MANGANESE

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Manganese is essential to iron and steel production by virtue of its sulfur-fixing, deoxidizing, and alloying properties. Steelmaking, including its ironmaking component, has accounted for most domestic manganese demand, presently in the range of 85% to 90% of the total demand. Among a variety of other uses, manganese is a key component of certain widely used aluminum alloys and is used in oxide form in dry cell batteries. The overall level and nature of manganese use in the United States is expected to remain about the same in the near term. No practical technologies exist for replacing manganese with other materials or for basing U.S. raw material supply on domestic deposits or other accumulations.

For U.S. foreign trade in manganese materials in 1998, volumes for all main categories of exports and imports generally increased compared with those of the prior year. On a content basis, the increase was 11% for imports overall. New record amounts of manganese dioxide and silicomanganese were received.

Prices decreased by roughly 2% for metallurgical-grade ore and by about 13% for silicomanganese. Year-average prices for ferromanganese increased by 2% for the high-carbon grade and 4% for the medium-carbon grade.

Activity in the Government's stockpile disposal program reduced the Government's inventory of manganese by about 6%, which still left an inventory of about 1.7 times annual domestic consumption. The larger disposals continued to be of metallurgical-grade ore and high- and medium-carbon ferromanganese.

In manganese-containing dry cell batteries, the feasibility of recycling such batteries by including them in the charge to steelmaking furnaces was shown. The alkaline form continued to dominate over those containing natural manganese dioxide.

World production of manganese ore was estimated to have decreased by about 6% to the lowest level since 1994, subject to uncertainties owing to the unavailability of firm data for China. (See table 1.) Significant portions of the world's manganese industry were available for sale during the year. Late in the year, the United Kingdom's Billiton Plc assumed control of a major South African producer of ores and ferroalloys and purchased Australia's main ore production and only ferroalloy production facilities. Joint ventures between Japanese and South African interests for production of refined manganese ferroalloys came on-stream in South Africa in the first part of the year.

Most data in this report are rounded by the U.S. Geological Survey (USGS) to three significant digits. Table footnotes will indicate which statistics have been rounded.

Legislation and Government Programs

The Annual Materials Plan (AMP) for fiscal year 1998 transmitted to the U.S. Congress on January 13 by the Defense Logistics Agency (DLA) remained the same as that proposed in February 1997. Under this AMP, which became effective on October 1, 1997, the maximum disposal authority for manganese materials for fiscal year 1998 was 18,144 metric tons (t) for natural battery-grade ore, 2,732 t for synthetic manganese dioxide, 36,287 t for chemical-grade ore, 226,796 t for metallurgical-grade ore, 45,359 t for the manganese ferro group, and 1,814 t for electrolytic manganese metal. The revised AMP for fiscal year 1999, which became effective October 19, 1998, specified the same maximum disposal authority for manganese materials as in the previous AMP.

During 1998, the DLA suspended offerings of high-carbon ferromanganese under DLA-FERROMANGANESE-001 after March 31 and for the remainder of the fiscal year. As of April 21, the DLA resumed sales of medium-carbon ferromanganese under DLA-FERROMANGANESE-002 and increased the quantity available for sale to include the entire remaining inventory of about 9,000 t. This quantity was sold early in June.

For 1998, disposals of manganese materials announced by the DLA totaled 8,981 t for natural battery-grade ore, 1,633 t for chemical-grade ore, 35,834 t for stockpile-grade metallurgical-grade ore, 141,347 t for nonstockpile-grade metallurgical-grade ore, 60,106 t for high-carbon ferromanganese, 8,582 t for medium-carbon ferromanganese, and 1,817 t for electrolytic metal. All disposals (sales) were cash transactions.

Data on physical inventory of manganese materials reported by the DLA indicated that all changes in 1998 were decreases and consisted of 5,883 t for natural battery-grade ore, 1,625 t for chemical-grade ore, 89,000 t for stockpile-grade metallurgical-grade ore, 288 t for nonstockpile-grade metallurgical-grade ore, 22,678 t for high-carbon ferromanganese, 14,243 t for medium-carbon ferromanganese, 5 t for silicomanganese, and 6,747 t for electrolytic metal. The estimated manganese content of manganese inventories being held by the Government at yearend was lowered by about 6%, to about 1.25 million metric tons (Mt). (See table 2.) Total

remaining inventory was about 1.7 times the current national apparent consumption.

Production

Ore and Concentrate.—No manganese was mined, including the small amounts of manganiferous material, such as has been produced for use in coloring brick.

Ferroalloys, Metal, and Synthetic Dioxide.—Production statistics for these materials were not published to avoid disclosing proprietary data. Elkem Metals Co.'s Marietta, OH, plant was the only domestic producer of manganese ferroalloys. (See table 3.) In January, Kerr-McGee Chemical LLC signed a letter of intent to sell its electrolytic and specialties businesses to Finnish Chemicals Oy (Ryan's Notes, 1998). The deal was called off, however, when negotiations between the two companies were terminated about 6 months later (Chemical Week, 1998b). The proposed sale would have included Kerr-McGee's plants for producing electrolytic manganese metal at Hamilton, MS, and electrolytic manganese dioxide (EMD) at Henderson, NV.

Consumption, Uses, and Stocks

Data relating to manganese end use and certain other information have indicated that metallurgical applications account for most domestic manganese consumption, 85% to 90% of which has been for steelmaking. This usage pattern is typical for most industrialized countries (Mining Magazine, 1990). Reported data for U.S. ore consumption in 1998 indicated that unit consumption of manganese in ironmaking, which could not be published to avoid disclosing proprietary data, was several times that for 1997 but still was a comparatively minor component of overall manganese use in steelmaking. Final reported data for U.S. consumption of manganese ferroalloys and metal were not available at the time this report was prepared. Relatively small quantities of manganese were used for alloying with nonferrous metals, chiefly in the aluminum industry as manganese-aluminum briquets that typically contained either 75% or 85% manganese. Use of the 85% grade continued to increase and appeared to have become greater than that of the 75% grade.

In 1998, domestic consumption of manganese ore decreased by about 2% to 499,000 t, and corresponding yearend stocks declined by almost 30%, to 196,000 t. Because of the need to avoid disclosing proprietary data, these figures do not include the relatively small quantities associated with ironmaking and cannot be disaggregated into end-use segments.

Comparatively small amounts of manganese were used domestically in animal feed, brick coloring, dry cell batteries, manganese chemicals, and plant fertilizers. These were among the many nonmetallurgical applications of manganese (Weiss, 1977; Harries-Rees, 1993; Major-Sosias, 1996). The source of manganese units for these applications was mainly manganese ore. Ownership of a plant in Pittsburg, KS, where manganese sulfate is made, changed when the Inspec Group plc of the United Kingdom was acquired in the latter part of 1998 by Laporte plc, also of the United Kingdom (Chemical Week, 1998c).

Data on domestic consumption of manganese ore, exclusive of that consumed within the steel industry, are collected by means of the Manganese Ore and Products survey. Approximately 15 firms were canvassed that process ore by such methods as grinding and roasting or that consume it in the manufacture of dry cell batteries and manganese ferroalloys, metal, and chemicals. The collective consumption of these firms is believed to constitute manganese ore consumption in the United States, exclusive of the steel industry. Full-year responses, or a basis upon which to estimate the data, were obtained from all these firms for 1998.

