MANGANESE

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Manganese (Mn) is essential to iron and steel production by virtue of its sulfur-fixing, deoxidizing, and alloying properties. Currently, no practical approaches exist for replacing it by other materials or for obtaining the bulk of U.S. requirements from domestic sources. Steelmaking, including its ironmaking component, has accounted for most domestic manganese demand, presently in the range of 85% to 90% of the total. 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 much the same in the near and medium term.

According to reported data, the rates of consumption of manganese as ore in ironmaking and as ferroalloys and metal in steelmaking changed insignificantly from those in 1994. The data on ferroalloys suggested some shifting from ferromanganese to silicomanganese.

Dry cell batteries continued to be a use of manganese that showed a comparatively high growth rate. Indicative of this were expansions of productive capacity for electrolytic manganese dioxide (EMD) in Australia and the United States and increased EMD output in Japan.

In manganese U.S. foreign trade in 1995, imports of ore and silicomanganese increased significantly compared with those in 1994. Imports of metal declined sharply. In response to petitions filed in November 1994, the Government ruled in December that antidumping duties should be imposed on imports of metal from China.

In price developments, the price for metallurgical-grade manganese ore delivered to U.S. customers stayed the same as that in 1994. Prices increased in the U.S. market for upgraded forms of manganese used in steelmaking. The price rise for silicomanganese accelerated to give a year-average price that was about one-fourth greater than that in 1994. The year-average price rose somewhat more than 7% for high-carbon ferromanganese. The price of domestically produced electrolytic metal was up moderately during the year.

The rate of disposal of manganese materials from Government stockpiles remained about the same as in 1994, in terms of manganese content. Disposals included all categories of ore and upgraded forms in inventory except synthetic manganese dioxide and silicomanganese. Government inventories of manganese, all forms, remained approximately equivalent to 2 years of apparent consumption, on the basis of quantity only.

World production of manganese ore was estimated to have returned to about the same level as in 1993. *(See table 1.)* Production increased in a number of countries that traditionally have been among the larger producers. World production of manganese ferroalloys was estimated to have been in the same general range as in 1992-94.

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

Legislation and Government Programs

Stockpile.—On February 15, the Defense Logistics Agency (DLA) submitted revisions to the Fiscal Year 1995 Annual Materials Plan (AMP) to Congress that included raising the maximum disposal level for metallurgical-grade manganese ore from 67,132 to 362,874 tons. Congress approved the revisions in April, thereby also affirming the maximum fiscal year 1995 disposal authority for other manganese materials as, in tons, 36,287 for chemical-grade ore; 54,431 for natural battery-grade ore; and 1,814 for electrolytic manganese metal. To implement disposal of electrolytic metal, DLA issued Solicitation of Offers DLA-MET-101 on June 23 that made 907 tons of metal available for sale beginning in July.

Also on February 15, DLA submitted to Congress its Fiscal Year 1996 AMP, which subsequently took effect on October 1. The Fiscal Year 1996 AMP carried over the same maximum disposal levels for manganese materials as those in the final Fiscal Year 1995 AMP.

In its Strategic and Critical Materials Report to the Congress for fiscal year 1995, DLA reported that its 11-year program on domestically upgrading ore into ferroalloys had been concluded by December 31, 1994. During this program, 940,084 tons of metallurgical-grade manganese ore was shipped from the stockpile and 523,114 tons of high-carbon ferromanganese was returned to the stockpile as upgraded material.

Disposals of manganese materials in 1995 announced by DLA totaled, in tons, natural battery-grade ore, 177; chemical-grade ore, 4,354; metallurgical-grade ore, 127,523; high-carbon ferromanganese, 17,980; medium-carbon ferromanganese, 1,996; and electrolytic metal, 1,293. Disposals of ore and metal were cash whereas those of ferromanganese were payment-in-kind.

Data reported by DLA indicated that changes in physical inventory of manganese materials in 1995 all were decreases and consisted of, in tons, natural battery-grade ore, 5,431; chemical-grade ore, 4,231; metallurgical-grade ore, 105,239; high-carbon ferromanganese, 16,069; medium-carbon ferromanganese, 2,032; and electrolytic metal, 995. At yearend, the estimated manganese content of the manganese inventories being held by the Government was 1.4 million tons. *(See table*

2.) The total inventory was 4.5% less than at the end of 1994 but still about twice the current national apparent consumption.

Other.—Two decisions by the U.S. Court of Appeals for the District of Columbia Circuit removed the final legal barriers to commercial use of methylcyclopentadienyl manganese tricarbonyl (MMT, "HiTEC 3000") in unleaded gasoline in the United States. In April, this court ruled that the Environmental Protection Agency (EPA) did not have the authority to deny a waiver to Ethyl Corp. that would permit use of MMT in unleaded gasoline. EPA subsequently granted the waiver, effective July 11 (60 FR 36414), but still contended that further tests of human health effects were necessary before MMT could be registered for use as an octane-enhancing additive. The Court of Appeals decided this issue in October by directing EPA to register use of MMT in unleaded gasoline retroactively to November 30, 1993.

In August, EPA denied (60 FR 44000-44003) the October 20, 1993, petition of the American Iron and Steel Institute that manganese and manganese compounds contained in ironmaking and carbon steelmaking slags be deleted from the list of toxic chemicals subject to section 313 of the Emergency Planning and Community Right-to-Know Act of 1986. EPA's reason for doing so was its belief that manganese ion can become available from these slags at levels than can reasonably be anticipated to induce adverse human health and environmental effects.

In December, the Food and Drug Administration established, with an effective date of January 1, 1997, a Reference Daily Intake of 2 milligrams for manganese as an essential mineral in human nutrition (60 FR 67164-67174).

Production

Ore and Concentrate.—Production and shipments continued to consist only of a small amount of manganiferous material for use in coloring brick. This material was mined in Cherokee County, SC, and had a natural manganese content in the range of 5% to 15%. Shipments data were not published to avoid disclosing proprietary data.

Ferroalloys, Metal, and Synthetic Dioxide.—Production statistics for these materials were not published to avoid disclosing proprietary data. Elkem Metals Co. was the only domestic producer of manganese ferroalloys, which was at its Marietta, OH, plant. *(See table 3.)* Late in the year, the U.S. and Canadian plants of Norway's Elkem A/S were combined into Elkem-North America, a new division of the parent company. This restructuring for lowering costs and improving efficiency included the making of improvements in manganese ferroalloys operations at the Marietta plant.

Also in the latter part of the year, Elkem Metals sold the manganese sulfide and ferrophosphorus powders business of its Niagara Falls, NY, plant to Sweden's Höganäs AB. These powders are used as additives in making powder metallurgy products. Subsequently, the Hoeganaes Corp., a subsidiary of The Interlake Corp., stated that after December 1995 Höganäs would transfer manufacture of manganese sulfide and ferrophosphorus powders to Sweden.

Kerr-McGee Chemical Corp. was expanding further the capacity of its plant for EMD at Henderson, NV. To be completed by the end of 1996, this increase of about 3,400 tons (15%) would raise the annual capacity of that plant to about 25,600 tons.

Consumption, Uses, and Stocks

The data relating to manganese end use plus certain other information indicated that metallurgical applications accounted for most manganese consumption, 85% to 90% of which has been for steelmaking. This usage pattern is typical of most industrialized countries.[1] On the basis of the data for reported consumption, unit consumption of manganese in ironmaking, which could not be published to avoid disclosing proprietary data, was at nearly the same comparatively low level as in 1994. Also on the basis of reported data, overall manganese unit consumption in steelmaking declined only minimally, with indications of some shift in usage from ferromanganese to silicomanganese. *(See tables 4 and 5.)* Relatively small quantities of manganese were used for alloying with nonferrous metals, chiefly in the aluminum industry as manganese-aluminum briquets containing 75% Mn and 25% Al. According to an industry source, while the aluminum industry was the largest consumer of manganese metal in North America, the steel industry was the largest consumer in Europe and the Far East.[2] The difference in consumption pattern was attributed to differing degrees of usage of aluminum in beverage cans.

