MANGANESE

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Manganese (Mn) 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.

Domestic consumption of manganese ore, exclusive of the relatively small quantities used at iron and steel plants, decreased a moderate amount to a level somewhat more than 3% below the average consumption of the prior 3 years. In the manufacture of dry cell batteries, domestic consumption of natural battery-grade ore was much reduced because of an almost complete shift in production to alkaline cells based on electrolytic manganese dioxide (EMD).

For U.S. foreign trade in manganese materials, export and import volumes decreased except for imports of ore and dioxide. On a content basis, the number of manganese units imported increased by about 3% while the number of units exported declined by about 30%. The amount of manganese dioxide received was again a new record.

Prices decreased for many key manganese materials, by about 7% internationally for metallurgical-grade ore, and, for imported ferroalloys on a year-average basis, 9% for high-carbon ferromanganese, 8% for medium-carbon ferromanganese, and 6% for silicomanganese. In 1999, price trends were negative for medium- and high-carbon ferromanganese and positive for silicomanganese. Sales of manganese materials from the Government's National Defense Stockpile reduced the Government's inventory of manganese by about 5%, leaving an inventory about 1.6 times annual domestic consumption. The larger disposals were of metallurgical-grade ore and high-carbon ferromanganese.

World production of manganese ore was estimated to have increased marginally over that for 1998. (See table 1.) China was the largest producer on a gross weight basis, but South Africa was the largest for contained weight. For the second successive year, a major consolidation took place in the world's manganese industry. This year, France's Eramet acquired the manganese and certain other businesses of Norway's Elkem ASA. This acquisition, which included the only domestic manganese ferroalloy plant, made Eramet the world's largest producer of manganese ferroalloys.

Most data in this report are rounded by the U.S. Geological Survey (USGS) to not more than three significant digits. Table footnotes will indicate which statistics have been rounded.

Legislation and Government Programs

Stockpile.—On February 17, the Defense National Stockpile Center (DNSC) of the Defense Logistics Agency transmitted to Congress its revised Annual Materials Plan (AMP) for fiscal year 1999 and proposed AMP for fiscal year 2000. These AMP's were the same as the AMP for fiscal year 1998 with respect to manganese except that the maximum sale quantity was increased to 27,216 metric tons (t) from 18,144 t for natural battery-grade ore. The maximum disposal authority for other manganese materials was 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 became effective April 2 and the AMP for fiscal year 2000 became effective October 1.

In its sales program for ores, the DNSC canceled Solicitation of Offers DLA-ORES-71 after March 2 and replaced it with DLA-MANGANESE-001, which had been issued on February 10. Under the new solicitation, quantities offered for sale during the remainder of fiscal year 1999 were 18,144 t of natural battery-grade ore, 36,287 t of chemical-grade ore, and 90,718 t of metallurgical-grade ore. Sales terms were negotiable under the new solicitation.

For 1999, disposals of manganese materials announced by the DNSC totaled 1,270 t for natural battery-grade ore, 3,175 t for chemical-grade ore, 63,263 t for stockpile-grade metallurgical-grade ore, -45,359 t for nonstockpile-grade metallurgical-grade ore, 15,307 t for high-carbon ferromanganese, and 960 t for electrolytic metal. All disposals were cash transactions. A disposal in March of 90,718 t of nonstockpile-grade metallurgical ore to Gar-Nic Enterprises of Stamford, CT, represented the then current portion of a contract for delivery of 328,492 t over a 3-year period. The net negative figure for nonstockpile-grade metallurgical-grade ore included a reversion to the stockpile of 136,078 t that resulted from a contract termination.

Data on physical inventory of manganese materials reported by the DNSC indicated that all net changes in 1999 were decreases and consisted of 3,694 t for natural battery-grade ore, 1,633 t for chemical-grade ore, 69,032 t for stockpile-grade metallurgical-grade ore, 1,237 t for nonstockpile-grade metallurgical-grade ore, 33,321 t for high-carbon ferromanganese, and 960 t for electrolytic metal. Also, a negative adjustment of 1,304 t for medium-carbon ferromanganese brought its accounting inventory to zero. The estimated manganese content of manganese inventories being held by the Government at yearend was lowered by about 5%, to slightly less than 1.2 million metric tons (Mt). (See table 2.) The total remaining inventory was about 1.6 times current national apparent consumption.

Other.—Actions by the U.S. Environmental Protection Agency that dealt with the environmental aspects of manganese included issuance of national emission standards for hazardous air pollutants from the production of ferromanganese and silicomanganese (U.S. Environmental Protection Agency, 1999b) and the listing of manganese compounds as an urban hazardous air pollutant within the National Air Toxics Program (U.S. Environmental Protection Agency, 1999a). The emission standards applying to manganese ferroalloy production affected only the nation's sole manganese smelter at Marietta, OH, and appeared to require changes mainly to data collection at that site (Bourge, 1999).

Production

Ore and Concentrate.—The only mine production of manganese, if any, consisted of small amounts of manganiferous material having a natural manganese content of less than 5%. This type of material has been produced in South Carolina for use in coloring brick.

Ferroalloys, Metal, and Synthetic Dioxide.—Production statistics for these materials were not published to avoid disclosing proprietary data. The only plant at which manganese ferroalloys were produced domestically was at Marietta, OH (table 3). This plant was included in the sale of the manganese business of Norway's Elkem ASA to France's Eramet, a transaction that the two companies agreed upon in January and completed as of June 30 (TEX Report, 1999a). Elkem Metals Co. operated the plant until the change of ownership, after which the facility became known as Eramet Marietta Inc.

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 1999 indicated that unit consumption of manganese in ironmaking, which could not be published to avoid disclosing proprietary data, was considerably less than that for 1998 and still was a comparatively minor component of overall manganese use in steelmaking. Reported data for U.S. consumption of manganese ferroalloys and metal in 1998 and 1999 are presented in tables 4 and 5, respectively. Because of revisions to procedures for estimating data, the data in these tables are not directly comparable to those for prior years, especially for ferromanganese. Also, because of the incompleteness of reporting to the USGS voluntary consumption survey, the figures in these tables are more representative of relative rather than absolute quantities. Combination of the indicated consumption pattern with estimates of apparent consumption suggests that manganese unit consumption in steelmaking during 1996-99 averaged about 6 kilograms per t, or significantly greater than that last reported for 1997 on the basis of reported data.

According to an analysis by Samancor Ltd., the distribution of usage of manganese ferroalloys among high-carbon ferromanganese, silicomanganese, and medium-carbon ferromanganese was 56%, 32%, and 12% by integrated steel mills; 9%, 49%, and 42% for minimills making flat products; 17%, 81%, and 2% for minimills making long products; and 32%, 30%, and 38% for specialty steel producers (Johan Kriek, May 25, 1999, Manganese alloys use in steel—Manganese, Third Analyst Seminar Billiton Ferroalloys, accessed May 26, 1999, at URLhttp://www.billiton.com/news/presentations/samancor/sld028.htm). Eramet characterized the world usage pattern as high-carbon ferromanganese, 47%; silicomanganese, 42%; and refined ferromanganese, 11% (TEX Report, 1999b).

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. A new nonferrous usage arose with initiation late in the year of the so-called Golden Dollar by the U.S. Mint. The three-layer design of this coin called for top and bottom layers of manganese bronze that enclosed a central core of copper. Manganese content of the bronze is 7% and of the coin overall is 3.5% (U.S. Mint, 1999).

