

IRON ORE

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Iron ore is essential to the economy and national security of the United States. As the basic raw material from which iron and steel are made, its supply is critical to any industrial country. Scrap is used as a supplement in steelmaking but is limited as a major feed material because the supply of high-quality scrap is limited. In 1999, the steel industry accounted for more than 98% of iron ore consumption. Domestically, production fell by 8%, and shipments decreased by 4%. Internationally, iron ore production fell by 6%.

Iron ore is a mineral substance which, when heated in the presence of a reductant, will yield metallic iron. It almost always consists of iron oxides, the primary forms of which are magnetite (Fe_3O_4) and hematite (Fe_2O_3). Taconite, the principal iron ore mined in the United States, has a low (20% to 30%) Fe content and is found in hard, fine-grained, banded iron formations.

Production

U.S. iron ore production in 1999, at 57.7 million metric tons (Mt), fell by 8%, the largest percentage drop since 1986. Although iron ore consumption rose in the last one-half of the year, production dropped steeply and in September reached its lowest point since August 1993. In anticipation of the expiration of the United Steel Workers of America labor contract, on July 31, U.S. producers produced at close to full capacity until the end of July. Once the contract was signed, a number of producers closed their operations and production dropped precipitously. Stocks that had built up in the first half of the year were used to satisfy demand in the second half. Mine stocks in March 1999, at 15 Mt, reached their highest level since June 1983 and fell to 5.7 Mt in December.

Iron ore production has failed to keep pace with steel demand for at least as far back as the early 1960's. However, until the early 1990's ore production increased or decreased in response to steel demand. In the 1990's steel demand has risen significantly while iron ore production has been flat. Steel demand rose from 96 Mt in 1990 to 133 Mt in 1999, an increase of 39%. In the same period iron ore production rose from 56Mt to 58 Mt., an increase of 2%.

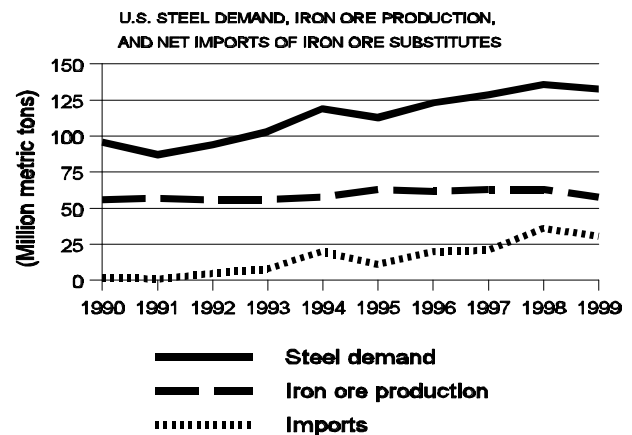
The primary factors that account for this are the growth of minimills and imports of iron ore substitutes. The U.S. steel industry can be seen as having two sectors, the integrated mills and the minimills. The integrated mills are the iron ore consumers and account for 98% of iron ore consumption. As would be expected, there is an excellent direct correlation (91%) between the number of active blast furnaces and iron ore consumption. Using blast furnaces, the integrated steelmakers

produce iron that is then moved to a basic oxygen furnace and converted to steel. Minimills use electric arc furnaces to melt ferrous scrap to produce steel. Minimills have gained market share at the expense of the integrated mills. Their share of the steel market rose from 37% in 1990 to 46% in 1999.

Iron ore substitutes include steel mill products, scrap, pig iron, and DRI. Steel mill products are unfinished steel, such as blooms, billets, and slabs, which must be finished before being shipped to consumers, and finished steel, which may be used by consumers as is. Pig iron is the product of blast furnaces and is used by integrated mills and, to some extent, by minimills. DRI is a product obtained by reducing iron ore to metal at temperatures below the melting point of iron.

Net imports of steel mill products rose from 11.7 Mt in 1990 to 27.5 Mt in 1999. For the same period, net imports of pig iron rose from 0.3 Mt to 4.7 Mt and net imports of DRI rose from 0.3 Mt to 0.9 Mt. The U.S. exports more scrap than it imports so the trade in scrap is referred to as net exports. Net exports of scrap fell from 10.3 Mt in 1990 to 1.8 Mt in 1999.

FIGURE 1



So, in the 1990's more iron ore substitutes in the form of steel mill products, pig iron, and DRI came into the country, and less iron ore substitutes in the form of scrap left the country.

The reason for using imported iron ore substitutes in the form of pig iron or semifinished steel is that it allows steelmakers to increase their shipments without having to increase their production from the blast furnace. A major increase in production would entail reopening blast furnaces

and hiring new personnel. The steel business is highly cyclical and when demand falls, as it inevitably will, the steelmakers will not have to shut down recently opened blast furnaces and lay off recently hired personnel. (See figure 1.)

The nine taconite mining operations in Michigan and Minnesota accounted for virtually all domestic iron ore production. Seven of these operations were on the Mesabi Iron Range in northeastern Minnesota: EVTAC Mining LLC, Hibbing Taconite Co., Inland Steel Mining Co., LTV Steel Mining Co., National Steel Pellet Co., Northshore Mining Co., and the US Steel Group of USX Corp. (Minntac). The two taconite operations on the Marquette Iron Range in the Upper Peninsula of Michigan were the Empire and the Tilden Mines.

In Michigan, the Empire Mine closed for 6 weeks, and the Tilden Mine closed for 10 weeks, both closures occurring in the August-September period (Cleveland-Cliffs Inc., written commun., 2000).

In Minnesota, EVTAC Mining continued to operate, but closed one of its production lines from June through the end of the year. The shutdown at Hibbing Taconite ran from August 8 through September 11 and involved about 605 employees (Hibbing Taconite Co., written commun., 2000). Northshore closed a pelletizing furnace in late July and idled the entire plant from October 30 to November 24 (Bloomquist, Lee, and Lincoln, Craig, August 2, 1999, Labor deals don't end taconite woes—Increase in imports, pellet inventories have plants scheduling downtime, Duluth News-Tribune, accessed August 2, 1999, at URL <http://www.duluthnews.com/news/day1/dnt/hib.htm>) (Cleveland-Cliffs Inc., written commun., 2000).

Minntac delayed starting an agglomerating line that had been idle since October 1998 (Bloomquist, Lee, Minntac delays line start-up—Market for taconite pellets still hurt by imports, officials say, Duluth News-Tribune, accessed April 14, 1999, at URL <http://www.duluthnews.com/day1/dnt/biz/tac.htm>). The line resumed operation on September 28 (U.S. Steel Group, USX-Minnesota Ore Operations, written commun., 2000).

U.S. production data for iron ore are developed by the U.S. Geological Survey (USGS) from two separate, voluntary surveys of domestic operations. The annual "Iron Ore" survey (1066-A) provided 100% of total production shown in tables 1 through 4. This information is supplemented by employment data, mine inspection reports, and information from consumers. The American Iron Ore Association (AIOA) provided data on ore shipments from loading docks on the upper Great Lakes, as well as receipts at transfer docks and furnace yards nationwide. The dock and steel plant data were compiled jointly by AIOA and the American Iron and Steel Institute (AISI).

Iron ore was produced by 12 companies; 4 other companies did not produce, but shipped iron ore from stockpiles. The nine taconite producers in Michigan and Minnesota accounted for 99% of domestic production. The 12 producing companies operated 13 mining operations, 10 iron ore concentration plants, and 10 pelletizing plants. Of the two iron ore producers that did not produce pellets, one produced iron ore as a byproduct of gold mining, and the others produced direct-shipment ore, which requires minimal processing. Of the 13 mining operations, 12 were open pit and 1 was underground. Virtually all ore was concentrated before shipment, and 99%

was pelletized. In 1999, combined United States and Canadian production represented 9% of the world output of usable ore in terms of metal content. Trends in world mine production since 1995 are shown on a country basis in table 17.

Domestic iron ore supply (production minus exports) satisfied 69% of domestic demand in 1999, compared with an average of 70% from 1990 through 1999. Domestic iron ore production, at 57.7 million tons, decreased by about 8% from that of 1998. Productivity in the Lake Superior District, in terms of thousands of tons of usable ore produced per worker, was 8.6, a slight decrease from that of 1998. Low-grade ores of the taconite type mined in Michigan and Minnesota accounted for 99.5% of total usable ore production. U.S. production of pellets totaled 57.1 million tons. The average Fe content of usable ore produced was 63%. Fluxed pellets' share of total pellet production continued to grow rapidly, rising to 61.5% in 1999 from 39.0% in 1994.

Labor contracts for six of the seven taconite operations in northeastern Minnesota expired on July 31 (Northshore is a nonunion operation). The contracts had been in place for 6 years. All but EVTAC signed new contracts. By mutual agreement, negotiations between EVTAC and the union were delayed (Iron Mining Association of Minnesota, oral commun., 2000). The previous contract was extended until June 2000, while company officials negotiated with the Minnesota Iron and Steel Co. (MIS) about a possible acquisition (EVTAC Mining, oral commun., 2000).