Domestic consumption of manganese ore in 1995 for metallurgical and nonmetallurgical uses was the greatest since 1990, totaling 486,000 tons as compared with 449,000 tons in 1994. Corresponding yearend stocks were 309,000 tons and 269,000 tons, respectively. Because of the need to avoid disclosing proprietary data, these figures cannot be disaggregated into end-use segment.

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.[3] The source of manganese units for these applications was mainly manganese ore.

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. By means of this survey, approximately 15 firms were canvassed that process ore by such methods as grinding and roasting or consume it in the manufacture of dry cell batteries and manganese ferroalloys, metal, and chemicals. For this segment of ore consumption, the collective consumption of these firms is believed to constitute that of the United States except for negligible quantities consumed by other firms, if any. In 1995, full-year responses were obtained from all but three plants. The data missing from them were estimated on the basis of information received from them in prior years and data trends of other firms having similar business activities. The data reported were thus estimated to represent almost 97% of total

consumption.

Among developments involving U.S. suppliers of manganese materials for agricultural uses, American MicroTrace Corp. (AMT) of Virginia Beach, VA, and AlliedSignal Inc. made an agreement in mid-1995 for Allied to supply its liquid manganese sulfate to AMT for conversion into granules and powder for subsequent sale by AMT, thereby augmenting AMT's marketing of sulfate. Allied's production of sulfate at Pittsburg, KS, continued to be as a coproduct of the manufacture of anisic aldehyde for such uses as making fragrances. AMT's plant at Fairbury, NE, subsequently came under new ownership when AMT was purchased late in the year by Tetra Technologies Inc. of Houston, TX, of which AMT became a subsidiary.

In the battery industry, demand for manganese for use in dry cell batteries continued to show a healthy growth rate worldwide. In its annual report for fiscal year 1995, Duracell Inc. reported a 14% increase in volume for North American sales of alkaline batteries that employ EMD. Other industry sources forecast the onset of slowly declining use in the United States of carbon-zinc cells, in which natural manganese dioxide is employed. In Japan, the proportion of alkaline cells in total production of dry cells advanced further, with expectations of exceeding 40% as compared with 29% in 1993. A similar trend of alkaline cells displacing carbon-zinc cells was evident in 1985-93 statistics for Italy.[4] For its line of rechargeable alkaline cells, Rayovac Corp. achieved "no-mercury added" status as well as significant performance improvements through design changes. Following its introduction in the United States in 1993, this type of rechargeable battery was reported to have gained a significant position in a market that has since grown by more than one-third.

The majority of processes in operation or being set up for recycling materials in dry cell batteries involved a pyrolysis step, including at least three for processing batteries collected from mandatory recycling in Switzerland. In the United States, a pyrolysis chamber that liberates mercury was a feature of new automated facilities for handling alkaline batteries at the Pecos, TX, plant of Recovery and Reclamation Inc. Capacity of that operation has been tripled to about 20,000 tons per year. Batteries processed at this plant included some being collected in the Netherlands and exported to Texas. In eastern Germany, a plant that was based on a hydrometallurgical process and targeted to treat 5,000 tons of batteries per year was becoming operational. In Japan, ferrite producers were working on development of technology for recovering iron, manganese, and zinc from dry cell batteries and using the recycled materials to produce soft ferrites.

Prices

For 1995, with the price of manganese in metallurgical-grade ore taken as 1.0, the corresponding approximate prices per manganese unit were 2.7 for high-carbon ferromanganese, 3.0 for silicomanganese, 4.6 for medium-carbon ferromanganese, and 10.1 for manganese metal. These price factors are based on year-average prices such as discussed in the following.

Manganese Ore.—The midrange value for the average price, c.i.f. U.S. ports, of metallurgical-grade ore containing 48% manganese was considered to have remained the same as in 1994, $2.40 per metric ton unit (mtu). This followed the trend in ore price development in other international transactions. It is recognized that prices somewhat above or below this value applied, depending on ore quality, time of year, and nature of the transaction. Because the mtu is 1% of a metric ton, i.e., 10 kilograms of contained manganese, the price of manganese in ore in 1995 and 1994 can be expressed as 24.0 cents per kilogram.

In 1995, the pricing of metallurgical-grade ore in international markets was set late in April when Japanese consumers and their traditional Australian and South African suppliers came to terms for deliveries during the Japanese fiscal year that began April 1. At that point, Australia's Broken Hill Pty. Co. Ltd. (BHP) and South Africa's Samancor Ltd. agreed to supply high-grade lumpy ore containing 48% manganese, the benchmark grade, at the same f.o.b. prices as in the previous contract year, $2.04 and $1.95 per mtu, respectively. In negotiations prior to settlement, these suppliers were reported to have been seeking price increases. However, their position was undercut by ore suppliers in Western Australia such as Portman Mining Ltd., which in January had offered ore to Japan at $1.95 per mtu, f.o.b.

The price of a metric ton of ore is obtained by multiplying the price per mtu by the percentage manganese content of the ore. The ore market consists of a number of submarkets because of differences between ores according to the various end uses such as ferroalloy production, blast furnace ironmaking, and battery manufacture.

Manganese Ferroalloys.—The general trend was for significant price advances, most notably for silicomanganese. The price information that follows refers to quotations for imported material, as no current price data were publicly available for domestic product. English units continued to be the basis for price quotes in the United States as given in sources such as Platt's Metals Week.

The price range for high-carbon ferromanganese containing 78% manganese, f.o.b. Pittsburgh or Chicago warehouse, began the year at $470 to $500 per long ton of alloy. The price range rose more or less continuously throughout the year, with some month-to-month fluctuation in the rate of rise. A very slight downturn in December gave a yearend price range of $560 to $575. The middle of the price range was 17% greater for December than for January and averaged $519 for the year, an increase of 7.5% above that for 1994.

The price range for imported silicomanganese with 2% carbon, in cents per pound of alloy, f.o.b. Pittsburgh or Chicago warehouse, began the year at 24.5 to 26, which was marginally higher than at the end of 1994. The trend in the range was slightly upward into May, at which point a nearly regular and higher rate of rise set in until a peak of 39.5 to 41.5 was reached in late October. This was followed by a moderate falloff that gave a yearend range of 36.75 to 39.5. The middle of the price range was 51% greater for December than for January and

averaged 31.5 for the year, an increase of almost 26% above that for 1994. The price rise for silicomanganese was driven by strong worldwide demand by the steel industry and also by increases during the year in the price of ferrosilicon. Trade journals indicated that this caused at least some steelmakers to turn to silicomanganese as a source of silicon. The increase in ferrosilicon price was about the same as that for silicomanganese eventually but was most pronounced in the first half of 1995.

Manganese Metal.—The price quotes for bulk shipments of domestic material were the same at the start of the year as those in effect since mid-November 1990, per pound f.o.b. shipping point: a range of $1.04 to $1.05 according to Platt's Metals Week and $1.05 according to American Metal Market. Platt's Metals Week listed two increases, to $1.09 to $1.10 in mid-March and to $1.15 in early October. For the October increase, American Metal Market gave a range of $1.14 to $1.15. The published prices averaged about $1.10 for the year, an increase of somewhat more than 5% above the average for 1994, and indicated a January-to-December change in 1995 of about +10%.

Foreign Trade

The volume of manganese units traded increased by approximately 6% for exports and 2% for imports, on the basis of reported or estimated manganese content. The across-the-board increases in overall export categories were in the range of 15% for silicomanganese and metal and just nominal for ore and ferromanganese. *(See table 6.)* The overall increase to the greatest level since 1989 in units imported resulted principally from significant rises in receipts of ore and silicomanganese. *(See table 7.)* Also on the basis of content, the ratio of the sum of ferroalloy plus metal imported to the corresponding sum for ore plus dioxide was 2.2, for the second consecutive year the lowest such ratio since 1989.

