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. Ironmaking and steelmaking have 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 declined in 1994 compared with those in 1993. The marginal drop of about 1% for the rate in steelmaking continued to be because of a lower usage rate for ferromanganese.

Further growth of manganese consumption in batteries was denoted by the expansion on schedule of domestic capacity for production of electrolytic manganese dioxide (EMD) as well as by the setting of another new record high for imports of manganese dioxide.

In manganese U.S. foreign trade in 1994, ore was a relatively more important component of imports than in recent prior years. Non-traditional sources contributed to silicomanganese imports. The silicomanganese trade dispute finally culminated in December in imposition of antidumping duties or restrictions on material from Brazil, China, and Ukraine. Imposition of antidumping duties on silicomanganese by the European Union, also in December, meant that such duties had become effective in all major steel producing areas of the Western World. In the United States, additional allegations of unfair trading practices arose late in the year for manganese metal and manganese sulfate from China.

Price movements varied for the main manganese materials. The price for metallurgical-grade manganese ore delivered to U.S. customers decreased for the fourth consecutive year, by a smaller extent than in 1993. Averaged over the year, the price in the U.S. market for high-carbon ferromanganese was virtually unchanged while that for silicomanganese increased about 7%.

The rate slowed for disposal of manganese materials from Government stockpiles. The Government still held inventories of manganese, all forms, that were equivalent to more than 2 years of apparent consumption.

World production of manganese ore was estimated to have totaled about the same as in 1993. *(See table 1.)* New or rejuvenated production of ore was underway in Western Australia, at a second mine in the Carajás area of northern Brazil, and in Namibia.

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

Legislation and Government Programs

Stockpile.—Effective April 22, the Defense Logistics Agency (DLA) revised the Fiscal Year 1994 Annual Materials Plan such that the maximum fiscal year 1994 disposal authority for metallurgical-grade manganese ore was raised to 363,000 tons from 227,000 tons, while that for high-carbon ferromanganese was reduced to zero from 45,400 tons. Maximum disposal authority remained the same for chemical-grade ore and natural battery-grade ore, 45,400 tons and 54,400 tons, respectively.

On September 28, DLA announced that in accordance with the Fiscal Year 1995 Annual Materials Plan the maximum quantities of manganese stockpile materials to be offered for sale during fiscal year 1995 included, in tons, chemical-grade ore, 36,300; natural battery-grade ore, 54,400; metallurgical-grade ore, 67,100; and electrolytic manganese metal, 1,810.

Disposals of manganese materials in 1994 announced by DLA totaled, in tons, natural battery-grade ore, 6,140; metallurgical-grade ore, 73,300; high-carbon ferromanganese, 15,000; and medium-carbon ferromanganese, 4,230. Disposals of ore were cash whereas those of ferromanganese were payment-in-kind. Metals Refining Co., Orem, UT, was placed in default for the 5-year contract made in October 1993 that called for removal of 145,000 tons of metallurgical-grade ore during fiscal year 1994.

Data reported by DLA indicated that changes in physical inventory of manganese materials in 1994 all were decreases and consisted of, in tons, natural battery-grade ore, 23,900; chemical-grade ore, 1,640; metallurgical-grade ore, 108,000; high-carbon ferromanganese, 4,810; medium-carbon ferromanganese, 3,910; and silicomanganese, 25. At yearend, the estimated manganese content of the manganese inventories being held by the Government was 1.5 million tons. *(See table 2.)* This was about 4.4% less than at the end of 1993 but still more than twice the current national apparent consumption.

Other.—Citing potential public health risks, the Environmental Protection Agency (EPA) announced on July 13 that it would still not grant a waiver to Ethyl Corp. that would permit use of methylcyclopentadienyl manganese tricarbonyl (MMT, "HiTEC 3000") as an octane-enhancing additive in unleaded gasoline (59 FR 42227-42261). Ethyl immediately filed an appeal of EPA's decision with the U.S. Court of Appeals for the District of Columbia Circuit. This appeal had not been acted upon by the end of 1994. In the course of this most recent consideration of Ethyl's petition, EPA revised the reference concentration (RfC) for inhaled manganese to a much lower value than had been in effect as of 1990--0.05 micrograms per cubic meter in place of the former value of 0.4 micrograms per cubic meter. Ethyl published its findings indicating that manganese oxides produced from use of MMT do not adversely affect the performance of automotive catalytic converters.[1] Also, Canadian workers and Ethyl published the results of a number of studies relating to atmospheric emissions of manganese resulting from use of MMT in Canada, where MMT has replaced lead in gasoline since the late 1970's.[2]

Deep Seabed Mining Exploration License USA-4 was surrendered to the National Oceanic and Atmospheric Administration (NOAA), U.S. Department of Commerce (DOC), by the Kennecott Consortium on May 21 (58 FR 33933) and reissued by NOAA to Ocean Minerals Co. on December 22 (59 FR 66942), in accordance with provisions of the Deep Seabed Hard Mineral Resources Act.

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. *(See table 3.)* Elkem Metals Co. remained the only domestic producer of manganese ferroalloys, which was at its Marietta, OH, plant. Anticipating the ending of the Government's program of converting manganese ore from the National Defense Stockpile into high-carbon ferromanganese, Elkem Metals was investing about $9 million toward improving the competitiveness of that plant. The investment included upgrading furnaces and refining equipment in order to add low-carbon grades of ferromanganese and silicomanganese to the plant's product mix.

In mid-1994 as scheduled, Kerr-McGee Chemical Corp. completed a 50% increase in annual capacity for EMD of its plant at Henderson, NV. As a result, that plant's EMD capability was raised to 22,200 tons per year.

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. *(See tables 4 and 5.)* This usage pattern is typical of most industrialized countries.[3] On the basis of the data for reported consumption, unit consumption of manganese in ironmaking, which for 1994 could not be published to avoid disclosing proprietary data, decreased even further. On the same basis, overall manganese unit consumption in steelmaking declined about 1% and followed the continuing downward trend in unit consumption for ferromanganese. *(See table 6.)* 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. A manganese-aluminum additive similar to this conventional briquet but with the manganese content elevated to 85% was undergoing commercial testing.[4]

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.[5] The source of manganese units for these applications was mainly manganese ore. In Europe, a new chemical application for manganese was short-lived. Unilever PLC initiated and then discontinued use of a manganese catalyst in laundry detergent.[6]

Data on domestic consumption of manganese ore, exclusive of that consumed within the steel industry, were 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 manganese ferroalloys, metal, and chemicals. Their collective consumption is believed to represent that of the United States except for negligible quantities consumed by other firms, if any. In 1994, responses were obtained from all firms canvassed. The aggregated consumption data obtained were incorporated into table 4, but for 1994 only the total could be displayed to avoid disclosing proprietary data. Total annual ore consumption increased rather than decreased for the first time since 1989.