MIS, Nashwauk, MN, was formed in 1996 to pursue development of direct reduced iron (DRI) and steel production on the Mesabi Iron Range of northeast Minnesota. The company is studying the feasibility of building a taconite plant to produce pellets, a DRI facility, and a minimill to produce steel. The operation would be at the site of the Butler Taconite facility near Nashwauk, MN, which closed in 1985. MIS was also considering purchasing EVTAC, which would produce pellets from ore mined at the Butler site (Kirk, 1996).

Michigan.—Michigan accounted for 23% of the output of usable ore in 1999. All the State's production was from the Empire and the Tilden Mines near Ishpeming, Marquette County, and 99% was pelletized. Both mining ventures were managed by subsidiaries of Cleveland-Cliffs Inc. Empire and Tilden signed new labor contracts for a 5-year period (Cleveland-Cliffs Inc., written commun., 2000a).

Minnesota.—Minnesota produced 76% of the national output of usable ore in 1999. All the State's production came from open pit mines on the Mesabi Range.

In December, after about 100 years of using its own in-pit-rail equipment, Minntac began using trucks only to move stripped overburden and waste rock and deliver crude ore to its crushing plant. The crushing plant was modified to accommodate trucks (Skillings Mining Review, 2000c) (U.S. Steel Group, USX-Minnesota Ore Operations, written commun., 2000).

Missouri.—Pea Ridge Iron Ore Co. produced iron oxide powder at its mining complex near Sullivan. The company has the only active underground iron mine in the country. In January 1991, the company ceased pellet production and began concentrating on specialty iron oxide products, which had

formerly been coproducts.

Consumption

Data on consumption and stocks of iron ore and iron ore agglomerates (pellets and sinter) at iron and steel plants were provided by the AIOA. Data on consumption of iron ore for nonsteel end uses were compiled from information gathered from USGS surveys.

The number of blast furnaces in operation during the year ranged from 32 to 36. Consumption of iron ore, including agglomerates reported to the AISI by integrated producers of iron and steel, totaled 71.1 Mt. This included 59.4 Mt of pellets; 11.0 Mt of sinter, briquettes, etc.; and 0.7 Mt of natural coarse ore. Of the ore consumed, 84% was of domestic origin, 8% came from Canada, and 8% came from other countries. Other materials consumed in sintering plants included mill scale, flue dust, limestone and dolomite, slag and slag scrap, and coke breeze. Other iron-bearing materials charged to blast furnaces included mill scale, slag scrap, and steel-furnace slag.

The four consumption numbers in this annual review are listed in tables 1, 6, 7, and 8. The following explains why more than one consumption number is used and how each of them is derived. The first consumption number (75.1 Mt in 1999) is in table 1 and is the sum of the quantity of ore consumed by form as reported by the AISI (American Iron and Steel Institute, 2000, table 32) and the quantities of ore consumed in direct reduced iron production and ore consumed in nonsteel uses, as reported to the USGS; the AISI number is reported in short tons and is converted to metric tons. The second consumption number (67.8 Mt in 1999) is in table 6 and is the quantity of ore consumed at U.S. iron and steel plants by originating area, as reported by the AIOA; the number has been converted from long tons, as it appears in the AIOA annual report, to metric tons (American Iron Ore Association, 2000, p. 45). The third consumption number (71.2 Mt in 1999) is in table 7 and is the quantity of ore consumed in U.S. iron and steel plants by type of ore as reported by the AISI; the number has been converted from short tons, as it is listed in the AISI annual report, to metric tons (American Iron and Steel Institute, 2000, table 32). The fourth consumption number (71.5 Mt in 1999) is in table 8 and is the sum of the AIOA number for consumption at United States Iron and Steel plants (American Iron Ore Association, 2000, p. 45) and two other numbers; these are the quantities of ore consumed in direct reduced iron production (2.4 Mt in 1999) and nonsteel uses (1.3 Mt in 1999) as reported to the USGS. In summary, iron ore consumption for steelmaking is calculated by the AIOA and the AISI using different methods. To obtain total domestic iron ore consumption, iron ore consumption for other end uses must be added to AIOA and AISI reported consumption, thereby generating four consumption numbers.

Prices

Most iron ore prices are negotiated between buyer and seller. Currently, about 60% of domestic ore is produced by captive mines (mines producing for company-owned blast furnaces)

and, therefore, does not reach the open market. The average free-on-board mine value of usable ore shipped in 1999 was \$25.52 per metric ton, considerably lower than that of 1998. This average value should approximate the average commercial selling price less the cost of mine-to-market transportation.

International iron ore prices fell in 1999. The price for Hamersley and Mount Newman fine ores for fiscal year 1999 (April 1, 1999, to March 31, 2000) in the Japanese market was 26.63 cents per 1% Fe per long ton unit, down 11% compared with that of the previous year (Duisenberg, 2000, p. 72-73). The price for lump ore was settled at 34.83 cents per 1% Fe per long ton unit, a decrease of 10% compared with that of 1998. The lump ore to fine ores premium for Australian ore sold to Japan, narrowed from 9.10 in 1998 to 8.07 cents per 1% Fe per long ton unit. There were similar price percentage decreases in Europe. Iron ore prices have declined over the long term as well. The price of Carajás fines, a grade of ore produced by Companhia Vale do Rio Doce (CVRD) and sold to Europe, when denominated in U.S. dollars and adjusted for inflation using the U.S. Consumer Price Index for All Urban Consumers, fell by 33% between 1990 and 1999.

Transportation

Near drought conditions in the Great Lakes basin from June 1998 through yearend 1999 led to lower than usual water levels that had a negative impact on iron ore shipments (Lake Carriers Association, 2000, p. 27). Lake Superior began the year at about 20 centimeters (cm) below the long-term average (LTA), ending 1999 at about 23 cm below LTA. The situation created by the low lake levels reduced the size of the largest cargo shipped from Two Harbors from that of 1998 by 3.1%; the size of the average cargo from Two Harbors was reduced by 7.3%. In the 20th century, more than 6.5 billion tons of iron ore was shipped via the Great Lakes (Lake Carriers Association, 2000, p. 37-38).

Almost no iron ore is consumed near where it is produced, requiring most ores to be transported, often great distances. Nearly all iron ore leaves the mine by rail, after which much of it is transferred to ships. In the United States, a much larger proportion of ore is moved by water than in other countries because of the proximity of the mines to the Great Lakes, which offer low-cost transportation. No taconite mine is more than about 160 kilometers (km) from Lake Superior or Lake Michigan, and most are much closer. In 1999, 95% of all domestic ore produced was transported on the Great Lakes and constituted 51% of U.S.-flag cargoes, more than twice that of stone and gypsum, the next largest dry bulk material category shipped. Excluding transshipments, U.S.-flag carriers moved 53.6 Mt of iron ore in 1999.

Foreign Trade

U.S. exports of iron ore were 2% higher than those of 1998 (tables 9 -15). Almost all exports consisted of pellets shipped via the Great Lakes to Canadian steel companies, which are partners in U.S. taconite projects in Michigan and Minnesota. U.S. imports of iron ore at 14.3 Mt, were 16% lower than those

of 1998. Net imports, which averaged 11.2 Mt from 1989 through 1999, were 8.1 Mt in 1999. This was equivalent to 15% of U.S. ore consumption. Canada's share of U.S. imports was 48%; Brazil's was 39%.

World Review

Production.—World iron ore production was 994 Mt, a 7% decrease compared with that of 1998 (table 17). Although iron ore production was widely distributed, occurring in about 50 countries, the bulk of world production came from just a few countries. The five largest producers, in decreasing order of production of gross weight of ore, were China, Brazil, Australia, India, and Russia. These countries accounted for about 71% of world production. China was the largest producer in gross weight of ore produced, but because its ore was of such low grade, the country's output ranked well below Australia's and Brazil's output in Fe content. Of the largest producing countries, Russia experienced the highest growth rate at 13%.

Consumption.—World steel production at 784 Mt was slightly higher than that of 1998. For the fourth consecutive year, China was the largest steel producer at 123 Mt. The combined output of the three largest steel-producing nations, China, Japan, and the United States, accounted for 40% of world production. The largest increase in steel production over that of 1998 took place in Kazakhstan (32%), Russia (14%), Ukraine (11%), and China (8%). World pig iron production at 541 Mt, grew by less than 1%. In 1999, DRI production (38 Mt) continued to increase.