Alkaline cells in which EMD is used have become the dominant type of primary battery except in Asia and Africa, where the most popular battery type is still the carbon-zinc cell in which natural manganese dioxide is used. As of 1998, major manufacturers of batteries in Europe, Japan, and North America were offering improved alkaline cells for use in popular devices calling for high battery drains (Powers and MacArthur, p. 56-57).

Tests in the United States indicated that prospects are good for recycling manganese-containing dry cell batteries in steelmaking. Beginning in September 1997, Duracell International Inc. and Birmingham Steel Corp. cooperated in trials in which production scrap from Duracell's manufacture of alkaline batteries was incorporated into the charge for an electric furnace at Birmingham Steel's Birmingham, AL, plant. Addition of this scrap to the charge at rates of 1% to 3% was not found to affect properties of the steel produced and to give some benefit in reducing ferromanganese requirements. Duracell and Birmingham Steel have since formed a partnership whereby all the scrap from Duracell's U.S. alkaline battery plants would be recycled at Birmingham Steel. By means of this operation, which was put in place as of May 1998, more than 1,000 t of battery waste was expected to be recycled annually rather than landfilled. The rate at which mercury levels were dropping in discarded batteries suggested that recycling of postconsumer batteries by the steel industry could be feasible within about 10 years (Watson, Andersen, and Holt, 1998).

Prices

For 1998, with the price of manganese in metallurgical-grade ore taken as 1.0, the corresponding price per manganese unit was approximately 2.6 for high-carbon ferromanganese, 2.3 for silicomanganese, 3.7 for medium-carbon ferromanganese, and an estimated 9.5 for manganese metal. These price factors are based on year-average prices, which for ferroalloys and metal were derived from prices listed in Platt's Metals Week.

Manganese Ore.—The average price, on the basis of cost, insurance, and freight (c.i.f.) U.S. ports, of metallurgical-grade ore containing 48% manganese was assessed at $2.40 per metric ton unit (mtu). Prices can be somewhat above or below this value, depending on ore quality, time of year, and nature of the transaction. The price of 1 t of ore is obtained by multiplying the mtu price by the percentage manganese content of the ore; that is, by 48 when the manganese content is 48%.

The ore market consisted of a number of submarkets because of differences between ores according to such various end uses as ferroalloy production, blast furnace ironmaking, and battery manufacture.

Because the mtu is 1% of 1 t (i.e., 10 kilograms of contained manganese), the price of manganese in ore in 1998 and 1997 can be expressed as 24.0 and 24.4 cents per kilogram, respectively. These values indicate a decrease of about 1.6% in U.S. c.i.f. price or somewhat less than the decrease in free-on-board (f.o.b.) price in international markets.

This was the second consecutive year that the international benchmark price for metallurgical-grade ore decreased, this year by approximately 2%. Late in February, price negotiations were concluded between Japanese consumers and their major suppliers. On an f.o.b. basis per mtu for delivery during the annual contract year, the prices agreed to were $2.04 for ore from Australia's Broken Hill Pty. Co. Ltd. (BHP) and $1.95 for ore from South Africas Samancor Ltd. These new prices were not reflected in the prices published by Metal Bulletin and Platt's Metals Week; both publications continued to list price ranges for previous contract years.

Manganese Ferroalloys.—For high- and medium-carbon ferromanganese, prices rose in the first part of the year to a plateau that lasted 3 to 4 months; prices then declined in the final quarter of the year. For silicomanganese, a declining trend that persisted throughout the year was arrested briefly in June and September. These trends and the price information that follows pertain to quotations for U.S. imports because public information on current prices for domestic product was not available. English units were the basis for price quotes in the United States.

For ferromanganese, the price range for the high-carbon grade containing 78% manganese, per long ton of alloy f.o.b. Pittsburgh or Chicago warehouse, began and ended the year at $475 to $500 and $490 to $505, respectively, for a net overall increase of 2%. For the year, the average for the middle of the price range was $502, which was about 2% greater than that of 1997. In mid-July, the price range was at its highest, $505 to $530. The price range for medium-carbon ferromanganese with a manganese content of 80% to 85% and a nominal carbon content of 1.5%, per pound of manganese f.o.b. warehouse, was 37 to 41 cents and 40.25 to 41 cents at the beginning and end of the year, respectively, for a net overall increase of about 4%. The middle of the price range decreased again, averaging 40.7 cents for the year, or about 5% less than that of 1997. The rising trends in the first part of the year seemed to be related to expanding world steel production and selective cutbacks in foreign ferromanganese production. Declines in the latter part of the year seemed attributable to economic developments in such areas as Asia.

For imported silicomanganese with 2% carbon, the price range, per pound of alloy, f.o.b. Pittsburgh or Chicago warehouse, was 25.5 to 27.0 cents and 20 to 21 cents at the beginning and end of the year, respectively, for a net decrease of 22%. For the year, the average for the middle of the price range, 23.6 cents, represented a further annual decrease, about 13% below that of 1997. The steady fall in silicomanganese prices presumably denoted a continuing problem of oversupply.

Manganese Metal.—Trade journals continued to indicate no change during the year for producer price; for bulk shipments of domestic material, per pound f.o.b. shipping point, American Metal Market listed a range of $1.15 to $1.17, and Platt's Metals Week and Ryan's Notes listed $1.15. For its North American transaction price, Ryan's Notes indicated a decline during the year of about 7% as a result of several price decreases that took place mostly by July; for this quote, year-average price was about 22% less than producer list price.

Foreign Trade

Trade volumes, in terms of manganese units contained, increased for exports of ferromanganese and silicomanganese and for imports of all main categories of manganese materials compared with those of 1997. (See tables 4 and 5.) For all categories combined, the increase in imports was about 11%. Also on the basis of content, the ratio of imports of ferroalloy plus metal divided by imports of ore plus dioxide increased to 2.85:1, the greatest since 1993.

In 1998, the data for ore exports include a significant revision from figures originally reported by the Bureau of the Census. A total of 98,500 t was subsequently revised to only 8,200 t when it was found that quantities that had been reported as ore should have been classified as "manganese oxides, other," at much reduced gross weights. The pattern of the ore export data reported for 1997 and at least partly for 1996 is similar to that first reported for 1998. This suggests that the ore export data for 1996 and 1997 should be similarly revised, which for 1997 would give a total of about 7,000 t rather than 84,000 t.

Exports rose for ferromanganese overall (+17%) and silicomanganese (+25%), but those of metal (-28%) decreased compared with those of 1997. Exports of ferromanganese containing more than 2% carbon more than doubled to 8,040 t to account for almost three-fifths of total ferromanganese exports. Exports of ferromanganese containing less than 2% carbon fell by 31%.

Reexports of ore, ferromanganese, silicomanganese, and metal were, in tons, zero; 7,340; 6,240; and 119, respectively. Virtually all the reexports of manganese ferroalloys and about one-half of those of metal went to Canada.

Among imports, average manganese contents returned to typical levels for ore overall and ferromanganese; the average percentage contents were 48.1% for ore and 78.5% for ferromanganese. Gabon continued to be the dominant ore source, supplying about three-fifths of the total. Imports of low-carbon ferromanganese were the greatest since 1989; those from Italy were up by nearly one-half. Increases in imports of medium-carbon ferromanganese containing no more than 2% carbon from the Republic of Korea, which supplied significant quantities of manganese ferroalloys for the first time, and especially South Africa were significant. The volume of imports of silicomanganese rose to a new record—those from South Africa increasing by more than one-third; record volumes were received from Argentina, Australia, Georgia, Mexico, and South Africa. Reported imports of spiegeleisen (pig iron containing about 20% manganese) increased slightly

to 340 t, all from South Africa at high unit values.