In 1999, domestic consumption of manganese ore decreased by about 4% to 479,000 t, while corresponding yearend stocks increased by about 6% to 172,000 t from a revised figure of 163,000 t for 1998. 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; Harben, Raleigh, and Harris, 1998). The source of manganese units for these applications was mainly manganese ore. Carus Chemical Company, Peru, IL, completed an expansion of its facilities for production of potassium permanganate that included development of technology for recycling manganese dioxide coproduct. The recycling technology reduces solid waste disposal concerns and was made available to customers in addition to its use in-house by Carus (Carus Chemical Company, 1999).

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 all manganese ore consumption in the United States, exclusive of that by the steel industry.

Full-year responses, or a basis upon which to estimate the data, were obtained from all these firms for 1999.

Consumption of natural battery-grade ore by the battery industry was much diminished from prior years, as domestic manufacturers of batteries containing manganese shifted their production almost totally to alkaline types in which EMD is used (Brodd, 1999). Worldwide, production of carbon-zinc batteries still dominated over alkaline cells by a factor of 1.8:1 (Powers and MacArthur, 1999). Incremental changes in materials and construction continued as an almost annual feature of technology for alkaline cells in response to competitive markets and the power requirements of proliferating electronic devices (MacArthur, Blomgren, and Powers, 2000, p. 58). In August, Rayovac Corp., Madison, WI, acquired the consumer battery business of ROV Limited, a marketer and manufacturer of batteries carrying the Rayovac name in many Latin American countries. The acquisition gave Rayovac control of Rayovac brand rights worldwide except for Brazil (Rayovac Corp., 2000, p. 47). ROV Limited had been created in 1982 as an entity separate from the U.S. company.

Prices

For 1999, 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, 3.6 for medium-carbon ferromanganese, and an estimated 9.8 for manganese metal. These price factors are nearly the same as for 1998. They are based on year-average prices, and 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 $2.26 per metric ton unit. It is recognized that prices were somewhat above or below this value, depending on ore quality, time of year, and nature of the transaction. The price of a metric ton of ore is obtained by multiplying the metric ton unit 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 manufacture of manganese chemicals.

Because the metric ton unit is 1% of a metric ton (i.e., 10 kilograms of contained manganese), the price of manganese in ore in 1999 and 1998 can be expressed as 22.6 and 24.0 cents per kilogram, respectively. These values indicate a decrease of about 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.

The international benchmark price for metallurgical-grade ore decreased for the third consecutive year, by about 7% in 1999. Price negotiations were concluded between Japanese consumers and their major suppliers as of about the April 1 beginning of the Japanese fiscal year. On an f.o.b. basis per metric ton unit for delivery during the annual contract year, the prices agreed to were $1.90 for ore from the Groote Eylandt Mine in Australia and $1.81 for ore from the Wessels Mine in South Africa. Whereas these mines previously belonged to separate owners who did their own price negotiating, this year the prices for deliveries from both mines were negotiated by South Africa's Samancor Ltd. This new aspect of ore price negotiations resulted from the United Kingdom's Billiton Plc having assumed control of both mines late in 1998.

Manganese Ferroalloys.—For high-carbon ferromanganese, the price trend was downward except for a rise that began in late November; the strongest decline was during the middle part of the year. For medium-carbon ferromanganese, the trend was gradually downward until mid-July when a plateau was reached that held for the rest of the year. For silicomanganese, a dip in January 1999 gave way in late February to a rising trend that continued throughout the year, with prices increasing the most rapidly during the summer. 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 $490 to $500 and $450 to $470, respectively, for a net overall decrease of 7%. For the year, the average for the middle of the price range was $459, which was approximately 9% less than that of 1998. For one week in November, the price range reached a low of $415 to $430. 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 40.25 to 41 cents and 35 to 38 cents at the beginning and end of the year, respectively, for a net overall decrease of about 10%. The middle of the price range continued its decline, averaging 37.4 cents for the year, or about 8% less than that of 1998. At least for high-carbon ferromanganese, price weakness was attributed to a combination of producer destocking because of consolidation within the manganese industry and switching by European steelmakers from use of ferromanganese to silicomanganese (CRU Bulk Ferroalloys Monitor, 1999).

For imported silicomanganese with 2% carbon, the price range, per pound of alloy, f.o.b. Pittsburgh or Chicago warehouse, was 19.75 to 21 cents and 24 to 26 cents at the beginning and end of the year, respectively, for a net increase of 24%. For the year, however, the average for the middle of the price range, 22.1 cents, represented a further annual decrease of more than 6% from that of 1998. Trade journals spoke of a supply tightness in the United States at the time of relatively rapid price increases during the summer.

Manganese Metal.—Without change, trade journals listed the same producer price as since about the beginning of 1996; 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 listing of North American transaction price, Ryan's Notes indicated an overall decline during the year of about 5%, with price the weakest during the fourth quarter; for this quote, year-average price was about one-fourth less than producer list price.

Foreign Trade

Trade volumes, in terms of manganese units contained, decreased compared with those of 1998 for all main categories of exports and imports except for imports of ore and dioxide. (See tables 6 and 7.) Even so, the number of manganese units imported was the greatest since 1996. Also on the basis of content, the ratio of imports of ferroalloy plus metal divided by imports of ore plus dioxide decreased from 2.85:1 in 1998 to 1.86:1, the least since 1989.

The number of manganese units exported was the least since at least prior to 1983 for total exports, ore, and metal. Exports of ferromanganese decreased by the smallest percentage, 16% for total and for each subcategory. Those for ferromanganese containing more than 2% carbon were 6,760 t (58% of total ferromanganese) and those containing less than 2% carbon were 4,860 t.

Reexports of ore, ferromanganese, silicomanganese, and metal were, in tons, 78; 11,700; 5,210; and 32, respectively. Compared with exports, reexports were nearly identical for ferromanganese and significantly greater for silicomanganese. All or virtually all of the reexports of ore and manganese ferroalloys and most of those of metal went to Canada; Mexico was the other principal destination.

Among imports, overall average manganese contents were at typical levels for ore (48.7%) and ferromanganese (78.5%). Average manganese content was the greatest since 1994 for ore and unchanged from that of 1998 for ferromanganese. Ore imports were up by approximately 40% overall to the highest level since 1996. Gabon continued as dominant ore source, supplying about three-fifths of the total.

In declining by 8%, the import volume for total ferromanganese followed the see-saw pattern of the preceding 5 years. Compared with those in 1998, imports increased for low- and medium-carbon ferromanganese and decreased for high-carbon ferromanganese. Imports of low-carbon ferromanganese were the greatest since the 1988 record. For medium-carbon ferromanganese, the data suggest a shift away from Japan and Norway as source countries in favor of France and South Africa. A one-fifth decline in imports from South Africa was the principal factor in the decrease for high-carbon ferromanganese. For silicomanganese, a percentage decline for South Africa of about the same magnitude and a drop by about three-fourths for India helped produce a fall overall. By contrast, record amounts were received from Australia, Kazakhstan, and Mexico. For manganese metal, unwrought, the relatively small shipments from the United Kingdom were a record for that country. Reported imports of spiegeleisen (pig iron containing about 20% manganese) were nominally greater at 343 t, all from South Africa at high unit value.

