâyri Ögelman Mining Co. Ltd.<br>Pinarbasi Madencilik Sanayi ve Ticaret Ltd.<br>Tekfen Dis. Ticaret A.S.<br>Tevfik Refik Bayoglu Madencilik.<br>Tut. Gen. Ticaret Ltd. Sti.<br>Türk Maadin A.S.   |
| Kazakhstan   | Donskoy Ore Dressing Complex.   |                         |   |
| Madagascar   | Kraomita Malagasy.  | United Arab Emirates    | Derkek Raphael & Co.<br>Dewent Mining Ltd.  |
| Oman         | Oman Chromite Company SAOG.   |                         |   |
| Philippines  | Benguet Corporation.<br>Heritage Resources & Mining Corporation.<br>Krominco Inc.<br>Velore Mining Corporation.   | Zimbabwe                | Maranatha Ferrochrome (Pvt.) Ltd.<br>Amble Mining Co.<br>Zimasco (Pvt.) Ltd.<br>Zimbabwe Alloys Ltd.  |
| Russia       | Saranov Complex.  |                         |   |
| South Africa | ASA Metals (Pty.) Ltd.<br>African Mining and Trust Co. Ltd.<br>Rustenburg Minerals Development Co. (Pty.) Ltd.<br>Zeerust Chrome Mine Ltd.<br>Bafokeng Chrome Holdings.<br>Bayer AG (Germany).<br>Bayer (Pty.) Ltd. |                         |   |

1/ Other chromite-producing countries included Burma, Cuba, Pakistan, and Vietnam.

TABLE 12  
PRINCIPAL WORLD FERROCHROMIUM PRODUCERS, 2000

| Country 1/ | Company   | Country 1/        | Company   |
|------------|---|-------------------|---|
| Albania    | Albkrom (Government owned).                     | India--Continued: | Srinivasa Ferro Alloys Ltd.                       |
| Brazil     | Cia. de Ferro Ligas da Bahia S.A.               |                   | Standard Chrome Ltd.                              |
| Chile      | Carbomet Industrial SA.                         |                   | The Sandur Manganese & Iron Ores Ltd.             |
| China      | Dandong Ferroalloy Plant.                       |                   | Tata Iron and Steel Co. Ltd.                      |
|            | Emei Ferroalloy (Group) Co. Ltd.                |                   | Bamnipal Plant.                                   |
|            | Gansu Huazang Metallurgical Group Co. Ltd.      |                   | Joda Plant.                                       |
|            | Hanzhong Ferroalloy Works (Government owned).   |                   | VBC Ferro Alloys Ltd.                             |
|            | Hengshang Iron & Steel.                         |                   | V.K. Ferro Alloys Private Ltd.                    |
|            | Hunan Ferroalloy (Government owned).            | Iran              | Faryab Mining Co.                                 |
|            | Hunan Lengshuijiang Electrochemical Works.      |                   | Abadan Ferroalloys Refinery.                      |
|            | Jiangyin Ferroalloy Factory (Government owned). | Italy             | Darfo S.p.A.                                      |
|            | Jilin Dongfeng Ferroalloy Works.                |                   | Fornileghe S.p.A.                                 |
|            | Jilin Ferroalloy Group Co. Ltd.                 |                   | Mineralsider S.p.A.                               |
|            | Jilin Huinan Ferroalloy Works.                  | Japan             | Nippon Denko Co. Ltd.                             |
|            | Jinzhou Ferroalloy (Group) Co. Ltd.             |                   | NKK Corp.   |
|            | Liaoyang Ferroalloy Group Corp.                 |                   | NKK Materials Co. Ltd.                            |
|            | Nanjing Ferroalloy Plant (Government owned).    |                   | Showa Denko K.K.                                  |
|            | Ningjin Metal Smelting Co. Ltd.                 |                   | Shunan Denko K.K.                                 |
|            | Qinghai Datong Ferroalloy Works                 | Kazakhstan        | Aksusky Ferroalloy Plant.                         |
|            | Quinhai Sanchuan Ferroalloy Co. Ltd.            |                   | Aktyubinsk Ferroalloy Plant.                      |
|            | Taonan Ferroalloy Works.                        | Norway            | Elkem ASA.  |
|            | Urad Zhongqi Ferrochrome Group Corp.            | Poland            | Huta "Laziska" Ferroalloy Plant.                  |
|            | Xibei Ferroalloy Works (Government owned).      | Russia            | Chelyabinsk Electrometallurgical Integrated Plant |
|            | Zhejiang Hengshan Ferroalloy Works.             |                   | Klutchevsk Ferroalloy Plant.                      |
| Croatia    | Dalmacija Ferro-Alloys Works.                   |                   | Metall Joint Venture.                             |
| Finland    | Outokumpu Oy;                                   |                   | Serov Ferroalloys Plant.                          |
|            | Outokumpu Steel Oy;                             | Slovakia          | Oravske Ferozliatinarske Zavody.                  |
|            | Outokumpu Chrome Oy.                            | Slovenia          | Tovarna Dusika Ruse-Metalurgija d.d.              |
| Germany    | Elektrowerk Weisweiler GmbH.                    | South Africa      | ASA Metals (Pty.) Ltd.                            |
| India      | Andhra Ferro Alloys Ltd.                        |                   | Associated Manganese Mines of South Africa Ltd    |
|            | Baheti Metal & Ferro Alloys Ltd.                |                   | Feralloys Ltd.                                    |
|            | Bharat Thermite Ltd.                            |                   | Hernic Ferrochrome (Pty.) Ltd.                    |
|            | Deepak Ferro Alloys Ltd.                        |                   | Samancor Ltd.                                     |
|            | Eastern Metals & Ferro Alloys Ltd.              |                   | Batlhako Ferrochrome Ltd.                         |
|            | Ferro Alloys Corp. Ltd.                         |                   | Ferrometals Division.                             |
|            | Charge Chrome Plant.                            |                   | Middelburg Ferrochrome Division.                  |
|            | Ferro-Alloys Unit.                              |                   | Palmiet Ferrochrome Division.                     |
|            | GMR Vasavi Industries Ltd.                      |                   | Tubatse Ferrochrome Division.                     |
|            | Hi-Tech Electrothermics Ltd.                    |                   | Xstrata A.G. (Switzerland).                       |
|            | Indian Metals and Ferroalloys Ltd.              |                   | Xstrata S.A. (Pty.) Ltd.                          |
|            | Indian Charge Chrome Ltd.                       |                   | Chromecorp (Pty.) Ltd.                            |
|            | Industrial Development Corp.                    |                   | Consolidated Metallurgical Industries Ltd.        |
|            | Ispat Alloys Ltd.                               |                   | Lydenburg Works.                                  |
|            | Jindal Strips Ltd.                              |                   | Rustenburg Works.                                 |
|            | Ferro Alloys Division.                          | Sweden            | Vargön Alloys AB.                                 |
|            | Mandsaur Ferro Alloys Ltd.                      | Turkey            | Eti Holdings A.S.                                 |
|            | Metramet Ferroalloys Pvt. Ltd.                  |                   | Eti Elektromatalurji.                             |
|            | Monnet Industries Ltd.                          |                   | Eti Krom A.S.                                     |
|            | Nav Chrome Ltd.                                 | United States     | Eramet Marietta Inc.                              |
|            | Nava Bharat Ferro Alloys Ltd.                   | Zimbabwe          | Maranatha Ferrochrome (Pvt.) Ltd.                 |
|            | Raghuvir Ferro Alloy Pvt. Ltd.                  |                   | Zimasco (Pvt.) Ltd.                               |
|            | Shri Girija Smelters Ltd.                       |                   | Zimbabwe Alloys Ltd.                              |

1/ Other ferrochromium-producing countries include Spain and Taiwan.

TABLE 13  
ANNUAL WORLD PRODUCTION CAPACITY OF CHROMITE ORE, FERROCHROMIUM,  
CHROMIUM METAL, CHROMIUM CHEMICALS, AND STAINLESS STEEL IN 2000 1/

(Thousand metric tons, contained chromium)

| Country              | Ore   | Ferro-<br>chromium | Metal | Chemicals | Stainless<br>steel |
|----------------------|-------|--------------------|-------|-----------|--------------------|
| Albania              | 48    | 27                 | --    | --        | --                 |
| Argentina            | --    | --                 | --    | 6         | --                 |
| Austria              | --    | --                 | --    | --        | 8                  |
| Bangladesh           | --    | --                 | --    | --        | 3                  |
| Belgium              | --    | --                 | --    | --        | 119                |
| Brazil               | 135   | 62                 | --    | --        | 41                 |
| Burma                | 1     | --                 | --    | --        | --                 |
| Canada               | --    | --                 | --    | --        | 39                 |
| Chile                | --    | 1                  | --    | --        | --                 |
| China                | 48    | 272                | 6     | 21        | 60                 |
| Croatia              | --    | 17                 | --    | --        | --                 |
| Cuba                 | 15    | --                 | --    | --        | 7                  |
| Czech Republic       | --    | --                 | --    | --        | 5                  |
| Finland              | 184   | 128                | --    | --        | 102                |
| France               | --    | --                 | 7     | --        | 204                |
| Germany              | --    | 17                 | 1     | --        | 255                |
| Greece               | 4     | --                 | --    | --        | --                 |
| India                | 462   | 183                | (2/)  | 8         | 111                |
| Indonesia            | 4     | --                 | --    | --        | --                 |
| Iran                 | 112   | 9                  | --    | 2         | --                 |
| Italy                | --    | 32                 | --    | --        | 204                |
| Japan                | --    | 113                | 1     | 17        | 660                |
| Kazakhstan           | 903   | 398                | 2     | 42        | --                 |
| Korea, Republic of   | --    | --                 | --    | --        | 306                |
| Macedonia            | 2     | --                 | --    | 5         | --                 |
| Madagascar           | 42    | --                 | --    | --        | --                 |
| Norway               | --    | 106                | --    | --        | --                 |
| Oman                 | 9     | --                 | --    | --        | --                 |
| Pakistan             | 8     | --                 | --    | 3         | --                 |
| Philippines          | 33    | --                 | --    | --        | --                 |
| Poland               | --    | 12                 | --    | 5         | --                 |
| Romania              | --    | --                 | --    | 9         | --                 |
| Russia               | 46    | 180                | 16    | 60        | 60                 |
| Slovakia             | --    | 38                 | --    | --        | --                 |
| Slovenia             | --    | 15                 | --    | --        | 13                 |
| South Africa         | 2,060 | 1,500              | --    | 24        | 95                 |
| Spain                | --    | 1                  | --    | --        | 204                |
| Sudan                | 14    | --                 | --    | --        | --                 |
| Sweden               | --    | 86                 | --    | --        | 128                |
| Taiwan               | --    | 1                  | --    | --        | 167                |
| Turkey               | 626   | 69                 | --    | 10        | 54                 |
| Ukraine              | --    | --                 | --    | --        | 33                 |
| United Arab Emirates | 23    | --                 | --    | --        | --                 |
| United Kingdom       | --    | --                 | 7     | 52        | 92                 |
| United States        | --    | 20                 | 3     | 56        | 390                |
| Vietnam              | 16    | --                 | --    | --        | --                 |
| Zimbabwe             | 213   | 227                | --    | --        | --                 |
| Total                | 5,010 | 3,510              | 43    | 320       | 3,360              |

-- Zero.

1/ Data are rounded to no more than three significant digits; may not add to totals shown.

2/ Less than 1/2 unit.