Among imports of manganese chemicals, those of manganese dioxide advanced by 15% to a new record level; record amounts were received from South Africa (+83%) and Australia (+20%). All but 0.1% of imports of dioxide appeared to have been wholly synthetic material. Data for imports under the classification of "sulfates, other," suggested that imports of manganese sulfate could have increased by about 4% because the volume of imports of material in that class rose by 68% for China and decreased by 12% for Mexico. Receipts from China and Mexico were 7,590 t at a value of $3.0 million and 16,000 t at a value of $8.8 million, respectively.

In March, the International Trade Administration announced the final results of its antidumping duty administrative review of manganese metal from China for the period of review from June 14, 1995, through January 31, 1997 (International Trade Administration, 1998). The weighted-average margins determined ranged from 1.56% to 11.77% for specified shippers and were again 143.32% for all other Chinese suppliers.

In August, the U.S. International Trade Commission (USITC) dismissed a request from Eveready Battery Co. that a changed circumstances (section 751(b)) review be conducted of the USITC's prior affirmative determination for EMD from Greece and Japan (U.S. International Trade Commission, 1998). This previous determination had resulted in the imposition of antidumping duties on U.S. imports of EMD from Greece and Japan as of November 1988.

The Generalized System of Preferences program was allowed to expire after June 30, 1998, but in October, Congress approved its retroactive extension through June 30, 1999, as a part of the Omnibus Budget Bill. Along with the extension, reimbursement of duties paid during the period when the program was not in effect was approved also (Customs Service, 1998). Categories of U.S. imports from developing countries that may have been affected included manganese dioxide, permanganate, and sulfate; low- and medium-carbon ferromanganese; silicomanganese; and manganese metal, other.

World Review[1]

Leading producer countries among a relatively concentrated production of manganese ore were Australia, Brazil, China, Gabon, India, South Africa, and Ukraine. (See table 6.) Leading producer countries among a more widely distributed production of manganese ferroalloys were Brazil, China, France, India, Japan, Norway, South Africa, and Ukraine. (See table 7.)

Australia.—The monthly production reports of BHP indicated a manganese ore production of 1.50 Mt at BHP's Groote Eylandt Mining Co. Pty. Ltd. (GEMCO) subsidiary. Reversing a growing trend, this was the lowest level since 1993.

In relation to its manganese interests, BHP began the year by relinquishing control of the EMD plant of Australian Manganese Company Ltd. (AMCL), one of its subsidiaries, to South Africa's Delta Electrical Industries Ltd. in late January and ended it by disposing of its main manganese assets—the GEMCO mining operation and the manganese smelter of Tasmanian Electro Metallurgical Co. Pty. Ltd. (TEMCO), another subsidiary. GEMCO and TEMCO were sold in mid-December to Billiton. On December 1, just prior to this sale, BHP and Norway's Elkem ASA terminated a cooperation agreement made in 1993 under which they jointly managed two manganese smelters in Norway that Elkem had been operating and to which BHP had been supplying Australian ore.

In April, possible resumption of ore production in the Woodie Woodie area of the Pilbara Manganese Province in Western Australia was indicated by the reconstitution of Valiant Consolidated Ltd. as Consolidated Minerals Ltd. This successor company planned for a restart of production by the end of the first quarter of 1999.

Brazil.—Ore production by Cia. Vale do Rio Doce (CVRD) increased by about 14% overall. For the Azul Mine in the Carajás region and the Urucum Mine in Mato Grosso do Sul State, output in tons and percentage change in parentheses from 1997 were 1,310,000 (+19%) and 284,000 (-5%), respectively.

Beginning early in the year, CVRD contacted possible interested parties concerning sale to them of the manganese ferroalloy plants under the management of Vale-Usiminas Participações (VUPSA), in which CVRD was a joint venture partner. Such a sale could have included the Azul and Urucum Mines. None of these facilities were sold in 1998.

Canada.—The Government reversed itself in July and lifted the ban it had imposed approximately 1 year earlier on importation and interprovincial trade of methylcyclopentadienyl manganese tricarbonyl (MMT), an octane-enhancer for gasoline. In so doing, the Government said that scientific data were insufficient to prove that use of MMT constituted a risk to automobile emissions systems or human health. The Government also said that it would pay the Ethyl Corp. of the United States, a supplier of MMT, $13 million to compensate for costs and lost profits (Chemical Week, 1998a).

China.—In 1998, imports of manganese ore, which totaled 1.18 Mt decreased again, by about one-tenth from that of 1997.

Exports of manganese ferroalloys decreased by about one-fourth overall, to 428,000 t. Quantities exported and percentage changes in parentheses from 1997 were 121,000 t (+14%) for high-carbon ferromanganese, 9,900 t (-77%) for medium- and low-carbon ferromanganese, and 298,000 t (-31%) for silicomanganese. Exporting of silicomanganese was affected negatively by antidumping duties imposed by the European Commission and the Republic of Korea but positively for those removed by Japan (TEX Report, 1999).

Chinese authors made several presentations on the technology of manganese smelting at the 8th International Ferroalloys Congress (INFACON 8), which was held in Beijing in June. For blast furnace smelting of high-carbon

[1]Discussions by country of the more significant developments during 1998 were based in a number of instances on news items in trade journals, such as American Metal Market, Metal Bulletin [London], Platt's Metals Week, Ryan's Notes, and TEX Report [Tokyo]. These items have not been acknowledged individually because the information they conveyed often was aggregated, possibly with that from other sources.

ferromanganese, these dealt with the need to use this process for lean domestic ores (Zhang, 1998) and using sinter prepared from either domestic or foreign ores (Xiong and Liu, 1998). A two-step process that uses shaking ladles has been developed for the production of medium- and low-carbon ferromanganese (Fu, 1998).

France.—Demonstration of the technical feasibility of producing high-carbon ferromanganese in an electric furnace using 100% sinter produced from feed from the Azul Mine in Brazil was reported at INFACON 8. Trials for this were conducted at the Dunkirk plant of Société Européenne d'Alliages pour la Sidérurgie (SEAS) (Pais, Brown, and Saab, 1998).

Gabon.—Exports of manganese ore produced from the Moanda Mine of Compagnie Minière de l'Ogooué S.A. (COMILOG) totaled 2.06 Mt, of which 2.02 Mt was metallurgical-grade ore and 42,000 t was dioxide ore. Shipments were made in 83 cargoes via the port of Owendo (Skillings Mining Review, 1999). Total exports were about 3% greater than those of 1997; those of metallurgical-grade ore increased by almost 5%, and those of dioxide ore decreased by about one-third. Total exports were the greatest since 1990.

In September, COMILOG announced a plan to invest $80 million in new plants for beneficiation and sintering that would allow processing of ore fines accumulated since the Moanda Mine was opened in 1962. These facilities were to have an annual production capacity of 600,000 t for a high-manganese content (56%) sinter. Shipments of the sinter to Société du Ferromanganèse de Paris-Outreau (SFPO), a French subsidiary of COMILOG, were projected to begin in 2001. SFPO's use of the sinter was expected to improve the productivity of its plant for blast furnace production of high-carbon ferromanganese.

Georgia.—The Government's efforts to privatize the Chiatura Mine continued to be unsuccessful. In the first part of the year, Association of Industry, a Russian firm, won an investment tender for a 75% share in Chiaturmarganets, which managed the mine. The Government subsequently nullified the contract with Association of Industry and, late in the year, again tendered a 75% share (Interfax Mining & Metals Report, 1998a).