Among imports of manganese chemicals, those of manganese dioxide increased by almost one-fourth to set again a new record for volume. The amount received from South Africa more than doubled to set a new record also, with South Africa displacing Ireland as source of the second largest amount. This was despite a 59% rise in receipts from Ireland to the greatest volume since that for 1993. All dioxide imports appeared to have been wholly synthetic material. Data for imports under the classification of "sulfates, other," suggested that imports of manganese sulfate could have advanced by 45%, with the volume of imports of material in that class doubling for China and increasing by 18% for Mexico. Receipts from China were 15,400 t at a value of $4.6 million and those from Mexico 18,800 t at a value of $9.4 million.

Antidumping duties on manganese metal, EMD, and potassium permanganate were altered by actions of the Government's trade agencies. For manganese metal, the International Trade Administration (ITA) amended in February the final results of its antidumping duty administrative review of manganese metal from China for the period of review (POR) of June 14, 1995, through January 31, 1997 (International Trade Administration, 1999g). The two lowest weighted-average margins, or additional duties, for specified shippers were raised from 1.56% to 1.94% and from 2.8% to 3.28%, while all other margins, including that of 143.32% for all nonspecified Chinese suppliers, remained the same. In September, for the POR of February 1, 1997, through January 31, 1998, the ITA set the lowest rate at 4.3% and raised the rate for another shipper to the "all-others" rate of 143.32% (International Trade Administration, 1999h).

In determinations that applied to EMD, for EMD from Greece the ITA in November found for the POR of April 1, 1997, through March 31, 1998, a margin of 0.00% for Tosoh Hellas A.I.C. and an "all-others" rate of 36.72% (International Trade Administration, 1999b). The ITA also conducted expedited 5-year "sunset" reviews for EMD from Greece and Japan and found that revoking the antidumping duty orders could lead to dumping. For Greece, the ITA's finding was that this would be at a margin of 36.72% for all shippers (International Trade Administration, 1999c). For Japan, the ITA's finding was that this would be at margins ranging from 71.91% to 77.73% (International Trade Administration, 1999d). The U.S. International Trade Commission (USITC) gave notice that it would make a full 5-year review of the antidumping duty orders on EMD from Greece and Japan (U.S. International Trade Commission, 1999a).

In determinations that applied to potassium permanganate, the ITA conducted expedited sunset reviews of the antidumping duty orders that applied to China and Spain and found for both countries that revocation of the antidumping order likely would lead to dumping. The ITA found that the corresponding margins would be 128.94% for China and 5.53% for Spain (International Trade Administration, 1999e, f). In its full 5-year review of these antidumping duty orders, the USITC found, however, that revocation of the order likely would lead to dumping in the case of China but not in the case of Spain (U.S. International Trade Commission, 1999b). Consequently, the ITA continued the antidumping duty order for material from China but revoked it for material from Spain (International Trade Administration, 1999a, i).

The Generalized System of Preferences (GSP) Program was allowed to expire after June 30, 1999, temporarily ending duty-free treatment for imports of selected goods from qualifying developing countries and territories. Effective December 17, the GSP Program was extended retroactively from July 1, 1999, through September 30, 2001, when the President signed the

Ticket To Work and Work Incentives Improvement Act of 1999 (Customs Service, 2000). The extension provided for reimbursement of duties paid during the period when the program was not in effect. Categories of U.S. imports that may have been affected by these developments 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 8.) Leading producer countries among a more widely distributed production of manganese ferroalloys were Brazil, China, France, India, Japan, the Republic of Korea, Norway, South Africa, and Ukraine. (See table 9.)

Australia.—In Western Australia, Consolidated Minerals Ltd. restarted manganese ore production from the Woodie Woodie area of the Pilbara Manganese Province at midyear. Consolidated finalized contracts for export to China, Japan, the Republic of Korea, and Ukraine that accounted for all of a projected first year's production of about 250,000 t of lump ore and 50,000 t of fines. Consolidated enlarged its potential supply of ore by achieving control of all the manganese prospects in the Woodie Woodie area by acquiring the Bell mining leases of Boral Contracting Pty. Ltd.

Also in Western Australia, Sovereign Resources (Australia) NL changed its name in December to HiTec Energy NL and proceeded with a plan to establish facilities for initial annual production of 10,000 t of manganese sulfate and 20,000 t ofEMD. Consolidated was a potential source of fine-grained feed for these facilities

Production of high-carbon ferromanganese by Tasmanian Electro Metallurgical Co. Pty. Ltd. was reduced by an extended maintenance shutdown of a furnace that lasted throughout most of the last third of the year.

Brazil.—Cia. Vale do Rio Doce (CVRD) decided against selling any of its facilities for producing manganese ore and ferroalloys. It lowered output levels, including by suspending mining at the Azul Mine in the Carajás region for 4 months during the second half of the year. CVRD acquired all or virtually all of the shares in manganese ferroalloy plants in which it had been a joint owner. This included the 35% share of the Dunkirk, France, plant of Société Européenne d'Alliages pour la Sidérurgie that had been outstanding and, in Brazil, the shares held by Usinas Siderúrgica de Minas Gerais S.A. (Usiminas) in Vale-Usiminas Participações (VUPSA). VUPSA was a 50-50 joint venture between CVRD and Usiminas, a steelmaker, that was formed in 1995 to operate ferroalloy plants that had belonged to the Paulista Group. These plants were those grouped under Cia. Paulista de Ferro-Ligas and the plant of Eletrosiderúrgica Brasileira S.A. One of the terms of Usiminas' withdrawal from VUPSA was an agreement that VUPSA would continue to supply Usiminas and a subsidiary with manganese ferroalloys for 10 years.

China.—An issue of Ore Geology Reviews was devoted to 10 papers on manganese deposits in China, of which the authors were mostly Chinese (Hein and Fan, 1999). One of these papers was an overview of Chinese manganese deposits, and the others dealt with 10 specific deposits located in central, northwest, and southern China. The manganese oxide ores in the Guangxi Autonomous Region were discussed in a separate publication (Tengfei, 1999). Imports of manganese ore that totaled 1.06 Mt for 1999 again were about one-tenth less than those for 1998.

The ferroalloy industry proposed to the Government a program for implementation in 2000 to 2005 that would restructure China's ferroalloy industry. Included in the program was improving pollution control and increasing productivity and efficiency by phasing out older and smaller units. The program was projected to reduce production of manganese ferroalloys (Metal Bulletin Monthly, 1999).

Exports of manganese metal increased by 7% in 1999 to 73,600 t. In 1998, exports of metal had risen to 68,000 t, an increase of 14% over those in 1997. Of the 1998 exports, about one-third each went to Japan and the Netherlands and one-tenth to the United Kingdom.

France.—In the first part of the year, Eramet expanded its manganese interests by completing as of June 30 its acquisition of the manganese assets of Norway's Elkem. The acquisition included plants in Norway at Porsgrunn and Sauda and in the United States at Marietta, OH, which made Eramet the world's leading producer of manganese ferroalloys. Ownership of the acquired assets was split between Eramet (60%) and State-owned Compagnie Générale des Matières Nucléaires (40%). Eramet subsequently acquired the Sima Group, a privately held French producer of specialty steels and nickel alloys. This second acquisition involved a complex exchange of shareholdings that also partially privatized Eramet.

Production of high-carbon ferromanganese was scaled back by more than 40,000 t at the Boulogne-sur-Mer plant of Société du Ferromanganèse de Paris-Outreau, which, through Compagnie Minière de l'Ogooué S.A. (Comilog), was owned by Eramet. The cutback resulted from a prolonged maintenance shutdown of one of the plant's blast furnaces and restriction of the use of oxygen injection to only the first part of the year.