Within the battery industry worldwide, production of carbon-zinc dry cell batteries, which predominantly was based on use of natural manganese dioxide, continued to hold a sizable lead over that of alkaline cells, which employed electrolytic manganese dioxide. Alkaline cells again had a high growth component, with U.S. output advancing 10% in volume compared with that in 1993. A potential future new market for manganese in batteries could come from the current emphasis on achieving an electric vehicle (EV) as an alternative to gasoline-powered automobiles. The United States Advanced Battery Consortium contracted with a joint venture between Duracell Intl. Inc. and Germany's Varta Batterie AG for development of a rechargeable EV battery system based on lithium-ion technology involving manganese oxide.

The motivation for recycling and/or recovery of materials from dry cell batteries shifted from concern about mercury content, which can be projected to vanish in the future, to strictly disposal and landfill issues. One option being investigated on a cooperative basis between European, Japanese, and U.S. organizations was the relatively low cost approach of recycling via existing commercial metals facilities. In the United States, the Eveready Battery Co. entered into an agreement with Drinkard Metalox Inc. of Charlotte, NC, for development of a solution process to recover metals such as manganese and zinc from primary household batteries. The technology to be developed was expected to operate at low temperatures with relatively small energy consumption.

Prices

For 1994, with the price of manganese in metallurgical-grade ore taken as 1.0, the corresponding approximate prices per manganese unit were 2.5 for high-carbon ferromanganese and silicomanganese, 4.3 for medium-carbon ferromanganese, and 9.6 for manganese metal. These price factors are based on year-average prices such as discussed in the following.

Manganese Ore.—The U.S. price of metallurgical-grade manganese ore decreased for the fourth year in succession. A mid-range value for the average price, c.i.f. U.S. ports, of metallurgical-grade ore containing 48% manganese was assessed as $2.40 per metric ton unit (mtu). It is recognized that prices $0.10 per mtu or more 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 1994 and 1993 can be expressed in cents per kilogram as 24.0 and 26.0, respectively. The percentage decrease in ore price for 1994 approached 8%, and was less than one-half that of 1993.

The price evolution in metallurgical-grade ore for the United States in 1994 approximately paralleled that in other international markets, as typified by contracts between Japanese consumers and Australian and South African suppliers for deliveries in the contract year ending March 31, 1995. For the benchmark of high-grade lumpy ore containing 48% manganese, negotiations that concluded in late June between Japanese steel mills and Australia's Broken Hill Pty. Co. Ltd. (BHP) resulted in a f.o.b. price of $2.04 versus $2.25 per mtu for the 1993 contract year. Shortly thereafter, Japan's South African ore suppliers agreed to a 9.3% decrease in f.o.b. price for lumpy ore, from $2.15 to $1.95 per mtu.

The price of a metric ton of ore is obtained by multiplying the mtu price 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.—Price information was based on quotations for imported material, as no current price data were publicly available for domestic product. Prices at yearend were lower than at the beginning of 1994, by 2% for high-carbon ferromanganese and about 5% for silicomanganese. The year-average price for high-carbon ferromanganese was 0.7% less than that for 1993, whereas for

silicomanganese the year-average price increased by more than 7%. 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, which began 1994 at $490 to $500, shifted downward $10 in mid-April and again in late June. The resulting range of $470 to $480 remained in effect until the last two weeks of the year, when adjustments were made that resulted in a broader final range of $470 to $500.

For silicomanganese, the trend in price level was downward until mid-October, when a recovery took place to about the general level that applied during the spring and summer. In January, the price range for imported silicomanganese with 2% carbon was 26 to 26.5 cents per pound of alloy, f.o.b. Pittsburgh or Chicago warehouse. A low of 24 to 25 cents reached the first week of October was followed by slightly higher quotes such that a final range of 24.5 to 25.5 cents was in effect by December.

Manganese Metal.—Trade journals continued to carry throughout the year only the same per pound prices already published effective mid-November 1990, which were for bulk shipments of domestic material, f.o.b. shipping point: a range of $1.04 to $1.05 according to Metals Week and $1.05 according to American Metal Market. However, in a mid-November report on the antidumping suit for manganese metal, Metals Week indicated that industry sources placed the then-current price range at 80 to 90 cents for domestic and South African metal and 70 to 76 cents for Chinese metal.

Foreign Trade

In terms of estimated manganese content, the total number of manganese units traded decreased about 20% for exports and increased about 3% for imports. For export categories, decreases were the rule; metal was an exception. *(See table 7.)* For import categories, receipts were up significantly for ore (especially from Gabon) and such higher value materials as low- and medium-carbon ferromanganese, unwrought metal, and manganese dioxide, but down for high-carbon ferromanganese and silicomanganese. *(See table 8.)* On the basis of content, the ratio of the sum of ferroalloy plus metal imported to the corresponding sum for ore plus dioxide was 2.6, the lowest such ratio since 1989.

Among exports, the modestly decreased quantity of ore was, as for 1992-93, among the least for the past two decades. The sizable drop in exports of ferromanganese was more pronounced for material with a carbon content of more than 2% (-48%) than for other ferromanganese (-32%). Reexports of ore, ferromanganese, and silicomanganese were all to Canada, and, in tons, were 426, 2,850, and 3,630, respectively. Of the 158 tons of metal reexported, 121 tons were shipped to Canada.

Among imports, the average manganese content was 48.7% for ore, which was the least since 1990, and 78.8% for ferromanganese, which was the greatest since 1972. The comparatively high average content for ferromanganese resulted from increased volumes for the refined grades, as the import volume for medium-carbon ferromanganese was second only to that for 1988.