Ghana.—In November, a plant for treating oxide ore tailings accumulated over the years began operation at the Nsuta Mine of Ghana Manganese Co. Output of the new plant, which was expected to have a yield ranging from 50% to 75%, consisted of two grades of manganese products, one of which was a battery-grade concentrate having an average manganese content of 52.5%. The plant had a gravity treatment plant based on use of sorting spirals and had an hourly capacity of 65 t. It was developed by Germany's AKW Apparate + Verfahren Gmbh u. Co. KG (Industrial Minerals, 1999).

Indonesia.—The Government imposed provisional antidumping duties of 55% on imports of ferromanganese and silicomanganese from China for a 4-month period beginning October 19. This was the result of complaints from PT Interferro Mangando, Indonesia's only producer of manganese ferroalloys.

Japan.—Overall imports of metallurgical-grade manganese ore decreased by about 12%, to 980,000 t. For ore containing more than 39% manganese, imports decreased only marginally, to 897,000 t, 97% of which was from Australia and South Africa. Imports from South Africa increased by one-third, to 555,000 t, and those from Australia decreased by 14%, to 314,000 t. Imports of ore containing no more than 39% manganese fell by 60%, to 83,000 t, of which 80% was from South Africa and 20% was from India. Imports of ferruginous manganese ore decreased by about 7%, to 220,000 t. The sources for almost all of these imports were India (64%), Ghana (24%), and South Africa (11%).

Production decreased for all categories of manganese ferroalloys and overall by 11%; the total was the lowest so far in the 1990's. The largest decline, which was roughly one-fifth, was for production of low-carbon ferromanganese.

Overall imports of manganese ferroalloys declined by 12%, to 311,000 t; those of silicomanganese decreased by 22%, to 201,000 t; and those of ferromanganese (mainly high-carbon) increased by 15%, to 110,000 t. China (55%) and Ukraine (17%) were the two leading sources of silicomanganese. South Africa (58%) and China (24%) were the largest sources of high-carbon ferromanganese. Imports of 4,780 t of ferromanganese, other, were almost all from South Africa and reflected Japanese participation in the startup of joint ventures for production of refined manganese ferroalloys in South Africa.

Exports of manganese ferroalloys dropped overall by 41%, to 27,000 t, and to the United States by about 60%, to 5,700 t. Nearly 99% of these exports (26,700 t) were ferromanganese containing less than 2% carbon.

Production of manganese dioxide decreased by about 10%, to 52,300 t, the least since 1990. Exports of manganese dioxide decreased by 21%, to 26,000 t, the smallest quantity so far in the 1990's.

Imports of unwrought manganese metal, including scrap, declined more than 3%, to 39,200 t; China (64%), South Africa (33%), and the United States (3%) continued to be the sources for practically all metal imports.

Korea, Republic of.—In September, the Government imposed antidumping duties on silicomanganese from China that ranged from about 18% to 24.7% for certain exporters and established a program of setting floor prices for other Chinese suppliers. The duties were effective from the second week of March until 2003.

Mexico.—Overall salable production by Cía. Minera Autlán declined by about 4% for ore, although production rose by 11% for ferroalloys. Data for 1998 output of ore products, in metric tons and percentage changes in parentheses from 1997 were manganese carbonates, 85,000 (-21%); oxide nodules, 400,000 (+1%); and manganese dioxide, manganous oxide, and other oxides, 25,000 (-22%). Within a production of 193,000 t of manganese ferroalloys, production increased by 52% for high-carbon ferromanganese and 13% for medium-carbon ferromanganese but was unchanged for silicomanganese. Production quantities for oxide nodules and ferroalloys total were the greatest so far in the 1990's.

Industrias Sulfamex S.A. de C.V.'s plant near Tampico was being expanded so as to increase Sulfamex's capacity for production of manganese sulfate by 50%, to upgrade its sulfate

to a manganese content of 32%, and to enable Sulfamex to become a supplier of manganous oxide (Tetra Technologies Inc., 1998). Sulfamex was a subsidiary of the U.S.'s Tetra Technologies Inc., of The Woodlands, TX.

Norway.—As mentioned under Australia, on December 1, Elkem and BHP terminated the agreement under which they had been cooperatively managing the manganese smelters at Porsgrunn and Sauda.

Also in the latter part of the year, Tinfos Jernverk A/S stated that it planned to add a third furnace to its manganese ferroalloys plant at Kvinesdal in southern Norway. The addition would increase the plants annual capacity for silicomanganese by about 50%, from about 135,000 t at present. The new furnace, for which the needed infrastructure already was in place, would also be able to produce ferromanganese.

South Africa.—According to preliminary data, ore production decreased by about 2% for metallurgical-grade ore and total ore and by about 5% for chemical-grade ore. Total production, of which 99% was metallurgical-grade ore, was the least since 1994. Within the production of metallurgical-grade ore, the proportion accounted for by ore containing 30% to 40% manganese decreased slightly to 35% and that for ore containing more than 48% manganese returned to 58%.

For the fiscal year ending June 30, 1998, ore production by Samancor declined by about 9%, to 2.1 Mt, and ore sales by The Associated Manganese Mines of South Africa Ltd. (Assmang) rebounded to increase by about 30%, to 1.5 Mt. The deposits in the Kalahari manganese field (KMF) from which Assmang and Samancor were producing, as well as others in South Africa, were discussed in a review of South African manganese (Astrup and Tsikos, 1998). Geological questions yet to be answered as to the origin of the KMF were pointed out by Tsikos and Moore (1998).

At about the end of the first quarter of the year, the Advalloy and Cato Ridge Alloys (Pty.) Ltd. joint ventures for production of refined manganese ferroalloys began commercial operations. Both experienced startup problems that seemingly were resolved later on. For Advalloy, the South African partner was Samancor, and projected annual production capacity was about 80,000 t, and for Cato Ridge Alloys, these were Assmang and 30,000 t, respectively.

Ownership structure of the world's manganese mining and smelting operations underwent a significant change within a matter of a few days in December when Samancor was restructured as a joint venture between Billiton (60%) and Anglo American Corp. of South Africa Ltd. (40%) and when, as mentioned under Australia, GEMCO and TEMCO were sold to Billiton. As a result, Samancor became manager not only of its own substantial manganese assets, but also of the mine and smelter formerly owned by BHP. The transition to South African management of Australia's principal manganese operations began in January when Delta Electrical took over AMCL's EMD plant.

Ukraine.—Ore output decreased to 73% of the 1997 total—that by the Ordzhonikidze complex in the western part of the Nikopol' Basin declined by 13%, to 1.64 Mt and that by the Marganets complex in the eastern part of the basin dropped by about one-half, to only 589,000 t. Of the 1998 total, these outputs were 74% at the Ordzhonikidze complex and 26% at the Marganets complex (Interfax Mining & Metals Report, 1999). Problems at the Marganets complex led to a midyear decision to close one of its two beneficiation plants (Interfax Mining & Metals Report, 1998b).

Current Research and Technology

The metallurgical and nonmetallurgical aspects of the manganese industry, including geology, mineralogy, ore deposits, and markets, were discussed by Harben, Raleigh, and Harris (1998).