Gabon.—Shipments of manganese ore produced from the Moanda Mine of Comilog totaled 2.02 Mt, or nearly the same as in 1998 (TEX Report, 2000).

Georgia.—After midyear, Saga-print, a Czech investment company, became the latest owner of a 75% share in Chiaturmarganets. At the time, annual production of concentrate at the dormant Chiatura Mine was projected to reach 50,000 t within 1 year and rise to 200,000 t within 4 years (Interfax Mining & Metals Report, 1999a).

Ghana.—The development and operation of a plant that started up late in 1998 for treating ore tailings that accumulated over the years at the Nsuta Mine of Ghana Manganese Co. was

[1]In a number of instances, discussions of the more significant developments during 1999 for specific countries were based on news items in trade journals, such as American Metal Market, Metal Bulletin, Platt's Metals Week, Ryan's Notes, and TEX Report. These items have not been acknowledged individually because the information they conveyed often was aggregated, possibly with that from other sources.

described in two articles (Bruder, 1999a, b).

Japan.—Overall imports of metallurgical-grade manganese ore increased by about 4%, to 1.02 Mt. For ore containing more than 39% manganese, imports increased about 6% to 953,000 t, of which 96% was from two sources, South Africa (590,000 t) and Australia (324,000 t). Imports of ore containing no more than 39% manganese decreased by 20%, to 66,900 t, of which virtually all was from South Africa (50,300 t) and India (16,500 t). Imports of ferruginous manganese ore again decreased by about 7%, to 206,000 t, most of which came from India (57%), Ghana (25%), and South Africa (11%).

Production of manganese ferroalloys decreased by about 6% to the lowest total of the 1990's. While production of high-carbon ferromanganese was virtually unchanged, that of low-carbon ferromanganese and silicomanganese decreased, by about 20% and 7%, respectively.

Overall imports of manganese ferroalloys increased by about 2%, to 317,000 t; those of high-carbon ferromanganese fell by about one-fourth to 79,300 t whereas those of medium- plus low-carbon ferromanganese more than doubled to 10,300 t and those of silicomanganese increased by about 13%, to 227,000 t. South Africa was the leading source of ferromanganese, with a share of about 47% for high-carbon receipts and 73% for refined grades. Shipments of silicomanganese from China to Japan rose by about 41% to 156,000 t. This was much higher than the voluntary limit of 90,000 t expected after the Japanese removed antidumping duties on Chinese silicomanganese in early 1998.

Exports of manganese ferroalloys decreased overall by 17%, to 22,500 t. Most of the shipments were refined ferromanganese (84%), of which 8,500 t or nearly one-half went to the United States.

Production of manganese dioxide increased by about 11% to 58,000 t, the greatest since 1995. Exports of manganese dioxide were 32,200 t, an increase of almost one-fourth to a level typical of the 1990's.

Imports of unwrought manganese metal, including scrap, increased by about 2%, to 39,900 t; China (72%), South Africa (23%), and the United States (4%) again were the sources for practically all metal imports.

Mexico.—Overall output of ore products by Cía. Minera Autlán decreased by 10%; 1999 production quantities in metric tons and, in parentheses, percentage changes from 1998 were manganese carbonates, 65,000 (-24%); oxide nodules, 378,000 (-6%); and manganese dioxide, manganous oxide, and other oxides, 16,000 (-36%). On the other hand, overall production of manganese ferroalloys advanced slightly from a revised figure of 192,000 t for 1998 to 193,000 t for 1999, thus making 1999 the year of largest production in the 1990's. The largest year-to-year changes were for high-carbon ferromanganese (-17%) and silicomanganese (+9%). A research investigation found Autlán's mining operations in Hidalgo State to have an adverse environmental effect in terms of manganese content of particulates (Aldape, Hernández-Méndez, and Flores, 1999).

Norway.—As mentioned under France, Elkem's facilities for production of manganese ferroalloys were acquired by Eramet in the first part of the year. The consequent switching of the ore feed for the former Elkem plants from Australian ore to Gabonese ore produced by Eramet (Comilog) soon caused an environmental issue to arise because of the latter ore's mercury content. Complaints about mercury emissions also were directed at the manganese ferroalloy plant of Tinfos Jernverk A/S, which was already in the process of installing a new plant for cleaning emissions.

Romania.—Production at Ferom SA's plant near the Black Sea at Tulcea was suspended for part of the year because of the company's having gone into receivership early in the year. Electrical power cost was a factor in a temporary shutdown that reduced output of silicomanganese and other ferroalloys.

Russia.—Uralsky Marganets (Urals Manganese) was being set up to establish facilities at the Polunochnoye station in the Ivdel district of the central Urals for milling manganese ores of the region. Annual production of the mill was projected to begin at 40,000 t of concentrate from 70,000 t of crude ore, and to grow to 100,000 t of concentrate from 200,000 t of crude ore. From crude ore with an average manganese content of about 20% manganese, the mill is expected to produce a 30% carbonate concentrate whose manganese content will be raised to 38% by agglomeration. The agglomerate is to be used as feed for production of ferromanganese and silicomanganese (Interfax Mining & Metals Report, 1999b, c).

In addition to ongoing blast furnace production of ferromanganese at the Kosogorsky metallurgical plant near Moscow, manganese ferroalloys were being produced in electric furnaces in the Urals at the Chelyabinsk Electrometallurgical Combine and the Serov ferroalloy plant in the Sverdlovsk region.

South Africa.—According to preliminary data, ore production increased by about 3% for metallurgical-grade ore and total ore and decreased by about 7% for chemical-grade ore. About 99% of total production was metallurgical-grade ore. Within the production of metallurgical-grade ore, the proportion accounted for by ore containing 30% to 40% manganese decreased somewhat to about 31% and that for ore containing more than 48% manganese increased correspondingly to about 61%.

Samancor, which established separate manganese and chrome divisions, achieved a doubling of the annual capacity of the sintering plant at the Mamatwan Mine to 1 Mt. This involved a change from on-strand to off-strand cooling, so that sintering would now occur over the entire length of the strand. Cooling and sinter handling would be done only on the newly commissioned equipment (African Mining, 1999). Shipments of manganese ore during 1999 by The Associated Manganese Mines of South Africa Ltd. (Assmang) declined somewhat, from 1.34 Mt to 1.30 Mt (Skillings Mining Review, 2000). At Assmang, a major development began that would provide within about 3 years a new shaft system at the Nchwaning Mine to replace the depleting output from the existing shaft. The new system is expected to reduce costs and allow more advanced mining technology to be used.

Production of manganese ferroalloys was cut back for various reasons, including maintenance, at all three producing companies. The sites where cutbacks occurred included two new facilities, Advalloy and Cato Ridge Alloys (Pty.) Ltd., for production of refined and specialty manganese ferroalloys. At

Advalloy, production of ultra low-carbon grades of ferromanganese and silicomanganese was suspended in the latter part of the year.

Ukraine.—A decrease in ore output of about 11% to less than 2 Mt principally resulted from a further decline (14%) in production to 1.41 Mt by the Ordzhonikidze complex in the western part of the Nikopol' Basin, after a decline of 13% in 1998. Production by the Marganets complex in the eastern part of the basin decreased slightly (-2%) to 580,000 t (Interfax Mining & Metals Report, 2000). Consequently, the share of production by the Ordzhonikidze complex slipped to 71% and that by the Marganets complex increased to 29%.