TABLE 14  
CHROMITE: WORLD PRODUCTION, BY COUNTRY 1/ 2/

(Metric tons, gross weight)

| Year | World total | Afghanistan | Albania 3/ | Argentina | Australia | Brazil | Burma | Canada | China | Colombia | Cuba    | Cyprus 6/ | Egypt 7/ | Finland |
|------|-------------|-------------|------------|-----------|-----------|--------|-------|--------|-------|----------|---------|-----------|----------|---------|
| 1900 | 53,200      | NA          | --         | NA        | 3,340     | NA     | NA    | NA     | --    | --       | --      | --        | --       | --      |
| 1901 | 90,200      | NA          | --         | NA        | 2,520     | NA     | NA    | NA     | --    | --       | --      | --        | --       | --      |
| 1902 | 85,300      | NA          | --         | NA        | 454       | NA     | NA    | NA     | --    | --       | --      | --        | --       | --      |
| 1903 | 95,500      | NA          | --         | NA        | 1,980     | NA     | NA    | NA     | --    | --       | --      | --        | --       | --      |
| 1904 | 118,000     | NA          | --         | NA        | 403       | NA     | NA    | NA     | --    | --       | --      | --        | --       | --      |
| 1905 | 144,000     | NA          | --         | NA        | 53        | NA     | NA    | NA     | --    | --       | --      | --        | --       | --      |
| 1906 | 161,000     | NA          | --         | NA        | 15        | NA     | NA    | NA     | --    | --       | --      | --        | --       | --      |
| 1907 | 112,000     | NA          | --         | NA        | 30        | NA     | NA    | NA     | --    | --       | --      | --        | --       | --      |
| 1908 | 67,000      | NA          | --         | NA        | --        | NA     | NA    | NA     | --    | --       | --      | --        | --       | --      |
| 1909 | 108,000     | NA          | --         | NA        | --        | NA     | NA    | NA     | --    | --       | --      | --        | --       | --      |
| 1910 | 108,000     | NA          | --         | NA        | --        | NA     | NA    | NA     | --    | --       | --      | --        | --       | --      |
| 1911 | 81,100      | NA          | --         | NA        | --        | NA     | NA    | NA     | --    | --       | --      | --        | --       | --      |
| 1912 | 123,000     | NA          | --         | NA        | 23        | NA     | NA    | NA     | --    | --       | --      | --        | --       | --      |
| 1913 | 147,000     | NA          | --         | NA        | 688       | NA     | NA    | NA     | --    | --       | --      | --        | --       | --      |
| 1914 | 157,000     | NA          | --         | NA        | 659       | NA     | NA    | NA     | --    | --       | --      | --        | --       | --      |
| 1915 | 185,000     | NA          | --         | NA        | 769       | NA     | NA    | NA     | --    | --       | --      | --        | --       | --      |
| 1916 | 281,000     | NA          | --         | NA        | 621       | NA     | NA    | NA     | --    | --       | 35      | --        | --       | --      |
| 1917 | 263,000     | NA          | --         | NA        | 1,140     | NA     | NA    | NA     | --    | --       | 17      | --        | --       | --      |
| 1918 | 312,000     | NA          | --         | NA        | 611       | NA     | NA    | NA     | --    | --       | 8,960   | --        | --       | --      |
| 1919 | 171,000     | NA          | --         | NA        | 254       | NA     | NA    | NA     | --    | --       | 14,700  | --        | --       | --      |
| 1920 | 172,000     | NA          | --         | NA        | 1,640     | NA     | NA    | NA     | --    | --       | 721     | --        | --       | --      |
| 1921 | 134,000     | NA          | --         | NA        | 63        | NA     | NA    | NA     | --    | --       | 610     | --        | --       | --      |
| 1922 | 140,000     | NA          | --         | NA        | 537       | NA     | NA    | NA     | --    | --       | --      | --        | --       | --      |
| 1923 | 205,000     | NA          | --         | NA        | 1,210     | NA     | NA    | NA     | --    | --       | 10,600  | --        | --       | --      |
| 1924 | 292,000     | NA          | --         | NA        | 785       | NA     | NA    | NA     | --    | --       | 19,900  | 2,860     | --       | --      |
| 1925 | 308,000     | NA          | --         | NA        | 978       | NA     | NA    | NA     | --    | --       | 30,300  | 2,020     | --       | --      |
| 1926 | 363,000     | NA          | --         | NA        | 607       | NA     | NA    | NA     | --    | --       | 36,600  | 650       | --       | --      |
| 1927 | 400,000     | NA          | --         | NA        | --        | NA     | NA    | NA     | --    | --       | 17,300  | 723       | --       | --      |
| 1928 | 452,000     | NA          | --         | NA        | --        | NA     | NA    | NA     | --    | --       | 34,200  | --        | --       | --      |
| 1929 | 635,000     | NA          | --         | NA        | 131       | NA     | NA    | NA     | --    | --       | 53,800  | 2,480     | --       | --      |
| 1930 | 559,000     | NA          | --         | NA        | 171       | NA     | NA    | NA     | --    | --       | 41,600  | 1,570     | --       | --      |
| 1931 | 383,000     | NA          | --         | NA        | 26        | NA     | NA    | NA     | --    | --       | 15,200  | 203       | --       | --      |
| 1932 | 299,000     | NA          | --         | NA        | 99        | NA     | NA    | NA     | --    | --       | 500     | 1,000     | --       | --      |
| 1933 | 409,000     | NA          | --         | NA        | 905       | NA     | NA    | NA     | --    | --       | 24,200  | --        | --       | --      |
| 1934 | 619,000     | NA          | --         | NA        | 1,740     | NA     | NA    | NA     | --    | --       | 50,200  | 982       | --       | --      |
| 1935 | 785,000     | NA          | --         | NA        | 605       | NA     | NA    | NA     | --    | --       | 48,500  | 1,200     | --       | --      |
| 1936 | 1,060,000   | NA          | --         | NA        | 422       | NA     | NA    | NA     | --    | --       | 71,100  | 508       | --       | --      |
| 1937 | 1,280,000   | NA          | --         | NA        | 466       | NA     | NA    | NA     | --    | --       | 94,600  | 1,640     | --       | --      |
| 1938 | 1,140,000   | NA          | 499        | NA        | 952       | NA     | NA    | NA     | --    | --       | 33,600  | 5,670     | --       | --      |
| 1939 | 1,190,000   | NA          | 3,080      | NA        | 118       | NA     | NA    | NA     | --    | --       | 59,600  | 1,120     | --       | --      |
| 1940 | 1,460,000   | NA          | 14,000     | NA        | 500       | NA     | NA    | NA     | --    | --       | 52,300  | 2,540     | --       | --      |
| 1941 | 1,660,000   | NA          | 20,000     | NA        | 356       | NA     | NA    | NA     | --    | --       | 163,000 | 4,820     | --       | --      |
| 1942 | 2,030,000   | NA          | 38,100     | NA        | 365       | NA     | NA    | NA     | --    | --       | 286,000 | 2,940     | 312      | --      |
| 1943 | 1,820,000   | NA          | 30,800     | NA        | 1,000     | NA     | NA    | NA     | --    | --       | 354,000 | 7,990     | 910      | --      |

See footnotes at end of table.

TABLE 14--Continued  
CHROMITE: WORLD PRODUCTION, BY COUNTRY 1/ 2/

(Metric tons, gross weight)

| Year | World total | Afghanistan | Albania 3/ | Argentina | Australia | Brazil  | Burma | Canada | China  | Colombia | Cuba    | Cyprus 6/ | Egypt 7/ | Finland |
|------|-------------|-------------|------------|-----------|-----------|---------|-------|--------|--------|----------|---------|-----------|----------|---------|
| 1944 | 1,400,000   | NA          | --         | NA        | 780       | NA      | NA    | NA     | --     | --       | 192,000 | 469       | 150      | --      |
| 1945 | 1,060,000   | NA          | --         | NA        | 287       | NA      | NA    | NA     | --     | --       | 173,000 | 1,070     | 150      | --      |
| 1946 | 1,170,000   | NA          | --         | NA        | --        | NA      | NA    | NA     | --     | --       | 174,000 | 1,160     | --       | --      |
| 1947 | 1,730,000   | NA          | --         | NA        | --        | NA      | NA    | NA     | --     | --       | 159,000 | 5,280     | 266      | --      |
| 1948 | 2,130,000   | NA          | 16,500     | NA        | 564       | NA      | NA    | NA     | --     | --       | 117,000 | 6,900     | 191      | --      |
| 1949 | 2,150,000   | NA          | 39,900     | NA        | 642       | NA      | NA    | NA     | --     | --       | 97,400  | 14,900    | 50       | --      |
| 1950 | 2,360,000   | 550         | 52,000     | --        | 905       | 3,230   | --    | --     | --     | --       | 65,800  | 18,400    | 36       | --      |
| 1951 | 2,810,000   | 75          | 45,400     | --        | 1,400     | 2,420   | --    | --     | --     | --       | 79,100  | 12,700    | --       | --      |
| 1952 | 3,360,000   | --          | 51,700     | --        | 1,420     | 2,650   | --    | --     | --     | --       | 61,800  | 13,500    | --       | --      |
| 1953 | 3,900,000   | --          | 47,000     | --        | 2,790     | 3,580   | --    | --     | --     | --       | 70,000  | 8,270     | 210      | --      |
| 1954 | 3,270,000   | --          | 100,000    | --        | 5,020     | 1,910   | --    | --     | --     | --       | 72,600  | 9,140     | 530      | --      |
| 1955 | 3,650,000   | --          | 122,000    | --        | --        | 4,120   | --    | --     | --     | --       | 77,200  | 8,710     | 840      | --      |
| 1956 | 4,140,000   | --          | 132,000    | --        | 6,190     | 4,110   | --    | --     | --     | --       | 53,700  | 5,310     | 255      | --      |
| 1957 | 4,640,000   | --          | 167,000    | --        | 3,100     | 7,940   | --    | --     | --     | --       | 115,000 | 5,150     | 103      | --      |
| 1958 | 3,830,000   | --          | 201,000    | --        | 788       | 5,290   | --    | --     | --     | --       | 75,100  | 12,000    | --       | --      |
| 1959 | 3,910,000   | --          | 248,000    | --        | 122       | 6,220   | --    | --     | --     | 50       | 39,700  | 12,400    | 250      | --      |
| 1960 | 4,430,000   | --          | 289,000    | --        | 537       | 5,670   | --    | --     | --     | 70       | 29,700  | 14,200    | 300      | --      |
| 1961 | 4,200,000   | --          | 232,000    | --        | --        | 15,500  | --    | --     | --     | 185      | 25,400  | 18,000    | 1,390    | --      |
| 1962 | 4,410,000   | --          | 251,000    | --        | 375       | 24,800  | --    | --     | --     | 140      | 35,400  | 6,540     | --       | --      |
| 1963 | 3,910,000   | --          | 294,000    | --        | 163       | 17,100  | --    | --     | --     | 110      | 56,600  | 4,910     | --       | --      |
| 1964 | 4,160,000   | --          | 307,000    | --        | 73        | 9,440   | --    | --     | --     | 400      | --      | 2,990     | --       | --      |
| 1965 | 4,810,000   | --          | 310,000    | --        | 23        | 17,000  | --    | --     | --     | 260      | --      | 4,990     | --       | --      |
| 1966 | 4,390,000   | --          | 313,000    | --        | --        | 15,000  | --    | --     | --     | --       | --      | 10,500    | --       | NA      |
| 1967 | 4,570,000   | --          | 327,000    | --        | 140       | 15,000  | --    | --     | --     | --       | --      | 21,800    | --       | 6,380   |
| 1968 | 4,940,000   | --          | 388,000    | --        | --        | 17,000  | --    | --     | --     | --       | --      | 25,100    | --       | 36,200  |
| 1969 | 5,321,000   | --          | 429,000    | --        | --        | 15,000  | --    | --     | --     | (5/)     | --      | 24,000    | 0        | 72,000  |
| 1970 | 6,053,000   | --          | 468,000    | --        | --        | 27,000  | --    | --     | --     | (5/)     | --      | 34,000    | 0        | 121,000 |
| 1971 | 6,435,000   | --          | 502,000    | (5/)      | --        | 28,000  | --    | --     | --     | 1,000    | 20,000  | 42,000    | 0        | 112,000 |
| 1972 | 6,101,000   | --          | 558,000    | --        | --        | 71,000  | --    | --     | --     | (5/)     | 20,000  | 24,000    | 0        | 97,000  |
| 1973 | 6,696,000   | --          | 611,000    | --        | --        | 73,000  | --    | --     | --     | 12,000   | 20,000  | 30,000    | 1,000    | 148,000 |
| 1974 | 7,461,000   | --          | 715,000    | (5/)      | --        | 108,000 | --    | --     | --     | 12,000   | 20,000  | 34,000    | (5/)     | 165,000 |
| 1975 | 8,288,000   | --          | 779,000    | --        | --        | 173,000 | --    | --     | --     | 12,000   | 32,000  | 27,000    | (5/)     | 331,000 |
| 1976 | 8,493,000   | --          | 830,000    | --        | --        | 186,000 | --    | --     | --     | 5,000    | 19,000  | 9,000     | (5/)     | 175,000 |
| 1977 | 9,448,000   | --          | 880,000    | --        | --        | 310,000 | --    | --     | --     | --       | 20,000  | 15,000    | 1,000    | 402,000 |
| 1978 | 10,944,000  | --          | 989,000    | --        | --        | 958,000 | --    | --     | --     | --       | 29,000  | 15,000    | 1,000    | 407,000 |
| 1979 | 9,323,000   | --          | 750,000    | --        | --        | 340,000 | --    | --     | --     | --       | 28,000  | 15,000    | (5/)     | 435,000 |
| 1980 | 9,902,000   | --          | 762,000    | --        | --        | 313,000 | --    | --     | --     | --       | 28,000  | 16,000    | --       | 362,000 |
| 1981 | 9,088,000   | --          | 710,000    | --        | --        | 237,000 | --    | --     | --     | --       | 21,000  | 10,000    | --       | 412,000 |
| 1982 | 8,480,000   | --          | 675,000    | --        | --        | 276,000 | --    | --     | --     | --       | 27,000  | 3,000     | --       | 345,000 |
| 1983 | 8,210,000   | --          | 685,000    | --        | --        | 161,000 | --    | --     | --     | --       | 34,000  | --        | --       | 246,000 |
| 1984 | 9,780,000   | --          | 720,000    | --        | --        | 260,000 | --    | --     | --     | --       | 37,900  | --        | --       | 446,000 |
| 1985 | 10,900,000  | --          | 825,000    | --        | --        | 190,000 | --    | --     | --     | --       | 37,700  | --        | --       | 506,000 |
| 1986 | 11,800,000  | --          | 850,000    | --        | --        | 353,000 | --    | --     | 50,000 | --       | 50,000  | --        | --       | 678,000 |
| 1987 | 11,900,000  | --          | 1,080,000  | --        | --        | 338,000 | --    | --     | 32,000 | --       | 52,400  | --        | --       | 543,000 |