Among reports dealing with manganese ore, Gutzmer and Beukes (1998) presented new information on the origin of Penganga Group deposits in Andhra Pradesh State, India, from which manganese was being extracted on a small scale. Tests of calcination of carbonate manganese ore from the Denîzlî-Tavas region of Turkey showed that its manganese content could be increased from 31% to 36% (Gevecî and others, 1998). The importance of taking into account possible hygroscopic effects when analyzing an ore was demonstrated for samples of Australian ore from Groote Eylandt (Merritt, 1998).

Pyrometallurgical and hydrometallurgical methods of treating marine manganese nodules were reviewed by Han (1998).

Investigations relating to manganese smelting included a thermodynamic assessment of the liquid iron-manganese-carbon system (Lee, 1998), the application of a thermodynamic model to ferromanganese smelting (Li, Morris, and Robertson, 1998), development of methodology for estimating emissions of CO_2 for recent practices for smelting manganese ferroalloys in Norway (Olsen, Monsen, and Lindstad, 1998), technology for dephosphorizing manganese ferroalloys as it applies to Ukrainian practices (Dashevskii and others, 1998), and laboratory studies conducted in India on recovery of manganese values from ferromanganese slag (Mohanty and others, 1998).

Studies concerned with the behavior of manganese in steelmaking included a set of papers dealing with the thermodynamics associated with direct addition of manganese ore into steel in steelmaking via the basic oxygen furnace (Sobandi, Katayama, and Momono, 1998a, b, c) and investigation of optimizing practices for alloying manganese into stainless steel (Norberg, Eriksson, and Torssell, 1998).

The potential of manganese-based sorbents for high-temperature desulfurization of coal gas was investigated; the sorbents were prepared using manganese acetate (Bakker and others, 1998).

Electrochemical and other applications of manganese oxides, especially the dioxide, were the focus of a review of porous manganese oxides (Brock and others, 1998) and of studies of preparation of manganese dioxide from sulfate electrolytes to which fluoride ion had been added (Ivanova and others, 1998) and of lithium-manganese-copper spinels as cathodes for lithium batteries (Ein-Eli and others, 1998a, b).

Toxicity aspects of manganese were reviewed for plants (El-Jaoual and Cox, 1998) and investigated for fumes arising in

shipyard welding (Castner and Null, 1998).

Studies were conducted on the availability of manganese from tea (Powell, Burden, and Thompson, 1998) and its chemical form in tea beverages (Özdemir and Güçer, 1998).

Outlook

The trend of domestic and global demand for manganese will continue to follow closely that of steel production. Although the growth rates for some nonmetallurgical components of manganese demand, especially batteries, may be higher than for steel production, this situation will have only a minor effect on overall manganese demand.

From 1986 to 1997, U.S. apparent consumption of manganese generally has been within about plus or minus 10% of 670,000 t of contained manganese. This largely has been a consequence of a reasonably comparable degree of variation in domestic steel production. During this period, manganese apparent consumption (see table 1) has tended to increase at about the same rate as raw steel production. Manganese apparent consumption may not have tracked steel production precisely because of the influence of unmeasured changes in stocks of manganese materials, such as those of importers. The effect of this may have outweighed changes in demand by steelmakers and may explain why the calculated apparent consumptions for 1996 and 1997 were higher and lower, respectively, than expected.

Data of the American Iron and Steel Institute indicated that overall domestic raw steel production in 1998 was virtually unchanged from that of 1997, which suggests that domestic manganese consumption for 1998 also changed little. Economic uncertainties make it difficult to project the course of manganese consumption during the short term. This is exemplified in the changes during 1998 and the first part of 1999 in forecasts of steel demand by the International Iron and Steel Institute (IISI) (Metal Bulletin, 1999). Assuming that the effect of imports on U.S. raw steel production abates and that steel production does not fall much below the present 1.4% annual growth rate, U.S. manganese consumption in 1999-2000 will be in the high end of the range from 670,000 to 770,000 t. This outlook also assumes no significant change in manganese unit consumption by U.S. steelmakers. The majority of U.S. demand for manganese units will be met by imports.

In its October 1998 forecast, the IISI gave no midterm outlook for the world's steel demand, but provided a broad-range estimate for 2005 that corresponded to an annual growth rate of about 1.5% between 1998 and 2005 (Gavaghan, 1998). The same growth rate was projected for the world's crude steel production in a long-term forecast by one of the world's larger suppliers of iron ore (TEX Report, 1998). Because of the strong link between manganese demand and steel production, the trend in global manganese demand also can be expected to be about 1.5%. The IISI forecast indicates that growth in steel demand will be particularly large in China.

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TABLE 1
SALIENT MANGANESE STATISTICS 1/

(Thousand metric tons, gross weight)

	1994	1995	1996	1997	1998
United States:					
Manganese ore (35% or more Mn):					
Exports	15	15	32	84	8
Imports for consumption	331	394	478	355 r/	332
Consumption	449	486	478 2/	510 2/	499 2/
Stocks, December 31: Consumers	269	309	319 2/	275 2/	196 2/
Ferromanganese:					
Exports	11	11	10	12	14
Imports for consumption	336	310	374	304	339
Consumption	347	348	326	337	NA
Stocks, December 31: Consumers and producers	36	33	27	21	NA
Consumption, apparent, manganese 3/	694	676	776	628	NA
Ore price, dollars per metric ton unit, c.i.f. U.S. ports	2.40	2.40	2.55	2.44	2.40
World production of manganese ore	18,000	23,300	24,300 r/	19,800 r/	18,700 e/

e/ Estimated. r/ Revised. NA Not available.
1/ Data are rounded to three significant digits, except prices.
2/ Exclusive of iron and steel plants.
3/ Thousand metric tons, manganese content. Based on estimates of average content for all significant components excepts imports, for which content is reported.

TABLE 2
U.S. GOVERNMENT DISPOSAL AUTHORITIES AND YEAREND
INVENTORIES FOR MANGANESE MATERIALS IN 1998 1/

(Metric tons, gross weight)

		Physical inventory, December 31				
		Uncommitted				
Material	Disposal authority	Stockpile grade	Nonstockpile grade	Total	Sold, pending shipment	Grand total
Natural battery ore	113,000	96,400	16,800	113,000	3,630	117,000
Synthetic manganese dioxide	2,730	2,730	--	2,730	--	2,730
Chemical ore	146,000	146,000	81	146,000	--	146,000
Metallurgical ore	949,000	663,000	286,000	949,000	157,000	1,110,000
High-carbon ferromanganese	688,000	878,000	--	878,000	38,500	916,000
Medium-carbon ferromanganese	--	--	--	--	--	--
Silicomanganese	--	--	--	--	--	--
Electrolytic metal	6,750	6,750	--	6,750	--	6,750

1/ Data rounded to three significant digits; may not add to totals shown.

Source: Defense Logistics Agency.

TABLE 3
DOMESTIC PRODUCERS OF MANGANESE PRODUCTS IN 1998

		Products 1/				
Company	Plant location	FeMn	SiMn	Mn	MnO_2	Type of process
Chemetals Inc.	Baltimore, MD	--	--	--	X	Chemical.
Do.	New Johnsonville, TN	--	--	--	X	Electrolytic.
Elkem Metals Co.	Marietta, OH	X	X	X	--	Electric furnace and electrolytic.
Kerr-McGee Chemical LLC	Hamilton, MS	--	--	X	--	Electrolytic.
Do.	Henderson, NV	--	--	--	X	Do.
Ralston Purina Co., Eveready Battery Co.	Marietta, OH	--	--	--	X	Do.

1/ FeMn, ferromanganese; SiMn, silicomanganese; Mn, manganese metal; MnO_2, synthetic manganese dioxide.