For silicomanganese, import volume decreased while still reaching a total second only to that in 1993, and sources proliferated. Receipts of silicomanganese from India and Romania were the first manganese materials from those countries since 1982 and 1984, respectively. Imports from the Republic of South Africa rose 80% to a record level. Reported imports of spiegeleisen were 162 tons, which was about one-third less than for the previous year; all were from Germany at a high unit value.

For imports of metal, the 61% increase in volume for unwrought material produced a new record for that category. The Chinese share of metal imports continued to advance to 24% of the combined total.

Among imports of manganese chemicals, those of manganese dioxide easily surpassed 1993's record quantity. Those from Australia rose, as has been the case every year since the beginning of shipments from that country in 1991. All dioxide imports appeared to have been synthetic material except for 20 tons reported from Canada at low unit value. Of imports under the classification "Other sulfates," which includes manganese sulfate, those from China decreased by about 23% to 4,010 tons at a value of $942,000 and those from Mexico by about 13% to 10,100 tons at a value of $5.62 million.

The terms of foreign trade with the United States were liberalized for a number of countries. Under the Generalized System of Preferences (GSP) program, duty-free status, as applicable, was granted in 1994 (effective date in parenthesis) to U.S. imports from Kazakhstan (March 4, 59 FR 8115), Romania (March 4, 59 FR 8115), the Republic of South Africa (May 10, 59 FR 19629), and Ukraine (March 23, 59 FR 10725). Late in the year, Congress retroactively extended until July 31, 1995, the GSP program itself. Technically as of October 1, for the second consecutive year, the program had been allowed to lapse.

Imports from China of chemical or metallurgical materials containing manganese were involved in several trade disputes. In the case of potassium permanganate, the International Trade Administration (ITA) of the U.S. Department of Commerce (DOC) established in May a country-wide dumping margin of 128.94% for material from China, thus eliminating the possibility of some shipments at a margin of about 40%. This was the final result of ITA's administrative review for 1990 (59 FR 26625-26630). On November 8, Elkem Metals, Pittsburgh, PA, and Kerr-McGee Chemical, Oklahoma City, OK, filed petitions with ITA and the U.S. International Trade Commission (ITC) alleging less than fair value (LTFV) imports of manganese metal from China. On December 20, ITC announced an affirmative decision (60 FR 146), with the consequence that ITA's antidumping investigation would continue. On November 30, American MicroTrace Corp., Virginia Beach, VA, filed petitions with ITA and ITC alleging LTFV imports of manganese sulfate from China.

In December, approximately 13 months after Elkem Metals and the Oil, Chemical and Atomic Workers, Local 3-639, Belpre, OH, had filed petitions with ITA and ITC alleging LTFV imports of silicomanganese from Brazil, China, Ukraine, and Venezuela, ITC made affirmative final determinations of such imports for Brazil, China, and Ukraine but not Venezuela (59 FR 65788). As one result, ITA issued antidumping orders on imports of silicomanganese from Brazil and China that specified cash deposit margins for material from Brazil as 64.93% for Cia. Paulista de Ferro-Ligas and 17.60% for all other Brazilian producers and for material from China as 150.00%. Secondly, for imports of silicomanganese from Ukraine, the restraint agreement that DOC had worked out with Ukraine as of October 31 (FR 59 60951-60958) became effective.

World Review[7]

Global outputs were estimated to have remained about the same for manganese ore and ferroalloys overall as those in 1993. *(See tables 9 and 10.)*

Australia.—BHP's monthly reports indicated that manganese ore output of BHP's Groote Eylandt Mining Co. Pty. Ltd. (GEMCO) subsidiary totaled about 1,750,000 million tons, an increase of about one-sixth above that for 1993. The total for GEMCO's shipments to foreign and domestic markets from operations in the Northern Territory rose by about 4% to 1,650,000 tons.[8] BHP announced in May that

it had purchased a 14% equity interest in Grupo Ferrominero S.A., which controls Cía. Minera Autlán (Autlán), the Mexican producer of manganese ore and ferroalloys. BHP further stated that in accordance with this transaction BHP was to supply Autlán's requirements for imported manganese ore for 5 years. In midyear BHP also announced that its Australian Manganese Co. Pty. Ltd. subsidiary was expanding the production capacity for EMD of its plant near Newcastle, New South Wales, for which GEMCO supplies the ore feed. The plant was to expand 24% to more than 22,000 tons annually at a cost of about $8 million.

Manganese ore production declined in Western Australia. In May, Portman Mining Ltd. shut down its operations in the Woodie Woodie area of the Pilbara Manganese Province. Citing adverse ore price developments, Portman put its project on a care and maintenance basis. In September, Portman became full owner of the project by acquiring the 50% interest formerly held by its joint-venture partners. In contrast with Portman's shutdown, Valiant Consolidated Ltd. was bringing another deposit in the Woodie Woodie area into modest production. Valiant was now the sole participant in a project that targeted a potential annual output of about 150,000 tons for mostly Far Eastern consumers.

Brazil.—At 503,000 tons, shipments of manganese ore by Indústria e Comércia de Minérios S.A. from operations at Serra do Navio, Amapá Territory, reached a total almost identical to that for 1993. Shipments were through Porto de Santana on the Amazon River and consisted of 250,000 tons to customers in Europe, 147,000 tons to South America (including Brazil), 88,600 tons to Asia, and 17,100 tons to North America.[9] The shipments total was about the same as the annual average for the past 5 years.

Production of manganese ore by Cia. Vale do Rio Doce (CVRD) from its Azul Mine in the Carajás region of northeastern Brazil was estimated to have returned to the 700,000-ton level last attained in 1990. In August, CVRD doubled its shareholding in Urucum Mineração S.A. from 46.66% to 93.32%. In 1992-93, Urucum's annual manganese ore production had been in the vicinity of 200,000 tons from a mine near Corumba in Mato Grosso do Sul State. For that area close to the Bolivian border in southwestern Brazil, CVRD was reported to be considering producing iron ore and building a ferromanganese plant.

Mineração Buritirama S.A. was formed as a joint venture to initiate production of manganese ore from Prometal Produtos Metalúrgicos S.A.'s Buritirama Mine in Pará State near CVRD's Azul Mine. Along with Prometal as majority shareholder, other participants in the venture were Brazil's Silex Trading Co. and Finland's Outokumpu Engineering Contractors. Production of medium-grade ore with a manganese content of about 45% and a relatively low phosphorus content was projected to start up at about 100,000 tons per year. The project was visualized to lead to annual production of concentrates in the range of 500,000 tons, of which 40% would be lump and 60% would serve as feed for a sinter plant that was expected to begin operating in 1996.