Trade.—In 1999, 47% of world iron ore production was exported, up from 43% in 1998. At 441 Mt, world exports decreased by 4%. Seaborne ore shipments totaled 403 Mt, accounting for 92% of exports. Australia was the leading exporter of iron ore, shipping 148 Mt to world markets, followed by Brazil, which exported 140 Mt, and India, which exported 29 Mt. Australia's chief export customers were Japan (47%), China (19%), and the Republic of Korea (14%), with Asia as a whole accounting for 86%. Most of Brazil's exports were split almost equally between Asia (41%) and Western Europe (40%), with Japan (18%) being the largest importing country. Western Europe and Asia accounted for 83% of world iron ore imports in 1999. Japan, as usual, was the leading importing country, accounting for 27% of imports. The next largest was China, which imported 13%, followed by Germany at 9% and the Republic of Korea at 8%.

Australia.—A large consortium was formed to build an integrated facility that would produce 3.85 million tons per year (Mt/yr) of finished steel products based on the Fortescue deposit in Western Australia (Hagopian, 1999a). The consortium, Austeel Pty. Ltd., included major Australian and international companies that were expected to contribute technical expertise and financial backing for the project.

Australian Bulk Minerals (ABM) announced plans to increase production in Tasmania (Metal Bulletin, 1999a). ABM bought the operation in 1997 after its previous owner had closed it (Kirk, 1999, p. 41.4). Afterward, the company spent about A\$150 million refurbishing the mine and concentrator at

Savage River and the pellet plant at Port Latta. The mine and pellet plant are connected by an 85 km pipeline through which concentrate in the form of slurry is pumped. After producing 1.9 Mt in 1999, ABM intends to raise production to 2.5 Mt in 2000 (Skillings Mining Review, 2000a).

The Broken Hill Pty. Co. Ltd. (BHP) and Hamersley Iron Ore Pty. Ltd., Australia's two largest iron ore producers, discussed a possible joint venture of their iron ore operations (Rio Tinto Press Release, June 15, 1999, accessed February 18, 2000 at URL: <http://www.riotinto.com/ok.html>). The talks ended without an agreement; the synergy of such a merger would have provided the potential for huge cost savings as well as ranking the new company ahead of CVRD of Brazil, the world's largest iron ore producer.

BHP made efforts to reduce costs and increase productivity. As part of its cost reduction drive, the company offered early retirement to many of its employees (TEX Report Co., Ltd., 1999a).

To reduce shipping costs, BHP entered a joint-venture arrangement with Cobam, a shipping company based in Belgium (TEX Report Co., Ltd., 1999c). The company acquired 50% of Cobam from its parent Cobelfret. As part of the agreement, BHP's bulk carrier "Iron Newcastle" will be operated by Cobam under the new name "Lowlands Yarra." BHP also reduced costs through making changes in the way it delivers its product (Cousins, 2000). Over a 5-year period, BHP examined the way it moved ore from its mine to its customers and found that the process could be greatly improved. After improvements were made, the company was able to increase the quantity of ore moved to Port Kembla by 33% without capital investments in transportation equipment or facilities.

BHP offered the 1,000 employees at its Pilbara iron ore operations in Western Australia individual staff contracts (TEX Report Co., Ltd., 1999b). Currently, 600 staff employees have direct employee contracts with the company. BHP intends to put its employees in mines, railways, and ports under the same system, thereby replacing the current employee contracts between the company and labor unions. The other two major Western Australia iron ore producers, Hamersley and Robe River Mining Co. Pty. Ltd., have had such agreements with their employees for some time (Metal Bulletin, 1999d). BHP is encouraging employees to change by offering higher pay and better sick leave and retirement entitlements. The object of these contracts is to broaden the range and type of work being done by employees to increase productivity.

BHP also increased productivity by upgrading the beneficiation plant at Mount Whaleback so that it could treat ore previously regarded as waste (Metal Bulletin, 1999e). At Port Hedland, the company upgraded the ore handling facilities and replaced a 370-metric ton (t) shiploader with a 520-t unit. The new loader was installed to meet future increases in loading rates.

Hamersley Iron in 1999 opened a mine and made strides in reducing costs. The new mine, Yandicoogina, usually referred to as Yandi, was Hamersley's sixth and began operation in January. Hamersley's other mines are the Mount Tom Price, Paraburdoo, Channar, Marandoo and Brockman No.2 Detritals.

The latter two are also mines and were developed primarily to extend the life of the Mount Tom Price Mine by blending their output with the Brockman-type lump ore of Tom Price. Yandi ore will be a discrete product, sold separately and branded HIY, giving the company three products—Brockman lump and fines and HIY (Metal Bulletin Monthly, 1999a). The new beneficiation plant and ore handling systems at Yandi have an installed capacity of 15 Mt/yr, and Hamersley only needs to increase the mining rate at a minimal capital outlay to achieve the planned production rate of 15 Mt/yr. This is expected to raise Hamersley's exports to about 70 Mt/yr (Metal Bulletin Monthly, 1999a). The company shipped 10.46 Mt of Yandi ore during the year (Skillings Mining Review, 2000b).

Yandi is in the Eastern Hamersley Range about 90 km northwest of Newman. The deposit is part of the larger Yandicoogina Channel iron deposits and is 26 km long and typically 500 meters (m) wide. The main ore zone is about 45 m deep in the center of the channel and lies some 11 m below the surface. Reserves are estimated at 310 Mt with an average grade of 58.5% Fe, although the total resource is reported to be more than 1 billion tons. It is a pisolitic goethite/hematite ore with low alumina content and is considered to be particularly suitable for sinter plants. The development also involved construction of a 147 km extension of Hamersley's existing railway and upgrading of the port at Dampier. A more than 2-km-long train with two locomotives and 226 cars takes about 9 hours to reach Dampier. The work at the port included the dredging of a holding basin as well as upgrading of the stockpiles and loading facilities, increasing shipping capacity from 60 Mt/yr to 70 Mt/yr. Hamersley loads about 550 vessels per year from the port (Metal Bulletin Monthly, 1999a).

Hamersley's cost reductions came through simplifying the company's management and production processes with the objective of increasing efficiency and productivity under the 'one mine' concept (Mining Journal, 1999b). The key element of this concept is operating Hamersley's six mines as one. Previously, each mine had operated as an individual entity. Now, the responsibility for controlling product quality has been moved from the individual mine to a team that undertakes planning processes from the drilling stage to the blending of iron ore stockpiles at the port. This avoids duplication of effort in technical services and management functions, thereby resulting in a direct reduction of costs.

Another aspect of the cost reduction program is the 'all staff program' whereby all employees are on individual contracts, as opposed to being represented by labor unions. Hamersley claims that this provides major competitive advantages by making the work force far more flexible.

The company also achieved cost reductions by updating the data acquisition (DAQ) systems used to maintain the 500-km rail network, which links Hamersley's mines to Dampier (Hogopian, 1999b). The railway is monitored at 0.5-m intervals throughout its length using a dedicated rail monitoring car equipped with a variety of sensors to regularly track conditions and schedule maintenance activities. This has significantly reduced the cost of maintenance.

In May, Robe River commissioned a scrubber trommel process plant at its Mesa J Mine that recovers ore from material

previously classified as sub-economic (North Ltd., 1999; TEX Report Co., Ltd., 1999f). Construction of the 750-metric tons per hour (t/hr) plant followed extensive trials, which indicated that washing and aggressive agitation of mixed ore and waste reduced impurities to a level that met customers' ore grade specifications. Robe River also began construction of a lump re-screening plant at its port facilities at Cape Lambert. The plant was designed to remove excessive undersized ore from the lump ore before feeding it to the ship loading system. Through restructuring, Robe reduced its mining employees from 617 in April to 567 in December (North Ltd., February 14, 2000, North Iron Ore—Future plans and aspirations, media release, accessed on February 15, 2000, at URL <http://www.north.com.au/news-releases/rel-2000021400.html>).

North Ltd. owns 53% of Robe River, 56% of the Iron Ore Company of Canada (IOC), an iron ore producer in Canada, and the West Angelas iron ore deposit in Western Australia. North is planning to develop the deposit, which would require building a 340-km rail line between West Angelas and Cape Lambert, the port from which Robe River exports its ore (TEX Report Co. Ltd., 2000). Because the deposit is close to existing Hamersley operations, North Ltd. went to court to gain access to the Hamersley rail line. North was joined by the management of the Hope Downs deposit, which would also benefit from using the rail line (Engineering and Mining Journal, 1999d). The court ruled in favor of Hamersley which argued that its rail line was an integral part of its iron ore production process and that sharing it would be unacceptably costly and disruptive (TEX Report Co., Ltd., 1999g).

In 1998, Hope Downs Management Services (HDMS) was established as a joint venture between Hope Downs Iron Ore Pty. Ltd., a wholly owned subsidiary of Hancock Prospecting Pty. Ltd., and Iscor Australia Pty. Ltd., a wholly owned subsidiary of Iscor Ltd. of South Africa. HDMS was to perform a feasibility study on the Hope Downs iron ore deposits in the Pilbara region of Western Australia (Kirk, 2000, p. 41.5). In January, HDMS completed a program of drilling to delineate the resource and provide sample material for customer testing (TEX Report Co., Ltd., 1999e).