TABLE 4
U.S. EXPORTS OF MANGANESE ORE, FERROALLOYS, AND METAL, BY COUNTRY 1/

Country	1997 Gross weight (metric tons)	1997 F.a.s. value (thousands)	1998 Gross weight (metric tons)	1998 F.a.s. value (thousands)
Ore and concentrates with 20% or more manganese:				
Belgium	10,400	$832	678	$109
Canada	3,410	904	2,690	713
Hong Kong	--	--	930	74
Mexico	61	7	2,870	294
Netherlands	16,400	1,320	--	--
Other	54,000 2/	4,330 2/	1,050	140
Total	84,300	7,390	8,210	1,330
Ferromanganese, all grades:				
Canada	10,300	7,610	13,100	7,770
Egypt	611	605	--	--
Japan	250	383	--	--
Mexico	487	548	494	444
Other	112	132	234	238
Total	11,800	9,270	13,800	8,450
Silicomanganese:				
Canada	4,700	2,780	6,240	3,740
Mexico	553	337	320	265
Other	107	165	165	191
Total	5,360	3,290	6,720	4,190
Metal, including alloys and waste and scrap:				
Belgium	402	989	20	40
Canada	1,200	3,210	1,480	3,710
France	1,370	3,180	698	1,480
Japan	1,150	2,700	838	1,930
Netherlands	958	2,850	1,020	2,920
United Kingdom	1,730	2,870	970	1,460
Other	1,090	2,900	684	1,670
Total	7,890	18,700	5,710	13,200

1/ Data are rounded to three significant digits; may not add to totals shown.
2/ Revised; unspecified group of countries differs from that in the 1997 Annual Report.

Source: Bureau of the Census.

TABLE 5
U.S. IMPORTS FOR CONSUMPTION OF MANGANESE ORE, FERROALLOYS, METAL,
AND SELECTED CHEMICALS, BY COUNTRY 1/

Country	1997 Gross weight (metric tons)	1997 Manganese content (metric tons)	1997 Customs value (thousands)	1998 Gross weight (metric tons)	1998 Manganese content (metric tons)	1998 Customs value (thousands)
Ore and concentrates with 20% or more manganese:						
All grades:						
Australia	31,300 r/	16,400 r/	$3,090	35,600	18,700	$3,370
Brazil	35,000	9,100	553	25,800	12,100	1,440
Gabon	208,000	99,400 r/	22,200	188,000	94,900	17,300
Ghana	--	--	--	15,300	4,940	410
Mexico	80,700 r/	30,100	4,930 r/	38,400	14,600	3,440
South Africa	--	--	--	27,400	13,800	1,750
Other	136 2/	70 2/ 3/	35 2/	1,710	934	143
Total	355,000 r/	155,000 r/	30,800 r/	332,000	160,000	27,800
More than 20%, but less than 47% manganese:						
Australia	--	--	--	40	40	24
Brazil	35,000	9,100	553	6,350	2,790	320
Gabon	(4/)	(4/)	(4/)	--	--	--
Ghana	--	--	--	15,300	4,940	410
Mexico	80,700	30,100	4,930	37,500	14,100	2,670
Total	116,000	39,200 r/	5,480 r/	59,200	21,900	3,430
47% or more manganese:						
Australia	31,300 r/	16,400 r/	3,090	35,500	18,600	3,340
Brazil	--	--	--	19,400	9,320	1,120
Gabon	208,000	99,400 r/	22,200 r/	188,000	94,900	17,300
South Africa	--	--	--	27,400	13,800	1,750
Other	136 2/	70 2/	35 2/	2,650	1,390	915
Total	240,000	116,000	25,300 r/	273,000	138,000	24,400
Ferromanganese:						
All grades:						
Australia	31,900	23,600	10,600	20,600	15,500	7,720
Brazil	39,100	29,900	16,600	7,870	5,900	3,570
China	7,760	6,300	6,330	12,700	9,730	6,150
France	65,200	50,700	27,500	81,500	63,700	34,400
Italy	4,940	4,370	7,060	7,190	6,370	9,890
Japan	13,700	11,100	10,200	9,630	8,100	8,100
Korea, Republic of	--	--	--	8,560	7,000	4,830
Mexico	31,200	25,000	22,200	25,700	20,700	15,900
Norway	4,200	3,270	2,770	7,120	5,710	4,430
South Africa	103,000	78,800	44,500	157,000	123,000	66,300
Other	2,900	2,230	1,280	1,040	881	579
Total	304,000	235,000	149,000	339,000	266,000	162,000
1% or less carbon:						
China	280	229	293	1,260	1,070	1,330
Italy	4,810	4,270	6,930	7,190	6,370	9,890
Japan	4,060	3,310	3,610	3,810	3,280	3,970
South Africa	2,160	1,980	3,830	2,220	2,050	3,860
Other	361 2/	181 2/	279 2/	20	16	18
Total	11,700	9,970	14,900	14,500	12,800	19,100
More than 1% to 2% or less carbon:						
Japan	9,660	7,760	6,570	5,820	4,820	4,130
Korea, Republic of	--	--	--	8,560	7,000	4,830
Mexico	31,200	25,000	22,200	25,700	20,700	15,900
Norway	3,850	3,100	2,520	7,120	5,710	4,430
South Africa	120	94	112	13,600	11,000	8,090
Other	13,500 2/	11,000 2/	10,300 2/	4,500	3,660	2,770
Total	58,300	46,900	41,700	65,200	52,800	40,200
More than 2%, but not more than 4% carbon:						
Canada	101	40	13	--	--	--
China	7	6	12	78	67	89
Total	108	47	25	78	67	89

See footnotes at end of table.

TABLE 5--Continued
U.S. IMPORTS FOR CONSUMPTION OF MANGANESE ORE, FERROALLOYS, METAL, AND SELECTED CHEMICALS, BY COUNTRY 1/