Among exports, a relatively low level for those of ore that now extended over 1992-95 was the least since 1983. Unit values indicated that about four-fifths of ore exports consisted of unprocessed metallurgical-grade ore. Practically all ore with higher unit value went to Canada. Exports of ferromanganese containing more than 2% carbon, which were 28% of total ferromanganese exports, decreased by 28% whereas those of other ferromanganese increased by 18%. Exports of metal were the greatest since 1990. Reexports of ore, ferromanganese, and silicomanganese were, in tons, 2,405, 2,249 and 3,955, respectively, almost all of which went to Canada. Of the 170 tons of metal reexported, 102 tons was shipped to Canada.

Among imports, the average manganese content was 47.4% for ore, which was the least since 1989, and 78.2% for ferromanganese, which was close to the averages for 1990-93. Quantities of ore imported increased for all main source countries except for Gabon; it was uncertain if the receipts reported from China were actually produced in that country. Summing over all grades of ferromanganese, receipts from Australia were the most ever whereas those from Norway were the least since 1965.

For silicomanganese, import volume rose 12% but, for the second consecutive year, still fell below the 1993 record quantity. For several of the many supplying countries, the amounts received were comparatively large, possibly the greatest ever. On the other hand, virtually no silicomanganese was received from Brazil and none from Ukraine. Receipts recorded otherwise from republics of the former Soviet Union included those from Georgia and Kazakstan, the latter for only a small amount. Reported imports of spiegeleisen were 261 tons, an increase of about 60%, and of relatively high unit value; source countries were Germany and South Africa.

For imports of metal, those of unwrought material fell by almost 40% to a level more in line with that for 1984-93; those of metal, other, were the least by far since reporting under this category began in 1989 in accordance with adoption of the Harmonized Tariff System.

Among imports of manganese chemicals, those of manganese dioxide declined by 10%, as for the first time those from Australia decreased, but the total was still the second greatest on record. All dioxide imports appeared to have been synthetic material. For potassium permanganate, the import volume rose by about one-sixth, particularly because of a quadrupling of receipts from India. Of imports under the classification “Other sulfates,” which includes manganese sulfate, those from China increased by about 3% to 4,135 tons at a value of $1.5 million and those from Mexico by about 40% to 14,213 tons at a value of $7.7 million.

Preferential tariff treatment for U.S. imports from developing countries expired after July 31 because the U.S. Congress failed to reauthorize the Generalized System of Preferences (GSP) program as of its renewal date. As of yearend, legislation had not been enacted that would retroactively extend the program as has occurred in the two preceding years. Imports of manganese materials affected by the lapse included manganese dioxide, refined ferromanganese, silicomanganese, and the "other" category of manganese metal.

Final determinations of the U.S. International Trade Commission (ITC) in trade disputes involving imports of manganese materials from China were negative for manganese sulfate and affirmative for manganese metal. On October 27, the ITC announced a unanimous decision that an industry in the United States is not injured by imports of manganese sulfate from China, even though it had announced on January 11 a unanimous determination that a reasonable indication of injury exists. The ITC's final decision negated the potential effect of a final determination made late in September by the International Trade Administration (ITA) of the U.S. Department of Commerce of less than fair value (LTFV) sales of manganese sulfate (60 FR 52155-52162). Consequently, dumping margins evaluated by ITA as 32.48% for one Chinese firm and as 362.23% for all other Chinese sources did not take effect. Petitions alleging LTFV imports of manganese sulfate from China had been filed by AMT in November 1994.

The ITC's affirmative final determination by a 4 to 2 vote that

the domestic industry was materially injured by imports of manganese metal from China was made on December 5. The dumping margins to be imposed, preliminarily determined by the ITA in June (60 FR 31282-31285), went through as many as three revisions (60 FR 37875-37876 and 56045-56052; Platt's Metals Week, December 11, 1995, pp. 1-2). The initial preliminary margins had ranged from 82.44% to 148.82% for certain specific suppliers of Chinese material but were reduced to a range of 0.97% to 11.77%. For all other Chinese suppliers, the reduction was much smaller, from 148.82% to 143.32%. Elkem Metals, Pittsburgh, PA, and Kerr-McGee Chemical, Oklahoma City, OK, were the petitioners constituting the domestic industry; they had filed in November 1994.

World Review[5]

World production of manganese ore was estimated to have recovered from a dip in 1994 as production increased in most of the major producing countries. *(See table 8.)* World production of manganese ferroalloys was estimated to have declined slightly, particularly because of decreases in electric furnace production in Brazil and South Africa. *(See table 9.)*

Australia.—According to BHP's monthly production reports, manganese ore output of BHP's Groote Eylandt Mining Co. Pty. Ltd. (GEMCO) subsidiary advanced about 4% to 1,820,000 tons. This was the highest level reached since GEMCO produced 1,890,000 tons in 1990. The 1990 output conceivably could have been exceeded were it not for a strike in the first quarter that caused BHP to declare force majeure on ore shipments. BHP's exports of manganese ore to China were reported to have increased to about one-sixth of production. A significant portion of the ore being shipped to China was repurchased by BHP in the form of silicomanganese for export, which included shipments to Japan.

BHP broadened its arrangements for supplying silicomanganese to Japan late in the year to include direct sales of silicomanganese produced in China from manganese ore supplied by BHP. BHP began selling silicomanganese to Japan in 1993, at which time the silicomanganese was a product of its ferroalloy subsidiary, Tasmanian Electro Metallurgical Co. Pty. Ltd. (TEMCO). TEMCO developed a way of producing a relatively light-weight aggregate from slag from its silicomanganese operations. Supplying this aggregate to local makers of concrete blocks aided TEMCO in alleviating problems of solid waste disposal.

In April, formal opening was conducted of an expansion that raised annual EMD capacity to more than 22,000 tons at the Australian Manganese Co. Pty. Ltd., another BHP subsidiary with a plant near Newcastle, New South Wales.

Australia's production of manganese ore continued to be augmented through the activities of Portman Mining and Valiant Consolidated Ltd. in the Woodie Woodie area of Western Australia. Portman restarted its operations in the Pilbara Manganese Province in April with a plan to lower costs by mining crude ore in concentrated fashion for less than a full year and building stocks that later could be drawn on for production of concentrates. Portman contracted to supply 200,000 tons of ore to Japan during the Japanese 1995 fiscal year. Valiant was producing high-grade ore from its Mike Mine, 101,000 tons of concentrate for the year and for shipment mostly to customers in the Far East.

Brazil.—Manganese ore shipments by Indústria e Comércia de Minérios S.A. from operations at Serra do Navio, Amapá Territory, totaled 392,000 tons. Destinations of the shipments, which were through Porto de Santana on the Amazon River, were, in tons, Europe, 251,000; South America (including Brazil), 105,000; North America, 21,400; and Asia, 15,000.[6] Compared with shipments in 1994, the overall total was more than one-fifth less; dropoffs of more than 80% in shipments to Asia and of nearly 30% in those to South American destinations caused the decline.

Shipments of manganese ore by Cia. Vale do Rio Doce (CVRD) from its Azul Mine in the Carajás region were a record 1,290,000 tons. Of this total, 824,000 tons was exported and 466,000 tons was shipped to domestic customers.[7] These shipments of ore, which were through Ponta da Madeira in northeastern Brazil, were roughly 90% greater across the board than sales quantities in 1994.

CVRD increased its participation in ventures involving production of manganese ferroalloys. At midyear, CVRD and Usinas Siderúrgica de Minas Gerais S.A. (Usiminas), a Brazilian steelmaker, assumed control of the ferroalloy plants of the Paulista Group. This group had been responsible for the majority of Brazil's production of manganese ferroalloys through output of the plants of Cia. Paulista de Ferro-Ligas (Paulista) and Eletrosiderúrgica Brasileira S.A. (Sibra). Paulista and Sibra had applied to the courts for protection under Brazilian bankruptcy law in December 1993. Control of the Paulista Group plants by CVRD and Usiminas was established through Vale-Usiminas Participações, a new, equally held company formed for that purpose. Late in the year, CVRD increased to 65% from 35% its shareholding in Société Européene d'Alliages pour la Sidérurgie (SEAS), a manganese ferroalloy producer in France, the majority of whose manganese ore requirements CVRD has been supplying under a long-term contract. CVRD also was reported to be studying further proposals for a manganese ferroalloy plant in Asuncion, Paraguay. This plant would be fed with manganese ore from Urucum Mineração S.A., a CVRD subsidiary and producer of manganese ore in Mato Grosso do Sul State.