Portman Mining Ltd. plans to increase its iron ore production from 1.65 Mt/yr to as much as 4 Mt/yr (Metal Bulletin, 1999j). The company's board of directors approved a total of A\$9.77 million for the expansion. Portman mines the Koolyanobbing and Cockatoo Island deposits in Western Australia. At the Koolyanobbing Mine, production would rise from the current 1.65 Mt/yr to 3 Mt/yr in 2001 (Metal Bulletin, 1999k). To increase production beyond that, Portman purchased three deposits, all north of Koolyanobbing: the Bungalbin, by 40 km; the Mount Jackson, by 90 km; and the Windarling, by 120 km. To help finance these purchases, Portman sold its 95% stake in the Burton coal mine (Metal Bulletin, 1999i). The expansion includes upgrading the Port of Esperance, from which Portman ships its ore, and the railway. The improvement at the port will allow Portman to ship its ore in larger vessels. Portman has a 60% stake in Koolyanobbing with Anshan Iron & Steel of China having the remaining 40%. Anshan is to retain its 40% share in the expanded Koolyanobbing Mine.

Brazil.—Early in the year, CVRD was forced to close all

seven of its pellet plants adjacent to the ore terminal at the Port of Tubãro because of low demand. At midyear, demand increased and the plants began working at full capacity (Knight, 1999).

The Brazilian Government was making plans to sell its remaining 31.5% holdings in CVRD (Kepp, 1999b). The sale was needed to help the Government reach 1999 economic targets agreed to with the International Monetary Fund (IMF) as a condition for receiving \$1.5 billion in aid. The IMF-led emergency aid was intended to boost monetary reserves following a massive capital flight. Late in the year, the Government decided to postpone the sale until 2000 because of depressed local stock market prices (Kepp, 1999a).

Ferteco Mineração S.A. began shipping ore from its new \$100 million terminal at Septiba (Metal Bulletin, 1999g). All Ferteco's product types are being shipped from the new terminal, including lump ore, concentrates, sinter feed, and pellet feed. The company is still also using CVRD's Tubarão port. In 1999, Ferteco exported about 11 Mt from Tubarão, 2 Mt from Septiba, and 1.5 Mt from Minerações Brasileiras Reunidas S.A.'s (MBR) Guaiba port near Septiba. Ferteco's shipping costs are lower from Septiba than from Tubarão, as the company does not have to pay freight charges to CVRD for using the Vitória-Minas railway to Tubarão. In 2000, the company is expected to divide exports equally between Tubarão and Septiba (Kepp, 1999c). Ferteco is expected to ship less ore through Tubarão in the future.

Ferteco built the Septiba port to handle the expected increased production from its mines and to hold down transportation costs (Kirk, 1999, p. 6). The terminal, which has a 2-Mt storage yard and 10,000 t/hr ship loader, can ship 15 Mt/yr. Ferteco also has the option to ship 2 Mt/yr of ore from MBR's terminal near Septiba. This terminal can receive ships of as much as 300,000 deadweight tons (dwt). In return, MBR can ship 2 Mt/yr of ore from Ferteco's port, which will allow MBR to unclog its Guaiba Island terminal by sending some of its clients' smaller ships to the Septiba port. The port-swap agreement between Ferteco and MBR went into effect as soon as the Septiba port opened. Currently, the Septiba Terminal is limited in the size of vessels it can load because the access channel has not been fully dredged (TEX Report Co., Ltd., 1999h). Dredging is to continue until the end of January 2000, at which time the depth will be 18.7 m and thus will be able to receive vessels of 230,000 dwt.

In late 1999, Arbed S.A., the Luxembourg-based steel producer, appointed an investment bank to evaluate the value of Samitri, its Brazilian iron ore mining affiliate (Metal Bulletin, 1999b). The move reportedly is linked to Arbed's desire to buy part of Cia. Siderurgica Nacional, Brazil's largest steelmaker.

Mineração Socoimex signed a long-term transport and bulk handling contract with CVRD that should allow Socoimex to increase its exports. Socoimex exports ore to customers in Europe and is developing new customers in Europe, North America, and Asia. Socoimex is based in Minas Gerais State at Gongo Soco. The agreement with CVRD involves the hauling, handling, and loading of Socoimex products using CVRD's Vitória-Minas railway and Tubarão ocean terminal in Espírito Santo State. Gongo Soco is located alongside the Vitória-

Minas railway in Barão de Cocais, 80 km from the State capital Belo Horizonte and 70 km from CVRD's mines at Itabira. The mine has a capacity of 7 Mt/yr and produces sinter feed, pellet feed, and lump ore. Reserves are reported to be 100 Mt of high-grade hematite containing more than 66% Fe and 200 Mt of medium-grade hematite containing from 58% to 66% Fe. The silica content is said to be below 1% (Metal Bulletin, 1999o).

Canada.—IOC continued its efforts to reduce costs during 1999. The company began mining the Luce deposit, its second superpit (Metal Bulletin, 1999f). In 1997, IOC began developing the first of two superpits that were expected to make its mining operations much more efficient (Kirk, 1998, p. 41.5). The first superpit was made from the combining of the Humphrey pit and the Humphrey West pit. The Luce was the second of the superpits. IOC completed negotiations with the United Steelworkers union concerning the reduction of its work force from 2,300 to 1,750 by 2004 (Dunn, 1999). The jobs will be eliminated by attrition and the cuts will help reduce its production costs by \$5.00 per ton, making IOC one of the lowest cost producers in the world. The Labrador Mining Co. Ltd. increased its equity position in IOC by purchasing an additional 6.95% of IOC's shares (Skillings Mining Review, 1999a). After the transaction was completed, shareholding of IOC was: North Ltd., 56.07%; Mitsubishi Corp., 25%; and Labrador Mining, 18.93%.

Wabush Mines was upgrading facilities and increasing capacity at its Scully Mine, near Labrador City in Newfoundland, and at its pellet plant at Pointe Noire on the St. Lawrence River in Quebec (Metal Bulletin, 1999m). At Scully, the concentrator that treats ore from the nearby mine is being upgraded from 6 Mt/yr to 7.5 Mt/yr. The mine complex is linked by a 450-km rail line to Pointe Noire, where Wabush has its port and pellet plant. The port has been dredged so that it can accommodate vessels of 120,000 dwt instead of the previous 80,000 dwt. Wabush completed a pellet screening plant that would limit the quantity of pellet chips in the final product. The company has served the North American market primarily, but wants to develop new products for the European and Asian markets.

China.—The Government announced that it was banning the construction of new iron and steel plants until 2000 to eliminate overproduction and that steel companies that had idled operations would not be allowed to resume production (Metal Bulletin Monthly, 1999b; American Metal Market, 1999). Even then, China will have to import more ore to feed its steel mills because domestic production from mines constructed in the early 1950's has decreased greatly because of either depleted iron ore reserves or increasing mining depth (Engineering and Mining Journal, 1999b). New discoveries in China have not kept pace with demand because of earlier Government cutbacks in exploration programs. To maintain current iron ore production of 250 Mt/yr, new mines will have to be constructed soon. The Government has earmarked special funding for 24 major iron ore projects totaling 59.2 Mt. Until these mines are completed, China is expected to import iron ore from multiple sources. To handle these large quantities of imports, China has increased its port capacity (Metal Bulletin,

1999h). At Qingdao, a berth at the port's new Qianwan area is able to handle ships of at least 200,000 dwt. The port of Xingang, near Tianjin, which currently can handle 50,000-dwt vessels, was expected to be upgraded to handle 150,000-dwt vessels. The first phase Meishan iron ore mining project of Nanking-based Shanghai Meishan Group reached its production target of 2.5 Mt/yr (Engineering and Mining Journal, 1999a).

India.—The National Mineral Development Corp. (NMDC) forecast that domestic demand for iron ore could reach 119 Mt in 2002 and perhaps 125 Mt in 2006. The State-owned company, which operates India's largest iron ore mines at Bailadila in Madhya Pradesh, is developing a new 5 Mt/yr-capacity mine at Bailadila based on reserves of 189 Mt grading 65% Fe. The mine is expected to become operational by 2002. It also is investing in a mine at Kumaraswamy which has reported reserves of 179 Mt. This mine is expected to have a capacity of 3 Mt/yr, eventually reaching 7 Mt/yr. NMDC expects India to maintain its position as a net exporter, with shipments to the international market expected to remain in the 30- to 35-Mt/yr range (Mining Journal, 1999a).

Kudremukh Iron Ore Co. Ltd. has installed a computer system for geo-modeling, mine planning and truck dispatching in which the global positioning system is used to coordinate shovel output, haulage and ore blending. In the pit, the introduction of air-decking techniques for blasting ore benches has reduced explosives costs by 20%, improved fragmentation, and reduced air and noise pollution.