Country	1997 Gross weight (metric tons)	1997 Manganese content (metric tons)	1997 Customs value (thousands)	1998 Gross weight (metric tons)	1998 Manganese content (metric tons)	1998 Customs value (thousands)
Ferromanganese:						
More than 4% carbon:						
Australia	31,900	23,600	$10,600	20,600	15,500	$7,720
Brazil	33,300	25,300	12,500	5,990	4,390	2,330
France	65,200	50,700	27,500	81,500	63,700	34,400
South Africa	101,000	76,700	40,600	142,000	110,000	54,300
Other	2,660	2,070	1,160	9,780	7,320	3,780
Total	234,000	178,000	92,400	259,000	201,000	103,000
Silicomanganese:						
Argentina	4,520	2,940	1,950	17,000	11,100	7,400
Australia	50,700	34,300	23,400	57,100	37,600	24,800
France	12,300	7,930	6,450	8,750	5,920	4,300
Georgia	9,630	7,030	4,840	20,300	14,500	8,970
India	29,900	20,000	14,700	41,900	27,600	19,200
Macedonia	4,300	2,930	2,370	10,200	7,000	4,670
Mexico	40,600	26,600	20,200	41,100	26,900	19,600
Romania	11,100	7,240	5,500	--	--	--
Russia	12,000	6,370	6,490	2,540	1,650	1,150
South Africa	87,400	58,700	42,900	118,000	79,500	52,900
Ukraine	7,490	5,660	4,360	--	--	--
Venezuela	25,700	16,900	12,300	17,700	11,600	8,100
Other	10,400 2/	6,660 2/	6,320 2/	12,100	7,620	7,570
Total	306,000	203,000	152,000	346,000	231,000	159,000
Metal:						
Unwrought:						
China	3,260	XX	4,970	3,230	XX	4,850
Russia	(4/)	XX	(4/)	150	XX	169
South Africa	9,500	XX	15,800	10,300	XX	16,300
Ukraine	981 r/	XX	1,270 r/	564	XX	895
Other	282 2/	XX	550 2/	339	XX	613
Total	14,000	XX	22,600	14,600	XX	22,800
Other:						
China	262	XX	375	32	XX	34
France	110	XX	1,000	122	XX	904
Mexico	61	XX	113	101	XX	177
United Kingdom	(5/)	XX	2	438	XX	952
Other	31 2/	XX	284 2/	50	XX	374
Total	465	XX	1,780	744	XX	2,440
Waste and scrap:						
Canada	85	XX	51	135	XX	115
China	40	XX	77	43	XX	12
Mexico	47	XX	34	37	XX	77
Other	54	XX	55	--	XX	--
Manganese dioxide:						
Australia	18,700	XX	26,300	22,500	XX	32,100
Belgium	743	XX	1,240	845	XX	1,350
China	732	XX	871	19	XX	22
Ireland	5,910	XX	8,310	5,280	XX	7,220
South Africa	2,360	XX	3,280	4,320	XX	6,150
Other	353	XX	929	180	XX	859
Total	28,800	XX	40,900	33,100	XX	47,700
Potassium permanganate:						
Czech Republic	630	XX	1,240	569	XX	1,110
Germany	303	XX	537	205	XX	345
India	278	XX	490	251	XX	408
Spain	374	XX	866	175	XX	391
Other	90	XX	175	36	XX	90
Total	1,680	XX	3,310	1,240	XX	2,340

See footnotes at end of table.

TABLE 5--Continued
U.S. IMPORTS FOR CONSUMPTION OF MANGANESE ORE, FERROALLOYS, METAL,
AND SELECTED CHEMICALS, BY COUNTRY 1/

r/ Revised. XX Not applicable.
1/ Data are rounded to three significant digits; may not add to totals shown.
2/ Revised; unspecified group of countries differs from that in the 1997 Annual Report.
3/ Includes U.S. Geological Survey's conversion of part of reported data (from apparent MnO_2 content to Mn content).
4/ Revised to zero.
5/ Less than 1/2 unit.

Source: Bureau of the Census, adjusted by the U.S. Geological Survey.

TABLE 6
MANGANESE ORE: WORLD PRODUCTION, BY COUNTRY 1/ 2/

(Thousand metric tons)

Country 3/	Range percent Mn e/ 4/	1994	1995	1996	1997	1998 e/
Gross weight:						
Australia 5/	37-53	1,920 e/	2,177	2,109	2,136	1,500 6/
Brazil 7/ 8/	30-50	2,199	2,398	2,506	2,124 r/	2,100
China e/ 9/	20-30	3,570	6,900	7,600	3,700 r/	4,000
Gabon 7/ 10/	45-53	1,436	1,930	1,980 e/	1,900 r/	2,092 6/
Ghana 7/	30-50	270	217	448 r/	437 r/	450
India 7/ 11/	10-54	1,632	1,764	1,797	1,800 e/	1,600
Kazakhstan 7/ (crude ore) e/	20-30	400	428	430	400	561 6/
Mexico 7/ 12/	27-50	307	472 e/	485	534	510
South Africa 7/ 10/	30-48+	2,851	3,199	3,240	3,121 r/	3,044 6/
Ukraine 7/	30-35	2,979	3,200	3,070	3,040	2,226 6/
Other 13/	XX	454 r/	624 r/	648 r/	621 r/	626
Total	XX	18,000	23,300	24,300 r/	19,800 r/	18,700
Metal content: e/						
Australia 5/	37-53	944	1,066 6/	1,023 6/	1,024 6/	729 6/
Brazil 7/ 8/	30-50	858	935	977	828 r/	819
China 9/	20-30	714	1,380	1,520	1,110 r/	1,200
Gabon 7/ 10/	45-53	663	891	915	879 r/	966
Ghana 7/	30-50	108	85 r/	152 r/	149 r/	144
India 7/ 11/	10-54	620	670	680	680	610
Kazakhstan 7/ (crude ore)	20-30	98	105	106	98	137
Mexico 7/ 12/	27-50	112	174	173	193 r/	187
South Africa 7/ 10/	30-48+	1,210	1,350	1,380	1,320 r/	1,300
Ukraine 7/	30-35	1,050	1,100	1,040	1,030	755
Other 13/	XX	149	216 r/	214 r/	193 r/	193
Total	XX	6,530 r/	7,980	8,180 r/	7,510 r/	7,040

e/ Estimated. r/ Revised. XX Not applicable.

1/ World totals and estimated data are rounded to three significant digits; may not add to totals shown.

2/ Table includes data available through June 18, 1999. Data pertain to concentrates or comparable shipping product, except that in a few instances the best data available appear to be for crude ore, possibly after some upgrading.

3/ In addition to the countries listed, Burkina Faso, Cuba, Panama, and Sudan may have produced manganese ore and/or manganiferous ore, but available information is inadequate to make reliable estimates of output levels.

4/ May be average content of each year's production rather than for content of typical products.

5/ Metallurgical ore.

6/ Reported figure.

7/ Gross weight reported; metal content estimated and rounded to three significant digits.

8/ Production of beneficiated ore as reported in Sumário Mineral (Brasilia).

9/ Includes manganiferous ore.

10/ Calculated metal content includes allowance for assumed moisture content.

11/ Much of India's production grades below 35% Mn.

12/ Mostly oxide nodules; may include smaller quantities of direct-shipping carbonate and oxide ores for metallurgical and battery operations.

13/ Category represents the combined totals of Bosnia and Herzegovina, Bulgaria, Burma, Chile, Colombia, Egypt, Georgia, Greece, Hungary, Indonesia, Iran, Italy (from wastes), Japan (low-grade ore), Malaysia, Morocco, Namibia, the Philippines, Romania, Russia (crude ore), Thailand, and Turkey.

TABLE 7
FERROMANGANESE AND SILICOMANGANESE: WORLD PRODUCTION, BY COUNTRY 1/ 2/

(Thousand metric tons, gross weight)