Late in the year, financial problems caused shutdown of the ferroalloy operations of Prometal Produtos Metalúrgicos S.A. as well as manganese mining by Prometal's Mineração Buritirama S.A. subsidiary. Prometal was a relatively small Brazilian producer of manganese ferroalloys that as of 1994 was attempting to produce manganese ore from the Buritirama Mine in the Carajás area of northeastern Brazil.

Mineração Corumbaense S.A. was reported to have produced no manganese ore in 1995 and to have discontinued its production.[8] Mineração Corumbaense had been producing predominantly iron ore from operations near Corumba in Mato Grosso do Sul State, not far from those of Urucum Mineração.

China.—Imports of manganese ore again were reported to have increased, rising more than one-third to 1,290,000 tons. Australia, Gabon, Myanmar, and South Africa were the leading ore sources, with imports from Myanmar signifying on-going border trade.[9]

In the ferroalloy industry, which for the past several years has positioned China as the world's largest producer of manganese ferroalloys, a joint venture (Shaoxing Comilog Ferro Alloys Co.) was formed early in the year between Shaoxing Iron and Steel Works and Comilog Asia Co., in which Compagnie Minière de l'Ogooué S.A. (COMILOG) had a majority interest. The joint venture, formed with exports partly an objective, split out from Shaoxing Steel's plant in Zhejiang Province three small blast furnaces used for producing ferromanganese.

In developments relating mostly to silicomanganese, the Zunyi Ferro-Alloy Works in Guizhou Province started up in the fall a new electric furnace as a joint venture with Glory Profit Co., a trading company based in Hong Kong. Other Chinese ferroalloy producers were reported to be switching between production of chromium and manganese ferroalloys, depending on market conditions. As mentioned under Australia, BHP broadened its arrangements for supplying to Japan silicomanganese produced in China.

The magnitude of China's manganese metal industry could not be decided upon by the ITC in its investigation of U.S. imports of manganese metal from China. Information received by the ITC indicated that China's manganese metal capacity was the largest or second largest in the world, with annual capacity in 1994 ranging from at least 31,000 tons to more than twice that amount.[10] China's exports of metal had risen in 1994 to 50,000 tons, or nearly one-half again as much as those in 1993.

France.—Capital structure of the two firms producing manganese ferroalloys was changed. For Société du Ferromanganèse de Paris-Outreau (SFPO), further investment by COMILOG and Société Nationale d'Investissement du Gabon (Sonadig) raised their combined shareholding in SFPO to nearly 90%. COMILOG's shareholding had been 47% and that of Sonadig 35% under the bankruptcy rescue plan for SFPO established in November 1994. For SEAS, as mentioned under Brazil, CVRD increased its shareholding to 65% from 35%.

Gabon.—Exports of manganese ore from COMILOG's Moanda Mine rose to a total of 1,940,000 tons, which consisted of 1,850,000 tons of metallurgical-grade ore and 88,500 tons of battery-grade ore. Shipments were made in 85 cargoes via the Port of Owendo.[11] Compared with 1994 exports, shipments increased more than 40% for metallurgical-grade ore and for total and about 20% for battery-grade ore. The export total was the greatest since 1990.

As discussed under China, COMILOG entered into a joint venture for blast furnace production of ferromanganese in China. COMILOG was itself undergoing a major change in ownership. COMILOG's board of directors approved in December the acquisition of a 17% shareholding in COMILOG by ERAMET, a French producer of nickel and high-speed steel. Subject to successful completion of a due-diligence process, ERAMET planned to increase its shareholding in COMILOG to 46%.

Ghana.—Production of manganese ore from the Nsuta Mine by Ghana National Manganese Corp. was the least since the early 1980's. However, export shipments were reported to have been 254,000 tons,[12] or slightly more than the comparatively low amount shipped in 1994.

Japan.—Overall imports of metallurgical-grade manganese ore increased about 5% to 1,177,000 tons. For ore containing more than 39% manganese, imports rose about 9% to 941,000 tons, more than nine-tenths of which was from Australia and South Africa. For ore containing no more than 39% manganese, imports declined about 10% to 236,000 tons, almost all of which was from, in order of magnitude, India, South Africa, and Ghana. Imports of ferruginous manganese ore were up by nearly 40% to 441,000 tons, virtually all of which was from India (69%) and Ghana (31%).

Production overall of manganese ferroalloys and of ferromanganese changed only marginally from quantities in 1994. Production of silicomanganese declined about 6% to nearly the same level as in 1993.

Imports of manganese ferroalloys rose by about one-fourth to total 364,000 tons. Increased imports of high-carbon ferromanganese easily surpassed 100,000 tons; almost all of the 122,000 tons received were about equally sourced between China and South Africa, from whom receipts were up by about 75% and by nearly a factor of 3, respectively. Imports of silicomanganese increased by almost one-fifth to 241,000 tons or just below the 1991 record total. China, Ukraine, and South Africa, in order of magnitude, were the three leading sources.

Exports of 45,600 tons of manganese ferroalloys again were almost double the total for the previous year. The rise was because of increased exports of ferromanganese containing less than 2% carbon, which advanced by about 83% to 41,600 tons. The principal recipients were, in order of magnitude, the United States, Australia, the Netherlands, and the Republic of Korea, all of whom took larger quantities than in 1994.

Production and exports of EMD each rose about one-tenth to become the greatest since 1988. Production was 60,400 tons, thus exceeding 60,000 tons for the first time since 1988; exports were 34,900 tons. In the latter part of the year, Tosoh Corp. spun off the production of EMD and other manganese oxides at its Hyuga plant in Miyazaki Prefecture as a separate business that became Tosoh Hyuga, a wholly owned subsidiary.

Production of electrolytic manganese metal, which had dwindled to less than 3,000 tons in 1994, came to an end when Tosoh stopped metal production at its Hyuga plant. Chuo Denki Kogyo Co. Ltd., the other producer in recent years, had ended its production in 1994. As discussed under South Africa, Tosoh subsequently entered into a joint-venture agreement involving future supply of manganese metal from South Africa.

Imports of unwrought manganese metal, including scrap, maintained the 1990's increasing trend and rose by about one-fifth to 33,800 tons, of which roughly 60% was from China and 40% from South Africa. This trend was in keeping with the effect of rising quality requirements on selection of alloying agent for steels such as those in which low contents of residual

elements are specified.[13]

Mexico.—Compared with that in 1994, overall output of ore products from the operations of Cía. Minera Autlán de C.V. (Autlán) in the Molango District of Hidalgo State was 54% greater. Data for salable production in 1995, in tons and percentage change from 1994 (in parenthesis), were carbonate ore sold, 98,400 (+35%); oxide nodules, 351,000 (+62%); and manganese dioxide, 22,800 (+34%). Production of nodules was the greatest since 1989. Dioxide was from the Nonoalco Mine, from which, besides battery ore, ceramic grade material has been produced since 1994. In the second half of the year, preparation of mining and treatment facilities began at the Terrenates Mine in Chihuahua State, northwestern Mexico. Output of this mine was targeted for production of manganese ore with a high ratio of manganese to iron.

Autlán's overall salable production of manganese ferroalloys decreased about 4%. Increases in production of about 5% for medium-carbon ferromanganese and 6% for silicomanganese were more than offset by a drop of about 30%, to 25,500 tons, for high-carbon ferromanganese. In October, production was restarted at the Gómez Palacio Plant in Durango State.

South Africa.—Preliminary data indicated that metallurgical-grade ore again accounted for more than 98% of manganese ore production, the balance being chemical-grade ore. Total ore production and production of metallurgical-grade ore each was more than 12% greater than in 1994 and the greatest since 1990. Of the output of metallurgical-grade ore, 36% of production consisted of ore containing 30% to 40% manganese and 54% of ore containing more than 48% manganese. For these two categories, production was greater by 14% and 11%, respectively, than in 1994. Sales of manganese ore by The Associated Manganese Mines of South Africa Ltd. for the fiscal year ending June 30, 1995, were 1,192,000 tons, an increase of 22% over that for the prior fiscal year.