China.—Imports of manganese ore were reported to have increased by two-thirds to 950,000 tons. However, this appeared to exceed probable imports by 200,000 tons in comparison with estimates of ore contracts that now placed the Republic of South Africa as third largest supplier after Australia and Gabon.[10]

Formation of joint ventures that involved smelting manganese ferroalloys in China was reported. Asia Minerals Investment Ltd., which was based in Hong Kong, took a share of about 25% in Emei Shan Asia Ferroalloy Co. Ltd., which was formed with Emei Ferroalloy Factory, Sichuan Province, and Liaoyang AML Ferroalloy Ltd., which was formed with Liaoyang Ferroalloy Factory, Liaoning Province. In each case, the Chinese ferroalloy producer assumed the remaining share of the joint venture and also a minority shareholding position in Asia Minerals. Japan's Itochu Corp., a trading company, and South Africa's Samancor Ltd. formed Hong Kong-based Universal Ore & Alloy Ltd. with the objective of smelting South African ore into ferromanganese in China. Itochu and Samancor were equal partners in this venture that would market the ferromanganese in China and other Asian countries.

In 1993, China's exports of manganese metal were more than 17% greater than those in 1992. The majority of the 1993 shipments went again to Japan and the Netherlands.

European Union.—Late in December the European Commission (EC) imposed antidumping duties on silicomanganese imported into member countries, which for the respective supplying countries were Brazil, 40.6%; the Republic of South Africa, 57.8% (45.3% for material from Transalloys Div. of Highveld Steel & Vanadium Corp. Ltd.); Russia, 57.4%; and Ukraine, 52.8%. This action was in response to a petition filed in the first part of 1993 by Euroalliages, an association of European ferroalloy producers formed also in 1993.

In November, the EC imposed an antidumping duty of 1.26 ECU per kilogram on potassium permanganate from China. This was in response to complaints from producers of permanganate in Germany and Spain.

France.—Complex internal shareholding problems caused Société du Ferromanganèse de Paris-Outreau (SFPO) to file the French equivalent of a Chapter 11 bankruptcy petition in April. In November, a French commercial court accepted the rescue plan of Compagnie Minière de l'Ogooué S.A. (COMILOG), then a relatively small shareholder in SFPO. Under this plan, the realigned ownership of SFPO became COMILOG, 47%; Société Nationale d'Investissement du Gabon, 35%; Italian interests, 9%; and Japanese and South African interests, 5% each. These developments did not lead to shutdowns of SFPO's plants for ferromanganese at Boulogne and silicomanganese at Dunkirk.

Gabon.—Exports of manganese ore from COMILOG's Moanda Mine totaled 1,370,000 tons, of which 1,290,000 tons was metallurgical-grade ore and 73,000 tons was battery-grade ore. Shipments were made via the Port of Owendo in 65 cargoes.[11] Compared with 1993 exports of 1,430,000 tons of metallurgical-grade ore and 32,000 tons of battery-grade, those in 1994 represented changes of about -9.5% and +128% respectively and a decrease overall of 6.4%.

Ghana.—Ghana National Manganese Corp. exported 245,000 tons of ore produced at its Nsuta Mine. The ore was shipped in 24 cargoes from the Port of Takoradi.[12] This volume of shipments was 20% less than that in 1993 and the least since 1987. The history of the mine and its geology and current operating practices were given in a recent review.[13]

Japan.—Imports of metallurgical-grade manganese ore declined about 7% to 1,123,000 tons. For ore containing more than 39% manganese, imports totaled less than 1 million tons for the third successive year and again were mainly from Australia and the Republic of South Africa. For ore containing no more than 39% manganese, imports were mainly from India and the Republic of South Africa. Imports of ferruginous manganese ore decreased by about one-half to 68,000 tons, all but 60 tons of which came from India.

Overall production of manganese ferroalloys decreased by roughly 9% to the lowest total since 1966. The drop was principally because of a 16% decline in production of high-carbon ferromanganese to 246,000 tons. Conversely, production increased for low-carbon ferromanganese and silicomanganese, with the percentage increases exceeding 5% and 6%, respectively.

Imports of manganese ferroalloys increased about 9% to 290,000 tons overall. Imports of

silicomanganese decreased about 3% to 204,000 tons whereas total imports of 86,000 tons of ferromanganese were more than twice as great as the 1993 total. The increase in ferromanganese imports was mostly of the high-carbon grade, for which imports rose to 82,000 tons. Trade journal reports indicated that a factor in the rise in imports of high-carbon ferromanganese was the need to replace domestically produced high-carbon material that was being converted into medium- and/or low-carbon grades for export.

Exports of manganese ferroalloys more than doubled to a total of 23,600 tons. By far the largest portion of the total was ferromanganese containing less than 2% carbon, which advanced to 22,800 tons. Japanese statistics indicated that the main reason for this increase was a rise to 13,600 tons in shipments to the United States.

Production and exports of EMD declined somewhat, for production by about 3% to 54,600 tons and for exports 6% to 31,500 tons. Output was reduced at Mitsui Mining & Smelting Co. Ltd.'s Takehara plant, Hiroshima Prefecture, because of a fire on May 31.

Imports of unwrought manganese metal, which included scrap, increased by about 14% to 28,000 tons and thus continued the progression of recent years. China (64%) again led the Republic of South Africa (30%) as a source country.

Mexico.—Overall output of ore products from the operations of Autlán in the Molango District of Hidalgo State decreased by more than 15%. Production data for 1994 in tons and percentage changes from 1993 (in parenthesis) were carbonate ore sold, 73,000 (+13%); oxide nodules, 217,000 (-22%); and, from the Nonoalco Mine, battery ore, 17,000 (-15%). Battery ore production was the smallest in at least the past decade. Autlán experienced a moderate overall increase in output of manganese ferroalloys. Salable production rose about 16% for silicomanganese and declined about 11%, to 36,000 tons, for high-carbon ferromanganese. As stated in more detail under Australia, Australia's BHP acquired a 14% interest in Grupo Ferrominero S.A., which controls Autlán.