See footnotes at end of table.

TABLE 14--Continued  
 CHROMITE: WORLD PRODUCTION, BY COUNTRY 1/ 2/

(Metric tons, gross weight)

| Year    | World total   | Afghanistan | Albania 3/ | Argentina | Australia  | Brazil        | Burma    | Canada | China         | Colombia | Cuba      | Cyprus 6/ | Egypt 7/ | Finland       |
|---------|---------------|-------------|------------|-----------|------------|---------------|----------|--------|---------------|----------|-----------|-----------|----------|---------------|
| 1988    | 12,900,000    | --          | 1,110,000  | --        | --         | 410,000       | --       | --     | 26,000        | --       | 52,200    | --        | 800      | 700,000       |
| 1989    | 14,000,000    | --          | 900,000    | --        | --         | 476,000       | 5,000    | --     | 25,000        | --       | 50,600    | --        | 2,450    | 513,000       |
| 1990    | 13,200,000    | --          | 957,000    | --        | --         | 263,000       | 1,000    | --     | 25,000        | --       | 50,000    | --        | 399      | 504,000       |
| 1991    | 13,300,000    | --          | 587,000    | --        | --         | 340,000       | 1,000    | --     | 25,000        | --       | 50,000    | --        | 649      | 473,000       |
| 1992    | 11,100,000    | --          | 322,000    | --        | --         | 449,000       | 6,200    | --     | 25,000        | --       | 10,400 r/ | --        | 600      | 499,000       |
| 1993    | 9,300,000     | --          | 115,000    | --        | --         | 308,000       | 1,000    | --     | 54,000        | --       | 17,600 r/ | --        | --       | 511,000       |
| 1994    | 10,400,000    | --          | 118,000    | --        | --         | 360,000       | 1,000    | --     | 62,000        | --       | 28,800 r/ | --        | --       | 573,000       |
| 1995    | 14,000,000    | --          | 160,000    | --        | --         | 448,000       | 1,000    | --     | 94,000        | --       | 30,700 r/ | --        | --       | 598,000       |
| 1996    | 11,600,000    | --          | 143,763 r/ | --        | 6,000      | 408,495       | 1,000 e/ | --     | 130,000 e/    | --       | 37,300    | --        | --       | 582,000 r/    |
| 1997    | 13,700,000 r/ | --          | 106,304 r/ | --        | 31,000     | 300,000       | 3,299    | --     | 200,000 r/ e/ | --       | 44,000    | --        | --       | 589,000       |
| 1998    | 13,400,000 r/ | --          | 102,189 r/ | --        | 130,000    | 301,000 r/    | 4,059    | --     | 21,000 r/ e/  | --       | 49,044    | --        | --       | 610,000 r/ e/ |
| 1999    | 14,100,000 r/ | --          | 71,434 r/  | --        | 130,000 e/ | 420,000 r/ e/ | 3,200 e/ | --     | -- r/ e/      | --       | 35,750    | --        | --       | 635,000 r/ e/ |
| 2000 e/ | 14,400,000    | --          | 70,000     | --        | 130,000    | 400,000       | 3,000    | --     | --            | --       | 40,000    | --        | --       | 640,000       |

See footnotes at end of table.

TABLE 14--Continued  
CHROMITE: WORLD PRODUCTION, BY COUNTRY 1/ 2/

(Metric tons, gross weight)

| Year | Greece | Guatemala | India  | Indonesia | Iran  | Japan  | Kazakh-<br>stan 8/ | Macedo-<br>nia 10/ | Madaga-<br>scar 11/ | New     |           |      | Pakistan 12/ | Philippines |
|------|--------|-----------|--------|-----------|-------|--------|--------------------|--------------------|---------------------|---------|-----------|------|--------------|-------------|
|      |        |           |        |           |       |        |                    |                    |                     | Morocco | Caledonia | Oman |              |             |
| 1900 | 5,600  | NA        | --     | --        | --    | --     | XX                 | XX                 | --                  | --      | 13,000    | --   | XX           | --          |
| 1901 | 4,850  | NA        | --     | --        | --    | --     | XX                 | XX                 | --                  | --      | 17,600    | --   | XX           | --          |
| 1902 | 11,700 | NA        | --     | --        | --    | --     | XX                 | XX                 | --                  | --      | 17,500    | --   | XX           | --          |
| 1903 | 8,480  | NA        | 260    | --        | --    | --     | XX                 | XX                 | --                  | --      | 34,400    | --   | XX           | --          |
| 1904 | 15,400 | NA        | 3,650  | --        | --    | --     | XX                 | XX                 | --                  | --      | 47,200    | --   | XX           | --          |
| 1905 | 8,900  | NA        | 2,750  | --        | --    | --     | XX                 | XX                 | --                  | --      | 76,900    | --   | XX           | --          |
| 1906 | 11,500 | NA        | 4,450  | --        | --    | --     | XX                 | XX                 | --                  | --      | 84,200    | --   | XX           | --          |
| 1907 | 11,700 | NA        | 7,390  | --        | --    | --     | XX                 | XX                 | --                  | --      | 29,800    | --   | XX           | --          |
| 1908 | 4,350  | NA        | 4,820  | --        | --    | --     | XX                 | XX                 | --                  | --      | 15,800    | --   | XX           | --          |
| 1909 | 9,600  | NA        | 9,400  | --        | --    | --     | XX                 | XX                 | --                  | --      | 40,000    | --   | XX           | --          |
| 1910 | 9,460  | NA        | 1,770  | --        | --    | 2,120  | XX                 | XX                 | --                  | --      | 40,000    | --   | XX           | --          |
| 1911 | 4,610  | NA        | 3,860  | --        | --    | 1,520  | XX                 | XX                 | --                  | --      | 21,900    | --   | XX           | --          |
| 1912 | 6,470  | NA        | 2,940  | --        | --    | 1,620  | XX                 | XX                 | --                  | --      | 27,300    | --   | XX           | --          |
| 1913 | 6,340  | NA        | 5,770  | --        | --    | 1,330  | XX                 | XX                 | --                  | --      | 45,900    | --   | XX           | --          |
| 1914 | 7,060  | NA        | 5,980  | --        | --    | 2,120  | XX                 | XX                 | --                  | --      | 71,100    | --   | XX           | --          |
| 1915 | 10,400 | NA        | 3,830  | --        | --    | 2,990  | XX                 | XX                 | --                  | --      | 82,100    | --   | XX           | --          |
| 1916 | 9,880  | NA        | 20,500 | --        | --    | 8,280  | XX                 | XX                 | --                  | --      | 69,700    | --   | XX           | --          |
| 1917 | 6,750  | NA        | 27,500 | --        | --    | 8,940  | XX                 | XX                 | --                  | --      | 54,800    | --   | XX           | --          |
| 1918 | 10,900 | NA        | 58,700 | --        | --    | 6,250  | XX                 | XX                 | --                  | --      | 55,200    | --   | XX           | --          |
| 1919 | 8,050  | NA        | 37,000 | --        | --    | 6,010  | XX                 | XX                 | --                  | --      | 46,400    | --   | XX           | --          |
| 1920 | 7,380  | NA        | 27,200 | --        | --    | 3,970  | XX                 | XX                 | --                  | --      | 31,300    | --   | XX           | --          |
| 1921 | 8,030  | NA        | 35,300 | --        | --    | 3,370  | XX                 | XX                 | --                  | --      | 22,900    | --   | XX           | --          |
| 1922 | 9,210  | NA        | 23,100 | --        | --    | 3,760  | XX                 | XX                 | --                  | --      | 13,200    | --   | XX           | --          |
| 1923 | 14,800 | NA        | 55,100 | --        | --    | 4,530  | XX                 | XX                 | --                  | --      | 24,100    | --   | XX           | --          |
| 1924 | 15,100 | NA        | 46,200 | --        | --    | 5,360  | XX                 | XX                 | --                  | --      | 23,000    | --   | XX           | --          |
| 1925 | 8,080  | NA        | 38,100 | --        | --    | 5,820  | XX                 | XX                 | --                  | --      | 34,700    | --   | XX           | --          |
| 1926 | 20,000 | NA        | 33,900 | --        | --    | 7,050  | XX                 | XX                 | --                  | --      | 33,200    | --   | XX           | --          |
| 1927 | 17,300 | NA        | 58,100 | --        | --    | 9,780  | XX                 | XX                 | --                  | --      | 33,500    | --   | XX           | --          |
| 1928 | 21,000 | NA        | 46,200 | --        | --    | 9,810  | XX                 | XX                 | --                  | --      | 50,800    | --   | XX           | --          |
| 1929 | 24,200 | NA        | 50,400 | --        | --    | 9,160  | XX                 | XX                 | --                  | --      | 52,600    | --   | XX           | --          |
| 1930 | 23,400 | NA        | 51,500 | --        | --    | 11,300 | XX                 | XX                 | --                  | --      | 61,900    | --   | XX           | --          |
| 1931 | 5,630  | NA        | 20,200 | --        | --    | 9,070  | XX                 | XX                 | --                  | --      | 74,100    | --   | XX           | --          |
| 1932 | 1,550  | NA        | 18,200 | --        | --    | 12,500 | XX                 | XX                 | --                  | --      | 69,400    | --   | XX           | --          |
| 1933 | 14,800 | NA        | 15,800 | --        | --    | 19,900 | XX                 | XX                 | --                  | --      | 50,100    | --   | XX           | --          |
| 1934 | 30,700 | NA        | 21,900 | --        | --    | 27,200 | XX                 | XX                 | --                  | --      | 55,200    | --   | XX           | --          |
| 1935 | 29,800 | NA        | 39,800 | --        | --    | 28,800 | XX                 | XX                 | --                  | --      | 55,300    | --   | XX           | 1,290       |
| 1936 | 47,300 | NA        | 50,800 | --        | --    | 35,100 | XX                 | XX                 | --                  | --      | 47,800    | --   | XX           | 11,900      |
| 1937 | 52,600 | NA        | 63,300 | --        | --    | 45,000 | XX                 | XX                 | --                  | --      | 48,000    | --   | XX           | 69,900      |
| 1938 | 42,500 | NA        | 44,900 | --        | --    | 52,800 | XX                 | XX                 | --                  | --      | 52,200    | --   | XX           | 66,900      |
| 1939 | 57,100 | NA        | 49,900 | --        | --    | 57,400 | XX                 | XX                 | --                  | --      | 57,300    | --   | XX           | 134,000     |
| 1940 | 29,700 | NA        | 56,400 | --        | --    | 56,700 | XX                 | XX                 | --                  | --      | 55,800    | --   | XX           | 204,000     |
| 1941 | 16,200 | NA        | 50,900 | --        | --    | 54,500 | XX                 | XX                 | --                  | --      | 64,500    | --   | XX           | 233,000     |
| 1942 | 24,300 | NA        | 50,400 | --        | 435   | 67,500 | XX                 | XX                 | --                  | --      | 67,600    | --   | XX           | 49,900      |
| 1943 | 15,500 | NA        | 33,800 | --        | 1,270 | 58,500 | XX                 | XX                 | --                  | --      | 47,000    | --   | XX           | 59,900      |