Among papers dealing with aspects of the geology of South Africa's major manganese ore fields in the Northern Cape Province, three pertained to the Kalahari field to the north and one to the Postmasburg field to the south.[14]

At Samancor, conversions between manufacture of chromium and manganese ferroalloys continued in response to market conditions at plants usually devoted to chromium ferroalloys, the Ferrometals plant at Witbank and the Palmiet Ferrochrome plant at Krugersdorp. Projects on recovery of metal from slag dumps and recycling of furnace sludge were undertaken at the Metalloys manganese ferroalloy plant at Meyerton. Samancor also was developing ways of dealing with technical and environmental problems associated with using coal as the main form of reducing agent at the Meyerton smelter.[15]

Manganese Metal Co. (Pty.) Ltd. (MMC), a Samancor subsidiary, agreed late in the year with Japan's Tosoh to form a 50:50 joint venture involving production and sales of manganese metal products. Included in the agreement were transfer of equipment used to produce manganese-aluminum briquets at Tosoh's Hyuga plant to MMC's metal plant at Nelspruit and an arrangement for MMC to supply Tosoh with metal and briquets. MMC was nearing completion of an expansion of production capacity at its other electrolytic metal plant at Krugersdorp. This expansion, which was projected to be finished early in 1996, would raise MMC's overall annual capacity for metal by 10% or about 4,000 tons.

Ukraine.—Low yields led to discontinuation of ore production at the experimental Tavrichesky complex for utilization of the Bol'shoy Tokmak deposit, and increases in electricity costs impacted production of manganese ferroalloys at the Nikopol' and Zaporozh'ye ferroalloy plants.[16] In spite of these and other problems, output of manganese ferroalloys was maintained at about the same level overall as in 1994.

Current Research and Technology

The U.S. Bureau of Mines published a study of domestic manganese consumption and recycling on the basis of data available for 1990. This was one of a set of four studies of materials flow for the strategic and critical commodities of cobalt, chromium, manganese, and platinum-group metals.[17] Reviews published by others on aspects of the manganese industry were on manganese and its alloys,[18] manganese compounds,[19] and high-carbon manganese austenitic steels.[20]

The possible environmental effects of use of MMT in gasoline were addressed in two studies. One inquired into the human health risk that might be associated with chronic exposure in Canada to low concentrations of automotive emissions[21] and the other into the accumulation of manganese oxides in soil and plants alongside roads in central Utah.[22]

Among reports dealing with extraction of manganese from ore, one outlined the status of a project on possible in situ leaching of sites within the manganiferous iron formations of the Cuyuna Range in Minnesota, for which an innovative core-drilling technique was employed.[23] In other research, microbial leaching for extraction of manganese from low-grade ores was reviewed.[24]

In studies related to the smelting of manganese ore, two were conducted on materials resulting from beneficiation of ore at Groote Eylandt, Australia. For these, the subjects were reduction of siliceous fines with graphite[25] and production of ferromanganese from sand concentrates by fluidized bed pre-reduction followed by plasma smelting in a DC arc furnace.[26] In another investigation, a staged materials and energy balance was constructed to assist examination of several factors to be considered when smelting high-carbon ferromanganese in submerged-arc electric furnaces.[27] Preliminary results of laboratory experiments performed in South Africa were reported for a study of applying direct current to a metal-slag system in order to electrochemically reduce manganous oxide from the slag.[28]

The mechanism of dissolution of manganese-aluminum and iron-aluminum briquets in liquid aluminum was investigated in the laboratory, and the dissolution rate of the briquets was compared with that of the powders making up the briquets.[29]
So-called high-nitrogen steels, in which manganese often serves as an alloying element, continued to be of international research

interest; some such steels have gone into limited commercial production.[30]

In thermodynamic studies involving manganese, Japanese workers reported in a related series of investigations on use of manganese-containing slags for dephosphorization of hot metal and steel,[31] manganese distribution ratios between slag and hot metal and liquid steel,[32] and activity of manganese oxide in steelmaking slags.[33] Thermodynamic analysis was used in another study to assess the role of manganese in 200-type stainless steels.[34] Also, available thermodynamic information for the hydrogen-manganese system was reviewed and evaluated.[35]

Active research on lithium batteries containing manganese resulted in reports that included a review of manganese oxides and their possible application in lithium batteries.[36] Programs on development of an orthorhombic lithium-manganese oxide[37] and of processes for recovering lithium, manganese, and other metals from waste lithium batteries were described.[38]

Outlook

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

For the past decade, U.S. apparent consumption of manganese has been within roughly plus or minus 10% of about 660,000 tons of contained manganese. This largely has been a consequence of and close to the degree of variation in domestic steel production during the same period. In this interval, manganese demand, which is presented as apparent consumption in table 1, generally has shown an increasing trend as has the level of activity in the steel industry. Manganese apparent consumption has not traced steel production precisely possibly because of the influence of unmeasured changes in stocks of manganese materials, such as those of importers. The effect of this may outweigh changes in demand by steelmakers.

Balancing positive and negative indications suggests that U.S. apparent consumption of manganese during the remainder of the 1990's will still be not far from 660,000 tons of contained manganese. Domestic steel output, the main determinant of manganese demand, is projected to decline slightly in 1996-2000, according to forecasts of the International Iron and Steel Institute (IISI) and others that were publicized in 1995. However, the trend in domestic steel production during this midterm actually may turn out more favorably, considering the uncertainty of such factors as developments in steel foreign trade and the effect of additional domestic capacity coming on-stream in the near term. The outlook for a stable manganese demand also assumes no significant change in manganese unit consumption in steelmaking. Present indications continue to be for no change or perhaps slight further decrease. The majority of U.S. demand for manganese units will be met by imports.

The outlook for world manganese demand during the balance of the 1990's still seems somewhat positive, and an annual growth rate of about 1.5% as inferred from forecasts of steel production 1 year ago may still apply. In 1995, the IISI scaled back its prior year's projected annual growth rate to 2000 for world apparent steel consumption, from 2.8% to 1.7%. In particular, growth in demand was reduced for China. In the new forecast, the larger steel producing and consuming areas foreseen to experience a relatively large increase in steel demand still included China, other portions of Asia except Japan, and Latin America. These areas also can be expected to show the higher increases in manganese demand.

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TABLE 1
SALIENT MANGANESE STATISTICS 1/

(Thousand metric tons, gross weight)

	1991	1992	1993	1994	1995
United States:					
Manganese ore (35% or more Mn):					
Exports	66	13	16	15	15
Imports for consumption	234	247	232	331	394
Consumption	473	438	389	449	486
Stocks, Dec. 31: Consumers	275	276	302	269	309
Ferromanganese:					
Exports	15	13	18	11	11
Imports for consumption	320	304	347	336	310
Consumption	346	339	341	347	348
Stocks, Dec. 31: Consumers and producers	50	28	30	36	33
Consumption, apparent, manganese 2/	598	596	696	694	NA
Ore price, dollars per metric ton unit, c.i.f. U.S. ports	3.72	3.25	2.60	2.40	2.40
World production of manganese ore	22,900	22,500 r/	21,200	18,500 r/	21,300 e/

e/ Estimated. r/ Revised. NA Not available.

1/ Data are rounded to three significant digits.

2/ 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 1995 1/

(Metric tons, gross weight)

		Physical inventory, Dec. 31				
		Uncommitted				
Material	Disposal authority	Stockpile grade	Nonstockpile grade	Total	Sold, pending shipment	Grand total
Natural battery ore	128,000	112,000	16,400	128,000	769	129,000
Synthetic manganese dioxide	2,730	2,730	--	2,730	--	2,730
Chemical ore	149,000	149,000	81	149,000	--	149,000
Metallurgical ore	1,180,000	788,000	392,000	1,180,000	250,000	1,430,000
High-carbon ferromanganese	760,000	965,000	--	965,000	--	965,000
Medium-carbon ferromanganese	--	17,700	--	17,700	--	17,700
Silicomanganese	--	183	--	183	--	183
Electrolytic metal	11,600	11,600	--	11,600	298	11,900

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

TABLE 3
DOMESTIC PRODUCERS OF MANGANESE PRODUCTS IN 1995

		Products 1/				
Company	Plant location	FeMn	SiMn	Mn	MnO2	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 Corp.	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; MnO2, synthetic manganese dioxide.