In the concentrator, new classifiers were introduced in 1996 to produce a preconcentrate with a higher iron content and reduce iron loss in the tailings. It is planned shortly to treat the magnetic concentrate by column flotation. Recent modifications to the pellet operation include the use of organic binders and introduction of solid carbon to reduce pellet abrasion. Kudremukh also has installed double-deck roller screens, a burner control system, and a high-pressure roll press to improve the blend of the pellet feed. These actions have increased the capacity of the existing plant from 3 Mt/yr to 3.5 Mt/yr. New shaft-pelletizing technology will be introduced shortly, raising annual capacity to 4 Mt/yr.

Efforts to divest the State-owned company have been delayed by a court ruling (Raghuvanshi, 1999). Kudremukh's labor union asked for a stay against the decision because the union feared that the current work force would be cut by at least 20%.

Sesa Goa, the largest iron ore producer in Goa, signed a memorandum of understanding with State of Orissa to begin mining iron ore in that State (Metal Bulletin 1999n). Sesa Goa's facilities at Mormugoa, on the west coast of India, are affected from June to September each year by monsoon rains that make shipping impossible. Sesa Goa began exporting Karnataka ore with an Fe content of as much as 64% from the port at Chennai on the east coast. Chennai has the required infrastructure and is not affected by the monsoon season. After exporting about 500,000 tons of ore through Chennai in 1997-98, Sesa Goa asked the Government for permission to export iron ore fines with an Fe content of as much as 66%. Traditionally, such high-grade material is the preserve of the State-owned export agency Minerals and Metals Trading

Company, but the Government gave Sesa Goa a license, and the company has drawn up plans to increase mining at Karnatka to about 2 Mt/yr for export.

Rio Tinto Plc. (51%) and Orissa Mining Corp. (49%) formed a joint venture to investigate the possibility of developing a major iron ore mining operation in the Keonjar-Singbhaum region of Orissa (Engineering and Mining Journal, 1999c; Skillings Mining Review, 1999c). Orissa Mining, a State-owned company, has transferred two mining blocks with reserves estimated at 800 Mt to the joint venture. The companies expect to spend as much as \$18 million establishing the feasibility of the project.

Stemcor, the United Kingdom-based steel trading group, signed an agreement to take a 51% stake in Essar Minerals, an Indian pellet producer (Metal Bulletin, 1999p). The agreement will allow Essar to raise enough money to increase the capacity of the plant from just over 3 Mt/yr to 7 Mt/yr.

Mauritania.—Société Nationale Industrielle et Minière de Mauritanie was planning the construction of a 3-Mt/yr to 4-Mt/yr pelletizing plant (Société Nationale Industrielle et Minière de Mauritanie, website, accessed September 28, 2000, at URL <http://www.snim.fr/recherche2.html>).

Mexico.—Minera del Norte SA, a wholly owned subsidiary of Altos Hornos de Mexico SA was converting the Prometeo Mine from an open pit operation to underground (Skillings Mining Review, 1999b). The pit, in the desert region straddling the States of Coahuila and Chihuahua, had a depth of 270 m. The \$38 million project was to include installation of support walls and roofs and air holes for ventilation.

Peru.—Shougang Hierro Peru SA, owned by Shoudu (Capital) Iron and Steel (Group) Co. (Shougang Group) of China, signed a \$100 million contract with three Spanish companies for the construction of a new pelletization plant, its third (TEX Report Co., Ltd., 1999d). The 3-Mt/yr-capacity plant is expected to be commissioned in 2002, doubling the facility's pelletizing capacity (Mining Journal, 1999c). The facility formerly belonged to the Peruvian Government, which sold it to China in 1992 (Kirk, 1993, p. 625). Shougang agreed at the time to increase production capacity at the mine to 10 Mt/yr and has been under pressure from the Peruvian Government since then to raise output.

South Africa.—Isacor Ltd. lost 100,000 t of ore when two sections of the Sishen-Saldanha (mine-to-port) railway were washed away during a period of abnormally high rainfall. The resulting derailments damaged 3 locomotives and 21 railcars (African Mineral Services, 2000). The disruptions were estimated to have cost Isacor R65 million.

The Associated Manganese Mines of South Africa Ltd. (Assmang) opened the southern section of its Beeshoek deposit, raising its mining capacity to about 5 Mt/yr (Metal Bulletin, 1999c). About 0.5 Mt/yr of the output goes to a domestic customer; the rest is sent to the port of Saldanha for export. The company expects to increase capacity to 6 Mt/yr when its transport allotment on the Saldanha rail link is raised. The expansion will include a new heavy media separation plant that will produce about 1 Mt/yr of ore for blending with Assmang's regular products. The plant will process contact ore that is contaminated with shale and low grade ore. Eventually

Assmang plans to raise capacity to about 10 Mt/yr, which will require opening a new mine. The company is studying which of its various tenements in the Beeshoek and Sishen areas would provide the best opportunities for expansion.

Sweden.—During the year, Luossavaara Kiirunavaara AB (LKAB) transferred all production at its Kiruna Mine to the new level at 1,045 m, and the old main level at 775 m was closed (Luossavaara Kiirunavaara AB, 1999, p. 28).

Ukraine.—To improve the quality of its pellets, Poltava GOK upgraded its concentration plant by installing a new crusher and five dry separation lines and was expected to add a further two separation lines by yearend (Metal Bulletin, 1999i). The new lines were expected to increase the Fe content of Poltava's pellets by 2% to 2.5%. This upgrade did not increase the production capacity of the operation, which is expected to continue to produce at current levels of about 6 Mt/yr.

Current Research and Technology

In 1997, LKAB constructed and began operating an experimental pilot-scale blast furnace at Luleå. Its primary purpose was the development of the next generation of blast furnace pellets. It was also expected to reduce lead times for product development and market introduction and result in better test methods for use in the production of pellets (Tottie, Magnus, 1999, LKAB's Experimental Blast Furnace at MEFOS/Luleå: LKAB, Research and Development, URL: http://www.lkab.se/english/company/r_d.html).

Outlook

Mergers and acquisitions are expected to cause major changes in the structure of the iron ore industry in the near term. Iron ore prices have been declining for some time (See Prices) and there is no reason to believe that this trend will not continue. Thus, iron ore producers must find ways of making profits other than raising prices. As the producers operate in an increasing global economy, there will be pressure to reduce production costs; one way of doing this is by mergers and acquisitions. Mergers in the mining industry, however, generally do not have as much potential for synergy as they do in other industries (Gillian O'Connor, Financial Times, Rio Tinto's North bid shows mining groups the way — The time may be right for companies to consider mergers, June 27, 2000, Accessed June 28, 2000, at URL: <http://news.ft.com/ft/gx.cgi/ftc?pagename=View&c=Article&cid=FT3CY74YZ9C&live=true&tagid=ZZZ A0MH2B0C&subheading=natural%20resources>).

Mining companies usually cannot share infrastructure because mines cannot be moved. Synergy can be achieved by the industry by the consolidation of corporate and other activities.

The domestic iron ore industry is totally dependent on the steel industry for sales. This dependence is not expected to change in the near future. Information about steel industry trends is provided in the outlook section in the Iron and Steel chapter of the 1999 USGS Minerals Yearbook. For the near term, growth of the U.S. iron ore industry is tied to the growth

of the integrated steelworks along the Great Lakes. Significant expansion in the domestic iron ore industry may be possible if one or more of the direct-reduction processes prove to be economic for existing and potential Great Lakes producers. If this occurs, the industry can supply the rapidly expanding minimill sector of the U.S. steel industry. Steel products require lower residual alloy content than can be readily achieved with scrap. This indicates a role for imported DRI in the coastal regions of the United States and domestically produced DRI further inland where cheaper power is available. New DRI operations have recently come on stream in Alabama and Louisiana. But, no matter how spectacular DRI growth is during the next decade, it will not be able to replace more than a fraction of the world's blast furnace production because of technological restrictions. The blast furnace is expected to remain the mainstay of the iron and steel industries in most developed countries during the next 25 years.

Based on recent growth rates in Asia, additional iron ore production capacity will be needed. As in the United States, much of the increase in consumption of iron in Asia will be from newly constructed minimills, but unlike the United States, where the consumption of iron ore in blast furnaces is declining, much of the additional ore needed will go to feed blast furnaces. Because iron ore prices have not risen substantially and industry observers see no reason to believe that they soon will, future increases in supply will probably not come from greenfield operations. Supply increases would come instead from low-cost brownfield expansions by existing producers in the major supplier countries such as Australia and Brazil. Most of the recent growth in iron ore consumption has come from Asia, particularly China, the Republic of Korea, and Taiwan. The International Iron and Steel Institute has forecast that world apparent consumption for steel would rise from 698 Mt in 1999 to 719 Mt in 2000 and to 763 Mt in 2005 (Ian Christmas, Secretary General, International Iron and Steel Institute, October 4, 1999, Short and medium term outlook for steel demand, Annual Report of the Secretary General, accessed August 21, 2000, at URL http://www.worldsteel.org/trends_indicators/demand_AUTUMN.html).