Current Research and Technology

Among many items in the current literature that reported on various of aspects of manganese and the topics addressed were the following:

Geology.—Time at which manganese deposits in Western Australia weathered (Dammer, McDougall, and Chivas, 1999), temperature of deposition of Wessels-type ore in South Africa's Kalahari field as derived from study of fluid inclusions (Lüders, Gutzmer, and Beukes, 1999), evolution of the Nsuta ore body in Ghana (Mücke, Dzigbodi-Adjimah, and Annor, 1999), and review of marine ferromanganese oxide deposits (Cronan, 1999).

Ore Treatment.—Reductive leaching of Ghanian ferruginous manganese oxide ore (about 30% Mn) in aqueous methanol-sulfuric acid (Momade and Momade, 1999a, b).

Refined Ferromanganese.—Optimization of the blowing pattern in production of refined ferromanganese by oxygen refining (You and others, 1999), and effect of ferromanganese additions on inclusions in steel (Sjöqvist and Jönsson, 1999).

Manganese Oxides.—Review of crystal structures (Post, 1999), review of structure and properties of porous crystals (Feng, Kanoh, and Ooi, 1999), evaluation of alumina-supported manganese oxide acceptor for regenerative removal of hydrogen sulfide from fuel gas at high temperature (Liang and others, 1999), potential new applications for manganites because of their "colossal" magnetoresistance (Fontcuberta, 1999), and review of EMD for batteries (Kozawa, Yamamoto, and Yoshio, 1999).

Lithium-Manganese Oxides.—Intensively researched for their use in rechargeable lithium-ion batteries; for example, stability of composite electrodes (Thackeray and others, 1999), layered structures (Paulsen, Thomas, and Dahn, 1999), and spinel prepared from potassium permanganate (Pisarczyk, 1999).

Biology.—Review of advances in understanding manganese as a bioelement (Yocum and Pecoraro, 1999), and consideration of whether dietary levels of manganese are appropriate (Finley and Davis, 1999).

Environment and Toxicology.—Study of bacterium leading to deposition of manganese in piping (Murdoch and Smith, 1999); papers based on presentations on manganese toxicology at the Fifteenth International Neurotoxicology Conference, Little Rock, AR, October 1997 (Cranmer, 1999); and investigations identifying manganese phosphate and manganese sulfate as major constituents of particulates emitted when methylcyclopentadienyl manganese tricarbonyl is used as an octane enhancer in gasoline engines (Colmenares and others, 1999; Ressler and others, 2000; and Zayed, Hong, and L'Espérance, 1999).

Outlook

The trend of domestic and global demand for manganese will continue to follow closely that of steel production. Although 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 1987 to 1998, U.S. apparent consumption of manganese has been within about plus or minus 14% of 680,000 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 for some years calculated apparent consumption showed positive or negative deviations from that which could be estimated on the basis of steel production.

Data of the American Iron and Steel Institute indicated that overall domestic raw steel production in 1999 was at almost the same level as for 1997-98. This suggests that domestic manganese consumption for 1999 changed little from that in these immediately prior years. The trend line for apparent consumption indicates a value for 1999 in the range of 750,000 t and that a value of 800,000 t is to be expected within 5 years. This is contingent upon U.S. raw steel production continuing to follow the present trend having an annual growth rate close to 1.4%. This outlook also assumes no significant change in manganese unit consumption by U.S. steelmakers, as seems likely (Sacco, 1999). The majority of U.S. demand for manganese units will be met by imports.

The trend in global growth of manganese demand can be expected to be about the same as that for domestic demand because of the strong link between manganese demand and steel production and a similarity in trends for steel production. The October 1999 forecast of the International Iron and Steel Institute implies an annual growth rate in global steel consumption of 1.6% from 1995 through 2005 and of 1.2% from 2000 through 2005 (Iron & Steelmaker, 1999). This forecast shows growth rate in consumption varying with geographical area, and assigns the highest growth rate from 1995 through 2005 to China (4.8%).

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TABLE 1
SALIENT MANGANESE STATISTICS 1/

(Thousand metric tons, gross weight)

	1995	1996	1997	1998	1999
United States:					
Manganese ore (35% or more Mn):					
Exports	15	32	84	8	4
Imports for consumption	394	478	355	332	460
Consumption 2/	486	478	510	499	479
Stocks, December 31: Consumers 2/	309	319	241 r/	163 r/	172
Ferromanganese:					
Exports	11	10	12	14	12
Imports for consumption	310	374	304	339	312
Consumption 3/	348	326	337	290	281
Stocks, December 31: Consumers and producers	33	27	21	26	40
Consumption, apparent, manganese 4/	676	776	643 r/	776	NA
Ore price, dollars per metric ton unit, c.i.f. U.S. ports	2.40	2.55	2.44	2.40	2.26
World production of manganese ore	23,300	24,300	21,900 r/	20,200 r/	20,400 e/

e/ Estimated. r/ Revised. NA Not available.
1/ Data are rounded to no more than three significant digits.
2/ Exclusive of iron and steel plants, except for 1995.
3/ Data for 1998 and later not directly comparable to that for prior years.
4/ 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
INVENTORIES FOR MANGANESE MATERIALS AS OF YEAREND 1999 1/

(Metric tons, gross weight)

Material	Disposal authority	Physical inventory: Uncommitted: Stockpile grade	Physical inventory: Uncommitted: Nonstockpile grade	Physical inventory: Uncommitted: Total	Physical inventory: Sold, pending shipment	Physical inventory: Grand total
Natural battery ore	112,000	95,000	16,800	112,000	1,360	113,000
Synthetic manganese dioxide	2,730	2,730	--	2,730	--	2,730
Chemical ore	143,000	143,000	81	143,000	1,360	145,000
Metallurgical ore	920,000	588,000	331,000	920,000	116,000	1,040,000
High-carbon ferromanganese	673,000	862,000	--	862,000	20,400	883,000
Electrolytic metal	5,790	5,790	--	5,790	--	5,790

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

Source: Defense National Stockpile Center.

TABLE 3
DOMESTIC PRODUCERS OF MANGANESE PRODUCTS IN 1999

Company	Plant location	Products 1/: FeMn	Products 1/: SiMn	Products 1/: Mn	Products 1/: MnO_2	Type of process
Chemetals Inc.	Baltimore, MD				X	Chemical.
Do.	New Johnsonville, TN				X	Electrolytic.
Eramet Marietta Inc.	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. CONSUMPTION, BY END USE, AND INDUSTRY STOCKS OF MANGANESE FERROALLOYS AND METAL IN 1998 1/

(Metric tons, gross weight)

End use	Ferromanganese: High carbon	Ferromanganese: Medium and low carbon	Ferromanganese: Total	Silico-manganese	Manganese metal
Steel:					
Carbon	127,000	100,000	228,000	85,500	644
High-strength, low-alloy	21,200	3,540	24,800	5,770	(2/)
Stainless and heat-resisting	12,400	(2/)	12,400	5,430	1,360
Full alloy	18,200	6,160	24,300	28,700	(2/)
Unspecified 3/	304	181	485	262	294
Total	179,000	110,000	290,000	126,000	2,300
Cast irons	10,100	506	10,700	783	5
Superalloys	W	W	W	--	131
Alloys (excluding alloy steels and superalloys)	1,350	391	1,740	(4/)	19,100 5/
Miscellaneous and unspecified	--	W	W	(4/)	W
Total consumption	191,000	111,000	302,000	126,000 6/	21,500
Total manganese content 7/	149,000	88,900	238,000	83,400	21,500
Stocks, December 31, consumers and producers	12,800	13,200	25,900	8,660	5,280

W Withheld to avoid disclosing company proprietary data; included with "Alloys (excluding alloy steels and superalloys)." --Zero.