See footnotes at end of table.

TABLE 14--Continued  
CHROMITE: WORLD PRODUCTION, BY COUNTRY 1/ 2/

(Metric tons, gross weight)

| Year | Greece | Guatemala | India   | Indonesia | Iran    | Japan  | Kazakh-<br>stan 8/ | Macedo-<br>nia 10/ | Madaga-<br>scar 11/ | New<br>Morocco | Caledonia | Oman   | Pakistan 12/ | Philippines |
|------|--------|-----------|---------|-----------|---------|--------|--------------------|--------------------|---------------------|----------------|-----------|--------|--------------|-------------|
| 1944 | 18,300 | NA        | 40,200  | --        | 12      | 71,100 | XX                 | XX                 | --                  | --             | 55,200    | --     | XX           | 69,900      |
| 1945 | 2,410  | NA        | 31,600  | --        | --      | 28,500 | XX                 | XX                 | --                  | --             | 59,800    | --     | XX           | --          |
| 1946 | 9,060  | NA        | 45,500  | --        | --      | 7,080  | XX                 | XX                 | --                  | --             | 24,900    | --     | XX           | 58,900      |
| 1947 | 2,640  | NA        | 35,300  | --        | --      | 2,410  | XX                 | XX                 | --                  | --             | 50,500    | --     | 22,000       | 195,000     |
| 1948 | 1,500  | NA        | 22,900  | --        | --      | 9,340  | XX                 | XX                 | --                  | --             | 75,000    | --     | 18,200       | 257,000     |
| 1949 | 3,720  | NA        | 19,700  | --        | --      | 27,100 | XX                 | XX                 | --                  | --             | 89,000    | --     | 17,200       | 247,000     |
| 1950 | 12,600 | 289       | 17,000  | --        | --      | 33,000 | XX                 | XX                 | --                  | --             | 84,800    | --     | 18,400       | 251,000     |
| 1951 | 25,300 | 1,140     | 17,000  | --        | 8,830   | 40,900 | XX                 | XX                 | --                  | --             | 88,800    | --     | 18,000       | 335,000     |
| 1952 | 32,200 | 105       | 36,800  | --        | 20,000  | 47,200 | XX                 | XX                 | --                  | --             | 108,000   | --     | 17,700       | 544,000     |
| 1953 | 36,800 | 400       | 65,800  | --        | 21,500  | 37,600 | XX                 | XX                 | --                  | --             | 122,000   | --     | 23,800       | 557,000     |
| 1954 | 26,800 | 132       | 46,200  | --        | 21,200  | 32,800 | XX                 | XX                 | --                  | --             | 85,000    | --     | 22,300       | 401,000     |
| 1955 | 25,300 | 260       | 90,800  | --        | 34,900  | 26,600 | XX                 | XX                 | --                  | --             | 46,100    | --     | 28,900       | 595,000     |
| 1956 | 78,900 | 888       | 53,500  | --        | 32,800  | 39,900 | XX                 | XX                 | --                  | --             | 48,900    | --     | 23,100       | 709,000     |
| 1957 | 87,200 | 998       | 79,800  | --        | 38,600  | 46,500 | XX                 | XX                 | --                  | --             | 64,200    | --     | 16,400       | 726,000     |
| 1958 | 65,500 | 1,060     | 64,000  | --        | 35,000  | 41,900 | XX                 | XX                 | --                  | --             | 47,400    | --     | 24,100       | 416,000     |
| 1959 | 20,700 | 410       | 95,600  | --        | 55,000  | 57,700 | XX                 | XX                 | --                  | --             | 44,000    | --     | 16,300       | 653,000     |
| 1960 | 34,900 | 181       | 100,000 | --        | 68,000  | 67,500 | XX                 | XX                 | --                  | --             | 39,200    | --     | 18,400       | 734,000     |
| 1961 | 31,100 | 100       | 48,700  | --        | 73,700  | 70,200 | XX                 | XX                 | 10,500              | --             | 36,700    | --     | 25,500       | 640,000     |
| 1962 | 56,200 | 20        | 66,600  | --        | 89,800  | 58,100 | XX                 | XX                 | 18,500              | --             | 15,500    | --     | 21,500       | 531,000     |
| 1963 | 51,200 | --        | 69,000  | --        | 99,800  | 43,700 | XX                 | XX                 | 11,200              | --             | --        | --     | 14,500       | 459,000     |
| 1964 | 50,900 | --        | 35,000  | --        | 98,000  | 44,000 | XX                 | XX                 | 11,800              | --             | --        | --     | 13,500       | 468,000     |
| 1965 | 50,600 | --        | 59,700  | --        | 129,000 | 41,800 | XX                 | XX                 | 2,380               | --             | --        | --     | 14,500       | 555,000     |
| 1966 | 55,800 | --        | 77,700  | --        | 141,000 | 32,800 | XX                 | XX                 | --                  | --             | --        | --     | 27,100       | 560,000     |
| 1967 | 12,000 | --        | 110,000 | --        | 109,000 | 45,200 | XX                 | XX                 | --                  | --             | 1,240     | --     | 26,400       | 420,000     |
| 1968 | 13,100 | --        | 206,000 | --        | 89,800  | 27,900 | XX                 | XX                 | --                  | --             | --        | --     | 26,000       | 439,000     |
| 1969 | 24,000 | --        | 227,000 | --        | 150,000 | 30,000 | XX                 | XX                 | 80,000              | --             | --        | --     | 23,000       | 469,000     |
| 1970 | 26,000 | --        | 271,000 | --        | 200,000 | 33,000 | XX                 | XX                 | 131,000             | --             | --        | --     | 29,000       | 566,000     |
| 1971 | 15,000 | --        | 261,000 | --        | 176,000 | 32,000 | XX                 | XX                 | 150,000             | --             | --        | --     | 24,000       | 430,000     |
| 1972 | 22,000 | --        | 295,000 | --        | 180,000 | 24,000 | XX                 | XX                 | 112,000             | --             | --        | --     | 26,000       | 349,000     |
| 1973 | 18,000 | --        | 288,000 | --        | 140,000 | 24,000 | XX                 | XX                 | 158,000             | --             | --        | --     | 17,000       | 581,000     |
| 1974 | 10,000 | --        | 396,000 | --        | 175,000 | 26,000 | XX                 | XX                 | 156,000             | --             | --        | --     | 10,000       | 530,000     |
| 1975 | 35,000 | --        | 500,000 | --        | 172,000 | 24,000 | XX                 | XX                 | 194,000             | --             | 2,000     | --     | 10,000       | 520,000     |
| 1976 | 34,000 | --        | 402,000 | --        | 160,000 | 22,000 | XX                 | XX                 | 221,000             | --             | 10,000    | --     | 11,000       | 431,000     |
| 1977 | 42,000 | --        | 353,000 | --        | 233,000 | 18,000 | XX                 | XX                 | 165,000             | --             | 8,000     | --     | 8,000        | 538,000     |
| 1978 | 37,000 | --        | 266,000 | --        | 198,000 | 9,000  | XX                 | XX                 | 138,000             | --             | 8,000     | --     | 11,000       | 540,000     |
| 1979 | 45,000 | --        | 310,000 | --        | 136,000 | 12,000 | XX                 | XX                 | 128,000             | --             | 12,000    | --     | 3,000        | 556,000     |
| 1980 | 42,000 | --        | 319,000 | --        | 82,000  | 14,000 | XX                 | XX                 | 180,000             | --             | 2,000     | --     | 3,000        | 496,000     |
| 1981 | 24,000 | --        | 335,000 | --        | 32,000  | 11,000 | XX                 | XX                 | 100,000             | --             | 5,000     | --     | 2,000        | 439,000     |
| 1982 | 29,000 | --        | 364,000 | --        | 41,000  | 11,000 | XX                 | XX                 | 44,000              | --             | 50,000    | --     | 4,000        | 322,000     |
| 1983 | 27,000 | --        | 360,000 | --        | 48,000  | 8,000  | XX                 | XX                 | 45,000              | --             | 92,000    | 24,000 | 6,000        | 267,000     |
| 1984 | 61,400 | --        | 423,000 | --        | 59,000  | 7,420  | XX                 | XX                 | 59,800              | --             | 84,200    | 7,000  | 3,000        | 261,000     |
| 1985 | 58,900 | --        | 569,000 | --        | 56,000  | 11,900 | XX                 | XX                 | 127,000             | --             | 78,800    | --     | 5,190        | 272,000     |
| 1986 | 60,100 | --        | 630,000 | --        | 54,000  | 10,600 | XX                 | XX                 | 82,900              | --             | 72,200    | 4,820  | 8,300        | 174,000     |
| 1987 | 63,800 | --        | 624,000 | --        | 92,100  | 11,800 | XX                 | XX                 | 107,000             | NA             | 61,800    | --     | 10,200       | 188,000     |

See footnotes at end of table.