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TABLE 1
SALIENT IRON ORE STATISTICS 1/

(Thousand metric tons and thousand dollars, unless otherwise specified)

	1995	1996	1997	1998	1999
United States:					
Iron ore (usable, less than 5% manganese): 2/					
Production	62,501	62,083	62,971	62,931	57,749
Shipments	61,100	62,200	62,800	63,200	60,700
Value	\$1,700,000 r/	\$1,750,000 r/	\$1,860,000 r/	\$1,970,000	\$1,550,000
Average value at mines, dollars per ton	\$28.00 r/	\$28.00 r/	\$30.00 r/	\$31.00	\$26.00
Exports	5,260	6,260	6,340	6,000	6,120
Value	\$184,000	\$232,000	\$235,000	\$245,000	\$243,000
Imports for consumption	17,600	18,400	18,600	16,900 r/	14,300
Value	\$491,000	\$556,000	\$551,000	\$517,000 r/	\$399,000
Consumption (iron ore and agglomerates)	83,100	79,600	79,500	78,200	75,100
Stocks, December 31:					
At mines, plants and loading docks 3/	4,240	4,650	4,860	6,020	5,710
At receiving docks 4/	2,140	2,250	2,880	4,080	2,770
At consuming plants	17,100	18,800	20,200	20,500	17,900
Total 5/	23,500	25,700	27,900	30,600	26,400
World: Production 6/	1,034,539 r/	1,017,470 r/	1,069,624 r/	1,062,278 r/	993,638 e/

e/ Estimated. r/ Revised.

1/ Data are rounded to no more than three significant digits, except "Production," and "World: Production;" may not add to totals shown.

2/ Direct-shipping ore, concentrates, agglomerates, and byproduct ore.

3/ Excludes byproduct ore.

4/ Transfer and/or receiving docks of Lower Lake ports.

5/ Sum of stocks at mines, consuming plants, and U.S. docks.

6/ Gross weight.

TABLE 2
EMPLOYMENT AT IRON ORE MINES AND BENEFICIATING PLANTS, QUANTITY AND TENOR OF ORE PRODUCED,
AND AVERAGE OUTPUT PER WORKER-HOUR IN THE UNITED STATES IN 1999, BY DISTRICT AND STATE 1/

District and State	Average number of employees	Worker-hours (thousands)	Production (thousand metric tons)				Average per worker-hour (metric tons)		
			Crude ore	Usable ore	Iron contained (in usable ore)	Iron content natural (percent)	Crude ore	Usable ore	Iron contained
Lake Superior:									
Michigan 2/	1,620	3,220	39,800	13,500	8,350	61.9	12.38	4.19	2.60
Minnesota	5,090	10,500	152,000	43,900	28,000	63.7	14.41	4.17	2.66
Total or average	6,720	13,700	191,000	57,400	36,300	63.2	13.93	4.18	2.64
Other States 3/	102	217	481	347	230	66.1	2.22	1.60	1.06
Grand total or average	6,820	14,000	192,000	57,700	36,500	63.3	13.75	4.14	2.62

1/ Data are rounded to no more than three significant digits, except "Average per worker-hour," and "Crude ore;" may not add to totals shown.

2/ Maintenance shop and research lab data are excluded.

3/ Includes California, Missouri, New Mexico, South Dakota, Texas, and Utah.

TABLE 3
CRUDE IRON ORE MINED IN THE UNITED STATES IN 1999,
BY DISTRICT, STATE, AND MINING METHOD 1/ 2/

(Thousand metric tons unless otherwise specified and exclusive of ore containing 5% or more manganese)

District and State	Number of mines			Total quantity
	Open pit	Underground		
Lake Superior:				
Michigan	2	39,800	--	39,800
Minnesota	8	152,000	--	152,000
Total	10	191,000	--	191,000
Other States:				
Missouri	1	--	448	448
Other 3/	1	33	--	33
Total	2	33	448	481
Grand total	12	191,000	448	192,000

-- Zero.

1/ Excludes byproduct ore.

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

3/ Includes California, New Mexico, South Dakota, Texas, and Utah.

TABLE 4
USABLE IRON ORE PRODUCED IN THE UNITED STATES IN 1999, BY DISTRICT,
STATE, AND TYPE OF PRODUCT 1/

(Thousand metric tons and exclusive of ore containing 5% or more manganese)

District and State	Direct shipping ore			Total quantity
	Concentrates	Agglomerates 2/		
Lake Superior:				
Michigan	19	--	13,500	13,500
Minnesota	189	48	43,700	43,900
Total	208	48	57,100	57,400
Other States:				
Missouri	6	269	--	275
Other 3/	33	--	--	73
Total	38	269	--	347
Grand total	247	317	57,100	57,700

-- Zero.

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

2/ Data may include pellet chips and screenings.

3/ Includes California, New Mexico, South Dakota, Texas, and Utah.

TABLE 5
SHIPMENTS OF USABLE IRON ORE FROM MINES IN THE UNITED STATES IN 1999 1/ 2/

(Exclusive of ore containing 5% or more manganese)

District and State	Gross weight of ore shipped (thousand metric tons)				Average iron content, natural (percent)	Value (thousands)
	Direct shipping ore	Concentrates	Agglomerates	Total		
Lake Superior:						
Michigan	32	--	14,300	14,300	61.9	W
Minnesota	2,410	--	43,500	45,900	63.5	\$1,150,000
Total reportable or average	2,440	--	57,800	60,300	63.1	1,150,000
Other States:						
Missouri	6	302	--	307	70.4	W
Other 3/	126	35	--	126	49.0	2,390
Total reportable or average 3/	131	336	--	433	64.2	XX
Total withheld	--	--	--	--	--	392,000
Grand total or average	2,580	336	57,800	60,700	63.1	1,550,000

W Withheld to avoid disclosing company proprietary data; included in "Total withheld." XX Not applicable. -- Zero.

1/ Includes byproduct ore.

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

3/ Includes California, New Mexico, South Dakota, Texas, and Utah.

TABLE 6
CONSUMPTION OF IRON ORE AT U.S. IRON AND STEEL PLANTS 1/ 2/

(Thousand metric tons)

Year	Iron ore originating areas					Total
	U.S. ores		Canadian ores		Foreign ores	
	Great Lakes	Other U.S.	Great Lakes	Other Canada		
1998	57,700	1	725	5,810	5,740	70,000
1999	56,800	--	439	5,190	5,380	67,800

-- Zero.

1/ Excludes dust, mill scale, and other revert iron-bearing materials added to sinter.

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

Source: American Iron Ore Association.

TABLE 7
CONSUMPTION OF IRON ORE AT U.S. IRON
AND STEEL PLANTS, BY TYPE OF PRODUCT 1/ 2/

(Thousand metric tons)

Type of product	1998	1999
Blast furnaces:		
Direct-shipping ore	786	645
Pellets	62,800	59,400
Sinter 3/	10,600	10,900
Total	74,300	70,900
Steelmaking furnaces:		
Direct-shipping ore	67	48
Pellets	18	24
Sinter 3/	191	172
Total	276	244
Grand total	74,600	71,200

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

2/ Includes agglomerates.

3/ Includes briquettes, nodules, and other.

Source: American Iron and Steel Institute.

TABLE 8
U.S. CONSUMPTION OF IRON ORE, BY END USE 1/ 2/

(Thousand metric tons and exclusive of ore containing 5% ore more manganese)

Year	Blast furnaces	Steel furnaces	Sintering plants 3/	Miscellaneous 4/	Subtotal integrated iron and steel plants 5/	Direct-reduced iron for steelmaking 6/	Nonsteel end uses 7/	Total
1998	63,500	101	6,330	48	70,000	2,400 r/	1,280	73,600 r/
1999	62,100	57	5,840	2	67,800	2,420	1,290	71,500

r/ Revised.

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

2/ Includes agglomerates.

3/ Excludes dust, mill scale, and other revert iron-bearing materials.

4/ Sold to nonreporting companies or used for purposes not listed.

5/ Data from American Iron Ore Association.

6/ U.S. Geological Survey estimates based on production reports compiled by Midrex Corp.

7/ Includes iron ore consumed in production of cement and iron ore shipped for use in manufacturing paint, ferrites, heavy media, cattle feed, refractory and weighing materials, and for use in lead smelting. Data from U.S. Geological Survey surveys.

TABLE 9
U.S. EXPORTS OF IRON ORE,
BY COUNTRY OF DESTINATION 1/ 2/

(Thousand metric tons and thousand dollars)

Country	1998		1999	
	Quantity	Value	Quantity	Value
Canada	5,990	244,000	6,100	242,000
Mexico	2	191	2	190
Other	13	1,130	24	1,270
Total	6,000	245,000	6,120	243,000

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

2/ Includes agglomerates.