TABLE 4
U.S. CONSUMPTION, BY END USE, AND INDUSTRY STOCKS OF MANGANESE FERROALLOYS AND METAL IN 1995 1/

(Metric tons, gross weight)

End use	Ferromanganese			Silico-manganese	Manganese metal
	High carbon	Medium and low carbon	Total		
Steel:					
Carbon	202,000	74,600	277,000	87,500	1,980
Stainless and heat-resisting	14,500	(2/)	14,500	5,040	1,710
Full alloy	19,500	5,080	24,500	28,900	(2/)
High-strength, low-alloy	17,400	3,790	21,100	7,410	(2/)
Unspecified 3/	364	230	593	454	994
Total steel	254,000	83,700	338,000	129,000	4,680
Cast irons	8,850	429	9,280	664	--
Superalloys	W	W	W	--	147
Alloys (excluding alloy steels and superalloys)	1,070	318	1,390	(4/)	19,100 5/
Miscellaneous and unspecified	W	W	W	(4/)	W
Total consumption	264,000	84,400	348,000	130,000 6/	24,000
Total manganese content 7/	206,000	67,100	273,000	87,100	24,000
Stocks, Dec. 31, consumers and producers	22,900	9,680	32,600	9,610	4,210

W Withheld to avoid disclosing company proprietary data; included with "Alloys (excluding alloy steels and superalloys)."
1/ Data are rounded to 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 90% 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. UNIT CONSUMPTION OF MANGANESE IN IRONMAKING AND STEELMAKING 1/

(Kilograms per metric ton of raw steel unless otherwise specified)

Form used		1994	1995
Ironmaking:			
Basis, production of raw steel 2/	million tons	91.2	95.2
Ore 3/		W	W
Steelmaking:			
Basis, production of raw steel and steel ca	million tons	92.2 r/	96.0 e/
Ore 3/		--	--
Ferromanganese		2.84	2.76
Silicomanganese		.81 r/	.89
Manganese metal		.06	.05
Total, steelmaking		3.71	3.70

e/ Estimated. r/ Revised. W Withheld to avoid disclosing company proprietary data.
1/ Data are rounded to three significant digits; may not add to totals shown.
2/ As ingots, continuous- or pressure-cast blooms, billets, slabs, etc.
3/ Containing 35% or more manganese.

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

Country	1994 Gross weight (metric tons)	1994 F.a.s. value (thousands)	1995 Gross weight (metric tons)	1995 F.a.s. value (thousands)
Ore and concentrates with 20% or more manganese:				
Belgium	3,020	$242	1,410	$113
Brazil	450	60	3,080	246
Canada	7,470	879	6,980	1,040
Chile	1,640	131	--	--
Japan	--	--	1,320	105
Korea, Republic of	883	71	1,600	150
Netherlands	1,400	112	--	--
Other	441 2/	55 2/	995	93
Total	15,300	1,550	15,400	1,750
Ferromanganese, all grades:				
Canada	9,760	8,280	8,950	8,110
Japan	39	38	514	523
Mexico	557	606	477	525
Trinidad and Tobago	308	242	316	179
Other	316 2/	300 2/	764	784
Total	11,000	9,470	11,000	10,100
Silicomanganese:				
Canada	6,470	5,260	6,000	4,700
Luxembourg	--	--	1,200	496
Mexico	369	226	609	415
Other	--	--	34	41
Total	6,840	5,490	7,840	5,650
Metal, including alloys and waste and scrap:				
Canada	1,750	4,090	1,600	3,930
Ghana	35	110	356	848
Japan	1,190	2,000	893	2,170
Netherlands	673	1,470	928	1,920
Taiwan	308	300	(3/)	5
United Kingdom	399	778	946	1,200
Other	506 2/	1,480 2/	915	2,520
Total	4,870	10,200	5,640	12,600

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 1994 Annual Report.
3/ Less than 1/2 unit.

Source: Bureau of the Census.

TABLE 7
U.S. IMPORTS FOR CONSUMPTION OF MANGANESE ORE, FERROALLOYS, METAL,
AND SELECTED CHEMICALS, BY COUNTRY 1/

Country	1994 Gross weight (metric tons)	1994 Manganese content (metric tons)	1994 Customs value (thousands)	1995 Gross weight (metric tons)	1995 Manganese content (metric tons)	1995 Customs value (thousands)
Ore and concentrates with 20% or more manganese:						
All grades:						
Australia	44,400	23,200	$3,870	60,200	31,600	$5,480
Brazil	16,800	4,530	268	22,900	7,080	514
Canada	9	4	2	--	--	--
China	--	--	--	18,000	7,420	1,150
Gabon	219,000	112,000	22,200	204,000	104,000	20,500
Mexico	34,700	13,700	2,250	62,200	23,600	3,460
Morocco	108	56 2/	32	71	37 2/	15
South Africa	15,500	7,780	1,150	26,000	13,100	2,200
Total	331,000	161,000	29,800	394,000	187,000	33,300
More than 20%, but less than 47% manganese:						
Brazil	16,800	4,530	268	21,100	6,130	337
Canada	9	4	2	--	--	--
China	--	--	--	9,500	3,150	617
Mexico	33,300	13,000	2,010	61,800	23,500	3,430
Total	50,000	17,600	2,280	92,400	32,700	4,380
47% or more manganese:						
Australia	44,400	23,200	3,870	60,200	31,600	5,480
Brazil	--	--	--	1,840	957	178
China	--	--	--	8,520	4,270	528
Gabon	219,000	112,000	22,200	204,000	104,000	20,500
Mexico	1,460	688	245	400	188	30
Morocco	108	56 2/	32	71	37 2/	15
South Africa	15,500	7,780	1,150	26,000	13,100	2,200
Total	280,000	143,000	27,500	301,000	154,000	28,900
Ferromanganese:						
All grades:						
Australia	14,400	10,600	4,520	32,300	24,300	11,400
Brazil	39,500	30,400	19,100	18,300	14,000	8,140
France	88,000	69,100	37,100	89,600	69,400	38,800
Italy	7,270	6,590	10,600	5,400	4,840	8,450
Japan	13,600	11,000	9,860	11,500	9,330	8,220
Mexico	25,900	20,500	16,900	22,300	17,700	15,400
Norway	12,600	10,300	8,760	413	338	354
South Africa	132,000	104,000	60,200	129,000	101,000	58,100
Ukraine	--	--	--	1,240	1,050	937
Other	2,720 3/	2,140 3/	1,940 3/	47	34	28
Total	336,000	265,000	169,000	310,000	242,000	150,000
1% or less carbon:						
France	168	142	229	--	--	--
Italy	7,270	6,590	10,600	5,400	4,840	8,450
Japan	3,280	2,700	2,340	1,540	1,290	1,310
Norway	357	298	430	413	338	354
South Africa	1,010	930	1,600	1,900	1,730	3,250
Ukraine	--	--	--	1,240	1,050	937
Other	112	92	185	28	25	35
Total	12,200	10,800	15,400	10,500	9,270	14,300
More than 1% to 2% or less carbon:						
Brazil	8,880	7,090	7,020	1,650	1,320	1,320
France	1,200	986	896	2,750	2,240	2,150
Germany	1,000	819	739	--	--	--
Japan	10,300	8,270	7,510	10,000	8,040	6,910
Mexico	24,300	19,400	16,400	21,100	16,900	15,100
Norway	12,300	9,960	8,330	--	--	--
South Africa	15,200	12,300	11,600	7,940	6,340	6,350
Other	1,290	1,030	1,030	21	14	8
Total	74,400	59,900	53,500	43,400	34,900	31,800
More than 2%, but not more than 4% carbon:						
Mexico	--	--	--	1,200	762	310