Namibia.—Manganese mining was resumed after a lapse of about 30 years at the Otjosondu Mine in central Namibia. Purity Manganese (Namibia) Ltd. began production at this previously worked site in the latter part of the year. The operation consisted of surface mining followed by crushing, screening, and jigging. Annual production of a medium-grade ore, having a manganese content of about 45% and a relatively low phosphorus content of 0.035%, was projected to be in the vicinity of 100,000 tons. Export was to be via the port of Walvis Bay on the west central coast, a distance of 400 km from the mine.[14]

South Africa, Republic of.—According to preliminary data, more than 98% of production of manganese ore consisted of metallurgical-grade ore; the balance was chemical-grade ore. Output of metallurgical-grade ore was 16% greater than that in 1993. The main production categories for metallurgical-grade ore were ore containing 30% to 40% manganese and ore containing more than 48% manganese. These two categories accounted for 35% and 54% of the metallurgical-grade subtotal, respectively, and for each the quantities produced were significantly greater than those in 1993.

South Africa's main manganese ore producers, Associated Manganese Mines of South Africa Ltd. and Samancor, were actively exploring marketing arrangements for their ores in China, possibly also to include ore-to-ferroalloy conversions (see China also). Samancor reassessed its methodology for analyzing ore reserves at its Wessels Mine so that demand for its higher-grade products could be met more profitably.[15] The Wessels Mine has been a source of a semiprecious gem-quality manganoan sugilite, the chemical composition and color development of which was investigated recently.[16]

Production of manganese ferroalloys in facilities ordinarily used to make chromium ferroalloys contributed to record high outputs of ferromanganese and manganese ferroalloys overall. At Samancor's Ferrometals plant at Witbank, production at three smaller ferrochromium furnaces was switched to high-carbon ferromanganese. Also at this plant, a campaign of converting high-carbon ferromanganese into medium-carbon ferromanganese was conducted. This was a short-term expedient pending resolution of financial difficulties at SFPO that were delaying implementation of a joint venture with SFPO to produce medium-carbon ferromanganese in France. At the Palmiet Ferrochrome plant at Krugersdorp, Samancor continued the production of silicomanganese begun from two furnaces in 1993.

Ukraine.—Production of manganese ore and concentrates was at the lowest level since the early 1960's, not only because of the general decline in steel production among Ukraine's traditional customers in the former Soviet bloc but also because of shortages of electricity and natural gas. Energy shortages also kept the output of manganese ferroalloys below capacity at the Nikopol' and Zaporozh'ye ferroalloy plants. Large-scale shipment to Japan of silicomanganese from the Nikopol' plant was reported to have taken place from relatively nearby Black Sea ports rather than by the usual method of a long overland haul via the Trans-Siberian Railway to ocean transport from such Far Eastern ports as Nakhodka.

Current Research and Technology

The U.S. Bureau of Mines analyzed material flows in the manganese industry, emphasizing trends in the United States in the 20th century and the details of flows as of about 1990.[17] The manganese industry also was the subject of a chapter in a new edition of a standard reference book on minerals.[18]

Industrial exposure of workers to manganese and associated health concerns was the subject of investigations by U.S. Government agencies. One dealt with exposures during welding[19] and the other with the possibility that manganese could be a hazard in plywood manufacture.[20]

Variations in practices of foreign steelmakers for control of manganese content were described. In the Republic of Korea, high carbon steels with relatively high manganese contents were being produced using a low-slag practice for dephosphorization in conjunction with a manganese ore addition.[21] In the Netherlands, selective use of iron ores to minimize manganese input and higher slag volumes in steelmaking were used to achieve manganese contents of 0.1% or less in so-called interstitial free steel.[22]

Investigations related to potential methods of improving the manufacturing or properties of manganese ferroalloys included study of counter-current technology for producing low-carbon ferromanganese[23] and means to lower the phosphorus content of manganese ferroalloys, by barium-containing compounds in treating high-carbon ferromanganese[24] and by metallic calcium in treating silicomanganese.[25]

The results of experiments involving electrolytic manganese metal were reported. These reports described the metal's nitriding behavior[26] and the recovery of aluminum upon use of manganese-aluminum briquets in the aluminum industry.[27]

Manganese-containing systems for which the available thermodynamic information were reviewed and evaluated included the carbon-iron-manganese metal ternary[28] and the MnO-SiO_2 slag binary.[29]

Studies were reported that supported proposed new uses for manganese based on the chemical properties of manganese oxides. One potential development was a humidity sensor in which EMD was a key ingredient,[30] and another was a sorbent embodying natural or synthetic manganese oxide for desulfurizing fuel gases obtained by gasifying coal.[31]

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 approximately plus or minus 10% of about 640,000 tons of contained manganese. This largely has been a consequence of a similar degree of variation in domestic steel production. Manganese demand, which is presented as apparent consumption in table 1, generally has corresponded to but not traced precisely the level of activity in the steel industry. Differences in the respective year-to-year variations are believed to show the influence of unmeasured changes in stocks of manganese materials, such as those of importers, the effect of which may outweigh changes in demand by steelmakers.

Through the year 2000, the outlook for U.S. steel output is for little or no increase and possibly even a slight decline, judging from forecasts of the International Iron and Steel Institute (IISI) and others that were publicized in 1994. The mid-term trend in domestic steel production may actually turn out to be more favorable, considering that the forecast base is a peak year, the uncertainties in steel foreign trade, and the effect of additional domestic capacity that is planned to come on-stream in the near term. Balancing of the positive and negative indications suggests that U.S. apparent consumption of manganese during the remainder of the 1990's will continue to range not far from 640,000 tons of contained manganese. This outlook also assumes no significant change in manganese unit consumption in steelmaking. Present indications are 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 is more positive than that for the United States, as also inferred from forecasts for the steel industry worldwide by IISI and others. IISI has projected an overall annual growth rate of 2.8% for world apparent steel consumption. This projection assumes that growth will be at a relatively higher pace in China (6.7%), other Asian countries except for Japan, Latin America, and Eastern Europe, and at closer to 1% in most other regions. Other forecasts suggest an annual growth rate of about 1.5% for steel production, which implies that world manganese demand can be expected to increase at about that rate.