Country 3/	1994					1995				
	Ferromanganese			Silico-manganese	Grand total	Ferromanganese			Silico-manganese	Grand total
	Blast furnace	Electric furnace	Total			Blast furnace	Electric furnace	Total		
Argentina	--	5 r/	5 r/	29	34 r/	--	6	6	27	33
Australia e/	--	100	100	100	200	--	110	110	100	210
Belgium e/	--	25	25	--	25	--	25	25	--	25
Brazil	--	200	200	248	448	--	130 e/	130 e/	167 e/	297 e/
Chile	--	10 r/	10 r/	1	11 r/	--	8	8	2	10
China e/	567	350	917	657	1,570	400	605	1,005	830	1,840
Croatia e/	--	1	1	22	23	--	--	--	--	--
Egypt e/	--	35	35	--	35	--	35	35	--	35
France	294	66	360	66 e/	426 e/	348	85 r/	433 r/	71 e/	504 r/
Georgia e/	--	10	10	10	20	--	5	5	10	15
Germany e/ 4/	--	20	20	--	20	--	20	20	--	20
India e/	--	200	200	170	370	--	180	180	190	370
Indonesia e/	--	10	10	--	10	--	14	14	7	21
Italy	--	16 e/	16 e/	40 e/	56 e/	--	20	20	104	124
Japan	--	345	345	69	414	--	347	347	65	412
Kazakhstan e/	--	--	--	40	40	--	--	--	20	20
Korea, North e/ 4/	--	9 r/	9 r/	--	9 r/	--	7 r/	7 r/	--	7 r/
Korea, Republic of	--	120	120	89	209	--	119	119	98	217
Mexico 5/	--	67	67	64	131	--	58	58	68	126
Norway	--	249	249	197	446	--	213	213	210 e/	423 e/
Philippines e/	--	5	5	--	5	--	5	5	--	5
Poland	66	--	66	32	98	46	--	46	20	66
Romania e/	--	31	31	35	67	--	28	28	57	86
Russia	80 r/ e/	--	80 r/ e/	--	80 r/ e/	83 r/	--	83 r/	1 e/	83 r/
Slovakia e/	--	25	25	12	37	--	25	25	12	37
South Africa	--	591	591	290	881	--	507	507	251	758
Spain e/	--	35	35	35	70	--	25	25	50	75
Taiwan	--	1 r/	1 r/	--	1 r/	--	13 r/	13 r/	--	13 r/
Thailand	--	(6/)	(6/)	1	1	--	--	--	--	--
Ukraine e/	30	170	200	600	800	25	170	195	600	795
Venezuela	--	--	--	47	47	--	--	--	48	48
Total	1,040 r/	2,690 r/	3,730 r/	2,850 r/	6,590 r/	902 r/	2,760 r/	3,660 r/	3,010	6,670 r/

See footnotes at end of table.

TABLE 7--Continued
FERROMANGANESE AND SILICOMANGANESE: WORLD PRODUCTION, BY COUNTRY 1/ 2/

(Thousand metric tons, gross weight)

Country 3/	1996					1997				
	Ferromanganese			Silico-manganese	Grand total	Ferromanganese			Silico-manganese	Grand total
	Blast furnace	Electric furnace	Total			Blast furnace	Electric furnace	Total		
Argentina	--	6 e/	6 e/	28 e/	34 e/	--	6 e/	6 e/	28 e/	34 e/
Australia e/	--	110	110	95	205	--	95	95	95	190
Belgium e/	--	25	25	--	25	--	25	25	--	25
Brazil	--	215	215	232	447	--	153 e/	153 e/	175 e/	328 e/
Chile	--	9 e/	9 e/	2 e/	10 e/	--	9 r/ e/	9 r/ e/	2 r/	10 r/
China e/	450	700	1,150	840	1,990	500 r/	680 r/	1,180 r/	770 r/	1,950 r/
Croatia e/	--	--	--	--	--	--	--	--	--	--
Egypt e/	--	35	35	--	35	--	35	35	--	35
France	337	100 r/	437 r/	61	498 r/	326	100 r/ e/	426 r/ e/	66 e/	492 r/ e/
Georgia e/	--	5	5	10	15	--	6	6	20 r/	26 r/
Germany e/ 4/	--	20	20	--	20	--	20	20	--	20
India e/	--	190	190	170	360	--	166 r/	166 r/	198 r/	364 r/
Indonesia e/	--	14	14	7	21	--	15	15	7	22
Italy	--	25	25	100	125	--	16 e/	16 e/	100 e/	116 e/
Japan	--	343	343	76	419	--	377	377	78	455
Kazakhstan e/	--	--	--	50	50	--	--	--	55 r/	55 r/
Korea, North e/ 4/	--	6 r/	6 r/	--	6 r/	--	6 r/	6 r/	--	6 r/
Korea, Republic of	--	126	126	83	210	--	159 e/	159 e/	77 e/	236 e/
Mexico 5/	--	69	69	93	162	--	68	68	105 r/	173 r/
Norway	--	215	215	210 e/	425 e/	--	235 r/ e/	235 r/ e/	230 r/ e/	465 r/ e/
Philippines e/	--	--	--	--	--	--	--	--	--	--
Poland	60	--	60	25	85	60 e/	--	60 e/	25 e/	85 e/
Romania e/	--	20	20	79	99	--	12	12	63	74
Russia	67 r/	--	67 r/	--	67 r/	47 r/	--	47 r/	--	47 r/
Slovakia e/	--	25	25	12	37	--	20	20	10	30
South Africa	--	562	562	241 e/	803 e/	--	499 r/ e/	499 r/ e/	286 r/ e/	785 r/ e/
Spain e/	--	30	30	70	100	--	35	35	100	135
Taiwan	--	14 r/	14 r/	--	14 r/	--	12 r/	12 r/	--	12 r/
Thailand	--	--	--	--	--	--	--	--	--	--
Ukraine e/	25	170	195	600	795	30	160	190	560	750
Venezuela	--	--	--	25	25	--	--	--	37	37
Total	939 r/	3,030 r/	3,970 r/	3,110	7,080 r/	963 r/	2,910 r/	3,870 r/	3,090 r/	6,960 r/

See footnotes at end of table.

TABLE 7--Continued
FERROMANGANESE AND SILICOMANGANESE: WORLD PRODUCTION, BY COUNTRY 1/ 2/

(Thousand metric tons, gross weight)

	1998 e/				
	Ferromanganese			Silico-	
Country 3/	Blast furnace	Electric furnace	Total	manga-nese	Grand total
Argentina	--	6	6	27	33
Australia e/	--	110	110	105	215
Belgium e/	--	20	20	--	20
Brazil	--	123	123	125	248
Chile	--	9	9	2	10
China e/	450	600	1,050	700	1,750
Croatia e/	--	--	--	--	--
Egypt e/	--	35	35	--	35
France	321	100	421	65	486
Georgia e/	--	10	10	35	45
Germany e/ 4/	--	20	20	--	20
India e/	--	138	138	188	326
Indonesia e/	--	15	15	7	22
Italy	--	16	16	100	116
Japan	--	334 7/	334 7/	71 7/	405 7/
Kazakhstan e/	--	--	--	57 7/	57 7/
Korea, North e/ 4/	--	6	6	--	6
Korea, Republic of	--	158 7/	158 7/	107 7/	265 7/
Mexico 5/	--	88	88	105 7/	193
Norway	--	235	235	230	465
Philippines e/	--	--	--	--	--
Poland	65	--	65	25	90
Romania e/	--	11	11	60	71
Russia	45 7/	--	45 7/	--	45 7/
Slovakia e/	--	20	20	10	30
South Africa	--	525	525	290	815
Spain e/	--	35	35	100	135
Taiwan	--	13	13	--	13
Thailand	--	--	--	--	--
Ukraine e/	30	150	180	500	680
Venezuela	--	--	--	35	35
Total	911	2,780	3,690	2,940	6,630

e/ Estimated. r/ Revised.

1/ Table includes data available through July 15, 1999.

2/ World totals and estimated data are rounded to three significant digits; may not add to totals shown.

3/ In addition to the countries listed, Iran is believed to have produced ferromanganese and silicomanganese, but production figures are not reported; general information is inadequate for the formulation of reliable estimates of output levels. Production of manganese ferroalloys, ferrosilicon, and silicon metal began in 1996 for Saudi Arabia, but data for actual production were not available. Data for United States production of manganese ferroalloys are not included to avoid disclosing company proprietary data.

4/ Data for ferromanganese includes silicomanganese, if any.

5/ Salable products from Aután.

6/ Less than 500 tons.

7/ Reported figure.