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/

Country	1994 Gross weight (metric tons)	1994 Manganese content (metric tons)	1994 Customs value (thousands)	1995 Gross weight (metric tons)	1995 Manganese content (metric tons)	1995 Customs value (thousands)
More than 4% carbon:						
Australia	14,400	10,600	$4,520	32,300	24,300	$11,400
Brazil	30,500	23,300	11,900	16,600	12,700	6,790
France	86,600	68,000	35,900	86,800	67,200	36,700
South Africa	116,000	90,800	47,000	119,000	93,400	48,600
Other	1,970 3/	1,360 3/	505 3/	18	14	16
Total	249,000	194,000	99,900	255,000	198,000	103,000
Silicomanganese:						
Argentina	1,290	836	646	9,510	6,180	4,550
Australia	34,000	22,400	14,500	46,300	30,800	23,600
Brazil	21,400	13,900	9,900	137	89	104
China	15,500	10,200	6,590	--	--	--
Croatia	9,950	6,470	4,590	--	--	--
France	8,200	5,420	3,930	21,500	13,600	11,100
Georgia	--	--	--	19,600	13,200	8,320
India	26,900	18,500	12,300	39,400	25,800	19,700
Mexico	18,200	11,600	8,520	22,400	14,400	10,800
Norway	5,150	3,130	4,330	9,710	6,010	7,430
Romania	1,500	1,000	659	14,700	9,720	9,290
South Africa	104,000	69,000	45,300	99,700	66,300	52,900
Ukraine	14,000	9,300	5,480	--	--	--
Venezuela	7,630	5,040	3,560	18,000	11,900	9,880
Other	5,540 3/	3,650 3/	3,060 3/	3,930	2,480	2,960
Total	273,000	181,000	123,000	305,000	201,000	161,000
Metal:						
Unwrought:						
China	3,370	XX	4,060	1,080	XX	1,590
South Africa	12,100	XX	17,700	9,120	XX	14,300
Other	1,110	XX	1,300	139	XX	158
Total	16,600	XX	23,000	10,300	XX	16,100
Other:						
China	1,500	XX	1,760	20	XX	37
France	58	XX	557	101	XX	953
South Africa	1,920	XX	2,940	--	XX	--
United Kingdom	117	XX	269	268	XX	647
Other	32 3/	XX	238 3/	11	XX	52
Total	3,630	XX	5,760	401	XX	1,690
Waste and scrap:						
Canada	44	XX	38	108	XX	130
Other	17	XX	25	38	XX	42
Manganese dioxide:						
Australia	18,700	XX	28,100	16,300	XX	22,900
Belgium	1,230	XX	2,130	1,030	XX	1,810
Brazil	848	XX	1,180	819	XX	1,110
Ireland	7,300	XX	10,600	8,070	XX	11,500
South Africa	1,440	XX	1,890	305	XX	416
Other	196	XX	449	289	XX	605
Total	29,700	XX	44,400	26,800	XX	38,300
Potassium permanganate:						
China	420	XX	316	284	XX	157
Czech Republic	453	XX	830	491	XX	886
India	72	XX	112	288	XX	456
Russia	69	XX	80	152	XX	165
Spain	352	XX	740	396	XX	831
Ukraine	18	XX	21	133	XX	154
Other	247 3/	XX	659 3/	152	XX	281
Total	1,630	XX	2,760	1,900	XX	2,930

XX Not applicable.
1/ Data are rounded to three significant digits; may not add to totals shown.
2/ Includes U.S. Geological Survey's conversion of part of reported data (from apparent MnO2 content to Mn content).
3/ Revised; unspecified group of countries differs from that in the 1994 Annual Report.

Source: Bureau of the Census, 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				
		1991	1992	1993	1994	1995 e/
Australia 5/	37-53	1,412 r/	1,251 r/	2,092	1,920 r/ e/	2,176 6/
Brazil 7/ 8/	30-50	2,000	1,993	1,837	2,320 r/	2,320
China e/ 9/	20-30	5,150	5,300	5,860	3,570 r/	5,000
Gabon 7/ 10/	50-53	1,620	1,556	1,290	1,440 e/	1,940
Georgia e/ 7/	29-30	XX	1,200	1,000	700 r/	500
Ghana 7/	30-50	320	276	295	270	176 6/
India 7/ 11/	10-54	1,401	1,810	1,655	1,630 r/ e/	1,650
Kazakstan e/ 7/	29-30	XX	100	150	133	130
Mexico 7/ 12/	27-50	254	407	363	307	472
South Africa 7/ 10/	30-48+	3,146	2,464	2,507	2,851	3,199 6/
Ukraine 7/	30-35	XX	5,819	3,800	2,980	3,200
U.S.S.R. 13/	29-30	7,240	XX	XX	XX	XX
Other 14/	XX	324 r/	280 r/	377 r/	399 r/	529
Total	XX	22,900	22,500 r/	21,200	18,500 r/	21,300

Country 3/	Range percent Mn e/ 4/	Metal content				
		1991	1992	1993	1994	1995 e/
Australia 5/	37-53	664 r/	596 r/	1,043	944 r/ e/	1,066 6/
Brazil 7/ 8/	30-50	780	777	716	905 r/	905
China e/ 9/	20-30	1,030	1,060	1,170	714 r/	1,000
Gabon 7/ 10/	50-53	748	718	595	663 e/	895
Georgia e/ 7/	29-30	XX	350	300	210 r/	150
Ghana 7/	30-50	120	106	115	108	69
India 7/ 11/	10-54	532	687	628	620 r/ e/	627
Kazakstan e/ 7/	29-30	XX	30	45	40	39
Mexico 7/ 12/	27-50	93	153	135	112	174
South Africa 7/ 10/	30-48+	1,369	1,077	1,076	1,210 e/	1,354
Ukraine 7/	30-35	XX	1,850	1,350	1,052	1,100
U.S.S.R. 13/	29-30	2,150	XX	XX	XX	XX
Other 14/	XX	117 r/	101 r/	135 r/	134 r/	198
Total	XX	7,600 r/	7,510 r/	7,310 r/	6,710 r/	7,580

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 4, 1996. 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.

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; average content was reported as 38.5% Mn in 1991.

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

13/ Dissolved in Dec. 1991.

14/ Category represents the combined totals of Argentina (low-grade ore), Bolivia, Bosnia and Herzegovina, Botswana, Bulgaria, Burma (Myanmar), Chile, Colombia, Egypt, Greece, Hungary, Indonesia, Iran, Italy (from wastes), Japan (low-grade ore), Malaysia, Morocco, Namibia, Philippines, Romania, Thailand, Turkey, Yugoslavia, and Zambia.

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

(Thousand metric tons, gross weight)