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TABLE 1
SALIENT MANGANESE STATISTICS 1/

(Thousand metric tons, gross weight)

	1990	1991	1992	1993	1994
United States:					
Manganese ore (35% or more Mn):					
Exports	70	66	13	16	15
Imports for consumption	307	234	247	232	331
Consumption	497	473	438	389	449
Stocks, Dec. 31: Consumers	379	275	276	302	269
Ferromanganese:					
Exports	7	15	13	18	11
Imports for consumption	380	320	304	347	336
Consumption	413	346	339	341	347
Stocks, Dec. 31: Consumers	56	50	28	30	36
Consumption, apparent, manganese 2/	630	598	596	696	NA
Ore price, dollars per metric ton unit, c.i.f. U.S. ports	3.78	3.72	3.25	2.60	2.40
World:					
Production of manganese ore	26,100	22,900	22,400 r/	21,200 r/	20,900 e/

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

1/ Previously published and 1994 data are rounded by the U.S. Bureau of Mines to three significant digits, except prices.

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 1994 1/

(Metric tons, gross weight)

Material	Disposal authority	Physical inventory, Dec. 31				
		Uncommitted			Sold, pending shipment	Grand total
		Stockpile grade	Nonstockpile grade	Total		
Natural battery ore	128,000	112,000	16,400	128,000	6,490	135,000
Synthetic manganese dioxide	2,730	2,730	--	2,730	--	2,730
Chemical ore	154,000	154,000	81	154,000	--	154,000
Metallurgical ore	1,320,000	919,000	397,000	1,320,000	220,000	1,530,000
High-carbon ferromanganese	778,000	982,000	--	982,000	--	982,000
Medium-carbon ferromanganese	--	19,700	--	19,700	--	19,700
Silicomanganese	--	183	--	183	--	183
Electrolytic metal	12,900	12,900	--	12,900	--	12,900

1/ Data rounded by the U.S. Bureau of Mines to three significant digits; may not add to totals shown.

TABLE 3
DOMESTIC PRODUCERS OF MANGANESE PRODUCTS IN 1994

Company	Plant location	Products 1/				Type of process
		FeMn	SiMn	Mn	MnO2	
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 AND INDUSTRY STOCKS
OF MANGANESE ORE, 1/ BY USE 2/

(Metric tons, gross weight)

Use	Consumption		Stocks, Dec. 31	
	1993	1994	1993	1994
Manganese alloys and metal	W	W	W	W
Pig iron and steel	17,000	W	13,000	W
Dry cells, chemicals, miscellaneous 3/	W	W	W	W
Total	389,000	449,000	302,000	269,000

W Withheld to avoid disclosing company proprietary data; included in "Total."
1/ Containing 35% or more manganese (natural).
2/ Previously published and 1994 data are rounded by the U.S. Bureau of Mines to three significant digits.
3/ Natural ore, including that consumed in making synthetic manganese dioxide.

TABLE 5
U.S. CONSUMPTION, BY END USE, AND INDUSTRY STOCKS OF
MANGANESE FERROALLOYS AND METAL IN 1994 1/

(Metric tons, gross weight)

End use	Ferromanganese			Silico-manganese	Manganese metal
	High carbon	Medium and low carbon	Total		
Steel:					
Carbon	196,000	78,200	274,000	83,100	3,370
Stainless and heat-resisting	12,800	(2/)	12,800	4,460	1,960
Full alloy	19,300	4,810	24,200	18,500	(2/)
High-strength, low-alloy	19,100	3,460	22,500	6,180	(2/)
Unspecified 3/	388	291	679	425	531
Total steel	247,000	86,800	334,000	113,000	5,850
Cast irons	10,400	492	10,900	605	--
Superalloys	W	W	W	--	122
Alloys (excluding alloy steels and superalloys)	1,340	618	1,960	(4/)	19,300 5/
Miscellaneous and unspecified	W	W	W	(4/)	W
Total consumption	259,000	87,900	347,000	113,000 6/	25,200
Total manganese content 7/	202,000	70,000	272,000	74,700	25,200
Stocks, Dec. 31: consumers and producers	24,100	11,800	35,900	5,840	4,220

W Withheld to avoid disclosing company proprietary data; included in "Alloys (excluding alloy steels and superalloys)."
1/ Data rounded by the U.S. Bureau of Mines to three significant digits; may not add to totals shown.
2/ Withheld to avoid disclosing company proprietary data; included in "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. UNIT CONSUMPTION OF MANGANESE
IN IRONMAKING AND STEELMAKING 1/

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

Form used		1993	1994
IRONMAKING			
Basis: Production of raw steel,	million tons 2/	88.8	91.2
Ore 3/		0.08	W
STEELMAKING			
Basis: Production of raw steel and steel castings,	million tons	89.7 r/	92.4 e/
Ore 3/		--	--
Ferromanganese		2.89	2.84
Silicomanganese		0.79	0.80
Manganese metal		0.07	0.06
Total, steelmaking		3.74	3.71

e/ Estimated. r/ Revised. W Withheld to avoid disclosing company proprietary data.
1/ Previously published and 1994 data are rounded by the U.S. Bureau of Mines 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 7
U.S. EXPORTS OF MANGANESE ORE, FERROALLOYS, AND METAL, BY COUNTRY 1/

Country	1993		1994	
	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	--	--	3,020	$242
Canada	8,710	$1,040	7,470	879
Chile	--	--	1,640	131
Korea, Republic of	1,340	159	883	71
Netherlands	2,810	294	1,400	112
Other 2/	3,070	302	892	115
Total	15,900	1,790	15,300	1,550
FERROMANGANESE, ALL GRADES				
Canada	15,900	12,900	9,760	8,280
Mexico	460	433	557	606
United Kingdom	40	72	10	16
Venezuela	237	178	66	60
Other	1,370	1,280	587	505
Total	18,000	14,800	11,000	9,470
SILICOMANGANESE				
Canada	8,900	6,410	6,470	5,260
Mexico	347	213	369	226
Other	172	98	--	--
Total	9,420	6,720	6,840	5,490
METAL, INCLUDING ALLOYS AND WASTE AND SCRAP				
Canada	1,050	2,510	1,750	4,090
Japan	1,010	2,930	1,190	2,000
Netherlands	927	2,030	673	1,470
Taiwan	36	59	308	300
United Kingdom	282	549	399	778
Other 2/	530 r/	1,330 r/	542	1,590
Total	3,840	9,400	4,870	10,200

r/ Revised.
1/ Previously published and 1994 data are rounded by the U.S. Bureau of Mines to three significant digits; may not add to totals shown.
2/ Unspecified group of countries differs from that in the 1993 Annual Report.