TABLE 14--Continued  
 CHROMITE: WORLD PRODUCTION, BY COUNTRY 1/ 2/

(Metric tons, gross weight)

| Year    | Greece    | Guatemala | India        | Indonesia | Iran       | Japan  | Kazakh-<br>stan 8/ | Macedo-<br>nia 10/ | Madaga-<br>scar 11/ | New       |        |           | Pakistan 12/ | Philippines |
|---------|-----------|-----------|--------------|-----------|------------|--------|--------------------|--------------------|---------------------|-----------|--------|-----------|--------------|-------------|
|         |           |           |              |           |            |        |                    |                    | Morocco             | Caledonia | Oman   |           |              |             |
| 1988    | 49,500    | --        | 821,000      | 7,640     | 60,300     | 9,510  | XX                 | XX                 | 64,200              | 1,000     | 70,300 | --        | 3,330        | 129,000     |
| 1989    | 62,300    | --        | 1,000,000    | 7,640     | 72,600     | 11,700 | XX                 | XX                 | 62,500              | 1,000     | 60,300 | 12,800    | 27,100       | 217,000     |
| 1990    | 35,400    | --        | 1,050,000    | 8,000     | 77,200     | 8,080  | XX                 | XX                 | 151,000             | 300       | 6,220  | --        | 18,200       | 183,000     |
| 1991    | 37,200    | --        | 940,000      | 1,950     | 90,100     | 8,000  | XX                 | XX                 | 149,000             | 500       | --     | --        | 31,500       | 191,000     |
| 1992    | 4,000     | --        | 1,080,000    | 2,000     | 130,000    | 8,000  | 3,500,000          | 6,000              | 161,000             | 302       | 8,170  | 1,760     | 22,900       | 65,700      |
| 1993    | 10,000    | --        | 1,000,000    | 2,500     | 124,000    | 7,000  | 2,900,000          | 5,000              | 144,000             | --        | --     | 10,200    | 22,200       | 61,700      |
| 1994    | 5,000     | --        | 909,000      | 2,500     | 354,000    | --     | 2,100,000          | 5,000              | 90,200              | --        | --     | 6,170     | 6,240        | 76,000      |
| 1995    | 5,000     | --        | 1,540,000    | 10,000    | 371,000    | --     | 2,420,000          | 5,000              | 106,000             | --        | --     | 5,300     | 17,000       | 111,000     |
| 1996    | 11,725    | --        | 1,363,205    | 13,300 e/ | 130,220    | --     | 1,190,000          | 5,000 e/           | 137,210             | --        | --     | 15,252    | 27,987       | 107,068     |
| 1997    | 12,020    | --        | 1,363,049    | 2,156     | 168,984    | --     | 1,798,300          | 5,000 e/           | 139,700             | --        | --     | 18,000    | 23,763       | 87,500      |
| 1998    | 12,000 e/ | --        | 1,311,310    | 4,700 e/  | 313,937 r/ | --     | 1,602,700          | 5,000 e/           | 104,300             | --        | --     | 28,684    | 8,885        | 53,871      |
| 1999    | 12,000 e/ | --        | 1,473,000 r/ | 6,355     | 311,235 r/ | --     | 2,405,000          | 5,000 e/           | 100,000 r/ e/       | --        | --     | 26,009 r/ | 16,279       | 19,566      |
| 2000 e/ | 12,000    | --        | 1,500,000    | 6,400     | 310,000    | --     | 2,607,000 9/       | 5,000              | 100,000             | --        | --     | 15,110 9/ | 26,643 9/    | 15,000      |

See footnotes at end of table.

TABLE 14--Continued  
CHROMITE: WORLD PRODUCTION, BY COUNTRY 1/ 2/

(Metric tons, gross weight)

| Year | Portugal | Russia 13/ | Sierra Leone | South Africa 14/ | Sudan | Thailand | Turkey  | U.S.S.R. 15/ | United Arab Emirates | United States | Vietnam 16/ | Yugoslavia 17/ | Zimbabwe 18/ | PNRC 19/ |
|------|----------|------------|--------------|------------------|-------|----------|---------|--------------|----------------------|---------------|-------------|----------------|--------------|----------|
| 1900 | NA       | XX         | --           | --               | --    | NA       | 9,750   | 19,100       | --                   | 142           | NA          | 100            | --           | 2,120    |
| 1901 | NA       | XX         | --           | --               | --    | NA       | 41,000  | 22,200       | --                   | 374           | NA          | 505            | --           | 1,160    |
| 1902 | NA       | XX         | --           | --               | --    | NA       | 34,600  | 19,700       | --                   | 320           | NA          | 270            | --           | 816      |
| 1903 | NA       | XX         | --           | --               | --    | NA       | 30,400  | 16,400       | --                   | 152           | NA          | 147            | --           | 3,180    |
| 1904 | NA       | XX         | --           | --               | --    | NA       | 19,200  | 26,600       | --                   | 125           | NA          | 279            | --           | 5,510    |
| 1905 | NA       | XX         | --           | --               | --    | NA       | 20,200  | 27,100       | --                   | 23            | NA          | 186            | --           | 7,780    |
| 1906 | NA       | XX         | --           | --               | --    | NA       | 32,600  | 19,000       | --                   | 109           | NA          | 320            | --           | 8,200    |
| 1907 | NA       | XX         | --           | --               | --    | NA       | 28,900  | 26,400       | --                   | 295           | NA          | 164            | 836          | 6,530    |
| 1908 | NA       | XX         | --           | --               | --    | NA       | 11,500  | 10,900       | --                   | 365           | NA          | 500            | 12,100       | 6,550    |
| 1909 | NA       | XX         | --           | --               | --    | NA       | --      | 22,200       | --                   | 608           | NA          | 332            | 23,200       | 2,240    |
| 1910 | NA       | XX         | --           | --               | --    | NA       | --      | 14,400       | --                   | 209           | NA          | 320            | 39,900       | 271      |
| 1911 | NA       | XX         | --           | --               | --    | NA       | --      | 1,200        | --                   | 122           | NA          | 250            | 47,500       | 142      |
| 1912 | NA       | XX         | --           | --               | --    | NA       | --      | 21,300       | --                   | 204           | NA          | 200            | 62,800       | --       |
| 1913 | NA       | XX         | --           | --               | --    | NA       | 14,000  | 15,000       | --                   | 259           | NA          | 305            | 57,500       | --       |
| 1914 | NA       | XX         | --           | --               | --    | NA       | 9,830   | 15,000       | --                   | 601           | NA          | 211            | 43,700       | 307      |
| 1915 | NA       | XX         | --           | --               | --    | NA       | --      | 15,000       | --                   | 3,330         | NA          | 370            | 55,000       | 11,500   |
| 1916 | NA       | XX         | --           | --               | --    | NA       | --      | 15,000       | --                   | 47,800        | NA          | 966            | 80,600       | 27,700   |
| 1917 | NA       | XX         | --           | --               | --    | NA       | --      | 14,000       | --                   | 44,400        | NA          | 1,810          | 66,200       | 37,300   |
| 1918 | NA       | XX         | --           | --               | --    | NA       | 1,000   | 14,000       | --                   | 83,800        | NA          | 500            | 28,400       | 43,700   |
| 1919 | NA       | XX         | --           | --               | --    | NA       | 3,500   | 4,000        | --                   | 5,160         | NA          | 500            | 32,000       | 13,200   |
| 1920 | NA       | XX         | --           | --               | --    | NA       | 25,000  | 2,770        | --                   | 2,540         | NA          | 10             | 54,700       | 14,600   |
| 1921 | NA       | XX         | --           | 1,080            | --    | NA       | 10,000  | 4,010        | --                   | 287           | NA          | 10             | 45,500       | 2,540    |
| 1922 | NA       | XX         | --           | 87               | --    | NA       | 2,500   | 847          | --                   | 361           | NA          | 15             | 84,800       | 1,330    |
| 1923 | NA       | XX         | --           | --               | --    | NA       | --      | 3,000        | --                   | 231           | NA          | --             | 87,700       | 3,880    |
| 1924 | NA       | XX         | --           | 4,570            | --    | NA       | 3,400   | 11,900       | --                   | 293           | NA          | 300            | 157,000      | 1,260    |
| 1925 | NA       | XX         | --           | 13,800           | --    | NA       | 7,510   | 30,100       | --                   | 110           | NA          | 12,200         | 123,000      | 895      |
| 1926 | NA       | XX         | --           | 12,000           | --    | NA       | 6,670   | 30,400       | --                   | 143           | NA          | 16,000         | 164,000      | 1,570    |
| 1927 | NA       | XX         | --           | 17,000           | --    | NA       | 18,300  | 19,300       | --                   | 204           | NA          | 8,760          | 198,000      | 2,200    |
| 1928 | NA       | XX         | --           | 31,800           | --    | NA       | 11,800  | 29,500       | --                   | 671           | NA          | 16,700         | 199,000      | 120      |
| 1929 | NA       | XX         | --           | 64,000           | --    | NA       | 16,200  | 52,900       | --                   | 273           | NA          | 43,000         | 266,000      | 234      |
| 1930 | NA       | XX         | --           | 13,700           | --    | NA       | 28,200  | 66,700       | --                   | 81            | NA          | 51,600         | 206,000      | 1,600    |
| 1931 | NA       | XX         | --           | 23,300           | --    | NA       | 25,400  | 67,000       | --                   | 272           | NA          | 58,400         | 81,600       | 2,890    |
| 1932 | NA       | XX         | --           | 19,400           | --    | NA       | 55,200  | 65,900       | --                   | 157           | NA          | 39,100         | 15,700       | 480      |
| 1933 | NA       | XX         | --           | 34,100           | --    | NA       | 75,400  | 109,000      | --                   | 857           | NA          | 26,200         | 35,000       | 2,620    |
| 1934 | NA       | XX         | --           | 61,400           | --    | NA       | 120,000 | 127,000      | --                   | 375           | NA          | 48,500         | 72,100       | 1,030    |
| 1935 | NA       | XX         | --           | 90,400           | --    | NA       | 150,000 | 178,000      | --                   | 523           | NA          | 53,000         | 106,000      | 1,370    |
| 1936 | NA       | XX         | --           | 176,000          | --    | NA       | 164,000 | 217,000      | --                   | 273           | NA          | 54,000         | 183,000      | 5,000    |
| 1937 | NA       | XX         | 741          | 169,000          | --    | NA       | 193,000 | 200,000      | --                   | 2,360         | NA          | 59,900         | 276,000      | 9,690    |
| 1938 | NA       | XX         | 505          | 177,000          | --    | NA       | 214,000 | 200,000      | --                   | 825           | NA          | 58,500         | 186,000      | 4,730    |
| 1939 | NA       | XX         | 10,800       | 160,000          | --    | NA       | 192,000 | 200,000      | --                   | 3,670         | NA          | 59,500         | 139,000      | 9,440    |
| 1940 | NA       | XX         | 17,800       | 164,000          | --    | NA       | 170,000 | 299,000      | --                   | 2,710         | NA          | 71,000         | 248,000      | 11,900   |
| 1941 | NA       | XX         | 13,900       | 142,000          | --    | NA       | 136,000 | 340,000      | --                   | 12,900        | NA          | 69,900         | 324,000      | 14,800   |
| 1942 | NA       | XX         | 10,700       | 338,000          | --    | NA       | 116,000 | 399,000      | --                   | 102,000       | NA          | 99,800         | 348,000      | 27,400   |
| 1943 | NA       | XX         | 16,300       | 163,000          | --    | NA       | 155,000 | 327,000      | --                   | 145,000       | NA          | 65,300         | 287,000      | 48,600   |

See footnotes at end of table.