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

2/ Withheld to avoid disclosing company proprietary data; included with "Steel: Unspecified."

3/ Includes electrical and tool steel, and items indicated by (2/).

4/ Withheld to avoid disclosing company proprietary data.

5/ Approximately 85% of this combined total was for consumption in aluminum alloys.

6/ Internal evaluation indicates that silicomanganese consumption is considerably understated.

7/ Estimated based on typical percent manganese content.

TABLE 5

U.S. CONSUMPTION, BY END USE, AND INDUSTRY STOCKS OF MANGANESE FERROALLOYS AND METAL IN 1999 1/

(Metric tons, gross weight)

End use	Ferromanganese: High carbon	Ferromanganese: Medium and low carbon	Ferromanganese: Total	Silico-manganese	Manganese metal
Steel:					
Carbon	127,000	94,100	221,000	78,300	1,110
High-strength, low-alloy	20,100	2,980	23,100	5,190	(2/)
Stainless and heat-resisting	13,900	(2/)	13,900	6,590	1,650
Full alloy	16,000	5,780	21,800	26,400	(2/)
Unspecified 3/	279	299	578	262	181
Total steel	178,000	103,000	281,000	117,000	2,950
Cast irons	10,100	523	10,700	1,090	5
Superalloys	W	W	W	--	W
Alloys (excluding alloy steels and superalloys)	1,350	465	1,810	(4/)	19,200 5/
Miscellaneous and unspecified	--	W	W	(4/)	W
Total consumption	189,000	104,000	293,000	118,000 6/	22,200
Total manganese content 7/	148,000	83,500	231,000	77,900	22,200
Stocks, December 31, consumers and producers	17,600	22,000	39,600	9,180	4,970

W Withheld to avoid disclosing company proprietary data; included with "Alloys (excluding alloy steels and superalloys)." --Zero.

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

2/ Withheld to avoid disclosing company proprietary data; included with "Steel: Unspecified."

3/ Includes electrical and tool steel, and items indicated by (2/).

4/ Withheld to avoid disclosing company proprietary data.

5/ Approximately 85% of this combined total was for consumption in aluminum alloys.

6/ Internal evaluation indicates that silicomanganese consumption is considerably understated.

7/ Estimated based on typical percent manganese content.

TABLE 6
U.S. EXPORTS OF MANGANESE ORE, FERROALLOYS, AND METAL, BY COUNTRY 1/

	1998		1999	
Country	Gross weight (metric tons)	F.a.s. value (thousands)	Gross weight (metric tons)	F.a.s. value (thousands)
Ore and concentrates with 20% or more manganese:				
Belgium	678	$109	--	--
Canada	2,690	713	1,250	$332
Hong Kong	930	74	--	--
Mexico	2,870	294	--	--
Singapore	--	--	2,440	180
Other	1,050	140	487	139
Total	8,210	1,330	4,170	651
Ferromanganese, all grades:				
Canada	13,100	7,770	10,700	5,920
Mexico	494	444	94	107
Venezuela	91	98	749	431
Other	115 2/	138 2/	54	54
Total	13,800	8,450	11,600	6,510
Silicomanganese:				
Canada	6,240	3,740	3,360	1,850
Mexico	320	265	250	220
Other	165	191	95	109
Total	6,720	4,190	3,700	2,180
Metal, including alloys and waste and scrap:				
Brazil	123	260	125	268
Canada	1,480	3,710	1,490	3,580
France	698	1,480	(3/)	6
Japan	838	1,930	659	1,470
Netherlands	1,020	2,920	190	411
United Kingdom	970	1,460	711	1,060
Other	581 2/	1,440 2/	365	1,140
Total	5,710	13,200	3,540	7,940

-- Zero.
1/ Data are rounded to no more than three significant digits; may not add to totals shown.
2/ Revised; unspecified group of countries differs from that in the 1998 Annual Report.
3/ Less than 1/2 unit.

Source: U.S. Census Bureau.

TABLE 7

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

Country	1998 Gross weight (metric tons)	1998 Manganese content (metric tons)	1998 Customs value (thousands)	1999 Gross weight (metric tons)	1999 Manganese content (metric tons)	1999 Customs value (thousands)
Ore and concentrates with 20% or more manganese:						
All grades:						
Australia	35,600	18,700	$3,370	44,900	23,500	$4,380
Brazil	25,800	12,100	1,440	2	1	2
Gabon	188,000	94,900	17,300	280,000	142,000	25,600
Ghana	15,300	4,940	410	26,100	10,200	505
Mexico	38,400	14,600	3,440	23,600	9,130	1,980
South Africa	27,400	13,800	1,750	85,300	39,100	4,690
Other	1,710	934	143	100	55 2/	54
Total	332,000	160,000	27,800	460,000	224,000	37,200
More than 20%, but less than 47% manganese:						
Australia	40	40	24	--	--	--
Brazil	6,350	2,790	320	--	--	--
Ghana	15,300	4,940	410	26,100	10,200	505
Mexico	37,500	14,100	2,670	22,500	8,600	1,910
South Africa	--	--	--	27,300	9,970	1,410
Other	--	--	--	18	6	7
Total	59,200	21,900	3,430	75,900	28,800	3,840
47% or more manganese:						
Australia	35,500	18,600	3,340	44,900	23,500	4,380
Brazil	19,400	9,320	1,120	2	1	2
Gabon	188,000	94,900	17,300	280,000	142,000	25,600
South Africa	27,400	13,800	1,750	58,000	29,200	3,280
Other	2,650	1,390	915	1,170	572 2/	117
Total	273,000	138,000	24,400	384,000	195,000	33,400
Ferromanganese:						
All grades:						
Australia	20,600	15,500	7,720	11,700	8,920	4,600
Brazil	7,870	5,900	3,570	6,580	5,000	2,430
China	12,700	9,730	6,150	7,280	5,530	3,540
France	81,500	63,700	34,400	96,300	74,500	45,300
Italy	7,190	6,370	9,890	3,800	3,260	4,620
Japan	9,630	8,100	8,100	6,920	5,900	6,120
Korea, Republic of	8,560	7,000	4,830	10,800	8,760	6,210
Mexico	25,700	20,700	15,900	27,600	22,200	16,600
Norway	7,120	5,710	4,430	20	9	19
South Africa	157,000	123,000	66,300	140,000	110,000	59,400
Other	1,040	881	579	1,340	1,060	533
Total	339,000	266,000	162,000	312,000	245,000	149,000
1% or less carbon:						
China	1,260	1,070	1,330	1,280	1,110	1,270
Italy	7,190	6,370	9,890	3,800	3,260	4,620
Japan	3,810	3,280	3,970	6,500	5,540	5,610
Mexico	20	16	18	2,220	1,770	2,010
South Africa	2,220	2,050	3,860	3,740	3,290	3,970
Other	-- 3/	-- 3/	-- 3/	69	64	70
Total	14,500	12,800	19,100	17,600	15,000	17,600
More than 1% to 2% or less carbon:						
France	--	--	--	9,540	7,700	7,970
Japan	5,820	4,820	4,130	424	361	511
Korea, Republic of	8,560	7,000	4,830	10,800	8,760	6,210
Mexico	25,700	20,700	15,900	25,400	20,400	14,600
Norway	7,120	5,710	4,430	20	9	19
South Africa	13,600	11,000	8,090	25,100	20,400	14,100
Other	4,500	3,660	2,770	--	--	--
Total	65,200	52,800	40,200	71,300	57,600	43,400
More than 2%, but not more than 4% carbon:						
China	78	67	89	--	--	--

See footnotes at end of table.