Country	1991					1992				
	Ferromanganese			Silico-manga-nese	Grand total	Ferromanganese			Silico-manga-nese	Grand total
	Blast furnace	Electric furnace	Total			Blast furnace	Electric furnace	Total		
Argentina	--	26	26	15	41	--	5	5	31	35
Australia e/	--	45	45	74	119	--	55	55	75	130
Belgium e/	--	25	25	--	25	--	25	25	--	25
Brazil	--	169	169	272	441	--	179	179	300	479
Canada e/ 3/	--	45	45	--	45	--	--	--	--	--
Chile	--	7	7	2	8	--	7	7	2	9
China e/	500	180	680	415	1,100	550	200	750	420	1,170
Croatia e/	XX	XX	XX	XX	XX	--	10	10	15 r/	25 r/
Czechoslovakia e/ 3/ 4/	--	90	90	--	90	--	70	70	--	70
Egypt e/	--	--	--	--	--	--	10	10	--	10
France 5/	290	30	320	30 e/	350	280 e/	60	340	80	420
Georgia e/	XX	XX	XX	XX	XX	--	100	100	50	150
Germany e/ 3/ 6/	220	40	260	--	260	130	30	160	--	160
India e/	--	211	211	70	281	--	198	198	93	291
Indonesia e/	--	--	--	--	--	--	--	--	--	--
Italy	--	14	14	55 e/	69	--	17	17	50	67
Japan	--	464	464	87	551	--	362	362	96	458
Kazakstan	XX	XX	XX	XX	XX	--	--	--	--	--
Korea, North e/ 3/	--	70	70	--	70	--	70	70	--	70
Korea, Republic of	--	95	95	74	169	--	86	86	83	168
Mexico	--	98	98	51	149	--	79	79	51	130
Norway	--	173	173	227	400	--	203	203	213	416
Peru e/	--	(7/) r/	(7/) r/	--	(7/) r/	--	--	--	--	--
Philippines e/	--	5	5	--	5	--	5	5	--	5
Poland	57	9 r/	67 r/	25 e/	92 r/	43 e/	5	48	25 e/	73
Romania e/	--	40	40	30	70	--	27	27	28	55
Russia e/	XX	XX	XX	XX	XX	200	--	200	--	200
Slovakia	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
South Africa	--	260	260	270	530	--	270	270	267	536
Spain e/	--	50	50	40	90	--	50	50	40	90
Taiwan	--	40	40	13	53	--	38	38	4	42
Thailand	--	2	2	4	5	--	1	1	4	5
Ukraine e/	XX	XX	XX	XX	XX	50	150 r/	200 r/	950 r/	1,150
U.S.S.R. e/ 8/	235 9/	370	605	1,100	1,710	XX	XX	XX	XX	XX
United Kingdom	178	--	178	--	178	137	--	137	--	137
Venezuela e/	--	1	1	31	31 r/	--	9	9	32	41
Yugoslavia e/ 10/	--	22 r/	22 r/	60 r/	82 r/	XX	XX	XX	XX	XX
Zimbabwe	--	--	--	--	--	--	--	--	--	--
Total	1,480	2,580	4,060	2,940 r/	7,010 r/	1,390	2,320 r/	3,710 r/	2,910 r/	6,620 r/

See footnotes at end of table.

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

(Thousand metric tons, gross weight)

Country	1993					1994				
	Ferromanganese			Silico-manga-nese	Grand total	Ferromanganese			Silico-manga-nese	Grand total
	Blast furnace	Electric furnace	Total			Blast furnace	Electric furnace	Total		
Argentina	--	5	5	19	24	--	5 e/	5 e/	20 e/	25 e/
Australia e/	--	75	75	75	150	--	100	100	100	200
Belgium e/	--	25	25	--	25	--	25	25	--	25
Brazil	--	202	202	284	486	--	200 r/	200 r/	248 r/	448 r/
Canada e/ 3/	--	--	--	--	--	--	--	--	--	--
Chile	--	9	9	2	11	--	9 e/	9 e/	2 e/	10 e/
China e/	520	220	740	525	1,270	567 r/	350 r/	917 r/	657 r/	1,570 r/
Croatia e/	--	10	10	40	50	--	10	10	30 r/	40 r/
Czechoslovakia e/ 3/ 4/	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
Egypt e/	--	30	30	--	30	--	35	35	--	35
France 5/	300 r/	57	357 r/	80	437 r/	294 r/	66 r/	360 r/	75 e/	435 r/ e/
Georgia e/	--	100	100	50	150	--	10 r/	10 r/	40 r/	50 r/
Germany e/ 3/ 6/	100	20	120	--	120	--	20	20	--	20
India e/	--	137 9/	137 9/	85 9/	222 9/	--	150	150	140 r/	290 r/
Indonesia e/	--	10	10	--	10	--	10	10	--	10
Italy	--	17	17	50 e/	67	--	16 e/	16 e/	40 e/	56 e/
Japan	--	383	383	65	448	--	345 r/	345 r/	69 r/	414 r/
Kazakstan	--	--	--	--	--	--	--	--	40	40
Korea, North e/ 3/	--	70	70	--	70	--	70	70	--	70
Korea, Republic of	--	101	101	82	183	--	120	120	89	209
Mexico	--	70 e/	70 e/	55 e/	125 e/	--	67 e/	67 e/	64 e/	131 e/
Norway	--	226	226	219	445	--	249	249	197	446
Peru e/	--	--	--	--	--	--	--	--	--	--
Philippines e/	--	5	5	--	5	--	5	5	--	5
Poland	56 r/	1 r/ e/	58 r/	25 e/	83 r/	55	1 r/	56 r/	25 e/	81 r/
Romania e/	--	16 r/	16 r/	22 r/	38 r/	--	31	31	35 r/	67
Russia e/	150	--	150	--	150	55 r/	--	55 r/	--	55 r/
Slovakia	--	22	22	12	34	--	25 e/	25 e/	12	37 e/
South Africa	--	393	393	268	661	--	591 r/	591 r/	290 r/	881 r/
Spain e/	--	40	40	35	75	--	35	35	35	70
Taiwan	--	14	14	--	14	--	7	7	--	7
Thailand	--	(7/)	(7/)	2	2	--	(7/)	(7/)	1 r/	1 r/
Ukraine e/	40	110 r/	150 r/	850 r/	1,000 r/	30	100 r/	130 r/	750 r/	880 r/
U.S.S.R. e/ 8/	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
United Kingdom	45	--	45	--	45	--	--	--	--	--
Venezuela e/	--	--	--	42	42	--	--	--	40	40
Yugoslavia e/ 10/	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
Zimbabwe	--	2	2	--	2	--	--	--	--	--
Total	1,210 r/	2,370 r/	3,580 r/	2,890 r/	6,470 r/	1,000 r/	2,650 r/	3,650 r/	3,000 r/	6,650 r/

See footnotes at end of table.

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

(Thousand metric tons, gross weight)

Country	1995 e/				
	Ferromanganese			Silico-manga-nese	Grand total
	Blast furnace	Electric furnace	Total		
Argentina	--	5	5	20	25
Australia e/	--	100	100	110	210
Belgium e/	--	25	25	--	25
Brazil	--	130	130	167	297
Canada e/ 3/	--	--	--	--	--
Chile	--	9	9	2	10
China e/	570	350	920	670	1,590
Croatia e/	--	10	10	30	40
Czechoslovakia e/ 3/ 4/	XX	XX	XX	XX	XX
Egypt e/	--	35	35	--	35
France 5/	350	80	430	80	510
Georgia e/	--	5	5	25	30
Germany e/ 3/ 6/	--	20	20	--	20
India e/	--	150	150	140	290
Indonesia e/	--	14	14	7	21
Italy	--	16	16	40	56
Japan	--	347 9/	347 9/	65 9/	412 9/
Kazakstan	--	--	--	20	20
Korea, North e/ 3/	--	70	70	--	70
Korea, Republic of	--	119	119	98	217
Mexico	--	58 9/	58 9/	68 9/	126 9/
Norway	--	225	225	200	425
Peru e/	--	--	--	--	--
Philippines e/	--	5	5	--	5
Poland	50 9/	1 9/	51 9/	25	76
Romania e/	--	28 9/	28 9/	57 9/	86 9/
Russia e/	55	--	55	--	55
Slovakia	--	25	25	12	37
South Africa	--	480	480	280	760
Spain e/	--	25	25	45	70
Taiwan	--	5	5	--	5
Thailand	--	(7/)	(7/)	1	1
Ukraine e/	30	100	130	700	830
U.S.S.R. e/ 8/	XX	XX	XX	XX	XX
United Kingdom	--	--	--	--	--
Venezuela e/	--	--	--	40	40
Yugoslavia e/ 10/	XX	XX	XX	XX	XX
Zimbabwe	--	--	--	--	--
Total	1,060	2,440	3,490	2,900	6,390

e/ Estimated. Revised. XX Not applicable.
1/ Table includes data available through Aug. 9, 1996.
2/ World totals and estimated data are rounded to three significant digits; may not add to totals shown.
3/ Data for ferromanganese includes silicomanganese, if any.
4/ Dissolved Dec. 31, 1992.
5/ Includes silicospiegeleisen, if any.
6/ Data for blast furnace ferromanganese includes spiegeleisen, if any.
7/ Less than 500 tons.
8/ Dissolved in Dec. 1991.
9/ Reported figure.
10/ Dissolved in Apr. 1992.