TABLE 14--Continued  
CHROMITE: WORLD PRODUCTION, BY COUNTRY 1/ 2/

(Metric tons, gross weight)

| Year | Portugal | Russia 13/ | Sierra Leone | South Africa 14/ | Sudan  | Thailand | Turkey  | U.S.S.R. 15/ | United Arab Emirates | United States | Vietnam 16/ | Yugoslavia 17/ | Zimbabwe 18/ | PNRC 19/ |
|------|----------|------------|--------------|------------------|--------|----------|---------|--------------|----------------------|---------------|-------------|----------------|--------------|----------|
| 1944 | NA       | XX         | 9,850        | 88,900           | --     | NA       | 182,000 | 299,000      | --                   | 41,400        | NA          | 9,980          | 277,000      | 38,200   |
| 1945 | NA       | XX         | 578          | 99,100           | --     | NA       | 148,000 | 299,000      | --                   | 12,700        | NA          | 5,990          | 186,000      | 11,800   |
| 1946 | NA       | XX         | 10,300       | 212,000          | --     | NA       | 103,000 | 299,000      | --                   | 3,730         | NA          | 68,000         | 151,000      | 4,320    |
| 1947 | NA       | XX         | 16,800       | 373,000          | --     | NA       | 157,000 | 499,000      | --                   | 860           | NA          | 54,400         | 155,000      | 4,760    |
| 1948 | NA       | XX         | 7,890        | 413,000          | --     | NA       | 286,000 | 599,000      | --                   | 3,280         | NA          | 62,600         | 231,000      | 5,090    |
| 1949 | NA       | XX         | 22,100       | 404,000          | --     | NA       | 452,000 | 349,000      | --                   | 393           | NA          | 109,000        | 244,000      | 11,600   |
| 1950 | 45       | XX         | 7,520        | 496,000          | --     | --       | 423,000 | 454,000      | --                   | 367           | --          | 115,000        | 292,000      | 14,500   |
| 1951 | 33       | XX         | 16,500       | 545,000          | --     | --       | 619,000 | 544,000      | --                   | 6,400         | --          | 99,600         | 300,000      | 5,200    |
| 1952 | 108      | XX         | 23,900       | 580,000          | --     | --       | 807,000 | 544,000      | --                   | 19,300        | --          | 107,000        | 323,000      | 16,000   |
| 1953 | 5        | XX         | 24,700       | 724,000          | --     | --       | 913,000 | 544,000      | --                   | 53,400        | --          | 127,000        | 420,000      | 98,100   |
| 1954 | 21       | XX         | 19,100       | 641,000          | --     | --       | 562,000 | 544,000      | --                   | 148,000       | --          | 124,000        | 401,000      | 777      |
| 1955 | --       | XX         | 21,100       | 542,000          | --     | --       | 649,000 | 680,000      | --                   | 139,000       | --          | 126,000        | 408,000      | 20,500   |
| 1956 | --       | XX         | 19,900       | 627,000          | --     | --       | 833,000 | 739,000      | --                   | 188,000       | --          | 119,000        | 407,000      | 19,100   |
| 1957 | --       | XX         | 16,000       | 666,000          | --     | --       | 955,000 | 771,000      | --                   | 151,000       | --          | 120,000        | 593,000      | 14,700   |
| 1958 | --       | XX         | 14,500       | 631,000          | --     | --       | 573,000 | 798,000      | --                   | 130,000       | --          | 114,000        | 561,000      | 20,600   |
| 1959 | --       | XX         | 18,100       | 680,000          | --     | --       | 388,000 | 853,000      | --                   | 95,300        | 6,620       | 107,000        | 493,000      | 24,300   |
| 1960 | --       | XX         | 5,460        | 772,000          | --     | --       | 481,000 | 916,000      | --                   | 97,100        | 19,400      | 101,000        | 606,000      | 30,800   |
| 1961 | --       | XX         | --           | 898,000          | --     | --       | 403,000 | 921,000      | --                   | 74,400        | 29,000      | 108,000        | 536,000      | 1,530    |
| 1962 | --       | XX         | 11,400       | 913,000          | 7,980  | --       | 527,000 | 1,150,000    | --                   | --            | --          | 97,000         | 461,000      | 63,900   |
| 1963 | --       | XX         | 2,780        | 792,000          | 17,000 | --       | 284,000 | 1,230,000    | --                   | --            | --          | 93,800         | 374,000      | --       |
| 1964 | --       | XX         | --           | 850,000          | 17,000 | --       | 413,000 | 1,300,000    | --                   | --            | --          | 88,400         | 448,000      | --       |
| 1965 | --       | XX         | --           | 942,000          | 29,900 | --       | 567,000 | 1,420,000    | --                   | --            | --          | 79,900         | 586,000      | --       |
| 1966 | --       | XX         | --           | 1,060,000        | 17,200 | --       | 529,000 | 1,500,000    | --                   | --            | --          | 54,200         | NA           | --       |
| 1967 | --       | XX         | --           | 1,150,000        | 25,000 | --       | 371,000 | 1,570,000    | --                   | --            | --          | 47,200         | 318,000      | --       |
| 1968 | --       | XX         | --           | 1,150,000        | 22,100 | --       | 419,000 | 1,650,000    | --                   | --            | --          | 45,300         | 381,000      | --       |
| 1969 | --       | XX         | --           | 1,197,000        | 25,000 | --       | 454,000 | 1,700,000    | --                   | --            | --          | 39,000         | 363,000      | --       |
| 1970 | --       | XX         | --           | 1,427,000        | 47,000 | --       | 519,000 | 1,751,000    | --                   | --            | --          | 41,000         | 363,000      | --       |
| 1971 | --       | XX         | --           | 1,644,000        | 21,000 | --       | 603,000 | 1,796,000    | --                   | --            | --          | 34,000         | 544,000      | --       |
| 1972 | --       | XX         | --           | 1,483,000        | 23,000 | --       | 395,000 | 1,851,000    | --                   | --            | --          | 28,000         | 544,000      | --       |
| 1973 | --       | XX         | --           | 1,649,000        | 32,000 | --       | 436,000 | 1,905,000    | --                   | --            | --          | 10,000         | 544,000      | --       |
| 1974 | --       | XX         | --           | 1,877,000        | 20,000 | --       | 666,000 | 1,950,000    | --                   | --            | NA          | 1,000          | 590,000      | --       |
| 1975 | --       | XX         | --           | 2,076,000        | 15,000 | (5)      | 717,000 | 2,077,000    | --                   | --            | NA          | 2,000          | 590,000      | --       |
| 1976 | --       | XX         | --           | 2,409,000        | 22,000 | --       | 581,000 | 2,087,000    | --                   | --            | 14,000      | 2,000          | 864,000      | --       |
| 1977 | --       | XX         | --           | 3,059,000        | 19,000 | 1,000    | 508,000 | 2,177,000    | --                   | --            | 13,000      | 2,000          | 677,000      | --       |
| 1978 | --       | XX         | --           | 3,144,000        | 18,000 | (5)      | 381,000 | 3,302,000    | --                   | --            | 13,000      | 2,000          | 478,000      | --       |
| 1979 | --       | XX         | --           | 3,297,000        | 28,000 | (5)      | 372,000 | 2,300,000    | --                   | --            | 14,000      | (5)            | 542,000      | --       |
| 1980 | --       | XX         | --           | 3,414,000        | 25,000 | --       | 373,000 | 2,903,000    | --                   | --            | 15,000      | (5)            | 553,000      | --       |
| 1981 | --       | XX         | --           | 2,870,000        | 25,000 | --       | 401,000 | 2,903,000    | --                   | --            | 15,000      | (5)            | 536,000      | --       |
| 1982 | --       | XX         | --           | 2,431,000        | 19,000 | --       | 453,000 | 2,939,000    | --                   | --            | 16,000      | --             | 432,000      | --       |
| 1983 | --       | XX         | --           | 2,466,000        | 20,000 | --       | 346,000 | 2,939,000    | --                   | --            | 16,000      | --             | 420,000      | --       |
| 1984 | --       | XX         | --           | 3,410,000        | 20,000 | --       | 487,000 | 2,940,000    | --                   | --            | 16,000      | --             | 477,000      | --       |
| 1985 | --       | XX         | --           | 3,700,000        | 8,800  | 30       | 589,000 | 3,360,000    | --                   | --            | 4,000       | 10,000         | 536,000      | --       |
| 1986 | --       | XX         | --           | 3,910,000        | 8,500  | 361      | 618,000 | 3,640,000    | --                   | --            | 4,000       | 8,780          | 533,000      | --       |
| 1987 | --       | XX         | --           | 3,790,000        | 13,000 | 5        | 762,000 | 3,570,000    | --                   | --            | 4,000       | 13,200         | 570,000      | --       |

See footnotes at end of table.

TABLE 14--Continued  
CHROMITE: WORLD PRODUCTION, BY COUNTRY 1/ 2/

(Metric tons, gross weight)

| Year    | Portugal | Russia 13/ | Sierra Leone | South Africa 14/ | Sudan     | Thailand | Turkey    | U.S.S.R. 15/ | United Arab Emirates | United States | Vietnam 16/ | Yugoslavia 17/ | Zimbabwe 18/  | PNRC 19/ |
|---------|----------|------------|--------------|------------------|-----------|----------|-----------|--------------|----------------------|---------------|-------------|----------------|---------------|----------|
| 1988    | --       | XX         | --           | 4,240,000        | 8,000     | 776      | 851,000   | 3,700,000    | --                   | --            | 4,000       | 11,500         | 561,000       | --       |
| 1989    | --       | XX         | --           | 4,950,000        | 25,000    | 416      | 1,080,000 | 3,800,000    | --                   | --            | 4,000       | 12,700         | 627,000       | --       |
| 1990    | --       | XX         | --           | 4,620,000        | 12,500    | --       | 836,000   | 3,800,000    | --                   | --            | --          | 10,800         | 573,000       | --       |
| 1991    | --       | XX         | --           | 5,100,000        | 10,000    | --       | 940,000   | 3,800,000    | --                   | --            | --          | 6,000          | 564,000       | --       |
| 1992    | --       | 121,000    | --           | 3,360,000        | 10,000    | --       | 759,000   | XX           | 1,000                | --            | --          | XX             | 522,000       | --       |
| 1993    | --       | 121,000    | --           | 2,840,000        | 11,500    | --       | 767,000   | XX           | 19,000               | --            | --          | XX             | 252,000       | --       |
| 1994    | --       | 143,000    | --           | 3,640,000        | 25,000    | --       | 1,270,000 | XX           | 55,000               | --            | 63,000      | XX             | 517,000       | --       |
| 1995    | --       | 151,000    | --           | 5,090,000        | 45,000    | --       | 2,080,000 | XX           | 37,000               | --            | 25,000      | XX             | 707,000       | --       |
| 1996    | --       | 96,700 9/  | --           | 5,078,000        | 12,000 e/ | --       | 1,279,032 | XX           | 56,000               | --            | 37,000      | XX             | 697,311 9/    | --       |
| 1997    | --       | 150,000 e/ | --           | 6,162,000        | 30,500 e/ | --       | 1,702,633 | XX           | 61,000 e/            | --            | 51,000      | XX             | 670,000 e/    | --       |
| 1998    | --       | 130,000 e/ | --           | 6,480,000        | 20,000 e/ | --       | 1,404,470 | XX           | 76,886               | --            | 54,000      | XX             | 605,000 e/    | --       |
| 1999    | --       | 100,000 e/ | --           | 6,817,050        | 10,000 e/ | --       | 770,352   | XX           | 60,000               | --            | 48,300 r/   | XX             | 654,000 r/ e/ | --       |
| 2000 e/ | --       | 100,000    | --           | 6,620,754 9/     | 10,000    | --       | 1,000,000 | XX           | 60,000               | --            | 55,000      | XX             | 640,000       | --       |

e/ Estimated. r/ Revised. NA Not available. XX Not applicable. -- Zero.