TABLE 7--Continued

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

	1998			1999		
Country	Gross weight (metric tons)	Manganese content (metric tons)	Customs value (thousands)	Gross weight (metric tons)	Manganese content (metric tons)	Customs value (thousands)
Ferromanganese:						
More than 4% carbon:						
Australia	20,600	15,500	$7,720	11,700	8,920	$4,600
Brazil	5,990	4,390	2,330	6,580	5,000	2,430
China	9,740	7,290	3,760	6,000	4,420	2,260
France	81,500	63,700	34,400	86,700	66,800	37,300
South Africa	142,000	110,000	54,300	111,000	86,500	41,200
Other	39 3/	27 3/	18 3/	1,270	994	463
Total	259,000	201,000	103,000	224,000	173,000	88,300
Silicomanganese:						
Argentina	17,000	11,100	7,400	--	--	--
Australia	57,100	37,600	24,800	67,500	45,000	26,600
France	8,750	5,920	4,300	6,740	4,500	2,930
Georgia	20,300	14,500	8,970	13,400	9,900	5,470
India	41,900	27,600	19,200	10,900	7,020	4,340
Kazakhstan	2,660	1,740	1,130	27,700	18,800	10,900
Macedonia	10,200	7,000	4,670	--	--	--
Mexico	41,100	26,900	19,600	58,800	38,600	24,900
South Africa	118,000	79,500	52,900	89,300	60,000	35,800
Ukraine	--	--	--	8,190	6,030	2,850
Venezuela	17,700	11,600	8,100	16,900	11,100	6,530
Other	12,000 3/	7,530 3/	7,590 3/	1,190	753	694
Total	346,000	231,000	159,000	301,000	202,000	121,000
Metal:						
Unwrought:						
China	3,230	XX	4,850	2,770	XX	3,860
Germany	300	XX	542	255	XX	433
South Africa	10,300	XX	16,300	8,910	XX	14,100
Ukraine	564	XX	895	429	XX	622
United Kingdom	--		--	497	XX	976
Other	189 3/	XX	240 3/	40	XX	69
Total	14,600	XX	22,800	12,900	XX	20,100
Other:						
China	32	XX	34	1,700	XX	847
France	122	XX	904	29	XX	308
Ukraine	--	XX	--	119	XX	129
United Kingdom	438	XX	952	(4/)	XX	45
Other	152 3/	XX	551 3/	195	XX	1,220
Total	744	XX	2,440	2,040	XX	2,550
Waste and scrap:						
Canada	135	XX	115	130	XX	183
China	43	XX	12	22	XX	61
Mexico	37	XX	77	--	XX	--
Manganese dioxide:						
Australia	22,500	XX	32,100	21,400	XX	30,200
Belgium	845	XX	1,350	591	XX	913
Germany	100	XX	538	86	XX	462
Ireland	5,280	XX	7,220	8,380	XX	11,700
South Africa	4,320	XX	6,150	10,400	XX	14,700
Other	100 3/	XX	342 3/	108	XX	219
Total	33,100	XX	47,700	40,900	XX	58,200
Potassium permanganate:						
Czech Republic	569	XX	1,110	750	XX	1,410
Germany	205	XX	345	37	XX	66
India	251	XX	408	420	XX	749
Spain	175	XX	391	491	XX	704
Other	36	XX	90	22	XX	46
Total	1,240	XX	2,340	1,720	XX	2,980

XX Not applicable. -- Zero.

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

2/ Includes U.S. Geological Survey's conversion of part of reported data (from apparent MnO_2 content to Mn content).

3/ Revised; unspecified group of countries differs from that in the 1998 Annual Report.

4/ Less than 1/2 unit.

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

TABLE 8

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

(Thousand metric tons)

Country 3/	Range percent Mn e/ 4/	Gross weight 1995	Gross weight 1996	Gross weight 1997	Gross weight 1998	Gross weight 1999 e/	Metal content 1995	Metal content 1996	Metal content 1997	Metal content 1998	Metal content 1999 e/
Australia 5/	37-53	2,180 r/	2,109	2,136	1,500	1,892 6/	1,066	1,023	1,024	729	926 6/
Brazil 7/	30-50	2,398	2,506	2,124	2,149 r/	1,644 p/	935	977	828	838 r/	641
China e/ 8/	20-30	6,900	7,600	6,000 r/	5,300 r/	5,500	1,380	1,520	1,200 r/	1,060 r/	1,100
Gabon 9/	45-53	1,930	1,983 r/	1,904 r/	2,092	2,092 6/	891	915	879	966	966 6/
Ghana	30-50	217	448	437	537 r/	541	85	152	149	172 r/ e/	173
India 10/	10-54	1,764	1,797	1,596 r/	1,557 r/	1,500	670 e/	680 e/	606 r/ e/	592 r/ e/	570
Kazakhstan (crude ore) e/	20-30	428	430	400	634 r/ 6/	980	105	106	98	155 r/	240
Mexico 11/	27-50	472	485	534	510	459 6/	174	173	193	187	169 6/
South Africa 9/	30-48+	3,199	3,240	3,121	3,044	3,122 6/	1,350	1,380	1,320	1,300	1,340 6/
Ukraine	30-35	3,200	3,070	3,040	2,226	1,986 6/	1,100 e/	1,040 e/	1,030 e/	755 e/	675
Other e/ 12/	XX	607 r/	648	608 r/	658 r/	636	215 r/	217 r/	194 r/	197 r/	194
Total	XX	23,300	24,300	21,900 r/	20,200 r/	20,400	7,970 r/	8,180	7,520 r/	6,950 r/	6,990

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

1/ World totals and estimated data are rounded to no more than three significant digits; may not add to totals shown.

2/ Table includes data available through July 28, 2000. 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/ Production of beneficiated ore as reported in Sumário Mineral (Brasilia).

8/ Includes manganiferous ore.

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

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

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

12/ 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, Romania, Russia (crude ore), Thailand, and Turkey.