Source: U.S. Census Bureau.

TABLE 10
U.S. EXPORTS OF IRON ORE, BY TYPE OF PRODUCT 1/ 2/

Type of product	1998			1999		
	Quantity (thousand metric tons)	Value (thousand dollars)	Unit value 3/ (dollars per metric ton)	Quantity (thousand metric tons)	Value (thousand dollars)	Unit value 3/ (dollars per metric ton)
Concentrates	28	620	\$22.14	30	912	\$30.22
Coarse ores	1	51	51.00	--	--	--
Fine ores	27	1,090	40.52	17	565	33.45
Pellets	5,910	242,000	40.95	6,050	241,000	39.77
Briquettes	--	--	--	(4/)	11	246.55
Other agglomerates	27	680	25.19	21	795	37.04
Roasted pyrites	9	446	49.56	4	269	61.53
Total	6,000	245,000	40.80 5/	6,120	243,000	39.72 5/

-- Zero.

1/ Data are rounded to no more than three significant figures, except unit value; may not add to totals shown.

2/ Includes agglomerates.

3/ Unit values shown are calculated from unrounded data.

4/ Less than 1/2 unit.

5/ Weighted average calculated from unrounded data by dividing total value by total tonnage.

Source: U.S. Census Bureau.

TABLE 11
U.S. IMPORTS OF IRON ORE, BY COUNTRY AND TYPE OF PRODUCT 1/ 2/

Country and type of product	1998			1999		
	Quantity (thousand metric tons)	Value (thousand dollars)	Unit value 3/ (dollars per metric ton)	Quantity (thousand metric tons)	Value (thousand dollars)	Unit value 3/ (dollars per metric ton)
Australia	807	6,850	\$8.49	694	8,430	\$12.14
Brazil	5,980	169,000	28.22	5,540	138,000	24.82
Canada	8,520	286,000	33.56	6,860	207,000	30.18
Chile	48	1,230	25.54 r/	69	1,300	18.83
Peru	126	1,710	13.59 r/	63	918	14.47
Sweden	373 r/	14,300 r/	38.34 r/	421	13,300	31.64
Venezuela	970 r/	34,700 r/	35.77 r/	327	21,100	64.53
Other	99 r/	3,120 r/	31.54 r/	275	9,320	33.89
Total	16,900 r/	517,000 r/	30.53 r/ 4/	14,300	399,000	28.00
Concentrates	1,360	23,400	17.20	1,440	23,800	16.58
Coarse ores	465	15,100	117.87 r/	318	9,850	31.03
Fine ores	3,180	56,400	17.74	3,390	70,800	20.87
Pellets	11,100	397,000	35.89	8,230	264,000	32.03
Briquettes	128 r/	4,490 r/	35.08 r/	195	16,900	87.00
Other agglomerates	715	19,600	27.37	676	13,700	20.19
Roasted pyrites	7	368	52.57	11	561	52.65
Total	16,900 r/	517,000 r/	30.53 r/ 4/	14,300	399,000	28.00 4/

r/ Revised.

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

2/ Includes agglomerates.

3/ Unit values shown are calculated from unrounded data.

4/ Weighted average calculated from unrounded data by dividing total value by total tonnage.

Source: U.S. Census Bureau.

TABLE 12
U.S. IMPORTS OF IRON ORE IN 1999,
BY COUNTRY AND TYPE OF PRODUCT 1/ 2/

(Thousand metric tons)

Country of origin	Concentrates	Coarse ores	Fine ores	Pellets	Other agglomerates 3/	Roasted pyrites	Total
Australia	247	--	376	7	64	--	694
Brazil	560	221	2,720	1,940	105	--	5,540
Canada	488	--	136	5,780	456	--	6,860
Chile	69	--	--	--	--	--	69
Peru	--	--	24	--	39	1	63
Sweden	54	--	--	367	--	--	421
Venezuela	--	22	--	111	195	--	327
Other	19	75	140	19	12	10	275
Total	1,440	318	3,390	8,230	871	11	14,300

-- Zero.

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

2/ Includes agglomerates.

3/ Includes briquettes.

Source: U.S. Census Bureau.

TABLE 13
AVERAGE UNIT VALUE FOR SELECTED IMPORTS OF IRON ORE
IN 1999 1/

Type of product	Country of origin	Average unit value 2/ (dollars per metric ton gross weight)
Concentrates	Brazil	16.28
Do.	Canada	16.48
Fine ores	Australia	10.69
Do.	Brazil	21.36
Pellets	do.	31.07
Do.	Canada	32.07
Briquettes	Venezuela	87.00

1/ Includes agglomerates.

2/ Weighted averages of individual Customs values.

Source: U.S. Census Bureau.

TABLE 14
U.S. IMPORTS OF IRON ORE, BY CUSTOMS DISTRICT 1/ 2/

(Thousand metric tons and thousand dollars)

Customs district	1998		1999	
	Quantity	Value	Quantity	Value
Baltimore	4,370	104,000	3,210	75,300
Charleston	763	28,600	412	13,000
Chicago	1,700	41,700	2,340	50,200
Cleveland	1,220	37,500	783	21,100
Detroit	1,800	68,100	1,290	45,100
Mobile	3,990	142,000	2,850	87,100
New Orleans	2,710 r/	83,800 r/	3,170	102,000
Philadelphia	179	6,380	84	2,550
Other	188 r/	4,540 r/	124	2,860
Total	16,900 r/	517,000 r/	14,300	399,000

r/ Revised.

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

2/ Includes agglomerates.

Source: U.S. Census Bureau.

TABLE 15
U.S. IMPORTS OF PELLETS, BY COUNTRY 1/

(Thousand metric tons and thousand dollars)

Country	1998		1999	
	Quantity	Value	Quantity	Value
Brazil	2,820	99,600	1,940	60,200
Canada	7,450	267,000	5,780	185,000
Peru	7	99	--	--
Sweden	294 r/	11,500 r/	367	11,600
Venezuela	508	19,200	111	3,780
Other	--	--	26	2,390
Total	11,100	397,000	8,230	264,000

r/ Revised. -- Zero.

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

Source: U.S. Census Bureau.

TABLE 16
SELECTED PRICES FOR IRON ORE IN THE JAPANESE MARKET

(F.o.b. shipping port basis. U.S. cents per dry long ton of iron, unless otherwise specified)

Country and producer	Ore types	April 1 - March 31	
		Fiscal year 1998	Fiscal year 1999
Australia:			
Hamersley Iron Pty. Ltd. and Mount Newman Mining Co. Pty. Ltd.	Lump ore	38.79	34.83
Do.	Fines	29.92	26.63
Robe River Iron Associates	do.	24.52	21.23
Savage River Mines Ltd.	Pellets	48.41	41.99
Brazil:			
Companhia Nipo-Brasileira de Pelotizacao (Nibrasco)	do.	51.15	44.38
Companhia Vale do Rio Doce (Carajas)	Fines	27.32	24.37
Companhia Vale do Rio Doce (Itabira)	do.	28.90	25.95
Do.	do.	26.82	23.87
Minerações Brasileiras Reunidas S.A.	Lump ore	28.71	25.78
Do.	do.	27.34	24.33
Samarco Mineração S.A.	Pellet feed	22.53	20.05
Canada, Iron Ore Company of Canada (Carol Lake)	Concentrates	26.01	23.15
Chile:			
Minera del Pacifico S.A. (El Algarrobo)	Pellets	47.67	41.35
Minera del Pacifico S.A. (El Romeral)	Fines	20.77	18.49
India:			
Minerals and Metals Trading Corp. (Bailadila)	Lump ore	37.40	33.59
Do.	Fines	28.72	25.56
Peru, Empresa Minera del Hierro del Peru S.A.	Pellet feed	20.39	18.15
South Africa: 1/			
South African Iron and Steel Industrial Corp. Ltd.	Lump ore	31.40	28.50
Do.	Fines	22.75	20.25

1/ Price per dry metric ton unit.

Source: Trust Fund Project on Iron Ore Information, Iron Ore 1999.