1/ Chromite ore production was reported by country starting in the 1911 Chromite Minerals Yearbook chapter (reporting production for the years 1906 through 1910) when production was reported in metric tons. Chromite ore production by country has since been reported continually in the Chromite Minerals Yearbook chapters from 1946 through 1996 and in its successor, the Chromium Minerals Yearbook chapters since 1947. In the 1958 Chromium Minerals Yearbook chapter, chromite ore production by country was reported in units of short tons from 1900 through 1958 time period. From 1959 through 1970, chromite ore production by country was reported in short tons. From 1971 through 1987, chromite ore production by country was reported in thousands of metric tons. Since 1988 (1984 year-of-data), chromite ore production has been reported in metric tons. Country chromite ore production data presented here are those reported in the Minerals Yearbook chapters from short to metric tons where necessary and rounded to thousand tons from 1969 through 1983, and rounded to no more than three significant digits from 1900 through 1968 and from 1989 to 1995. Since unrounded data were not available before 1996, world production was computed from country production converted in units but not yet rounded; world production was then rounded to no more than three significant digits. From 1996 through 2000, chromite ore world production and estimated country production were rounded to no more than three significant digits. From 1996 through 2000, chromite ore world production and estimated country production were rounded to no more than three significant digits. Chromite ore production by country from 1900 through 1949 came from the 1958 chapter remainder, from chromium chapters.

2/ Figures for all countries represent marketable output unless otherwise noted.

3/ Direct shipping plus concentrate production from 1995 through 2000.

4/ Average Cr<sub>2</sub>O<sub>3</sub> content was as follows: 1996--42.2%; 1997--37.4%; 1998-99--45% (revised); and 2000--45%.

5/ Less than 500 short tons.

6/ Production estimates as exports from 1950 through 1960.

7/ Egypt reported as United Arab Republic from 1956 through 1961.

8/ Kazakhstan formerly part of the U.S.S.R. from 1900 through 1991.

9/ Reported figure.

10/ Macedonia reported as Yugoslavia from 1900 through April 1992.

11/ Madagascar reported as Malagasy Republic from 1950 through 1974.

12/ Pakistan reported with India from 1900 through 1946.

13/ Russia reported as the U.S.S.R. from 1900 through 1991.

14/ South Africa reported as the Union of South Africa from 1900 through 1957.

15/ The U.S.S.R. dissolved in December 1991.

16/ Reported as North Vietnam from 1959 through 1961.

17/ Yugoslavia part of Austria-Hungary from 1900 through 1917; Kingdom of the Serbs, Croats and Slovenes from 1918 through 1945; and Yugoslavia from 1946 through April 1992.

18/ Zimbabwe reported as Southern Rhodesia from 1900 through 1960 and 1960 through 1975, and as Federation of Rhodesia and Nyasaland from 1961 through 1975.

19/ Production not reported by country includes data from Afghanistan, Argentina, Brazil, Bulgaria, Canada, Guatemala, India, Iran, Iraq, Jordan, Lebanon, Mexico, Norway, Portugal, Romania, Sweden, and the United Kingdom from 1900 through 1949; Bulgaria and Romania from 1950 through 1962; and North Vietnam for 1962.

Source: U.S. Geological Survey and U.S. Bureau of Mines publications, including Mineral Resources of the United States, Minerals Yearbooks, Commodity Data Summaries, and Mineral Commodity Summaries.

TABLE 15  
FERROCHROMIUM: WORLD PRODUCTION, BY COUNTRY 1/

(Metric tons, gross weight)

| Year    | World total  | Albania    | Australia | Brazil       | Chile  | China         | Croatia 2/ |
|---------|--------------|------------|-----------|--------------|--------|---------------|------------|
| 1974    | 1,855,000    | --         | 4,000     | 38,000       | --     | --            | XX         |
| 1975    | 1,695,000    | --         | 4,000     | 53,000       | --     | --            | XX         |
| 1976    | 2,136,000    | --         | --        | 60,000       | --     | 59,000        | XX         |
| 1977    | 2,419,000    | --         | --        | 66,000       | --     | 73,000        | XX         |
| 1978    | 2,649,000    | --         | --        | 63,000       | --     | 91,000        | XX         |
| 1979    | 2,996,000    | NA         | --        | 84,000       | --     | 91,000        | XX         |
| 1980    | 2,858,000    | 4,000      | --        | 93,000       | --     | 118,000       | XX         |
| 1981    | 2,649,000    | 28,000     | --        | 119,000      | --     | 118,000       | XX         |
| 1982    | 2,306,000    | 30,000     | --        | 97,000       | --     | 118,000       | XX         |
| 1983    | 2,370,000    | 35,000     | --        | 77,000       | --     | 118,000       | XX         |
| 1984    | 2,830,000    | 40,000     | --        | 125,000      | --     | 118,000       | XX         |
| 1985    | 2,974,000    | 43,000     | --        | 127,000      | --     | 122,000       | XX         |
| 1986    | 3,210,000    | 46,000     | --        | 109,000      | --     | --            | XX         |
| 1987    | 3,310,000    | 26,300     | --        | 105,000      | 475    | NA            | XX         |
| 1988    | 3,800,000    | 33,700     | --        | 130,000      | 2,210  | NA            | XX         |
| 1989    | 3,890,000    | 38,800     | --        | 113,000      | 2,840  | 180,000       | XX         |
| 1990    | 3,760,000    | 24,000     | --        | 83,800       | 1,870  | 340,000       | XX         |
| 1991    | 3,880,000    | 25,000     | --        | 82,200       | 2,510  | 380,000       | XX         |
| 1992    | 3,620,000    | 21,700     | --        | 91,100       | 2,110  | 410,000       | 56,500     |
| 1993    | 3,270,000    | 35,600     | --        | 83,900       | 680    | 372,000       | 27,300     |
| 1994    | 3,700,000    | 33,800     | --        | 77,100       | 1,580  | 370,000       | 31,700     |
| 1995    | 4,710,000    | 43,000     | --        | 101,000      | 2,730  | 500,000       | 26,100     |
| 1996    | 3,950,000    | 31,189     | --        | 77,231 3/    | 2,079  | 423,000 e/    | 10,559     |
| 1997    | 4,830,000 r/ | 31,144 r/  | --        | 74,485 r/ 3/ | -- r/  | 480,000 e/    | 24,231     |
| 1998    | 4,750,000 r/ | 30,252 r/  | --        | 72,507 r/ 3/ | -- r/  | 424,000 e/    | 11,770     |
| 1999    | 4,930,000 r/ | 28,120 r/  | --        | 90,784 r/ 3/ | -- r/  | 400,000 e/    | -- r/      |
| 2000 e/ | 5,130,000    | 9,900      | --        | 91,000 3/    | --     | 450,000       | 15,753 4/  |
|         | Czecho-      |            |           |              |        |               |            |
| Year    | slovakia 5/  | Finland    | France    | Germany 6/   | Greece | India         | Iran       |
| 1974    | (7/)         | 48,000     | 112,000   | (7/)         | --     | 15,000        | --         |
| 1975    | (7/)         | 40,000     | 56,000    | (7/)         | --     | 10,000        | --         |
| 1976    | 30,000       | 40,000     | 102,000   | 89,000       | --     | 17,000        | --         |
| 1977    | 30,000       | 34,000     | 102,000   | 79,000       | --     | 18,000        | --         |
| 1978    | 30,000       | 44,000     | 93,000    | 75,000       | --     | 22,000        | --         |
| 1979    | 28,000       | 49,000     | 95,000    | 81,000       | --     | 22,000        | --         |
| 1980    | 27,000       | 53,000     | 44,000    | 77,000       | --     | 16,000        | --         |
| 1981    | 27,000       | 52,000     | 27,000    | 70,000       | --     | 32,000        | --         |
| 1982    | 25,000       | 54,000     | 38,000    | 62,000       | --     | 42,000        | --         |
| 1983    | 25,000       | 59,000     | 20,000    | 57,000       | 18,000 | 35,000        | --         |
| 1984    | 24,000       | 59,000     | 19,000    | 64,000       | 33,000 | 55,000        | --         |
| 1985    | 25,000       | 133,000    | 1,000     | 69,000       | 34,000 | 66,000        | --         |
| 1986    | 28,200       | 134,000    | 1,000     | 82,000       | 38,300 | 84,100        | --         |
| 1987    | 29,000       | 143,000    | 1,000     | 71,000       | 49,000 | 126,000       | --         |
| 1988    | 29,200       | 156,000    | 13,200    | 56,900       | 44,100 | 140,000       | --         |
| 1989    | 29,800       | 169,000    | 18,100    | 55,400       | 43,600 | 151,000       | --         |
| 1990    | 37,500       | 157,000    | 25,000    | 58,500       | 30,300 | 169,000       | --         |
| 1991    | 41,200       | 190,000    | 23,100    | 38,300       | 10,500 | 229,000       | --         |
| 1992    | 52,500       | 187,000    | 6,690     | 26,500       | --     | 193,000       | --         |
| 1993    | XX           | 218,000    | --        | 16,400       | --     | 228,000       | --         |
| 1994    | XX           | 254,000    | --        | 17,300       | --     | 251,000       | 7,150      |
| 1995    | XX           | 247,000    | --        | 21,700       | --     | 304,000       | 11,900     |
| 1996    | XX           | 227,811    | --        | 25,303       | --     | 261,666 8/    | 10,500     |
| 1997    | XX           | 236,652    | --        | 25,856       | --     | 286,973 8/    | 11,450     |
| 1998    | XX           | 230,906    | --        | 20,879       | --     | 345,125 8/    | 13,745     |
| 1999    | XX           | 256,290 r/ | --        | 16,960       | --     | 350,000 e/ 8/ | 13,680 r/  |
| 2000 e/ | XX           | 260,600 6/ | --        | 17,000       | --     | 352,000 8/    | 14,000     |

See footnotes at end of table.

TABLE 15--Continued  
FERROCHROMIUM: WORLD PRODUCTION, BY COUNTRY 1/

(Metric tons, gross weight)