Source: Bureau of the Census.

TABLE 8
U.S. IMPORTS FOR CONSUMPTION OF MANGANESE ORE, FERROALLOYS, METAL,
AND SELECTED CHEMICALS, BY COUNTRY 1/

Country	1993			1994		
	Gross weight (metric tons)	Manganese content (metric tons)	Customs value (thousands)	Gross weight (metric tons)	Manganese content (metric tons)	Customs value (thousands)
ORE AND CONCENTRATES WITH 20% OR MORE MANGANESE						
All grades						
Australia	58,800	30,200	$5,830	44,400	23,200	$3,870
Brazil	11,900	5,570	941	16,800	4,530	268
Canada	--	--	--	9	4	2
Gabon	131,000	66,700	15,300	219,000	112,000	22,200
Mexico	17,800	7,320	1,810	34,700	13,700	2,250
Morocco	83	43 2/	25	108	56 2/	32
South Africa, Republic of	12,000	6,010	978	15,500	7,780	1,150
Total	232,000	116,000	24,900	331,000	161,000	29,800
More than 20% but less than 47% manganese						
Brazil	8,000	3,690	664	16,800	4,530	268
Canada	--	--	--	9	4	2
Mexico	17,800	7,320	1,810	33,300	13,000	2,010
Total	25,800	11,000	2,470	50,000	17,600	2,280
47% or more manganese						
Australia	58,800	30,200	5,830	44,400	23,200	3,870
Brazil	3,930	1,890	277	--	--	--
Gabon	131,000	66,700	15,300	219,000	112,000	22,200
Mexico	--	--	--	1,460	688	245
Morocco	83	43 2/	25	108	56 2/	32
South Africa, Republic of	12,000	6,010	978	15,500	7,780	1,150
Total	206,000	105,000	22,500	280,000	143,000	27,500
FERROMANGANESE						
All grades						
Australia	23,500	18,100	8,670	14,400	10,600	4,520
Brazil	43,900	33,700	18,900	39,500	30,400	19,100
France	77,200	60,200	35,300	88,000	69,100	37,100
Italy	6,920	6,270	9,700	7,270	6,590	10,600
Japan	6,530	5,230	4,740	13,600	11,000	9,860
Mexico	26,700	20,500	16,800	25,900	20,500	16,900
Norway	3,710	3,010	2,920	12,600	10,300	8,760
Russia	10,800	7,780	3,070	374	251	85
South Africa, Republic of	134,000	105,000	60,100	132,000	104,000	60,200
Other 3/	14,600 r/	11,100 r/	7,350 r/	2,350	1,890	1,850
Total	347,000	271,000	168,000	336,000	265,000	169,000
1% or less carbon						
China	700	560	557	--	--	--
France	1,040	921	1,570	168	142	229
Italy	6,920	6,270	9,700	7,270	6,590	10,600
Japan	32	27	66	3,280	2,700	2,340
Norway	708	558	740	357	298	430
South Africa, Republic of	20	17	41	1,010	930	1,600
Other	318	278	418	112	92	185
Total	9,730	8,630	13,100	12,200	10,800	15,400
More than 1% to 2% or less carbon						
Brazil	5,110	4,100	4,260	8,880	7,090	7,020
France	3,790	3,110	3,180	1,200	986	896
Germany	4,750	3,910	3,750	1,000	819	739
Japan	6,500	5,200	4,670	10,300	8,270	7,510
Mexico	22,200	17,600	15,700	24,300	19,400	16,400
Norway	3,000	2,450	2,180	12,300	9,960	8,330
South Africa, Republic of	10,800	8,760	8,540	15,200	12,300	11,600
Other	65	52	46	1,290	1,030	1,030
Total	56,200	45,200	42,300	74,400	59,900	53,500

See footnotes at end of table.

TABLE 8--Continued
U.S. IMPORTS FOR CONSUMPTION OF MANGANESE ORE, FERROALLOYS, METAL,
AND SELECTED CHEMICALS, BY COUNTRY 1/

Country	1993			1994		
	Gross weight (metric tons)	Manganese content (metric tons)	Customs value (thousands)	Gross weight (metric tons)	Manganese content (metric tons)	Customs value (thousands)
			More than 4% carbon			
Australia	23,500	18,100	$8,670	14,400	10,600	$4,520
Brazil	38,800	29,600	14,700	30,500	23,300	11,900
France	72,400	56,100	30,500	86,600	68,000	35,900
Russia	10,800	7,780	3,070	374	251	85
South Africa, Republic of	123,000	96,300	51,500	116,000	90,800	47,000
Other 3/	13,300 r/	9,230 r/	3,710 r/	1,600	1,110	420
Total	281,000	217,000	112,000	249,000	194,000	99,900
			SILICOMANGANESE			
Australia	26,700	17,600	10,200	34,000	22,400	14,500
Brazil	64,800	42,100	26,300	21,400	13,900	9,900
China	51,200	33,500	20,500	15,500	10,200	6,590
Croatia	7,550	4,910	3,200	9,950	6,470	4,590
France	13,700	9,030	5,890	8,200	5,420	3,930
India	--	--	--	26,900	18,500	12,300
Mexico	23,000	14,800	9,880	18,200	11,600	8,520
Norway	6,520	4,100	5,600	5,150	3,130	4,330
South Africa, Republic of	57,600	37,900	26,400	104,000	69,000	45,300
Ukraine	37,600	26,500	13,700	14,000	9,300	5,480
Venezuela	14,000	9,070	5,340	7,630	5,040	3,560
Other 3/	13,400 r/	8,690 r/	6,530 r/	8,330	5,480	4,360
Total	316,000	208,000	133,000	273,000	181,000	123,000
			METAL			
Unwrought:						
China	2,500	XX	3,190	3,370	XX	4,060
South Africa, Republic of	7,630	XX	11,200	12,100	XX	17,700
Other	228	XX	431	1,110	XX	1,300
Total	10,400	XX	14,800	16,600	XX	23,000
Other:						
China	220	XX	258	1,500	XX	1,760
South Africa, Republic of	4,300	XX	6,630	1,920	XX	2,940
Other	93 r/	XX	675 r/	208	XX	1,060
Total	4,620	XX	7,560	3,630	XX	5,760
Waste and scrap:						
Canada	112	XX	32	44	XX	38
Other	42	XX	53	17	XX	25
			MANGANESE DIOXIDE			
Australia	12,300	XX	18,300	18,700	XX	28,100
Belgium	1,180	XX	1,980	1,230	XX	2,130
Brazil	1,270	XX	1,770	848	XX	1,180
Ireland	8,560	XX	12,500	7,300	XX	10,600
South Africa, Republic of	238	XX	347	1,440	XX	1,890
Other 3/	278 r/	XX	653 r/	196	XX	449
Total	23,800	XX	35,500	29,700	XX	44,400
			POTASSIUM PERMANGANATE			
China	1,090	XX	995	420	XX	316
Czech Republic	571	XX	852	453	XX	830
Germany	40	XX	74	100	XX	171
Japan	--	XX	--	109	XX	147
Spain	125	XX	277	352	XX	740
Other 3/	134 r/	XX	465 r/	197	XX	555
Total	1,960	XX	2,660	1,630	XX	2,760