TABLE 17
IRON ORE, IRON ORE CONCENTRATES, AND IRON ORE AGGLOMERATES: WORLD PRODUCTION, BY COUNTRY 1/

(Thousand metric tons)

Country 4/	Gross weight 2/					Metal content 3/				
	1995	1996	1997	1998	1999 e/	1995	1996	1997	1998	1999 e/
Algeria	2,200 r/	2,245	1,637 r/ e/	1,783 r/ e/	1,800	1,100	1,100	800 r/ e/	900 r/	900
Argentina e/	-- r/	--	--	--	--	-- r/	--	--	--	--
Australia	142,936	147,100	157,766	153,964 r/	154,979 5/	88,653	93,000	97,901	95,185 r/	94,868 5/
Austria	--	1,853	1,800 e/	1,797 r/	1,752 5/	660 e/	504	490 r/ e/	500 r/	500
Azerbaijan e/	150	150	NA	NA	NA	83	83	NA	NA	NA
Bosnia and Herzegovina e/	150	150	150	150	150	52	50	50	50	50
Brazil	183,839	174,157	185,128	207,017 r/	190,345 5/	112,793	112,000	122,184	124,210 r/	114,207 5/
Bulgaria	483	475 r/	479	462 r/	466	290	320	320 e/	277 r/ e/	280
Canada 6/	38,560 r/	34,400 r/	37,277	37,808 r/	34,487 p/	24,561 r/	21,911 r/	24,914 r/	24,082 r/	21,967 p/
Chile	7,847 r/	8,324 r/	8,010 r/	9,112 r/	8,345 5/	5,233	5,386 r/ 5/	5,287 r/	6,014 r/	5,508 5/
China e/	249,350	249,550	268,000	246,900 r/	209,000	75,000	75,000	80,400	74,500 r/	63,000
Colombia	550 r/	600 r/	640	530 r/	580 p/	300 r/	330 r/	350 r/	295 r/	320 p/
Egypt	2,042	2,429	2,744 r/	3,001 r/	3,000	1,100 r/	1,700	1,400 r/	1,500 r/	1,500
France e/	1,496 5/	1,464 5/	523 r/	250 r/	250	432	430	150	75 r/	35
Germany	69	100	201	200	200	18	15 e/	28	28	28
Greece e/ 7/	1,970	1,990	NA	NA	1,600	800	810	NA r/	NA	600
Guatemala e/	2 r/	5 r/ 5/	4 r/	4	3	1 r/	3 r/	2	2 r/	2
India	65,173	66,657	69,453 r/	72,532 r/	67,750 5/	41,710	42,660	44,400	48,000	43,500
Indonesia	366 r/	425 r/	516 r/	560 r/	563 5/	200 r/ e/	230 r/ e/	280 r/ e/	310 r/ e/	310
Iran 8/	9,080	9,850	12,750	12,300 r/	12,300	4,500	4,800	6,300	6,000 r/	6,000
Japan	3	4	4	2 r/	1 5/	1	2	2	1 r/	1 5/
Kazakhstan	14,900	13,000 r/	12,600 r/	8,693 r/	9,091 5/	8,400 r/	7,300 r/	7,100 r/	4,900 r/	5,200
Korea, North e/	11,000	11,000	10,000	10,000	8,000	5,100	5,100	4,700	4,700	3,900
Korea, Republic of	184	221	297 r/	238 r/	188 5/	103	124	166	133	106 5/
Macedonia e/	15	15	15	15	15	9	9	9	9	9
Malaysia	202	325 r/	269	376 r/	337 5/	123	208	172	243	216 5/
Mauritania	11,610 r/	11,360 r/	11,700	11,400	11,500	7,000 r/	7,384 r/	7,605 r/	7,410 r/	7,475
Mexico 9/	9,375	10,182	10,466	10,557	11,200	5,625	6,109	6,280	6,334	6,800
Morocco	47	12	12 r/	12 r/	12	30 r/	8 r/	8 r/	8 r/	8
New Zealand 10/	2,362	2,334	2,478	2,700 r/	2,400 5/	710 r/ e/	700 r/ e/	740 r/ e/	10 r/ e/	720
Nigeria e/	168	100	50	-- r/	--	50 r/ e/	33 r/	17 r/ e/	-- r/	--
Norway	2,012	1,705	1,700	1,600	1,700	1,348	1,023	1,100	1,000	1,000
Peru	6,235	4,364	4,439	4,439	4,230 5/	3,948	2,916	2,966	2,885 r/	2,583 5/
Portugal 11/	15	19	18 e/	16	16	5	7	7 e/	7	7
Romania e/	570	670	670 r/	250 r/	200	147 5/	175 5/	170	85 r/	71
Russia	78,300 r/	72,100 r/	70,900 r/	72,343	81,311 5/	45,200 r/	41,600 r/	40,900 r/	41,700 r/	46,900
Serbia and Montenegro e/	110 5/	110	110	100	50	34 5/	34	34	31	15
Slovakia	500 r/ e/	436 r/	453 r/	479 r/	450	225	190 r/	200 r/	215 r/	200
South Africa 12/	31,946	30,830	33,225	32,948	29,508 5/	19,806	19,115	20,600 e/	20,400	18,442 5/
Spain 13/	2,307	1,269	--	--	--	1,073	588	--	53 r/	--
Sweden	19,058	20,273	21,893	20,930	18,558 5/	12,211	12,975 e/	13,912 e/	13,186	11,506 5/

See footnotes at end of table.

TABLE 17--Continued
 IRON ORE, IRON ORE CONCENTRATES, AND IRON ORE AGGLOMERATES: WORLD PRODUCTION, BY COUNTRY 1/

(Thousand metric tons)

Country 4/	Gross weight 2/					Metal content 3/				
	1995	1996	1997	1998	1999 e/	1995	1996	1997	1998	1999 e/
Thailand	34	86	44	91	90	17 e/	43 e/	22 e/	46 e/	45
Tunisia	224	239 e/	264 r/	220	220	122	130	137 e/	119	120
Turkey	4,931	6,404 e/	5,986 r/	5,885 r/	4,300	2,754	3,500 e/	3,239 r/	3,200 r/ e/	2,400
Ukraine	50,400	47,600	53,000 e/	50,758 r/	47,540 5/	27,700	26,200	29,200 e/	28,000 r/	26,200
United Kingdom	1	1	1	1	1	(14/)	(14/)	(14/)	(14/)	(14/)
United States	62,501	62,083	62,971	62,931	57,749 5/	39,577	39,243	40,022	39,724	36,530 5/
Venezuela	18,955 r/	18,480 r/	18,503 r/	16,553 r/	17,000	12,575 r/	11,520 r/	12,245 r/	11,014 r/	11,200
Zimbabwe e/	311 5/	324	479 5/	372 5/	400	160	160	240 r/	190 r/	200
Total	1,034,539 r/	1,017,470 r/	1,069,624 r/	1,062,278 r/	993,638	551,541 r/	546,726 r/	577,048 r/	567,531 r/	535,427

e/ Estimated. p/ Preliminary. r/ Revised. NA Not available. -- Zero.

1/ Table includes data available through July 14, 2000.

2/ Insofar as availability of sources permit, gross weight in this table represent the nonduplicative sum of marketable direct-shipping iron ores, iron ore concentrates, and iron agglomerates produced from imported iron ores have been excluded under the assumption that the ore from which such materials are produced has been credited as marketable ore in the country where it was mined.

3/ Data represent actual reported weight of contained metal or are calculated from reported metal content. Estimated figures are based on latest available iron content reported, except for the following countries for which grades are U.S. Geological Survey estimates: Azerbaijan, Kazakhstan, North Korea, and Ukraine.

4/ In addition to the countries listed, Cuba and Vietnam may also produce iron ore, but definitive information on output levels, if any, is not available.

5/ Reported figure.

6/ Series represented gross weight and metal content of usable iron ore (including byproduct ore) actually produced, natural weight.

7/ Nickeliferous iron ore.

8/ Data are for year beginning March 21 of that stated.

9/ Gross weight calculated from reported iron content based on grade of 60% Fe.

10/ Concentrates from titaniferous magnetite beach sands.

11/ Includes manganese iron ore.

12/ Includes magnetite ore as follows, in thousand metric tons: 1995--2,325; 1996--2,070; 1997-98--NA; 1999-2,200.

13/ Includes byproduct ore.

14/ Less than 500 tons.

TABLE 18
IRON ORE: WORLD PELLETIZING CAPACITY,
BY CONTINENT AND COUNTRY IN 1999

	Rated capacity (million metric tons, gross weight)
North America:	
Canada	27.3
Mexico	13.7
United States	66.8
Total 1/	<u>108.0</u>
South America:	
Argentina	2.0
Brazil	41.5
Chile	4.4
Peru	3.4
Venezuela	9.9
Total 1/	<u>61.3</u>
Europe:	
Belgium	0.7
Netherlands	3.8
Norway	1.4
Russia	34.0
Sweden	16.4
Turkey	1.0
Ukraine	32.0
Total 1/	<u>89.3</u>
Africa:	
Liberia	3.0
South Africa	0.6
Total 1/	<u>3.6</u>
Asia:	
Bahrain	4.0
China	20.0
India	8.5
Iran	9.0
Japan	3.0
Kazakhstan	8.4
Total 1/	<u>52.9</u>
Oceania: Australia	<u>4.0</u>
World total 1/	<u>319.0</u>

1/ Data may not add to totals shown because of independent rounding.

Sources: International Iron and Steel Institute, Brussels, Belgium; United Nations Commission on Trade and Development; Trust Fund Project on Iron Ore Information; U.S. Geological Survey.