| Year    | Italy     | Japan         | Kazakh-<br>stan 9/ | Mace-<br>donia 2/ | Mexico       | Norway           | Philippines              |
|---------|-----------|---------------|--------------------|-------------------|--------------|------------------|--------------------------|
| 1974    | 40,000    | 542,000       | XX                 | XX                | --           | 31,000           | --                       |
| 1975    | 44,000    | 486,000       | XX                 | XX                | --           | 27,000           | --                       |
| 1976    | 45,000    | 464,000       | XX                 | XX                | 4,000        | 32,000           | --                       |
| 1977    | 40,000    | 399,000       | XX                 | XX                | 3,000        | 23,000           | --                       |
| 1978    | 37,000    | 274,000       | XX                 | XX                | 5,000        | 15,000           | 10,000                   |
| 1979    | 43,000    | 366,000       | XX                 | XX                | 5,000        | 12,000           | 10,000                   |
| 1980    | 41,000    | 403,000       | XX                 | XX                | --           | 11,000           | 10,000                   |
| 1981    | 10,000    | 306,000       | XX                 | XX                | 3,000        | 12,000           | 10,000                   |
| 1982    | 36,000    | 328,000       | XX                 | XX                | 6,000        | 10,000           | 12,000                   |
| 1983    | 12,000    | 298,000       | XX                 | XX                | 3,000        | 4,000            | 27,000                   |
| 1984    | 13,000    | 318,000       | XX                 | XX                | 7,000        | 4,000            | 48,000                   |
| 1985    | 58,000    | 340,000       | XX                 | XX                | 6,000        | --               | 51,000                   |
| 1986    | 55,900    | 281,000       | XX                 | XX                | 2,670        | --               | 55,000                   |
| 1987    | 59,000    | 264,000       | XX                 | XX                | 6,300        | --               | 47,000                   |
| 1988    | 87,100    | 295,000       | XX                 | XX                | 9,300        | --               | 73,000                   |
| 1989    | 87,300    | 334,000       | XX                 | XX                | 2,570        | --               | 82,000                   |
| 1990    | 53,000    | 304,000       | XX                 | XX                | 275          | 60,000           | 55,700                   |
| 1991    | 47,200    | 279,000       | XX                 | XX                | 72           | 83,000           | 23,700                   |
| 1992    | 60,300    | 276,000       | 400,000            | 3,960             | 70           | 102,000          | 27,400                   |
| 1993    | 53,500    | 211,000       | 328,000            | 4,380             | --           | 80,000           | 11,900                   |
| 1994    | 22,700    | 193,000       | 373,000            | 3,160             | --           | 120,000          | 16,200                   |
| 1995    | 51,000    | 210,000       | 512,000            | 3,770             | --           | 148,000          | 50,500                   |
| 1996    | 29,915    | 193,695 3/    | 352,000            | 3,780             | --           | 108,900          | 6,736                    |
| 1997    | 11,295    | 186,432 3/    | 600,000            | 460               | --           | 145,124          | --                       |
| 1998    | 11,487    | 142,931 3/    | 535,000            | --                | --           | 174,678          | --                       |
| 1999    | 12,000 e/ | 119,777 3/    | 597,946            | --                | --           | 159,714          | --                       |
| 2000 e/ | 12,000    | 130,074 3/ 4/ | 640,000            | --                | --           | 165,000          | --                       |
| Year    | Poland    | Romania       | Russia 9/          | Slovakia 10/      | Slovenia 10/ | South<br>Africa  | Southern<br>Rhodesia 11/ |
| 1974    | (7/)      | --            | XX                 | XX                | XX           | 184,000          | 181,000                  |
| 1975    | (7/)      | --            | XX                 | XX                | XX           | 217,000          | 200,000                  |
| 1976    | 50,000    | --            | XX                 | XX                | XX           | 350,000          | 186,000                  |
| 1977    | 50,000    | --            | XX                 | XX                | XX           | 350,000          | XX                       |
| 1978    | 47,000    | --            | XX                 | XX                | XX           | 660,000          | XX                       |
| 1979    | 49,000    | --            | XX                 | XX                | XX           | 780,000          | XX                       |
| 1980    | 47,000    | 34,000        | XX                 | XX                | XX           | 800,000          | XX                       |
| 1981    | 41,000    | 36,000        | XX                 | XX                | XX           | 753,000          | XX                       |
| 1982    | 35,000    | 39,000        | XX                 | XX                | XX           | 472,000          | XX                       |
| 1983    | 48,000    | 42,000        | XX                 | XX                | XX           | 675,000          | XX                       |
| 1984    | 48,000    | 45,000        | XX                 | XX                | XX           | 867,000          | XX                       |
| 1985    | 49,000    | 44,000        | XX                 | XX                | XX           | 852,000          | XX                       |
| 1986    | 36,200    | 44,000        | XX                 | XX                | XX           | 870,000          | XX                       |
| 1987    | 35,900    | 42,000        | XX                 | XX                | XX           | 965,000          | XX                       |
| 1988    | 36,300    | 23,400        | XX                 | XX                | XX           | 994,000          | XX                       |
| 1989    | 28,200    | 26,800        | XX                 | XX                | XX           | 1,050,000        | XX                       |
| 1990    | 13,700    | 20,600        | XX                 | XX                | XX           | 1,020,000        | XX                       |
| 1991    | 1,930     | 20,400        | XX                 | XX                | XX           | 1,150,000        | XX                       |
| 1992    | 35,300    | 6,970         | 400,000            | XX                | 17,100       | 771,000          | XX                       |
| 1993    | 38,400    | 3,910         | 256,000            | 50,600            | 8,810        | 834,000          | XX                       |
| 1994    | 7,350     | 3,890         | 266,000            | 48,600            | 13,400       | 1,100,000        | XX                       |
| 1995    | 18,300    | 15,100        | 290,000            | 65,300            | 23,200       | 1,520,000        | XX                       |
| 1996    | 1,100 r/  | 9,650         | 135,000 e/         | 19,900            | 22,819       | 1,478,000 12/    | XX                       |
| 1997    | 6,200 r/  | 950           | 247,000 e/         | 11,394            | 9,232        | 1,939,500 12/    | XX                       |
| 1998    | 4,200 r/  | 873           | 203,000            | 11,715            | 10,621       | 2,025,300 12/    | XX                       |
| 1999    | 3,500 e/  | --            | 249,000            | 6,986             | 560          | 2,155,202 r/ 12/ | XX                       |
| 2000 e/ | 3,500     | --            | 274,000            | 7,000             | 600          | 2,200,000 12/    | XX                       |

See footnotes at end of table.

TABLE 15--Continued  
FERROCHROMIUM: WORLD PRODUCTION, BY COUNTRY 1/

(Metric tons, gross weight)

| Year    | Spain  | Sweden  | Turkey     | U.S.S.R. 13/ | United States | Yugo-<br>slavia 14/ | Zim-<br>babwe 11/ |
|---------|--------|---------|------------|--------------|---------------|---------------------|-------------------|
| 1974    | 22,000 | 101,000 | 9,000      | 184,000      | 306,000       | 39,000              | XX                |
| 1975    | 18,000 | 93,000  | 9,000      | 206,000      | 179,000       | 54,000              | XX                |
| 1976    | 20,000 | 116,000 | 25,000     | 210,000      | 195,000       | 43,000              | XX                |
| 1977    | 16,000 | 134,000 | 35,000     | 535,000      | 197,000       | 36,000              | 200,000           |
| 1978    | 14,000 | 166,000 | 40,000     | 553,000      | 160,000       | 51,000              | 200,000           |
| 1979    | 20,000 | 190,000 | 30,000     | 553,000      | 224,000       | 65,000              | 200,000           |
| 1980    | 16,000 | 144,000 | 32,000     | 390,000      | 167,000       | 69,000              | 260,000           |
| 1981    | 17,000 | 146,000 | 41,000     | 400,000      | 149,000       | 69,000              | 184,000           |
| 1982    | 15,000 | 117,000 | 40,000     | 415,000      | 83,000        | 51,000              | 180,000           |
| 1983    | 14,000 | 120,000 | 30,000     | 415,000      | 18,000        | 64,000              | 158,000           |
| 1984    | 14,000 | 134,000 | 48,000     | 420,000      | 86,000        | 63,000              | 178,000           |
| 1985    | 17,000 | 135,000 | 50,000     | 420,000      | 100,000       | 73,000              | 156,000           |
| 1986    | 14,000 | 126,000 | 50,000     | 798,000      | 95,600        | 68,600              | 187,000           |
| 1987    | 16,000 | 112,000 | 52,500     | 806,000      | 107,000       | 56,300              | 187,000           |
| 1988    | 25,400 | 143,000 | 54,000     | 1,050,000    | 120,000       | 93,300              | 190,000           |
| 1989    | 29,000 | 154,000 | 59,700     | 828,000      | 147,000       | 90,400              | 173,000           |
| 1990    | 15,000 | 118,000 | 62,000     | 700,000      | 109,000       | 82,700              | 222,000           |
| 1991    | 6,000  | 121,000 | 84,700     | 700,000      | 68,300        | 91,000              | 187,000           |
| 1992    | --     | 133,000 | 85,800     | XX           | 60,900        | --                  | 191,000           |
| 1993    | 2,390  | 128,000 | 90,000     | XX           | 63,000        | --                  | 124,000           |
| 1994    | 2,300  | 134,000 | 97,600     | XX           | 67,400        | --                  | 183,000           |
| 1995    | 1,320  | 130,000 | 94,300     | XX           | 72,500        | --                  | 254,000           |
| 1996    | 805    | 138,110 | 101,450    | XX           | 36,800 15/    | --                  | 243,000           |
| 1997    | 490    | 101,842 | 108,320    | XX           | 60,700 15/    | --                  | 233,386           |
| 1998    | 1,145  | 123,958 | 110,175    | XX           | W 15/         | --                  | 246,782           |
| 1999    | 935    | 113,140 | 110,000 e/ | XX           | W 15/         | --                  | 244,379 r/        |
| 2000 e/ | 1,000  | 135,000 | 110,000    | XX           | W 15/         | --                  | 246,324 4/        |

e/ Estimated. r/ Revised. NA Not available. W Withheld to avoid disclosing company proprietary data. XX Not applicable. -- Zero.

1/ Ferrochromium production was reported by country starting in the 1976 Ferroalloys Minerals Yearbook Chapter (data series starting in 1974 ) as part of the world ferroalloy production table. Ferrochromium production was reported in units of thousand short tons from the 1976 chapter through the 1989 chapter. In the 1990 Ferroalloys Minerals Yearbook Chapter (1986 data), reporting units changed to metric tons. Ferrochromium production by country was added to the Chromium Minerals Yearbook Chapter in 1988 where production was reported for 1988 as thousand metric tons. Reporting ferrochromium production by country in the Chromium chapter lapsed for 2 years after which it was reintroduced in 1991 as a 5-year table (first year-of-data 1987) in units of metric tons. Ferrochromium production by country has since been reported in the Chromium chapter. In 1994, a policy of rounding data to no more than three significant digits was implemented. The policy applies to published data such as production for a specific country for a specific year. Information computed from that data, such as world production, is to be computed from unrounded data. Country ferrochromium production data presented here is that reported in the Minerals Yearbook Chapters converted from short to metric tons where necessary and rounded to thousand metric tons from 1974 through 1985 and rounded to no more than three significant digits from 1986 through 1995. Since unrounded data were not available before 1996, world production was computed from country production converted in units but not yet rounded; world production was then rounded to no more than three significant digits. From 1996 through 2000 ferrochromium world production, U.S. production, and estimated country production were rounded to no more than three significant digits.

2/ Croatia and Macedonia reported as part of Yugoslavia from 1974 through 1991.

3/ Includes high- and low-carbon ferrochromium.

4/ Reported figure.

5/ Czechoslovakia dissolved on December 31, 1992.

6/ Reported as East and West or Democratic and Federal Republic of Germany from 1974 through 1990.

7/ Undistributed.

8/ Includes ferrochrome and charge chrome.

9/ Kazakhstan and Russia reported as part of the U.S.S.R. from 1974 through 1991.

10/ Slovakia reported as part of Czechoslovakia from 1974 through 1992; Slovenia reported as part of Czechoslovakia from 1974 through 1991.

11/ Zimbabwe reported as Southern Rhodesia from 1974 through 1976.

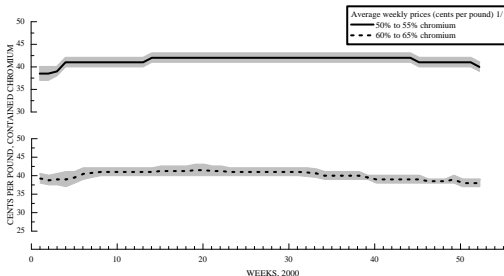
12/ Includes high- and low-carbon ferrochromium and ferrochromium silicon.

13/ The U.S.S.R. dissolved in December 1991.

14/ Yugoslavia dissolved in April 1992.

15/ Includes high- and low-carbon ferrochromium, ferrochromium silicon, chromium metal, and other chromium materials.

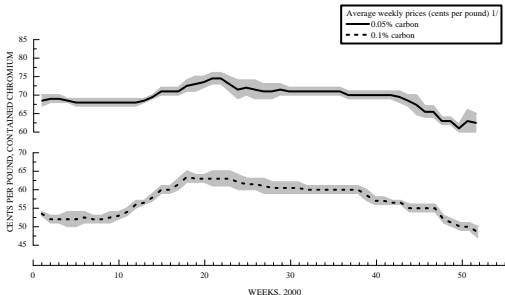
FIGURE 1  
U.S. IMPORTED HIGH-CARBON FERROCHROMIUM IN 2000



1/ Average weekly price shown against price range background.

Source: Platt's Metals Week

FIGURE 2  
U.S. IMPORTED LOW-CARBON FERROCHROMIUM IN 2000



1/ Average weekly price shown against price range background.

Source: Platt's Metals Week