r/ Revised. XX Not applicable.

1/ Previously published and 1994 data are rounded by the U.S. Bureau of Mines to three significant digits; may not add to totals shown.

2/ Includes U.S. Bureau of Mines conversion of part of reported data (from apparent MnO_2 content to Mn content).

3/ Unspecified group of countries differs from that in the 1993 Annual Report.

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

TABLE 9
MANGANESE ORE: WORLD PRODUCTION, BY COUNTRY 1/ 2/

(Thousand metric tons)

Country 3/	Range percent Mn e/ 4/	Gross weight 1990	1991	1992	1993	1994 e/
Australia 5/	37-53	1,920	1,480	1,210 r/	2,090 r/	2,000
Bosnia and Herzegovina e/ 6/	25-45	XX	XX	10	2	2
Brazil 7/ 8/	30-50	2,300	2,000	1,990 r/	1,840 r/	2,300
Bulgaria 7/	25-35	39	34 e/	29 r/ e/	--	--
Chile	25-35	40	44	50	63 r/	60
China e/ 9/	20-30	4,080	5,150	5,300	5,860 r/	5,900
Gabon 7/ 10/	50-53	2,420	1,620	1,560	1,290 r/	1,440
Georgia e/ 7/	29-30	XX	XX	1,200	1,000	800
Ghana 7/	30-50	247	320	276	295	270 11/
Hungary 7/ 12/	30-33	60	30	18	59 r/	55
India 7/ 13/	10-54	1,390	1,400	1,810 r/	1,660 r/	1,600
Iran 7/ 14/	30-35	54	48	40	55 r/ e/	40
Kazakhstan e/ 7/	29-30	XX	XX	100 r/	150 r/	133
Mexico 7/ 15/	27-50	451	254	407	363	307 11/
Morocco 7/	50-53	49	59	44	43	31 11/
Romania 7/ 12/	20-25	40	20	15	15	28
South Africa, Republic of 7/ 10/	30-48+	4,400	3,150	2,460	2,510	2,850 11/
Ukraine 7/	30-35	XX	XX	5,820	3,800 r/	2,980 11/
U.S.S.R. 16/	29-30	8,500	7,240	XX	XX	XX
Yugoslavia 6/ 17/	25-45	51	40 e/	XX	XX	XX
Other 18/	XX	66	49	51 r/	66 r/	60
Total	XX	26,100	22,900	22,400 r/	21,200 r/	20,900

	Range percent Mn e/ 4/	Metal content 1990	1991	1992	1993	1994 e/
Australia 5/	37-53	909	701	568 r/	1,040 r/	980
Bosnia and Herzegovina e/ 6/	25-45	XX	XX	4	1	1
Brazil 7/ 8/	30-50	897 r/	780 r/	777 r/	716 r/	897
Bulgaria 7/	25-35	11	9 11/	7 11/	--	--
Chile	25-35	12	13 e/	13 r/ e/	16 r/	16
China e/ 9/	20-30	816	1,030	1,060	1,170 r/	1,180
Gabon 7/ 10/	50-53	1,120	748	718	595 r/	663
Georgia e/ 7/	29-30	XX	XX	350	300	240
Ghana 7/	30-50	96	120	106	115	108
Hungary 7/ 12/	30-33	18	9	5	18 r/	17
India 7/ 13/	10-54	525	532	687 r/	628 r/	607
Iran 7/ 14/	30-35	18	16	13	18 r/	13
Kazakhstan e/ 7/	29-30	XX	XX	30 r/	45 r/	40
Mexico 7/ 15/	27-50	166	93	153	135	112 11/
Morocco 7/	50-53	26	31	23	23	17
Romania 7/ 12/	20-25	10	5	4	4	6
South Africa, Republic of 7/ 10/	30-48+	1,910	1,370	1,080	1,080	1,210
Ukraine 7/	30-35	XX	XX	1,850 r/	1,350 r/	1,050
U.S.S.R. 16/	29-30	2,500	2,150	XX	XX	XX
Yugoslavia 6/ 17/	25-45	18	14 e/	XX	XX	XX
Other 18/	XX	29	20	22	28 r/	26
Total	XX	9,080 r/	7,640 r/	7,470 r/	7,280 r/	7,190

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

1/ Previously published and 1994 data are rounded by the U.S. Bureau of Mines to three significant digits; may not add to totals shown.

2/ Table includes data available through July 14, 1995. 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, Namibia, 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 for average content of each year's production rather than for content of typical products.

5/ Metallurgical ore.

6/ All production in Yugoslavia from 1990-91 came from Bosnia and Herzegovina.

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/ Reported figure.

12/ Concentrate.

13/ Much of India's production grades below 35% Mn; average content was reported as 38.5% Mn in 1990-91.

14/ Data are for Iranian years beginning Mar. 21 of year stated.

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

16/ Dissolved in Dec. 1991.

17/ Dissolved in Apr. 1992.

18/ Category represents the combined totals of Argentina, (low-grade ore) Bolivia, Botswana, Burma, Colombia, Egypt , Greece, Indonesia, Italy (from wastes), Japan (low-grade ore), Philippines, Thailand, Turkey, and Zambia.