TABLE 9
FERROMANGANESE AND SILICOMANGANESE: WORLD PRODUCTION, BY COUNTRY 1/ 2/

(Thousand metric tons, gross weight)

	1995					1996				
	Ferromanganese			Silico-		Ferromanganese			Silico-	
	Blast	Electric		manga-	Grand	Blast	Electric		manga-	Grand
Country 3/	furnace	furnace	Total	nese	total	furnace	furnace	Total	nese	total
Argentina	--	6	6	27	33	--	7 r/	7 r/	25 r/	32 r/
Australia e/	--	110	110	100	210	--	110	110	95	205
Belgium e/	--	25	25	--	25	--	25	25	--	25
Brazil	--	130	130	167	297	--	215	215	232	447
Chile	--	8	8	2	10	--	8 r/	8 r/	2	10
China e/	400	605	1,005	830	1,835	450	700	1,150	840	1,990
Egypt e/	--	35	35	--	35	--	35	35	--	35
France 4/	348	85	433	71 e/	504 e/	337	100	437	61 e/	498 e/
Georgia e/	--	13 r/	13 r/	8 r/	20 r/	--	8 r/	8 r/	7 r/	15
Germany e/ 5/	--	20	20	--	20	--	20	20	--	20
India e/	--	180	180	190	370	--	190	190	170	360
Indonesia e/	--	14	14	-- r/	14 r/	--	14	14	7	21
Italy	--	20	20	104	124	--	25	25	100	125
Japan	--	347	347	65	412	--	343	343	76	419
Kazakhstan e/	--	--	--	20	20	--	--	--	50	50
Korea, North e/ 5/	--	7	7	--	7	--	6	6	--	6
Korea, Republic of	--	119	119	98	217	--	126	126	83	210
Mexico 6/	--	58	58	68	126	--	69	69	93	162
Norway e/	--	213 7/	213 7/	210	423	--	215 7/	215 7/	210	425
Philippines e/	--	5	5	--	5	--	--	--	--	--
Poland	46	--	46	21 r/ e/	67 r/ e/	60	--	60	25	85
Romania	--	28	28	57	86	--	20	20	79	99
Russia 8/	83	--	83	1 e/	83 e/	67	--	67	--	67
Slovakia e/	--	25	25	12	37	--	25	25	12	37
South Africa	--	507	507	251	758	--	562	562	241 e/	803 e/
Spain e/	--	25	25	50	75	--	30	30	70	100
Taiwan	--	13	13	--	13	--	14	14	--	14
Ukraine e/	100 r/	170	270 r/	600	870 r/	100 r/	170	270 r/	600	870 r/
Venezuela	--	--	--	48	48	--	--	--	25	25
Total	977 r/	2,770 r/	3,750 r/	3,000 r/	6,740 r/	1,010 r/	3,040 r/	4,050 r/	3,100 r/	7,160 r/

See footnotes at end of table.

TABLE 9--Continued
FERROMANGANESE AND SILICOMANGANESE: WORLD PRODUCTION, BY COUNTRY 1/ 2/

(Thousand metric tons, gross weight)

	1997					1998				
	Ferromanganese			Silico-		Ferromanganese			Silico-	
	Blast	Electric		manga-	Grand	Blast	Electric		manga-	Grand
Country 3/	furnace	furnace	Total	nese	total	furnace	furnace	Total	nese	total
Argentina	--	8 r/	8 r/	26 r/	35 r/	--	5 r/	5 r/	25 r/	30 r/
Australia e/	--	95	95	95	190	--	110	110	105	215
Belgium e/	--	25	25	--	25	--	20	20	--	20
Brazil	--	153	153	175	328	--	122 r/	122 r/	124 r/	246 r/
Chile	--	6 r/	6 r/	3 r/	9 r/	--	4 r/	4 r/	4 r/	8 r/
China e/	500	680	1,180	770	1,950	550 r/	500 r/	1,050	639 r/	1,689 r/
Egypt e/	--	35	35	--	35	--	35	35	--	35
France 4/	326	100	426	66 e/	492 e/	321 e/	100 e/	421 e/	65 e/	486 e/
Georgia e/	--	4 r/	4 r/	17 r/	21 r/	--	10	10	35	45
Germany e/ 5/	--	20	20	--	20	--	10 r/	10 r/	--	10 r/
India e/	--	166	166	198	364	--	165 r/	165 r/	193 r/	358 r/
Indonesia e/	--	15	15	7	22	--	13 r/	13 r/	7	20 r/
Italy	--	16	16	100 e/	116 e/	--	16	16	100	116
Japan	--	377	377	78	455	--	334	334	71	405
Kazakhstan e/	--	--	--	55	55	--	--	--	57 7/	57 7/
Korea, North e/ 5/	--	6	6	--	6	--	6	6	--	6
Korea, Republic of	--	159	159	77	236	--	158	158	107	265
Mexico 6/	--	68	68	105	173	--	87 r/	87 r/	105	192 r/
Norway e/	--	235	235	230	465	--	235	235	230	465
Philippines e/	--	--	--	--	--	--	--	--	--	--
Poland e/	48 r/	--	48 r/	20 r/	68 r/	50 r/ 7/	--	50 r/ 7/	25	75 r/
Romania e/	--	12	12	63	74	--	4 r/ 7/	4 r/ 7/	84 r/ 7/	88 r/ 7/
Russia 8/	47	--	47	--	47	65 r/	--	65 r/	--	65 r/
Slovakia e/	--	20	20	10	30	--	20	20	10	30
South Africa	--	499	499	286 e/	785 e/	--	542 r/	542 r/	265 r/ e/	807 r/ e/
Spain e/	--	35	35	100	135	--	35	35	100	135
Taiwan	--	12	12	--	12	--	13	13	--	13
Ukraine e/	125 r/	160	285 r/	560	845 r/	112 r/	150	262 r/	486 r/ 7/	748 r/
Venezuela	--	--	--	37	37	--	--	--	35 e/	35 e/
Total	1,050 r/	2,910	3,950 r/	3,080 r/	7,030 r/	1,100 r/	2,690 r/	3,790 r/	2,870 r/	6,660 r/

See footnotes at end of table.

TABLE 9--Continued
FERROMANGANESE AND SILICOMANGANESE: WORLD PRODUCTION, BY COUNTRY 1/ 2/

(Thousand metric tons, gross weight)

	1999 e/				
	Ferromanganese			Silico-	
	Blast	Electric		manga-	Grand
Country 3/	furnace	furnace	Total	nese	total
Argentina	--	5	5	25	30
Australia e/	--	95	95	105	200
Belgium e/	--	--	--	--	--
Brazil	--	110	110	110	220
Chile	--	4	4	4	8
China e/	500	550	1,050	700	1,750
Egypt e/	--	35	35	--	35
France 4/	302	100	402	65	467
Georgia e/	--	15	15	50	65
Germany e/ 5/	--	10	10	--	10
India e/	--	160	160	190	350
Indonesia e/	--	14	14	7	21
Italy	--	16	16	100	116
Japan	--	315 7/	315 7/	66 7/	381 7/
Kazakhstan e/	--	--	--	75	75
Korea, North e/ 5/	--	6	6	--	6
Korea, Republic of	--	140	140	100	240
Mexico 6/	--	79 7/	79 7/	114 7/	193 7/
Norway e/	--	235	235	230	465
Philippines e/	--	--	--	--	--
Poland	60	--	60	25	85
Romania e/	--	(9/)	(9/)	1	1
Russia 8/	90	--	90	--	90
Slovakia e/	--	20	20	10	30
South Africa	--	510	510	240	750
Spain e/	--	35	35	100	135
Taiwan	--	--	--	--	--
Ukraine e/	58	200	258	499 7/	757
Venezuela	--	--	--	35	35
Total	1,010	2,650	3,660	2,850	6,510

e/ Estimated. r/ Revised. -- Zero.

1/ Table includes data available through July 28, 2000.

2/ World totals and estimated data are rounded to no more than 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/ Silicomanganese includes silicospiegeleisen, if any.

5/ Ferromanganese includes silicomanganese, if any.

6/ Salable products from Autlán.

7/ Reported figure.

8/ Russia is believed to have produced some silicomanganese during 1996-99, but data for actual production were not available.

9/ Less than 1/2 unit.